Erection Work, Operating and Maintenance Instructions

Machine: Fan Pump, FP series

Issued: PFe/Subosits, 2002-01
Checked: HPp/Hartl

Rev.0, Printed: 2002.03.04
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1 INTRODUCTION

This manual is part of the technical documentation of Andritz AG. It is intended as a supplement to the training provided, to supply the basic knowledge required for proper, safe and economical use of the plant and machinery delivered by Andritz AG. Observing these instructions helps avoid hazards and reduce repair and downtime costs, as well as increasing the reliability and useful life of machines.

1.1 Use

Target group

This operating manual is intended for users with a knowledge of mechanical engineering and is for the exclusive use of the operator of the mill and his personnel.

Personnel entrusted with work on the machine must have read and understood these operating instructions and comply with them. This refers in particular to the following tasks:

- Handling, starting and stopping
- Troubleshooting
- Maintenance and upkeep
- Haulage
- Maintenance and disposal of process materials, cleaning of machine and area around the machine.

The following sections are especially important:

- the Chapter on SAFETY,
- the safety instructions contained in various other chapters

Supplementary instructions

The mill operator shall complete this manual by adding national regulations on safety at work, health protection and environmental protection.

Instructions on any special operational conditions concerning work organization, sequence of work/operations and the personnel assigned to the job shall also be added. This also includes instructions on supervising and reporting obligations.

Safekeeping

Keep the entire operating manual near the place where the machine is installed and within easy reach.

1.2 Standards and guidelines

The machine/plant has been built in accordance with state-of-the-art standards and the recognized safety rules. The equipment conforms with the equivalent appropriate standards.
1.3 How to use the manual

**Presentation**
- Chapter and paragraph headings are printed in capitals in the continuous text.

**SAFETY**
- Designations of indicating and handling elements are written in inverted commas in the continuous text.
  - Operate switch "xxx"
- Lists without numbering do not require operations to be carried out in a certain order.

**Pictograms**
The following pictograms are used in the manual:

- **Warning signs**
  - Warning signs are shown with an explanation of the type of the hazard.
  - The meaning of the different graduations of hazards are described in the Chapter on SAFETY.

- **Marks an instruction on handling of the machine or system.**

- **Marks a useful piece of information**

- **Marks a cross-reference to another Chapter with absolute path indication.**
  - e.g. ➔ /FAN PUMP/SAFETY

**Work steps (operations)**
- Work steps are presented in tables. Work steps are numbered and must be carried out in the order specified.
1.4 Warranty and guarantee

Andritz AG’s general terms of delivery and sale shall apply.
Guarantee and liability claims on Andritz AG shall become void if personal injury or material damage is caused by one or several of the following:

- Use of the machine/system for any purpose other than its designated use.
- Non-conformity of erection work, start-up and handling of the machine/system.
- Non-observance of the safety instructions in the manual.
- Non-authorized structural changes to the machine/system.
- Non-observance of the maintenance and upkeep instructions.

In the event of a claim for repair under guarantee, ANDRITZ AG reserves the right to assess the damage to the machine/system.
1.5 Manufacturer’s name and address

Andritz AG
Stattegger Strasse 18
A-8045 Graz

Our service department will be pleased to help you and can be contacted at:

Andritz AG
Stattegger Strasse 18
A-8045 Graz

Service department for pumps

Tel.: +43/316-6902-2327
Fax: +43/316-6902-413
email: Johann.Tesch@andritz.com

In case of emergency outside working hours

Tel.: +43 316 6902-0

1.6 Copyright

The operating manual is protected by copyright. All usual rights reserved. It must not be wholly or partly reproduced without authorization by Andritz AG. Contraventions shall entail damage claims and may have penal consequences. All rights shall also be reserved for any patents granted, registration of trade marks and technical modifications without prior notification.

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2 SAFETY

2.1 General safety regulations

The chapter on safety contains general safety regulations which must be observed when working on the machine/plant.

In addition, the chapters in the operating manual contain further safety regulations. These are marked by DANGER SIGNS.

Safety instructions on components not supplied by Andritz AG are contained in the descriptions of the components (/FAN PUMP/SUPPLIER DOCUMENTATION). The safety instructions supplement ANDRITZ AG’s operating instructions.

All safety instructions must be observed. Disregarding the safety instructions may cause a risk to life and limb, environmental pollution hazards and damage to property.

2.2 Danger and warning signs

The entire SAFETY chapter is of extreme importance and relevant to safety. The information in this chapter, therefore, is not marked with special danger symbols.

The Chapters on ERECTION WORK, START-UP, OPERATION and MAINTENANCE in this Manual are marked by a pictogram. The following warning signs are used:

DANGER

This symbol indicates there may be a risk to life and limb.

Non-compliance with the warning signs may lead to serious health problems or even fatal injuries, and can cause extensive damage to property.

WARNING

This symbol points to an imminent health risk, as well as a risk of environmental pollution and of damage to property.

Non-compliance with the warning sign may cause moderate health problems and/or extensive environmental pollution and damage to property.

CAUTION

This symbol points to a dangerous situation.

Non-observance of these signs may cause environmental pollution and damage to property.
Further symbols and pictograms used are described under INTRODUCTION.

2.3 Designated use

The fan pump should only be used according to the specifications forming part of the purchase order.

Any change in the application must be checked by the operator and, if necessary, approved by Andritz AG.

Non-observance of the application can lead to environmental or property damage, or to personal injury.

Any modifications to the scope of supply made without the agreement of Andritz AG are considered contrary to the designated use.

The term designated use shall also include adherence to the operating instructions, observance of the operating, inspection and maintenance conditions and of the regulations on cleaning and upkeep.

2.4 General remarks on machine/plant safety

The fan pump has been built in accordance with state-of-the-art standards and the recognized safety rules. Nevertheless, its use may constitute a risk to life and limb of the user or of third parties, or cause damage to the machine/plant and to other material property.

The fan pump may only be operated when in perfect condition and with due consideration to safety and the risks involved. All protective devices and the emergency cut-out devices must be in place and fully functional.

Malfunctions and unforeseen changes in the fan pump must be remedied immediately.
2.5 User's obligations

Designated use
The user of the fan pump is responsible for its designated use.

Work instructions
In addition to the operating instructions, applicable legal stipulations and other rules governing the safety at work, health and environmental protection must be observed and personnel instructed in them.

Qualification of assigned personnel
The fan pump may only be operated, maintained and serviced by authorized, skilled personnel with hands-on training.

Personnel must not be below the legal minimum age.

Any person undergoing training, serving an apprenticeship or being instructed must not work on the fan pump except under the supervision of an experienced person.

Instructions
The user’s operating and maintenance personnel will be instructed by manufacturer personnel or his contractual distributor upon completion of installation work.

The user undertakes to have new, additional operating and maintenance personnel instructed in machine operation and maintenance of the fan pump to the same extent and applying the same care, and with due consideration to the safety instructions.

Workers entrusted with the transportation, erection work and start-up of the fan pump must have read and understood the operating instructions, especially the chapter on SAFETY, the safety instructions concerning a certain activity, as well as the safety instructions issued by sub-suppliers.

Definition of areas of responsibility
The user shall be responsible for:

- definition of the machine operator's responsibility and his right to give instructions
- definition of the contents and responsibility for keeping the records on functioning and any failure of the monitoring equipment (log book)
- personnel areas of responsibility in terms of operating, tooling, maintenance and upkeep.
Inspections

The operator undertakes

- to check at regular intervals whether the safety instructions and regulations governing work on the fan pump are observed.
- to carry out regular training to confirm the level of knowledge of the operating and maintenance personnel.

Attaching safety devices

The user shall ensure that the following equipment, regulations, symbols and instructions are mounted in the production area:

- Safety devices and regulations (see Chapter 2.7)
- Fire prevention regulations
- Markings on the floor for driveways, protective fencing and danger areas (yellow)
- Fencings and covers
- Railings (foot, centre and chest height)
- Emergency lighting
- Emergency-off switch
- Repair switch for drive motors
- Signs on fire-fighting equipment
- Signs for emergency calls
- Direction arrows to exits
- Direction arrows to escape routes
- Signs to first-aid post
2.6 General obligations of personnel

To avoid personal and material damage anybody working on the machine shall

- observe the safety instructions in the operating regulations and on the fan pump.
- stop and secure the fan pump in case of a safety-relevant functional disorder. Report the disorder and have it repaired immediately.
- not perform any work in a manner disregarding safety considerations.
- use only the machine accesses, paths and passages foreseen for this purpose.
- not touch rotating parts and/or reach out beyond them.
- keep the machine and the work place clean, not place tools or other objects on the fan pump.
- not wear any garments/pieces of jewellery which might get stuck on rotating/moving pump parts, including ties, scarves, rings and necklaces.
- not wear long hair hanging down.
- familiarize themselves before starting work with the function and any failure of machine monitoring equipment (log book).
- refrain from smoking in the vicinity of the fan pump.
- Personal protective apparel must be worn when working on the fan pump. (see Section 2.8).
- Due to the high temperatures and humidity, people wearing glasses may find that their glasses steam up, thus exposing the wearer to a risk of injury.
- The operating personnel must be acquainted with the safety data sheets in order to be able to recognise how dangerous the chemicals can be.
2.7 Safety devices

The fan pump must not be operated without effective safety equipment.

Safety equipment must not be circumvented, dismantled or made unserviceable. The safety equipment is here to protect operating personnel.

Safety equipment and access thereto must be kept free.

Safety covers

The fan pump must not be operated without safety covers mounted.

Fig. 2-1 shows the protective covers for the fan pump.

![Safety covers and Coupling guard](image-url)

Fig. 2-1 Protective covers for the fan pump
2.8 Personal protective apparel

General safety equipment

The following must always be worn when performing work on the fan pump:

- protective clothing to prevent the pulp from coming into contact with the skin.
- gloves to prevent hand injuries
- goggles to prevent eye injuries
- safety shoes as protection against crushing
- the required personal ear protection to avoid hearing defects
- standard hard hat as protection against head injuries

2.9 Safety at the machine installation site

Adequate lighting must be provided (industrial lighting).

The foundations must be sized to withstand the loads caused by the fan pump. Customer will be provided with a load plan.

Area around machine and marked escapes to be kept free. Area around machine must be marked as danger zone.

Make sure machine and surrounding area are kept clean. In particular, oil and grease on the floor and on machine elements may cause slipping. This is therefore a considerable source of injuries, as are tools.

