

Operation guide

PAHT G pumps (WEG Motor)

PAHT G 256-308

Operation, Installation and
Maintenance Manual



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Validity

This manual is valid for PAHT G pumps both non ATEX and ATEX certified versions. An ATEX certified pump is indicated by Ex in the designation - example PAHT G 256 Ex.

In case the pump delivered is ATEX certified, the additional ATEX instruction must also be read.

Non ATEX			ATEX certified	
PAHT G 256	Code no.	180B6090	PAHT G 256 Ex	180B6190
	Serial no.	XXXXXX02-XXX		XXXXXX02-XXX
PAHT G 308	Code no.	180B6091	PAHT G 308 Ex	180B6191
	Serial no.	XXXXXX02-XXX		XXXXXX02-XXX



Pump

Type PAHT G

Serial no.

Code no.



The serial number is referring to the Serial no. on the product label. The digits shown (02) indicate the version number of the pump. This documentation is compatible with previous pump versions.

1. Introduction

1.1 General

The PAHT G pumps and pump units are manufactured by Danfoss A/S, and are sold and marketed by a net of authorized distributors world wide.

This manual contains the necessary instructions for the installation, operation and service of the pumps used for technical water.

In case the pump delivered is ATEX certified, the additional ATEX instruction must also be read.

The PAHT G pumps must not be used for other purposes than those recommended and specified without first consulting your local pump distributor.



Use of the pump in other applications not suitable for the pump unit can cause damages to the pump unit, with risk of personal injury.



All personnel being responsible for operation and maintenance of the pump unit must read and fully understand these instructions, especially the section "Safety", before:

- Transportation of the pump unit
- Lifting the unit
- Installing the pump unit
- Connecting the pump unit to the water system
- Connecting the electric motor and instrumentation
- Commissioning the unit
- Servicing the motor pump unit, mechanical and electrical parts
- Decommissioning the motor pump unit

The pump must always be installed and used in accordance with existing national/local sanitary, safety regulations and laws.

It is the responsibility of the safety officer or the chief operator to assure compliance with all local regulations that are not taken into account in this manual.



Changing the pumps' or pump units' operational limits and hardware:

- Changes to the delivered pump or motor pump system may only be done with a written approval from Danfoss High Pressure Pumps.
- Operation outside the Danfoss specifications requires a written approval from Danfoss High Pressure Pumps.

- If any changes are made without written approval the warranty will automatically become void.

It is important that these instructions are always available to the personnel concerned.

If the recommendations in the manual are not followed, Danfoss reserves the right to void the warranty.

1.2 Symbols



Indicates something to be noted by the reader



Indicates a situation which will or could result in damage to the pump and its function



Indicates a situation which will or could result in personal injury and/or damage to the pump



Electrical hazard - Indicates a high-voltage warning



Safety glasses required



Hearing protection required



Safety shoes required



Safety helmet required



Protective garments must be worn

Protective garments must be worn



**Danger Hot
Do not touch**

**Danger HOT.
Do not touch**



Electrical hazard

Electrical hazard

1.3 Manufacturer and customer service address:

Danfoss A/S
High Pressure Pumps
Nordborgvej 81,
DK-6430 Nordborg
Denmark

Telephone: +45 7488 2222
Fax: +45 7445 3831
Email: highpressurepumps@danfoss.com
Web: hpp.danfoss.com

Your local Danfoss pump distributor can be found on our homepage.

1.3 Country specific information

1.4.1 United Kingdom

UK importer:

Danfoss Ltd.
22 Wycombe End
HP9 1NB Beaconsfield
United Kingdom

2. Safety



2.1 General information

Dangers that can arise from not following the instructions:

When the pump or pump system is managed by untrained personnel, there is a danger of:

- Death or fatal injuries
- Costly damages and claims



Electrical hazard

All electrical installation work must only be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations.

It is recommended to install a lockable circuit breaker to avoid inadvertent starting and/or electrical hazard. The lockable circuit breaker must be used during installation, operation and maintenance.

It is recommended to place a local safety switch nearby the pump, enabling service personnel to cut power for the electric motor.

Protect the motor and other electrical equipment from overloads with suitable equipment.

In case the pump delivered is ATEX certified, the additional ATEX instruction must also be read.



Protective garments must be worn



Always wear suitable safety clothing when handling the pump.

When working near the pump system, safety shoes, safety glasses, hearing protection and safety helmet must always be worn.