The floor around the fan pump must be provided with a non-slip finish.

Ramps, platforms and lifts must be used to avoid injury or excessive physical effort.

2.10 Temperature

The fan pump is designed for a stock temperature of 55°C. If pulp at temperatures higher than 65°C is to be used, the operator must take the necessary safety measures (e.g. protective gloves, training of operating staff, etc.).

2.11 Noise

The total noise emissions from all machines in the production room can restrict spoken communication and impair hearing.
The machine is designed such that no operator is required in the immediate vicinity of the machine. Appropriate hearing protection should be worn throughout maintenance and adjusting work while the machine is running.

2.12 Electrical equipment

All work on the electrical equipment, without exception, must be carried out by skilled electricians.

Any form of contact with electrical equipment may cause fatal injuries.

Employees performing work on live parts should be accompanied by an assistant who can operate the emergency switch if necessary.

Users of medical electronic equipment, such as pacemakers, must not enter the electric danger zone.

Machine must be earthed to avoid electrostatic loading.

2.13 Steam and fumes/smoke

Unusual chemical reactions may take place in the fibre stock during a prolonged standstill and hazardous fumes may be produced.

The machine must be thoroughly cleaned if shut down for longer than 2 hours.

The area must be sufficiently ventilated.

2.14 Oils and greases

The safety instructions for the products concerned must be observed when handling oil, grease and other chemical substances.

Suitable skin protection is required when handling aggressive media. See manufacturers’ information for the type of skin protection required.

Also observe relevant requirements for disposal.
3 TECHNICAL DATA

3.1 Data sheet

3.2 Characteristic curve

3.3 Dimensioned drawing

3.4 Principal section

3.5 Parts list
4 DESCRIPTION

4.1 Field of application

The fan pump is used in continuous operation to pump clean liquids and various pulps in the paper industry.

Fig. 4-1 Fan pump
4.2 Main components of fan pump

![Diagram of fan pump components]

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Volute casing – upper part (102.2)</td>
<td>F</td>
<td>Shaft seal</td>
</tr>
<tr>
<td>B</td>
<td>Volute casing – lower part (102.1)</td>
<td>G</td>
<td>Bearing</td>
</tr>
<tr>
<td>C</td>
<td>Pump shaft (211)</td>
<td>H</td>
<td>Split bearing housing (351.352)</td>
</tr>
<tr>
<td>D</td>
<td>Impeller - bipartite (232,233)</td>
<td>I</td>
<td>Pedestal (890)</td>
</tr>
<tr>
<td>E</td>
<td>Wear ring (502)</td>
<td>J</td>
<td>Mounting for the magnetic-inductive flow meter (690)</td>
</tr>
</tbody>
</table>

Tab. 4-1 Main components of fan pump
Volute casing – upper part (102.2) and lower part (102.1)

**Function:** Guiding the medium with a favourable flow pattern. Converting the speed energy into pressure energy.

**Design:**
- Pressure-sealed, double-flow pump casing with delivery and suction channels.
- Suction and delivery flange.
- Mounting for the bearing housing with bearing assembly, shaft and impeller.

Pump shaft (211)

**Function:** Holding the impeller, shaft seal, bearing and coupling. Transmitting the drive energy to the impeller and thus, to the medium.

**Design:** Drive shaft made of high-quality, acid-proof stainless steel.

Impeller (232,233)

**Function:** Accelerating the medium by charging it with energy.

**Design:** Bipartite, made of acid-proof stainless cast steel.
**Wear ring (502)**  
**Function:** Choke between suction and delivery side of the impeller.  
**Design:** Hydraulically optimised ring made of acidproof stainless steel.

![Wear ring](image)

**Shaft seal**  
**Function:** Seal between medium (suction side) and the atmosphere.  
**Design:** Stuffing box with stuffing box packing, sealing water ring, adjustable stuffing box gland, and sealing water connection.

![Shaft seal](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>211</td>
<td>Pump shaft</td>
<td>461</td>
<td>Stuffing box packing</td>
</tr>
<tr>
<td>451</td>
<td>Seal casing</td>
<td>458</td>
<td>Sealing water ring</td>
</tr>
<tr>
<td>452</td>
<td>Stuffing box gland</td>
<td>902.3</td>
<td>Stud bolt</td>
</tr>
<tr>
<td>524.1</td>
<td>Shaft protection sleeve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 4-2 Stuffing box parts
**Design:** Two-way mechanical seal with sealing water connection

![Two-way mechanical seal](image)

**Fig. 4-7** Two-way mechanical seal

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>433.1</td>
<td>Mechanical seal coming into contact with the medium</td>
<td>433.2</td>
<td>Mechanical seal coming into contact with the atmosphere</td>
</tr>
<tr>
<td>451</td>
<td>Seal casing</td>
<td>500</td>
<td>Support ring</td>
</tr>
<tr>
<td>506</td>
<td>Retaining ring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tab. 4-3** Two-way mechanical seal
Bearing

**Function:** Interface between stationary and rotating parts. Absorption of axial and radial forces.

**Design:** Self-aligning roller bearing with steel cage. Designed as fixed and movable bearing, suitable for grease or oil lubrication.

![Bearing with bearing housing](image)

**Fig. 4-8** Bearing with bearing housing

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Item</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>352</td>
<td>Bearing housing – upper part</td>
<td>524.2</td>
<td>Sleeve</td>
</tr>
<tr>
<td>321</td>
<td>Self-aligning roller bearing</td>
<td>507</td>
<td>Splash ring</td>
</tr>
<tr>
<td>923</td>
<td>Locknut</td>
<td>351</td>
<td>Bearing housing – lower part</td>
</tr>
<tr>
<td>421</td>
<td>Rotary shaft lip seal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pedestal (890)**

**Function:** Holding the fan pump for assembly purposes without foundation block.

**Design:** Grey cast iron

For detailed information on the design of the fan pump, see:
- Principal section
- Parts list
### 4.3 Type specification

#### 4.3.1 Applicable standards

- **Dimensions**: ISO 2858
- **Design**: ISO 5199
- **Inspection (Q, H, NPSH)**: EN 809, EN 292-1, EN 292-2
- **Product safety**: EN 809, EN 292-1, EN 292-2
- **Flanged drilling**: ISO 2084, PN 10 (DIN 2501, SFS 2123)
  - ISO 2084, PN 16 (DIN 2501, SFS 2123)
  - JIS B2210 10K standard flange
  - JIS B2210 16K
  - ANSI B 16.1 Class 125
  - ANSI B 16.5 Class 150

#### 4.3.2 Model designation

**Type plate**

Each fan pump has a type plate mounted on the volute casing showing the main pump data.

![Type plate](image.png)

**Fig. 4-10** Type plate

- Q.....Capacity (m³/h)
- H.....Delivery head (m)
- P.....Motor power (kW)
- n.....Motor speed (rpm)
- C.....Consistency (%)
- γ.....spec. gravity (kg/m³)
4.4 Application limiting values

The limit values shown for the fan pump in the present Chapter should not be exceeded under any circumstances.

**Pressure and temperature limits**

The permitted pressure and temperature limit values according to table (Tab. 4-5) must be observed.

<table>
<thead>
<tr>
<th>Type</th>
<th>Pressure in suction branch</th>
<th>Pressure in delivery branch</th>
<th>Temperature Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP40-400</td>
<td>0.2 min./1 bar max.</td>
<td>6.2 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP40-500</td>
<td>0.2 min./1 bar max.</td>
<td>6.2 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP40-700</td>
<td>0.2 min./1 bar max.</td>
<td>6.2 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP40-900</td>
<td>0.2 min./1 bar max.</td>
<td>8.5 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP60-500</td>
<td>0.2 min./1 bar max.</td>
<td>8.5 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP80-600</td>
<td>0.2 min./1 bar max.</td>
<td>10 bar max.</td>
<td>50°C max.</td>
</tr>
<tr>
<td>FP80-800</td>
<td>0.2 min./1 bar max.</td>
<td>10 bar max.</td>
<td>50°C max.</td>
</tr>
</tbody>
</table>

Tab. 4-5 Pressure and temperature limit values

**Sealing water - shaft seal**

The permitted pressure and quantity data on the shaft seal according to table (Tab. 4-6Tab. 4-7) must be observed.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sealing water - pressure (inlet)</th>
<th>Sealing water - quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP40-400</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP40-500</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP40-700</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP40-900</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP60-500</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP80-600</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x2.5 l/min</td>
</tr>
<tr>
<td>FP80-800</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x3.5 l/min</td>
</tr>
</tbody>
</table>

Tab. 4-6 Sealing water - shaft seal (stuffing box)
### Mechanical seal

The limit values for the mechanical seal with regard to pressure and temperature can be found in the manufacturer’s operating manual.

> /SUPPLIER DOCUMENTATION/MECHANICAL SEAL

<table>
<thead>
<tr>
<th>Type</th>
<th>Sealing water - pressure (inlet)</th>
<th>Sealing water - pressure (outlet)</th>
<th>Sealing water - quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP40-400</td>
<td>2 bar min./3 bar max.</td>
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<td>min.2x1.5 l/min</td>
</tr>
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<td>FP40-500</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP40-700</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP40-900</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP60-500</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x1.5 l/min</td>
</tr>
<tr>
<td>FP80-600</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x2.5 l/min</td>
</tr>
<tr>
<td>FP80-800</td>
<td>2 bar min./3 bar max.</td>
<td>2 bar min./3 bar max.</td>
<td>min.2x3.5 l/min</td>
</tr>
</tbody>
</table>

Tab. 4-7  Sealing water - shaft seal (mechanical seal)
Permitted load on supports

The permitted loads on supports according to table (Tab. 4-8) must be observed.

- Force in kN
- Torque in kNm

<table>
<thead>
<tr>
<th>FP types</th>
<th>$F_{1S}$</th>
<th>$F_{1D}$</th>
<th>$F_{1S} + F_{1D}$</th>
<th>$F_{2S}$</th>
<th>$F_{2D}$</th>
<th>$F_{3S} + F_{3D}$</th>
<th>$M_{1S}$</th>
<th>$M_{1D}$</th>
<th>$M_{2S}$</th>
<th>$M_{2D}$</th>
<th>$M_{2S} + M_{2D}$</th>
<th>$M_{3S}$</th>
<th>$M_{3D}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-900</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-500</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>9.5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>80-600</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80-800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 4-8 Permitted loads on supports

- $F_{1S} + F_{1D}$ values with same direction of dynamic effect
- $F_{3S} + F_{3D}$ values with opposite direction of dynamic effect
- $M_{2S} + M_{2D}$ values for same direction of torque effect

Fig. 4-11 Permitted load on supports
Relation between output and speed

The relation between output and speed according to table Tab. 4-9 must be observed.

<table>
<thead>
<tr>
<th>Pump Type</th>
<th>Shaft material 1.4462</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relation between output and speed</td>
</tr>
<tr>
<td></td>
<td>P(kW) / n(rpm)/</td>
</tr>
<tr>
<td>FP40-400</td>
<td></td>
</tr>
<tr>
<td>FP40-500</td>
<td></td>
</tr>
<tr>
<td>FP40-700</td>
<td></td>
</tr>
<tr>
<td>FP40-900</td>
<td></td>
</tr>
<tr>
<td>FP60-500</td>
<td>0.61</td>
</tr>
<tr>
<td>FP80-600</td>
<td></td>
</tr>
<tr>
<td>FP80-800</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 4-9  Relation between output and speed
4.5 Technological Description

Definition
The fan pump is used in continuous operation to pump clean liquids and various pulps used in the paper industry, with the aim of obtaining well mixed medium and of increasing the pressure.

Supply of medium
The medium to be pumped and mixed enters the volute casing through a suction pipe connected to the inlet flange. In the suction channel the medium is split and then enters the suction area of the impeller in twin flow and with a favourable flow pattern.

Pressure increase
The medium is sucked in by the twin-flow impeller from both left and right (twin-flow) in axial direction towards the centre of the impeller.

The medium is sucked in by the twin-flow impeller from both left and right (twin-flow) in axial direction towards the centre of the impeller.

In the impeller the medium undergoes radial acceleration, thus receiving speed energy, due to the rotational energy and the shape of the blades (changing from axial to radial). In the volute casing the speed energy is converted into pressure energy. The medium then enters the delivery pipe, which is connected to the outlet flange.
# ERECTION WORK and TRANSPORT

## 5.1 General

This chapter describes certain steps for transport, storage and installation of the fan pump which may be the responsibility of the user.

Activities which are carried out by ANDRITZ AG, including works assembly, are not the subject of this description.

## 5.2 Safety regulations

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disregarding the safety regulations may cause a risk to life and limb. Disregarding the safety regulations may cause a risk to life and limb and damage to the machine or its components. All safety instructions in this Chapter must be strictly observed.</td>
</tr>
</tbody>
</table>

| General safety instructions | All applicable accident prevention rules must be observed. Do not exceed permissible crane loads and weights on lifting gear and ropes/shackles. Secure loads against falling down. Do not step or walk below suspended loads. Standing below suspended loads is dangerous and thus forbidden. Jerking must be avoided. This refers especially to the handling of pre-assembled machines. |
| Qualification of assigned personnel | Transport and unloading to be carried out by personnel specially familiar with such work. Workers entrusted with lifting and conveying equipment must have the required national qualification. Start-up may only be carried out by trained, skilled workers. |
| Personal protective apparel | The following protective equipment must be worn when carrying out start-up and transport work: |
| Tools | Only use tools of a reputable brand and in good condition for any work performed on the fan pump. |
5.3 Haulage

During transport of the fan pump or loading/unloading (pump may fall).
The loading equipment must bear the name of the manufacturer, the type of material and the permitted load!
Do not lift machine and transport crates except at the points marked for lifting by crane or forklift.
Do not step or walk below suspended loads.

Supply

The fan pump is supplied pre-assembled. Machine components and auxiliary materials are packed in crates.
Transport sizes and weights are stated in the shipping documents.

Largest supply weights:
/FAN PUMP/TECHNICAL DATA

Acceptance

- Check whether supply is complete (against shipping documents and packing lists) and in perfect condition.
- In the event of transport damage or short supply, do not accept goods but notify forwarder and ANDRITZ AG's shipping department.
- If there is a hidden defect, notify forwarder and ANDRITZ AG's shipping department within two weeks.
The complete fan pump should only be raised as follows after unpacking:
The complete fan pump should only be raised if the lifting devices have been attached under the suction and delivery flanges. The lifting devices must be short enough to prevent the fan pump from tilting (Fig. 5-1).

**DANGER**

*Never* lift the complete fan pump from the lugs (Fig. 5-1) provided for the upper part of the volute casing. This could cause a risk to life and limb and/or damage to the pump.

Fig. 5-1  Lifting the fan pump
Lifting the pump components

Individual pump components should only be raised as follows:

- The upper part of the volute case can be raised at the points marked (lugs) with the aid of shackles Fig. 5-2.

![Fig. 5-2 Lifting the upper part](image)

- The lower part of the fan pump can only be raised if the lifting devices have been attached under the suction and delivery flanges (Fig. 5-3)

![Fig. 5-3 Lifting the lower part](image)
5.4 Storage

Short-term storage If the pump is to be stored for less than three months before erection work begins, please observe the following storage instructions.

- Store the fan pump in a dry place, with suitable protection against dirt and corrosion.
- Packing should not be removed until erection work begins.
- If there is no oil or grease in the bearing housing, it must be filled with oil or grease to protect the bearing assembly against corrosion.
- Rotate the pump shaft manually every two weeks to prevent damage to the shaft bearing assembly.

Long-term storage If the pump is to be stored for more than three months before erection work begins, please observe the following storage instructions.

- Store the fan pump in a dry place, with suitable protection against dirt and corrosion.
- Incidental should be protected against damage and unauthorized withdrawal by storing in a lockable room.
- Drain any liquid from the fan pump
- Rotate the pump shaft manually every two weeks to prevent damage to the shaft bearing assembly.
- If the fan pump has a casing of grey cast iron and a stuffing box packing, remove the packing cord and coat the stuffing box body with an anti-rust agent.
- If there is no oil or grease in the bearing housing, it must be filled with oil or grease to protect the bearing assembly against corrosion.

**CAUTION**

The grease or oil in the bearing housing must be renewed before start-up. Anti-rust agents must be removed entirely.
5.5 Installation

General

Installation takes place in accordance with the sequence plan defined by ANDRITZ AG.

Disregarding the sequence plan and the installation instructions may result in hazardous situations causing a danger to life and limb and in machine damage. The sequence of erection work is important and must be strictly observed.

Implementation of the various steps must be documented in the certificate of completion of erection work.

The sequence of erection work is shown in step-by-step tables. Individual activities are numbered in their order of precedence.

Preservation

Those machine components which are not corrosion-resistant should be protected against corrosion with preserving grease.

The preservative grease need not be removed.

Required documentation at installation site

The following supplementary documentation must be available at the beginning of erection work.

- foundation and arrangement drawing
- assembly drawings for the different sub-assemblies
- pipe connection diagram
- documentation on electrical, measuring and control equipment
- list of components for sub-assemblies
- packing lists for each individual delivery

Space requirement for erection work, operation and maintenance will be defined together with the ANDRITZ AG representative in charge before the beginning of erection work.

Ambient temperature during erection work should not be less than 10-15°C.
5.5.1 Erection of the fan pump

Foundation

The foundation should be made according to ANDRITZ AG's foundation plan.

The following preparations have to be made prior to placing the fan pump on the foundation:

- Mark axes and levels on the foundation.
- Check the finish of the foundation before beginning erection work.

Mounting and foundation work

The foundations are to be laid according to the following table.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insert anchor bolts into the bore holes provided at the fan pump.</td>
</tr>
<tr>
<td>2</td>
<td>Place fan pump with anchor bolts on the foundation such that the anchor bolts protrude into the recesses.Raise the pump according to Chapter 5.3</td>
</tr>
<tr>
<td>3</td>
<td>Level the pump to ±0.5 mm with lining plates.</td>
</tr>
<tr>
<td>4</td>
<td>Grout supports with shrink-free grouting compound (Fig. 5-4 and/or Fig. 5-5).</td>
</tr>
<tr>
<td>5</td>
<td>After the hardening period (1 to 2 days), align the pump accurately and tighten the anchor bolts with the required tightening torque. A formal record must be made of pump alignment.</td>
</tr>
</tbody>
</table>

Tab. 5-1 Foundations

Fig. 5-4 Fundation work with pedestal
Due to the fan pump or components of the fan pump falling during transport on installation site. Raise fan pump according to the transport instructions in Chapter 5.3.
Do not step or walk below suspended loads.

Due to parts of the body being jammed or crushed during installation work. Wear your personal protective apparel.

Transport devices that are forgotten may result in risks to life and limb and in damage to the machine. Remove all transport devices.
5.5.2 Pipework

**DANGER**

If pipework is not mounted professionally. This can result in risks to life and limb and in damage to the machine. Under no circumstances should the fan pump be used to support a pipe!

---

**WARNING**

If there is risk of dangerous backflow after the pump is shut down, a reflux check device must be installed in the delivery pipe!

---

Support

When planning the pipework, a supplement must be included for heat expansion.

Pipes should always be mounted stress-free. During erection work ensure that the pipes are supported in such a way that no forces, vibrations or weight can be transferred to the pump.

The suction and delivery pipes must be supported on a foundation so that the weight of the pipe is not transferred to the fan pump (Fig. 5-6). The pipework is secured to the foundation with pipe clamps.

![Pipe foundation diagram](image)

\[ S = (1.2 \ldots 2) \times d \]

\[ s = \text{no. of pipe clamps} \]

Fig. 5-6 Pipe foundation
Suction pipe

The following must be observed at the suction pipe:

- The suction pipe should be kept as short as possible to maintain pipe friction losses at a minimum.
- Run a pressure test to check the pipe for leaks.
- The suction pipe should rise or fall slightly towards the fan pump.
- If a reducing piece is installed directly upstream of the fan pump, the narrowing section thereof should always be at the bottom (Fig. 5-7).
- Inlet points in the suction pipe should be located at a distance from the fan pump suction flange that is equivalent to a minimum of 5 times the diameter of the suction pipe.

![Fig. 5-7 Suction pipe](image)

5.6 Instruments

**Magnetic-inductive flow meter (690)**
(if included in scope of supply)

Instructions on installation and operation of the flow meter can be found in the enclosed description from the manufacturer.

This device must be adjusted under the supervision of Andritz personnel.
5.7 Cold test

Prerequisites

The following utilities must be available:

- Electric power
- Water

Lubrication

- First filling of lubricant and recording of all further lubrication procedures according to the section headed "Lubrication" in the MAINTENANCE chapter.