Danger Hot
Do not touch

Under certain operational conditions the surface of the pump can be above 60°C / 140°F. Under these conditions the pump must be labelled with a "Danger Hot" sign.

When using an electric motor, the motor must always be supplied with adequate cooling ventilation.

When using an electric motor together with a VFD (Variable Frequency Drive), the motor must be designed for operation with VFD. VFD operation may increase the temperature inside the electric motor if the motor is not designed for VFD operation. This can damage the motor and cause unintended breakdown.



Before start-up, the settings for all protective devices, such as sensors/switches and safety valves must be verified and free flow from safety valves must be ensured.



All pipe and hose connections must be stress-free mounted, securely fastened to the pump and well supported. Improper installation will or could result in personal injury and/or damage to the pump.

Use of this manual does not relieve operation and maintenance personnel of the responsibility of applying good judgment when operating and maintaining the pump and its components.

2.2 Preferred system design

Danfoss recommends to build systems with a high degree of safety. Danfoss preferred system design and P&ID are found in appendix 1, Data sheet, and appendix 2, Instruction.



It is always the system builders' responsibility that the system design does not cause any kind of hazard and is adapted to local regulations and standards.

Proper installation, proper start up and shut-down devices as well as high-pressure protection equipment is essential.

2.3 Commissioning and servicing the unit

It is recommended that commissioning and servicing are carried out by a minimum of two people, where one is acting as a supervisor.

2.4 Adhere to the following important points

- Before using the pump/pump unit it is very important to read and understand this user manual.

- Do not try to lift the pump unit manually; most of the pumps weigh more than 20 kilos, see specific weight for the pump in the appendix 1, Data sheet.
- Always bleed the pump prior to initial start-up.
- Do not mount the pump without the bell housing and a flexible coupling.
- Do not try to start the unit before the system components are mounted, bled and adjusted.
- Flush the system thoroughly before connecting the pump or pump unit.
- Check rotation direction of the motor before mounting the pump.

2.5 In case of doubt

Please contact Danfoss A/S in case of doubt. Contact information are listed in section 1.3, Manufacturer and customer service address.

3. Technical data



3.1 Approved applications and operational limits for the pumps

The pump and the pump units are designed for the use in systems with technical water.

The PAHT G pumps must not be used for other purposes than those recommended and specified without first consulting your local pump distributor.



Use of the pump in other applications not suitable for the pump unit can cause damages to the pump unit, with risk of personal injury.

For system integration of the pumps, please see appendix 1, Data sheet and appendix 2, Instruction.

3.2 Application range

See appendix 1, Data sheet.

3.3 Electric motor data

See recommended motor in appendix 1, Data sheet or appendix 3, IOM for motors. The motors mentioned are the most common used motors by Danfoss High Pressure Pumps.

3.4 Noise and vibration

Noise level for a pump unit with a "standard" motor measured according to EN ISO 3744:2010, see appendix 1, Data sheet. Possibilities to reduce noise and vibration are described in the same Data sheet.

3.5 Dimension drawings

Dimensions of the different pumps can be found in appendix 1, Data sheet.

3.6 Space requirement

When doing service or replacing the complete pump unit, it is recommended to have sufficient space available around the pump in order to ensure easy access. Sufficient space means at least 1 meter/40 inches around the pump. When working with high pressures, it is important to have the right space available around the pump as stated in the safety requirements.



3.7 Filtration

(10µm absolute [$\beta_{10} \geq 5000$])

Requirements are specified in appendix 1, Data sheet and appendix 2, Instruction.

Danfoss recommends not to build a filter bypass function or use filters with an integrated bypass. If the above recommendation is not followed the warranty for the pump will automatically become void.

It should be possible to monitor the condition of the filter via the differential/delta pressure across the filter.

Using insufficient filtration or a filter bypass can cause a failure or decreased service life of the pump.

3.8 Properties of water



Recommended **NOT** to use the pump for other media than specified in the Data sheet.

3.9 Air bubbles

Large bubbles in a pressurised system can result in damage to piping, equipment and the pump.

All air must be bled from both the low-pressure and high-pressure side before the system is pressurised. Special consideration



shall be given in order to minimize air bubbles in feed flow. Air bubbles can cause cavitation.

3.10 Chemicals

The pumps should not be exposed to any chemicals that can result in damage to piping, equipment and internal parts of the pump.

4. Arrival inspection, transportation, handling, lifting and storage

4.1 Arrival inspection

The pump is packed in a cardboard or wood box with plugs in the port connections to protect the pump from damage during transportation.