Cold test

Cold test is to be carried out together with the customer's authorized representative.

The work steps listed in the cold test certificate shall be carried out for the cold test, and documented.

⇒ /ATTACHMENT/CERTIFICATES AND BLOCK DIAGRAMS

Final inspection

The customer and the erection work supervisor shall conduct a final inspection of the installation on completion of the cold tests.

Certificates

The following certificates are issued after completion of the ISO cold test

- Cold test certificate
- Certificate of completion of erection work.

Certificates:

⇒ /ANNEX/CERTIFICATES AND BLOCK DIAGRAMS

CAUTION

Machine may be damaged if inappropriate oil or grease grades are used as first filling.
Only use oils or greases with the properties listed in the lubrication schedules.

CAUTION

Machine may be damaged if inappropriate oil or grease grades are used as first filling.
Only use oils or greases with the properties listed in the lubrication schedules.
6 START-UP

6.1 General

Initial start-up of the fan pump shall be prepared and carried out by the Contractor or by ANDRITZ AG personnel. Start-up takes place in accordance with the start-up sequence plan and ANDRITZ AG’s start-up protocols.

During start-up practical machine training will also take place on the machine. Participants must have undergone theoretical training.

6.2 Safety regulations

DANGER

Disregarding the safety regulations may cause a risk to life and limb. Disregarding the safety regulations may cause a risk to life and limb and damage to the machine or its components.
All safety instructions in this Chapter must be strictly observed.

General safety instructions

Start-up shall be carried out under the control of ANDRITZ AG’s start-up supervisor or by the Buyer.

All applicable accident prevention rules must be observed.

Qualification of assigned personnel

Start-up may only be carried out by trained, skilled workers.

Personal protective apparel

The following protective equipment must be worn when carrying out start-up and erection work:

- Hard hat
- Protective shoes
- Goggles
- Gloves must be worn when handling aggressive media such as oil, cleaning agent, chemicals, lubricants, white water, etc.
6.3 Prerequisites for start-up

The following must be checked before start-up:

**DANGER**

Motor may be started up unintentionally.
Risk to life and limb and risk of damaging the machine or its components.
Take care that the motor cannot be started up!

**Check for leaks**
The pump and pipework must be leakproof before start-up.
Leaks, particularly in the suction pipe, can reduce performance of the pump substantially and interfere with filling of the pump before start-up.

Parts of the pump which are under pressure are not considered pressure vessels in terms of the official regulations on pressure vessels.

**Sense of rotation of motor**
Before start-up check that the motor is rotating in the right direction.

**CAUTION**
Before checking the sense of rotation of the motor, it is essential to remove the coupling spacer.
The motor must rotate in the direction of the arrow provided on the motor casing.

**Free rotation**
The pump must be able to rotate freely. Here the two coupling halves should be separated from one another.
By rotating the pump end coupling half the operator can check whether the shaft can be rotated freely.
Aligning the coupling
A further check should be performed to ensure that the coupling is properly aligned. Coupling alignment should then be verified in writing.

For assembly and disassembly of the coupling, as well as the tolerances to be observed here, please see:

/FAN PUMP/SUPPLIER DOCUMENTATION/COUPLING

Pump lubrication
Before start-up, check the lubricant (oil or grease) to be used for the pump and the drive bearing.

_DANGER_
Due to the pump not being lubricated correctly!
This can result in risks to life and limb and in damage to the machine.
The pump should never be operated without a suitable lubricant!

If the pump is kept in storage for a longer period before being put into operation, dirt and water may enter the pump in the meantime. If there are substantial fluctuations in temperature, there may be some condensation.

Shaft seal and sealing water
Some parameters must be checked in order to ensure that the stuffing boxmechanical seal is functioning well.

- Only clean water from an external source should be used.
- The maximum particle size of 80 microns must not be exceeded.
- The maximum solids content of 2 mg/l (ppm) must not be exceeded.
- The stuffing boxmechanical seal must have an adequate supply of sealing water. Throughput 3-5 l/min
6.4 Start-up

**CAUTION**

**Machine may be damaged by inappropriate starting.**
All electric interlocks must be functional and checked.

### Starting up the fan pump

If all preliminary requirements (see Chapter 6.3) have been fulfilled, the pump can then be started up according to the following table:

<table>
<thead>
<tr>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Suction pipe and pump casing must be filled with the medium.</td>
</tr>
<tr>
<td>2 The pump casing must be vented with the vent screw (903.5).</td>
</tr>
<tr>
<td>3 The shaft seal must have an adequate supply of sealing water.</td>
</tr>
<tr>
<td>4 There must be sufficient sealing water escaping from the stuffing box (30 - 80 Tropfen/min).</td>
</tr>
<tr>
<td>5 The mechanical seal must have a supply of sealing water. The flow of sealing water should only be throttled at the outlet.</td>
</tr>
<tr>
<td>6 The valve in the suction pipe is fully open.</td>
</tr>
<tr>
<td>7 The valve in the delivery pipe is completely closed.</td>
</tr>
<tr>
<td>8 Start up pump and open the delivery side valve far enough to obtain the desired flow rate.</td>
</tr>
<tr>
<td>9 Check stuffing box to see whether enough liquid is coming out. If not, the stuffing box gland must be slackened right away. If the packing material still becomes too hot after the gland has been slackened, the operator must shut down the pump and look for the cause of the problem. When the stuffing box has been running for approx. 10 minutes without any problems, it can then be tightened again moderately. To set the stuffing box, see Chapter on &quot;Maintenance&quot;.</td>
</tr>
</tbody>
</table>

Tab. 6-1 Starting up the fan pump

**DANGER**

**If the pump runs dry!**
This can result in risks to life and limb and in damage to the machine.
The pump should never be allowed to run dry under any circumstances, not even briefly.
First trial run

Functioning of the pump must be monitored carefully during the first few hours in operation. Particular attention must be paid to the following:

- temperature of the shaft seal
- required amount of sealing water to the shaft seal
- bearing temperature and vibration
- pressure and flow rate in the pump

If there are any unusual noises, it is essential to look for the cause without delay and then eliminate the problem!

After start-up, the fan pump is handed over to the mill operator in a complete, reliable condition and ready for operation.

6.5 Certificates

The following certificates must be completed and signed after start-up:

- Start-up certificate:
  ➔ /ANNEX/CERTIFICATES AND BLOCK DIAGRAMS

- Provisional acceptance certificate:
  ➔ /ANNEX/CERTIFICATES AND BLOCK DIAGRAMS
7 OPERATION

7.1 General

This chapter describes the activities required for starting, operating and stopping the fan pump. Possible malfunctions and troubleshooting methods are also presented.

7.2 Safety regulations

DANGER

Disregarding the safety regulations may cause a risk to life and limb. Disregarding the safety regulations may cause a risk to life and limb and damage to the machine or its components. All safety instructions in this Chapter must be strictly observed.

General safety instructions

All applicable accident prevention rules must be observed.

Operating the fan pump is not permitted without all the required safety devices.

Qualification of assigned personnel

The equipment may only be operated by qualified personnel.

Operating personnel must know where the emergency-off switches and the escape routes are located.

Operating personnel must have been instructed in the function and possible failure of machine monitoring equipment, and in carrying out maintenance and inspection work (shift log book, maintenance inspection records).

Personal protective apparel

The following personal protective equipment/apparel shall be used when performing work on the machine (e.g. troubleshooting):

- Hard hat
- Protective gloves
- Protective shoes
- Goggles
7.3 Control via DCS

The fan pump can be started up and operated entirely from the DCS.

7.4 Starting

Prerequisites

All preliminary requirements for start-up must be fulfilled before switching on the pump.

see:

/FAN PUMP/START-UP/Preliminary requirements for start-up

Before starting the fan pump, the following parameters must be fulfilled:

- Suction pipe and pump casing must be filled with the medium.
- The pump casing must be vented.

If the pump runs dry!

This can result in risks to life and limb and in damage to the machine.

The pump should never be allowed to run dry under any circumstances, not even briefly.

- The shaft seal must have an adequate supply of sealing water.
- There must be sufficient sealing water escaping from the stuffing box. (30 - 80 drops/min)
- The mechanical seal must have a supply of sealing water.
- The valve in the delivery pipe is completely closed first of all.

Immediately after starting up the pump, open the valve in the delivery pipe far enough to obtain the desired flow rate. The required flow rate must always be set using the valve on the delivery side!

If the operating pressure (see instruments) is not obtained within a short time, the pump must be stopped again and the cause of the problem found!
Automatic starting  All the necessary steps are performed automatically by the distributed control system during start-up.

Manual start  Carry out the following steps for manual start.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Operating device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Open suction-side valve</td>
<td>OPEN</td>
</tr>
<tr>
<td>2</td>
<td>Switch on motor</td>
<td>START</td>
</tr>
<tr>
<td>3</td>
<td>Open delivery-side valve</td>
<td>OPEN</td>
</tr>
</tbody>
</table>

Tab. 7-1  Manual start

7.5  Checks after initial start-up

The following items must be checked after initial start-up:

- temperature of the shaft seal
- required amount of sealing water to the shaft seal
- bearing temperature and vibration
- pressure and flow rate in the pump

CAUTION  If there are any unusual noises, it is essential to look for the cause without delay and then eliminate the problem!
7.6 Normal operation

---

DANGER

Do not operate without all safety devices ON.

---

While the pump is in operation the operating personnel should record the relevant data (shift record and data sheets).

Activities during normal operations

once per shift

The following work has to be performed per shift in normal operation.

<table>
<thead>
<tr>
<th>Component</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan pump, complete</td>
<td>Visual check (sealing water, etc.)</td>
</tr>
</tbody>
</table>

Tab. 7-2 Activities to be performed in every shift
7.7 Fan pump requirements (delivery head and flow rate)

Sizing

The pump sizing (delivery head/flow rate) refers to the values shown on the pump's type plate.

The values obtainable for head and flow rate can be read off the impeller diameter and the defined operating speed is shown in the performance diagram.

If the impeller diameter or speed of the pump is changed, the duty point moves to a different performance curve for head and flow rate.

Flow rate change

The power consumption point on the curve can be changed by opening or closing the valve in the delivery pipe further or by altering the pump speed.

---

CAUTION

Longer periods of pumping with the valves closed can cause damage to the pump!
Too low NPSH\textsubscript{plant} value can cause damage to the impeller!

Changing the operating parameters

If the operating parameters for which the pump has been sized are changed, the following considerations should also be taken into account:

1. All parameters for the pump (pressure, impeller diameter, ...) were sized for the original duty point. These factors should be fully checked for the new operating conditions.

2. The fan pump can be operated for a short time with the delivery valve closed. For continuous operation, however, a minimum flow rate is required. The curve shown in the performance diagram for the required suction pressure (set NPSH\textsubscript{pump} begins at the point of the permitted continuous minimum flow rate.

3. The inlet characteristics of the system (actual NPSH\textsubscript{plant}), as well as the drive motor and shaft outputs, must always be checked under changed operating conditions.

4. The efficiency of the pump is the deciding factor in its overall service life, thus the power requirement of the pump must be checked.

5. The performance diagram is based on values with clean water. If other liquids are pumped, the data on delivery head and flow rate, as well as power requirement, may change. These factors were taken into account when the pump was originally selected and should also be considered in the light of any new operating conditions.
7.8 Stopping

**Automatic stop**
When using the group stop, all necessary steps are carried out automatically with the DCS.

**Manual stop**
Carry out the following steps for manual stop.

- Stop the pump motor
- Close the valve in the delivery pipe
- Close the valve in the suction pipe, if necessary
- Allow the pressure to escape from the pump
- Close the inlet for the sealing liquid

---

**WARNING**
If there is a danger of the pump liquid freezing, the pump and pipes should be emptied!
### 7.9 Operating malfunctions and troubleshooting

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump is not pumping medium</td>
<td>Insufficient pre-filling of pump Steambubbles forming in suction pipe (NPSH&lt;sub&gt;plant&lt;/sub&gt;)</td>
<td>Repeat pre-filling of the pump and suction pipe</td>
</tr>
<tr>
<td></td>
<td>Pressure difference between inlet pressure and steam pressure is too low</td>
<td>Check the suction pipe</td>
</tr>
<tr>
<td></td>
<td>Air entering the suction pipe, suction port or shaft seal</td>
<td>Check the suction pipe and the shaft seal</td>
</tr>
<tr>
<td></td>
<td>Suction pipe, suction valve or impeller are clogged</td>
<td>Check the suction pipe and the entire pump for clogging</td>
</tr>
<tr>
<td></td>
<td>Speed too low</td>
<td>Check the speed requirements</td>
</tr>
<tr>
<td></td>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td>Check the resistance in the pipe</td>
</tr>
<tr>
<td>Insufficient delivery head</td>
<td>Unexpected air/gas content in pumping medium</td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td></td>
<td>Unexpectedly high viscosity in the medium</td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td></td>
<td>Suction pipe, suction valve or impeller are clogged</td>
<td>Check the suction pipe and the entire pump for clogging</td>
</tr>
<tr>
<td></td>
<td>Speed too low</td>
<td>Check the speed requirements</td>
</tr>
<tr>
<td></td>
<td>Wrong direction of rotation</td>
<td>Change sense of rotation of the motor</td>
</tr>
<tr>
<td></td>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td>Check and minimise the pipe resistance</td>
</tr>
<tr>
<td></td>
<td>Pump parts coming into contact with pressure are worn, damaged or clogged</td>
<td>Check the pump and change any worn or damaged parts if necessary</td>
</tr>
<tr>
<td></td>
<td>Delivery-side valve partly open or closed</td>
<td>Open valve</td>
</tr>
</tbody>
</table>

**Tab. 7-3 Operating malfunctions and troubleshooting**
### Inadequate or irregular flow rate

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam bubbles forming in the suction pipe</td>
<td></td>
<td>Repeat pre-filling of the pump and suction pipe</td>
</tr>
<tr>
<td>Wrong direction of rotation</td>
<td></td>
<td>Change sense of rotation of the motor</td>
</tr>
<tr>
<td>Net positive suction height (NPSH&lt;sub&gt;plant&lt;/sub&gt;) is too low</td>
<td></td>
<td>Check whether the suction valve is fully open and the suction pipe clear</td>
</tr>
<tr>
<td>Pressure difference between NPSH&lt;sub&gt;plant&lt;/sub&gt; and NPSH&lt;sub&gt;pump&lt;/sub&gt; is too low</td>
<td></td>
<td>Check the suction pipe</td>
</tr>
<tr>
<td>Air inlet in the suction pipe, suction port or shaft seal</td>
<td></td>
<td>Check the suction pipe and the shaft seal</td>
</tr>
<tr>
<td>Unexpected air/gas content in pumping medium</td>
<td></td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td>Unexpectedly high viscosity in the medium</td>
<td></td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td>Suction pipe, suction valve or impeller are clogged</td>
<td></td>
<td>Check the suction pipe and the entire pump for clogging</td>
</tr>
<tr>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td></td>
<td>Check the resistance in the pipe</td>
</tr>
<tr>
<td>Pump parts coming into contact with pressure are worn, damaged or clogged</td>
<td></td>
<td>Check the pump and change any worn or damaged parts if necessary</td>
</tr>
</tbody>
</table>

### High power loss

<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed too high</td>
<td></td>
<td>Check the motor speed</td>
</tr>
<tr>
<td>Wrong direction of rotation</td>
<td></td>
<td>Check the sense of rotation of the motor</td>
</tr>
<tr>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td></td>
<td>Check the resistance in the pipe</td>
</tr>
<tr>
<td>Unexpected specific gravitation in pumping medium</td>
<td></td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td>Unexpectedly high viscosity in the medium</td>
<td></td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td>Bent or eccentric pump shaft</td>
<td></td>
<td>Replace the pump shaft and bearing</td>
</tr>
<tr>
<td>Rotating objects or pump parts causing friction in the pump</td>
<td></td>
<td>Disassemble and check the inside of the pump</td>
</tr>
<tr>
<td>Pump parts coming into contact with pressure are worn, damaged or clogged</td>
<td></td>
<td>Check the pump and change any worn or damaged parts if necessary</td>
</tr>
</tbody>
</table>

**Tab. 7-3** Operating malfunctions and troubleshooting
<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive noise and/or vibration</td>
<td>Pressure difference between NPSH_{plant} and NPSH_{pump} is too low</td>
<td>Check the suction pipe</td>
</tr>
<tr>
<td></td>
<td>Unexpected air/gas content in pumping medium</td>
<td>Contact Andritz AG for further instructions</td>
</tr>
<tr>
<td></td>
<td>Air inlet in the suction pipe, suction port or shaft seal</td>
<td>Check the suction pipe and the shaft seal</td>
</tr>
<tr>
<td></td>
<td>Suction pipe, suction valve or impeller are clogged</td>
<td>Check the suction pipe and the entire pump for clogging</td>
</tr>
<tr>
<td></td>
<td>Speed too low</td>
<td>Check the speed requirements</td>
</tr>
<tr>
<td></td>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td>Check the resistance in the pipe</td>
</tr>
<tr>
<td></td>
<td>The pump flow rate is below the permitted minimum level (cavitation)</td>
<td>Check the requirements of the pump system</td>
</tr>
<tr>
<td></td>
<td>The foundation is too weak</td>
<td>Reinforce the foundation</td>
</tr>
<tr>
<td></td>
<td>Pump is subjected to additional load if the pipe is not adequately supported</td>
<td>Check pipe support</td>
</tr>
<tr>
<td></td>
<td>Pump and motor are not in true alignment</td>
<td>Check pump/motor alignment or re-align</td>
</tr>
<tr>
<td></td>
<td>Broken or eccentric pump shaft</td>
<td>Replace the pump shaft and bearing</td>
</tr>
<tr>
<td></td>
<td>Rotating objects or pump parts causing friction in the pump</td>
<td>Disassemble and check the inside of the pump</td>
</tr>
<tr>
<td></td>
<td>Pump parts coming into contact with pressure are worn, damaged or clogged</td>
<td>Check the pump and change any worn or damaged parts if necessary</td>
</tr>
<tr>
<td></td>
<td>Bearing worn or loose</td>
<td>Disassemble the pump and replace the bearings if necessary</td>
</tr>
<tr>
<td></td>
<td>Insufficient or excessive lubrication</td>
<td>Check that pump has appropriate lubrication</td>
</tr>
<tr>
<td></td>
<td>Impeller damaged or unbalanced</td>
<td>Disassemble the pump and replace the impeller if necessary</td>
</tr>
</tbody>
</table>

Tab. 7-3 Operating malfunctions and troubleshooting
<table>
<thead>
<tr>
<th>Malfunction</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive wear on bearing</td>
<td>Pump and motor are not in true alignment</td>
<td>Check pump/motor alignment or re-align</td>
</tr>
<tr>
<td></td>
<td>Broken or eccentric pump shaft</td>
<td>Replace the pump shaft and bearing</td>
</tr>
<tr>
<td></td>
<td>Rotating objects or pump parts causing friction in the pump</td>
<td>Disassemble and check the inside of the pump</td>
</tr>
<tr>
<td></td>
<td>Impeller damaged or unbalanced</td>
<td>Disassemble the pump and replace the impeller if necessary</td>
</tr>
<tr>
<td></td>
<td>Insufficient or excessive lubrication</td>
<td>Check that pump has appropriate lubrication</td>
</tr>
<tr>
<td></td>
<td>Bearing not installed properly or dirty</td>
<td>Replace bearing assembly if necessary and check the lubricating system for contamination</td>
</tr>
<tr>
<td>Pump overheating/jamming</td>
<td>Delivery-side valve closed</td>
<td>Open valve</td>
</tr>
<tr>
<td></td>
<td>Insufficient pre-filling of pump</td>
<td>Repeat pre-filling of the pump and suction pipe</td>
</tr>
<tr>
<td></td>
<td>Pressure difference between NPSH plant and NPSH pump is too low</td>
<td>Check the suction pipe</td>
</tr>
<tr>
<td></td>
<td>The pump flow rate is below the permitted minimum level (cavitation)</td>
<td>Check the requirements of the pump system</td>
</tr>
<tr>
<td></td>
<td>Pump and motor are not in true alignment</td>
<td>Check pump/motor alignment or re-align</td>
</tr>
<tr>
<td></td>
<td>Bearing worn or loose</td>
<td>Disassemble the pump and replace the bearings if necessary</td>
</tr>
<tr>
<td></td>
<td>Broken or eccentric pump shaft</td>
<td>Replace the pump shaft and bearing</td>
</tr>
<tr>
<td></td>
<td>Impeller damaged or unbalanced</td>
<td>Disassemble the pump and replace the impeller if necessary</td>
</tr>
<tr>
<td></td>
<td>Rotating objects or pump parts causing friction in the pump</td>
<td>Disassemble and check the inside of the pump</td>
</tr>
<tr>
<td></td>
<td>Flow resistance in the pipe is greater than the delivery head generated at the pump</td>
<td>Check and minimise the pipe resistance</td>
</tr>
</tbody>
</table>

Tab. 7-3 Operating malfunctions and troubleshooting
8 MAINTENANCE

8.1 General

This chapter describes the maintenance and upkeep of the fan pump, which is the responsibility of the machine/mill operator.