When the shipment has arrived it is important to check the pump for any damages. The name plate/type designation must be in accordance with the delivery note and your order.

In case of damage and/or missing parts, a report should be documented and presented to the carrier at once.



4.2 Warning

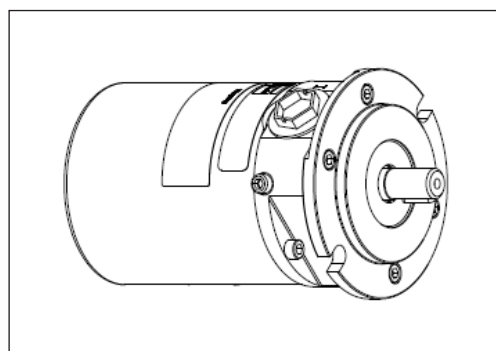
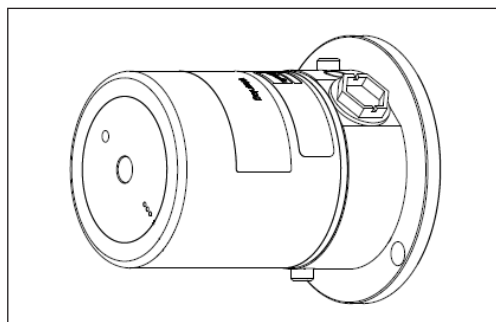
Before any lifting operation is performed, environmental conditions must be taken into consideration (Ex-rated areas, wind speed, wet/dry conditions, lifting height, etc.).

4.3 General safety information

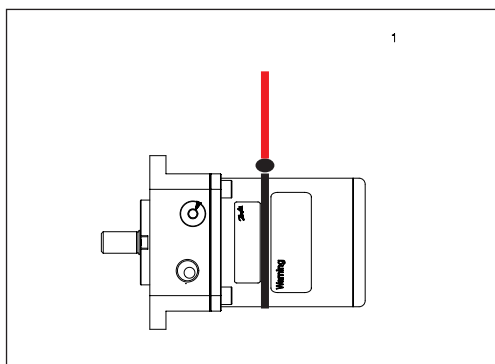
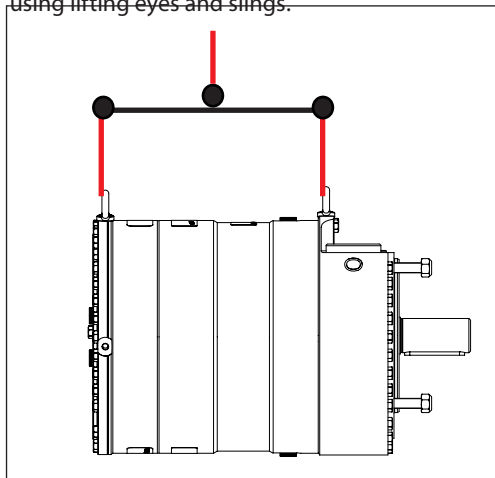
Personnel involved in lifting and transporting the equipment (see Safety, chapter 2) must be trained in handling and safety procedures when lifting heavy loads. Many of the pumps and pump units weigh more than 20 kilos, which requires lifting slings and suitable lifting devices; e.g. an overhead crane or industrial truck to be used as minimum.

4.4 Transport and handling

Small pumps which have a weight below 20 kilos (weight can be found in appendix 1, Data sheet) can be handled by hand if they are not mounted together with an electric motor. The weight of a small pump with a motor will be above 20 kilos.



Pumps which have a weight above 20 kilos (see appendix 1, Data sheet) must be handled by using lifting eyes and slings.

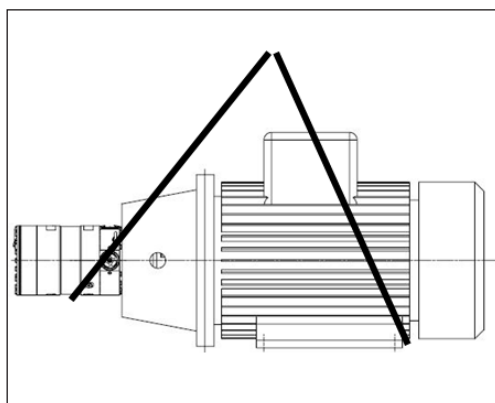


Never use only one sling and make sure the slings does not slip off the pump.