All activities mentioned in this chapter must be performed at the correct time.

The ANDRITZ AG service department is at your disposal for troubleshooting, as well as for extensive maintenance and repair work. (⇒ /FAN PUMP/INTRODUCTION)

Workers trained and authorized by Andritz AG may also carry out repairs on site after obtaining consent from AAG.

8.2 Safety regulations

Disregarding the safety regulations may cause a risk to life and limb. Disregarding the safety regulations may cause a risk to life and limb and damage to the machine or its components.

All safety instructions in this Chapter must be strictly observed.

General safety instructions

All applicable accident prevention rules must be observed.

Sufficient space for maintenance work must be included right away in the arrangement drawing.

Maintenance and upkeep must not be performed when the machine is in operation.

Do not exceed permissible crane loads and weights on lifting gear and ropes/shackles. Secure loads against falling down.

Do not step or walk below suspended loads. Standing below suspended loads is dangerous and thus forbidden.

Machine must be thoroughly cleaned before carrying out any maintenance work.

Use only genuine spare parts.

Energy supply

Before beginning any maintenance or repair work the operator must disconnect the energy supply to all drives securely. This can be achieved with a maintenance switch, lockable racks in the MCC, or with other suitable measures that comply with the safety regulations.

Qualification of assigned personnel

Maintenance and upkeep must be carried out by trained and skilled personnel.
Work on the electrical equipment must be carried out without exception by skilled electricians.

### Personal protective apparel

The following protective equipment must be worn when carrying out cleaning and maintenance:

- Hard hat
- Protective gloves
- Protective shoes
- Goggles

### Tools

Only use tools of a reputable brand and in good condition for any work performed on the fan pump.

#### 8.3 Regular maintenance

Regular monitoring of operations and performance of the fan pump will allow the operator to detect any need for maintenance and repairs in good time. This guarantees a high level of efficiency, a trouble-free operating sequence, and minimises the maintenance costs!

The discharge pressure, flow rate and power consumption should be monitored continuously.

For machines operating continuously (24 hours/day, 7 days/week), a prescheduled maintenance period every two weeks is recommended. During these periods the machine should be shut down, thoroughly cleaned and checked for wear.

Machines operating less than 24 hours per day should be subjected to these routine checks and cleaned at each stoppage.

### General machine checks

The following checks should be made when the machine is at a standstill:

<table>
<thead>
<tr>
<th>Component</th>
<th>Checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft seal</td>
<td>Leaks and wear</td>
</tr>
<tr>
<td>Bearing</td>
<td>Lubricant quantity (oil level)</td>
</tr>
<tr>
<td>Static seals</td>
<td>Leaks</td>
</tr>
<tr>
<td>Coupling</td>
<td>Wear on the coupling pads</td>
</tr>
<tr>
<td>Complete pump</td>
<td>Visual check</td>
</tr>
</tbody>
</table>

Tab. 8-1 General machine checks
In the course of general machine checks all additional units should also be checked to guarantee that the entire plant functions satisfactorily. For these checks, the attached manufacturer’s maintenance and upkeep instructions must be observed.

/FAN PUMP/SUPPLIER DOCUMENTATION

Malfunctions and unforeseen modifications found during these checks must be eliminated immediately.

Cleaning

Clean the fan by hosing down or brushing when it is at a standstill.

WARNING

Contact with the pulp may cause skin damage and burning. Persons handling the pulp should not suffer from an allergic condition to such substances. Personal protective apparel must be worn.

CAUTION

Do not use caustic agents for cleaning. Make sure no water, steam or other cleaning medium enters electrical plant components.
8.4 Maintenance schedule

In addition to the work outlined below, maintenance and work required for normal operations (FAN PUMP/OPERATION/NORMAL OPERATION) must also be carried out.

**monthly**

The following maintenance work is to be carried out at monthly intervals.

<table>
<thead>
<tr>
<th>Component</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearings</td>
<td>• Check temperature</td>
</tr>
<tr>
<td></td>
<td>• Measure vibrations</td>
</tr>
<tr>
<td></td>
<td>• Oil level/Grease level is to be checked</td>
</tr>
<tr>
<td></td>
<td>• Check for strange noises</td>
</tr>
<tr>
<td>Volute casing (upper part – lower part)</td>
<td>• Check for corrosion and wear</td>
</tr>
<tr>
<td>Shaft with bearing</td>
<td>• Check for smooth running</td>
</tr>
<tr>
<td>Coupling</td>
<td>• Check alignment</td>
</tr>
<tr>
<td></td>
<td>• Check pads for wear</td>
</tr>
<tr>
<td>Stuffing box seal Mechanical seal</td>
<td>• Check for leaks</td>
</tr>
<tr>
<td></td>
<td>• Check for wear</td>
</tr>
<tr>
<td>Pipework</td>
<td>• Check for leaks</td>
</tr>
<tr>
<td>Complete pump</td>
<td>• Check for leaks</td>
</tr>
<tr>
<td></td>
<td>• Cleaning</td>
</tr>
</tbody>
</table>

Tab. 8-2 Monthly maintenance work

**semi-annually**

The following maintenance work is to be carried out at 6-monthly intervals.

<table>
<thead>
<tr>
<th>Component</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete pump</td>
<td>• Check mounting of pump on the foundation</td>
</tr>
<tr>
<td>Motor</td>
<td>• Check mounting of motor on the foundation</td>
</tr>
</tbody>
</table>

Tab. 8-3 6-monthly maintenance work

**annually**

The following maintenance work is to be carried out at annual intervals.

<table>
<thead>
<tr>
<th>Component</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete pump</td>
<td>• Complete service according to instructions from Andritz AG</td>
</tr>
<tr>
<td></td>
<td>(Oil change/Grease change, impeller check, etc.)</td>
</tr>
</tbody>
</table>

Tab. 8-4 Annual maintenance work
8.5 Fasteners

Screw material

Bolts and screws are manufactured in several classes of material. The heads of these screws and bolts are marked to identify the strength class of the screw or bolt. Damaged or lost fasteners should only be replaced with fasteners of the same material.

Check

Unless they are suitably tightened, screws can work loose or fail under operating conditions. In the course of maintenance work, all fastening screws must be checked.

- during the first six months: every 2 to 2½ months
- after the first six months: semi-annually

Tighten

During checks and maintenance work it is imperative to tighten all fastening screws to the torque specified for each screw in the drawings or in the table below.

Prestressing forces and tightening torques in the table apply to normal screw connections. Please contact Andritz AG in the event of special requirements.

The thread and screw head should be lubricated with an appropriate lubricant (for example Molyslide Plus from Loctite).

<table>
<thead>
<tr>
<th>Class</th>
<th>Pre-stressing forces [kN]</th>
<th>Tightening torques (Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Thread</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M10</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>M12</td>
<td>18</td>
<td>38</td>
</tr>
<tr>
<td>M16</td>
<td>33</td>
<td>70</td>
</tr>
<tr>
<td>M20</td>
<td>51</td>
<td>110</td>
</tr>
<tr>
<td>M24</td>
<td>74</td>
<td>158</td>
</tr>
<tr>
<td>M30</td>
<td>118</td>
<td>251</td>
</tr>
<tr>
<td>M38</td>
<td>172</td>
<td>368</td>
</tr>
<tr>
<td>M42</td>
<td>235</td>
<td>502</td>
</tr>
<tr>
<td>M48</td>
<td>309</td>
<td>860</td>
</tr>
</tbody>
</table>

Tab. 8-5  Tightening Torques and Pre-stressing Forces for Rigid Screws (Normal thread)

⚠️ CAUTION

Wrong torque tightening may cause machine damage and hazards leading to personal injury.
The above pre-stressing forces and tightening torques must be observed.
8.6 Lubrication

8.6.1 Oil lubrication

**WARNING**

Bearing housings are supplied without oil filling. Fill bearing with a suitable lubricating oil before start-up.

---

**CAUTION**

The first oil change should be carried out after 100 operating hours. The next oil changing intervals as shown in Tab. 8-6.

**Oil grade**

Use only high-grade mineral oils with a viscosity according to ISO VG 46 under normal conditions.

The following products can be used:

- EXXON Teresso 46
- SHELL Tellus Oil S46
- MOBIL DTE Oil Medium
- NESTE Paine 46
- KLÜBER Crucolan 46
- TEBO Larita Oil 46
Oil change

The first oil change should be carried out after 100 operating hours. After this oil changes should be performed according to Tab. 8-6.

<table>
<thead>
<tr>
<th>Oil change interval</th>
<th>1 year</th>
<th>6 months</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface temperature of the bearing housing</td>
<td>65°C</td>
<td>75°C</td>
<td>85°C</td>
</tr>
</tbody>
</table>

Tab. 8-6 Oil change intervals

The viscosity of the oil used must not drop below 6 cST when it is at operating temperature. The operating temperature is approximately 15°C higher than the surface temperature of the bearing housing!

The oil should be changed at operating temperature. The oil change should be performed according to the following table.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove the two vent valves (672).</td>
</tr>
<tr>
<td>2</td>
<td>After placing a suitable oil collecting container at the ready, remove the two hexagon head plug screws (903.2) and drain the used oil out of both bearing housings.</td>
</tr>
<tr>
<td>3</td>
<td>Screw in the two oil drainage hexagon head plug screws (903.2) with a new seal and tighten.</td>
</tr>
<tr>
<td>4</td>
<td>Fill in the fresh oil at (672) up to the middle of the oil level glass (642).</td>
</tr>
<tr>
<td>5</td>
<td>Screw in the two vent valves (672).</td>
</tr>
</tbody>
</table>

Tab. 8-7 Change oil
Oil quantities

The following oil quantities are required, depending on the pump size:

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Oil content (in litres)/bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP40-400</td>
<td></td>
</tr>
<tr>
<td>FP40-500</td>
<td>2.5</td>
</tr>
<tr>
<td>FP40-700</td>
<td></td>
</tr>
<tr>
<td>FP40-900</td>
<td></td>
</tr>
<tr>
<td>FP60-500</td>
<td>2.5</td>
</tr>
<tr>
<td>FP80-600</td>
<td></td>
</tr>
<tr>
<td>FP80-800</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 8-8 Oil quantities

The oil level may drop during operation. If an oil level controller is installed, this too must be filled with oil.

8.6.2 Grease lubrication

The bearings are filled with grease during works assembly. The bearings should be topped up with approx. 10 g of grease before being put into operation.

Grease types

The following lubricating greases should be used for operating conditions at which the surface temperature of the bearing housing is less than +80°C.

- EXXON Beacon 2
- SHELL Alvania R3
- SHELL Alvania G3
- SKF LGMT2
- FAG Arcanol L71V

WARNING

If the surface temperature of the bearing housing rises above +80°C, Andritz AG should be consulted.

Lubrication

The bearings for the fan pump should be re-greased according to the following table.
### Tab. 8-9  Lubrication schedule

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Lubricating point</th>
<th>First filling</th>
<th>Relubricate</th>
<th>Lubricating interval at 1000 rpm</th>
<th>Lubricating interval at 1500 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP40-400</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP40-500</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP40-700</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP40-900</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP60-500</td>
<td>Bearing</td>
<td>120 g</td>
<td>40 g</td>
<td>3000 h</td>
<td>2000 h</td>
</tr>
<tr>
<td>FP80-600</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FP80-800</td>
<td>Bearing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CAUTION**

Bearing damage may be caused by incorrect lubrication. Different grades of grease should not be mixed.
Grease change

The old grease should be cleaned off the bearing housing each time the rotor unit is removed (annual service). After re-assembly the bearing should be given a filling of fresh grease.

The grease in the bearings is to be changed according to the following table:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove bearing cover (360.1,360.2).</td>
</tr>
<tr>
<td>2</td>
<td>Remove top section of bearing housing (352).</td>
</tr>
<tr>
<td>3</td>
<td>Remove grease from the bottom section of the bearing housing (351).</td>
</tr>
<tr>
<td>4</td>
<td>Re-assemble bearing in reverse order.</td>
</tr>
<tr>
<td>5</td>
<td>Top up grease according to Tab. 8-9 at the grease nipple (636).</td>
</tr>
</tbody>
</table>

Tab. 8-10 Grease change

Fig. 8-2 Grease lubricating at the bearing
8.7 Aligning the coupling

The coupling alignment must be checked after each of the following assembly steps and corrected if necessary.

In particular:

- after mounting and before grouting in the pump
- after grouting in
- after installing the pipework
- after the trial run with water

If the alignment changes during production, the pump can also be aligned at operating temperature.

Aligning tolerances

Permitted tolerances ➔/FAN PUMP/SUPPLIER DOCUMENTATION/COUPLING
8.8 Removing and installing the rotor unit

Preparations

The following parts must be prepared before starting to disassemble the rotor unit:

- Tools
- Lifting gear
- Belts, ropes
- Replacement parts

The machine must be thoroughly cleaned before carrying out any maintenance work.

Complete the following work before starting to remove the unit itself:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switch off pump and secure against being switched on again.</td>
</tr>
<tr>
<td>2</td>
<td>Remove the hoses leading to the shaft seal.</td>
</tr>
<tr>
<td>3</td>
<td>Remove coupling guard (681), cap (683) and covers (683.1).</td>
</tr>
<tr>
<td>4</td>
<td>Remove the intermediate coupling piece after loosening the screws.</td>
</tr>
<tr>
<td>5</td>
<td>Drain oil out of bearing housings.</td>
</tr>
</tbody>
</table>

---

**DANGER**

Limbs can be trapped or crushed during disassembly work. Wear your personal protective apparel.
Fig. 8-5  Removing and installing the rotor unit

Raising the upper part of the volute casing
Removing the rotor unit

The rotor unit comprises the impeller (232,233), the shaft (211), the bearings, and the sealing units.

Remove the rotor unit according to the following table: The activities listed in the table are to be carried out on both sides of the pump.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loosen the screws (914.2) at the seal casing (451).</td>
</tr>
<tr>
<td>2</td>
<td>Loosen the screws (901.2) at the bearing cover (306.2, 360.1).</td>
</tr>
<tr>
<td>3</td>
<td>Loosen hexagon nuts (920.1) at the upper part of the volute casing (102.2), remove the taper pins (560.1) and raise the upper part of the volute casing. Raise the upper part of the volute casing according to Fig. 8-5.</td>
</tr>
<tr>
<td>4</td>
<td>Loosen hexagon nuts (920.2) at the upper part of the bearing casing (352), remove the taper pins (560.4) and raise the upper part of the bearing casing.</td>
</tr>
<tr>
<td>5</td>
<td>Lift the rotor unit out of the lower part of the volute casing according to Fig. 8-7 and place on a suitable support (wooden).</td>
</tr>
<tr>
<td>6</td>
<td>Dismantle the coupling according to the instructions issued by the coupling manufacturer.</td>
</tr>
</tbody>
</table>

Tab. 8-11 Removing the rotor unit
### Installation of the rotor unit

Proceed according to the following table when installing the rotor unit:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Replace O-rings (412.7 and 412.6) and lift the rotor unit into the lower part of the volute casing (102.1) according to Fig. 8-7.</td>
</tr>
<tr>
<td>2</td>
<td>Ensure that all loose parts fit into the positions where they belong. The bore holes in the wear rings (502) must fit exactly over the hexagon socket head cap screws (914.1) in the lower part of the volute casing (anti-torsion device for the wear rings).</td>
</tr>
<tr>
<td>3</td>
<td>Clean the sealing surfaces of the bearing housing (upper and lower part) and seal with surface seal (400.2).</td>
</tr>
<tr>
<td>4</td>
<td>Raise upper part of bearing housing (352), insert taper pins (560.4) and screw onto the lower part of the bearing housing with the hexagon nuts (920.2).</td>
</tr>
<tr>
<td>5</td>
<td>Sealing surfaces of the volute casing (upper and lower part) are to be cleaned.</td>
</tr>
</tbody>
</table>
| 6    | A PTFE surface seal is to be applied to the contact surfaces of the lower part of the volute casing (102.1) according to Fig. 8-6.  
Seal type: GORE-TEX, DEO6 3.2 x 0.7  
The points marked "A" in Fig. 8-6 should also be sealed with a surface seal (400.2 - Loctite 510). |
| 7    | Mount the upper part of the volute casing (102.2) carefully with the taper pins (560.1) inserted. (The taper pins are intended as a guide). |
| 8    | Tighten hexagon nuts (920.1) of the volute casing upper part (102.2) alternately.  
See Tab. 8-5 for tightening torques. |
| 9    | Insert O-ring (412.7) and tighten the screws (901.2) at the bearing cover (306.2, 360.1).  
See Tab. 8-5 for tightening torques. |
| 10   | Insert O-ring (412.6) and tighten the screws (914.2) at the seal casing (451).  
See Tab. 8-5 for tightening torques. |
| 11   | Assemble the coupling according to the instructions issued by the coupling manufacturer.  
/FAN PUMP/SUPPLIER DOCUMENTATION/COUPLING |

Tab. 8-12  Installing the rotor unit

After installing the rotor unit as described above, the activities listed in Tab. 8-11 should be carried out in reverse order.
8.9 Changing the bearing assembly

In order to avoid damage to the bearing it is essential to observe the lubrication intervals indicated in section 8.6 - Lubrication, as well as to use the recommended oils lubricating greases.

---

DANGER

Limbs can be trapped or crushed during installation work. Wear your personal protective apparel.

---

Fig. 8-8 Bearing
Removing the bearing

Proceed according to the following table when changing the bearing:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove rotor unit as per section 8.8.</td>
</tr>
<tr>
<td>2</td>
<td>Remove the feather key (940.2).</td>
</tr>
<tr>
<td>3</td>
<td>Remove the fastening screw (904.2) for the sleeve (524.2).</td>
</tr>
<tr>
<td>4</td>
<td>Pull off the sleeve (524.2) with the O-ring (412.3) and the rotary shaft seal (421).</td>
</tr>
<tr>
<td>5</td>
<td>Loosen the fastening screw (904.4) and push the splash ring (507) towards the centre of the shaft.</td>
</tr>
<tr>
<td>6</td>
<td>Bend the safety catch on the locking plate (931) out of the groove in the lock nut (923).</td>
</tr>
<tr>
<td>7</td>
<td>Remove the lock nut (923) and take the lock washer (931) off the shaft.</td>
</tr>
<tr>
<td>8</td>
<td>Pull the ball bearing (321) off the shaft with a stripping device. CAUTION: Do not position the stripping device at the outer bearing race.</td>
</tr>
<tr>
<td>9</td>
<td>Take off the ring (504.2) and pull off the bearing cover (360.2, 360.1) with the rotary shaft seal (421).</td>
</tr>
</tbody>
</table>

Tab. 8-13 Removing the bearing

![Diagram](image)

Fig. 8-9 Loose bearing
## Installing the bearing

Proceed according to the following table when installing the bearing:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Loosen the fastening screw (904.4) for the splash ring (507) and push the splash ring towards the centre of the shaft.</td>
</tr>
<tr>
<td>2</td>
<td>Push on the bearing cover (360.1, 360.2) with the new rotary shaft seal (421) up to the splash ring.</td>
</tr>
<tr>
<td>3</td>
<td>Push on ring (504.2).</td>
</tr>
<tr>
<td>4</td>
<td>Replace ball bearing (321).</td>
</tr>
<tr>
<td>5</td>
<td>Heat the ball bearings (321) according to the instructions from the bearing manufacturer (approx. 80°C) and push onto the shaft as far as the ring (504.2).</td>
</tr>
<tr>
<td>6</td>
<td>Mount the lock nut (923) with the lock washer (931) and tighten (by turning to the right).</td>
</tr>
<tr>
<td>7</td>
<td>Bend the safety catch on the locking plate (931) into the groove in the lock nut (923).</td>
</tr>
<tr>
<td>8</td>
<td>Pull on the sleeve (524.2) using the O-ring (412.3) coated with silicone grease until it is resting on the shoulder of the shaft.</td>
</tr>
<tr>
<td>9</td>
<td>Tighten the fastening screw (904.2) for the sleeve (524.2).</td>
</tr>
<tr>
<td>10</td>
<td>Mount the feather key (940.2).</td>
</tr>
</tbody>
</table>
| 11   | Install rotor unit as per section 8.8.  
      |   After installing the rotor unit, the splash ring (507) must be tightened so that it has 3 mm clearance to the bearing cover.  
      |   Caution: On the fixed bearing side, the fixed ring (504.1) is to be installed in the bearing housing. |

Tab. 8-14 Mounting the Bearing
### 8.10 Changing the stuffing box packing

**Removing the packing**

Proceed according to the following table when removing the stuffing box:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove the cover (683.1).</td>
</tr>
<tr>
<td>2</td>
<td>Loosen the hexagon nuts (920.3) and remove the bipartite stuffing box gland (452).</td>
</tr>
</tbody>
</table>
| 3    | Remove old stuffing box packings (461) and pull out the sealing water ring (458).  
**CAUTION:** Do not scratch or mark the shaft protection sleeve! |
| 4    | Clean stuffing box chamber thoroughly. |
| 5    | Check shaft protection sleeve (524.1) and replace if worn.  
Notches or grooves on the surface of the shaft protection sleeve cause excessive wear on the stuffing box packing! |

Tab. 8-15 Removing the stuffing box

---

**Fig. 8-10 Stuffing box**

---

**DANGER**

Limbs can be jammed or crushed during installation work. 
Wear your personal protective apparel.
## Installation

Proceed according to the following table when installing the stuffing box:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
</table>
| 1    | Mark packing (see Fig. 8-12) and cut to the appropriate length.  
Keep packing clean, do not stretch or squash when measuring and cutting.  
Do not damage shaft protection sleeve! |
| 2    | Wrap packing round the shaft protection sleeve (524.1). |
| 3    | Push first packing ring (461) into the stuffing box, starting at the butt joint.  
The ends of the ring must form a butt joint with no gap. |
| 4    | Push the first packing ring right in using a suitable tool. Mount the second packing ring with the butt joint offset by 120 degrees. |
| 5    | Mount the sealing water ring (458) and the remaining packing rings with the butt joint offset by 120 degrees.  
The ends of all the rings must form a butt joint with no gap. |
| 6    | When the stuffing box gland (452) has been installed, tighten all hexagon nuts (920.3) evenly according to the setting guidelines provided below. |
| 7    | Mount the cover (683.1). |

Tab. 8-16 Installing the stuffing box

![Diagram of stuffing box](image)  
Fig. 8-11 Stuffing box
The following settings must be observed:

- Never tighten the stuffing box gland so far that drainage of sealing water is brought to a complete halt. At least a few drops should drain off per minute in order to avoid excessive friction and wear on the shaft.
- Set the stuffing box such that the shaft protection sleeve at the stuffing box gland is always moist.
- The stuffing box should be checked every 15 minutes during the first few hours in operation.
- The stuffing boxes should leak excessively at start-up and be adjusted for a normal slow leak after the running-in period.
- Loosen the screws at the stuffing box gland if the stuffing box overheats.
- Do not tighten gland nuts more than 1/6 of a turn in 15 minutes running time.

The stuffing box will be damaged if the stuffing box gland is screwed too tight.
Only use the tools intended for the purpose!

Fig. 8-12 Marking the stuffing box packing
8.11 Changing the mechanical seal

Change the mechanical seal according to the following table:

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove rotor unit as per section 8.8.</td>
</tr>
<tr>
<td>2</td>
<td>Remove bearing as per section 8.9.</td>
</tr>
<tr>
<td>3</td>
<td>Remove bearing cover (360.1, 360.2) and splash ring (507).</td>
</tr>
<tr>
<td>4</td>
<td>Loosen screws (914.2) and pull off sealing unit.</td>
</tr>
<tr>
<td>5</td>
<td>Loosen the screws (901.5) and remove the retaining ring (506).</td>
</tr>
<tr>
<td>6</td>
<td>Change mechanical seals (433.1, 433.2) and O-rings (412.4, 412.5).</td>
</tr>
</tbody>
</table>

**CAUTION**: The seal must be installed and removed according to the enclosed instructions from the manufacturer. See /FAN PUMP/SUPPLIER DOCUMENTATION/MECHANICAL SEAL

<table>
<thead>
<tr>
<th>Step</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Re-assemble in reverse order.</td>
</tr>
</tbody>
</table>

---

**DANGER**: Limbs can be jammed or crushed during installation work. Wear your personal protective apparel.
8.12 Removing and installing the impeller

**DANGER**

Limbs can be trapped or crushed during disassembly work. Do not touch the shaft with your hands while pushing the impeller off!

**DANGER**

Injury at the impeller! Impellers may have very sharp edges, particularly when they are worn. Wear protective clothing and gloves!

**WARNING**

Use a hydraulic pump that can build up a pressure of at least 700 bar to push the impeller off. (PA-133, THAP-150 from SKF).

**WARNING**

Beware of high pressure in the hydraulic system! Hydraulic pumps and pipes are under high pressure. Wear your personal protective apparel! Always make sure that the connections and joints are in perfect condition!
Pushing off the impeller

Proceed according to the following table when pushing the impeller off:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remove both wear rings (502) from the impeller.</td>
</tr>
<tr>
<td>2</td>
<td>Turn hexagon socket pipe plug (903.1) out of the impeller half (232).</td>
</tr>
<tr>
<td>3</td>
<td>Raise the pump shaft on one side and fill the parting liquid slowly into the tap bore hole. Use parting liquid with a viscosity of 900 cST at 20°C (LHDF 900 from SKF) or a comparable grade.</td>
</tr>
<tr>
<td>4</td>
<td>Connect hydraulic pump (A) to the oil inlet opening.</td>
</tr>
<tr>
<td>5</td>
<td>Apply pressure to the hydraulic pump until the impeller half (232) comes away from the shaft. Pull impeller half (232) off the shaft seat in one go.</td>
</tr>
<tr>
<td>6</td>
<td>Then pull off the impeller half (233) according to step 2-5.</td>
</tr>
</tbody>
</table>

Tab. 8-18  Pushing the impeller off
Installation of the impeller

Preliminary requirements:

- Clean room with no draft, temperature +20°C
- Lifting device, e.g. crane, for manipulating the shaft
- Ring bolt for manipulating the shaft
- 2 heat sources, e.g. low-pressure gas burner for heating the impeller halves
- Workbench on which to place the two impeller halves, with a bore hole so that the bottom impeller half can be heated from below.
- Assembly devices: 3 nos. spacer plates t=0.3 mm made of acid-proof stainless steel
- Pump shaft and impeller halves comply with the requirements in relation to measuring accuracy, roundness and true running.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clean pump shaft and impeller halves, particularly the fitting surfaces of the impeller hub and the pump shaft.</td>
</tr>
<tr>
<td>2</td>
<td>Place the impeller half (232)* on the workbench as shown and insert the parallel pin (562.1).</td>
</tr>
<tr>
<td>3</td>
<td>Place the three spacer plates on the impeller half. At these points they should protrude beyond the contours of the impeller because they have to be removed again after the shrink-on process.</td>
</tr>
<tr>
<td>4</td>
<td>Position the impeller half (233)* in a central position above (232).</td>
</tr>
<tr>
<td>5</td>
<td>Turn the ring bolt into the central bore in the pump shaft.</td>
</tr>
<tr>
<td>6</td>
<td>Move the pump shaft into position above the hub bore hole in the impeller halves using a lifting device and lower it until the shaft seat is just above the hub of the top impeller half.</td>
</tr>
<tr>
<td>7</td>
<td>Heat both impeller hubs evenly at the same time. The temperature difference between shaft and hub should be 205°C. Avoid overheating at isolated points of the hubs.</td>
</tr>
<tr>
<td>8</td>
<td>Lower the pump shaft rapidly into the impeller hubs until its shoulder is resting on the impeller hub.</td>
</tr>
<tr>
<td>9</td>
<td>Wait until the components have cooled down slowly to ambient temperature.</td>
</tr>
<tr>
<td>10</td>
<td>Remove spacer plates.</td>
</tr>
<tr>
<td>11</td>
<td>Move the pump shaft into the horizontal and turn one hexagon socket pipe plug (903.1) into each impeller half.</td>
</tr>
<tr>
<td>12</td>
<td>Grind off plug head flush with the flow surface of the impeller.</td>
</tr>
</tbody>
</table>

Tab. 8-19 Installation of the impeller

*) For easy differentiation: The bore diameter at item (233) is always larger than the bore diameter at item (232).
**WARNING**

High temperatures occur during this work. Take care when working with hot surfaces. Appropriate fire extinguishing equipment must be available. Personal protective clothing must be worn!

---

**Fig. 8-15** Installation of the impeller

![Diagram of impeller installation](image-url)
8.13  Turning and balancing the impeller

**Turning the impeller**

The impellers are manufactured in standard diameters at intervals of 5 mm.

- Since the output (characteristic curve) of the pump depends on the diameter of the impeller, the characteristic curve for the appropriate impeller diameter is shown in the performance diagram.

  The performance diagram also indicates the number of blades and the outlet width.

  - The turned diameter $D_2$ is calculated from the performance characteristics, see FAN PUMP/TECHNICAL DATA
  - The turning angle $\alpha$ always measures 5.63°.

![Fig. 8-16  Turning the impeller](image)
Balancing the pump shaft with impeller

All impellers must be balanced dynamically together with the shafts and shaft protection sleeves according to ISO 1940/1 G6.3.

Proceed according to the following table when balancing the impeller:

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clean all contact surfaces of the pump shaft carefully with the balancing machine.</td>
</tr>
<tr>
<td>2</td>
<td>Insert steel fillers in the feather key grooves and secure adequately. Always take account of the centrifugal forces arising!</td>
</tr>
<tr>
<td>3</td>
<td>Balance the pump shaft with impeller dynamically according to ISO 1940/1, Chapter 7.3.2.3.</td>
</tr>
</tbody>
</table>

Tab. 8-20 Balancing the pump shaft with impeller

Caution: If it is necessary to machine the impeller after it has been mounted on the pump shaft, ensure that neither the pump shaft is damaged, nor the impeller distorted.