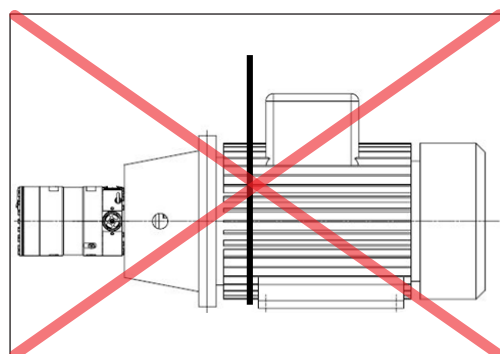
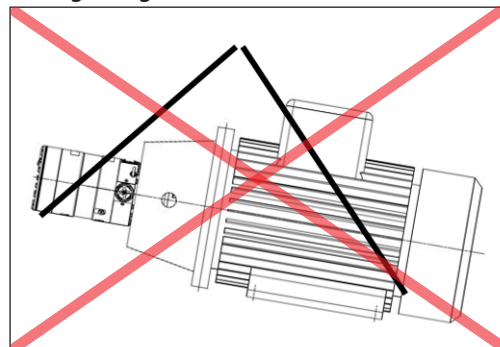
When the pump is mounted together with an electric motor, the pump unit always weigh more than 20 kilos and must be handled by using slings around the pump unit.

See below examples of where to/not to attach the lifting slings on the pump unit:

Correct lifting with 2 separate slings:



Wrong lifting:



When lifting the pump unit, one sling must be attached to the electric motor and one sling around the pump.

Only some motors and pumps have specific lifting eyes.

Do not use connections/nozzles for lifting!
Do not use only one sling!

Make sure that the unit/load is balanced before lifting. The centre of the mass varies from pump/pump unit size to pump/pump unit.

How to mount the pump and the electric motor correctly, see appendix 1, Data sheet or appendix 2, Instruction.



Incorrect lifting can result in personal injury and/or damage to the pump unit, see appendix 2, Instruction.

Once the lifting is done the lifting eye must be removed from the pump.

4.5 Return to supplier

Please see maintenance chapter 7.

4.6 Storage

Each pump is tested before shipment, and will therefore contain water. For storage temperature and frost protection see appendix 2, Instruction.

The pumps are NOT delivered frost protected from the factory.

5. Installation and commissioning



5.1 Important dimensions

Physical dimensions and connections of the pump unit are described in appendix 1, Data sheet.



5.2 Cleanliness

It is very important that the tubes and pipes are **completely clean**: no dirt, chips or burrs are allowed.

Flush all piping before connecting the high-pressure pump to ensure the system is clean. Internal surfaces of the piping must not be corroded. If dirt or rust is not removed, the pump and the valves can be damaged. In worst case the pump can be damaged beyond repair!



5.3 Fluid temperature

Before start-up, the fluid and pump housing temperature must be within the specified temperature range listed in appendix 1, Data sheet.

5.4 Electrical data

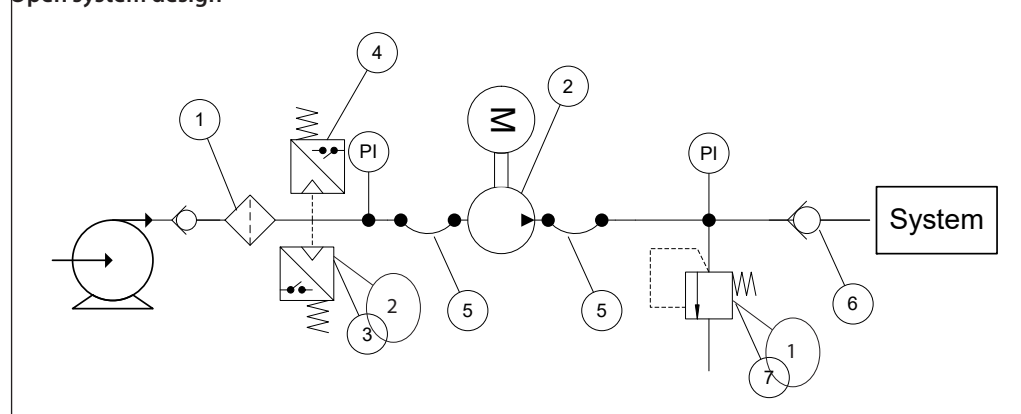
Check voltage, current frequency and rated power on the electric motor and VFD settings on the name plate placed on both the motor and VFD.



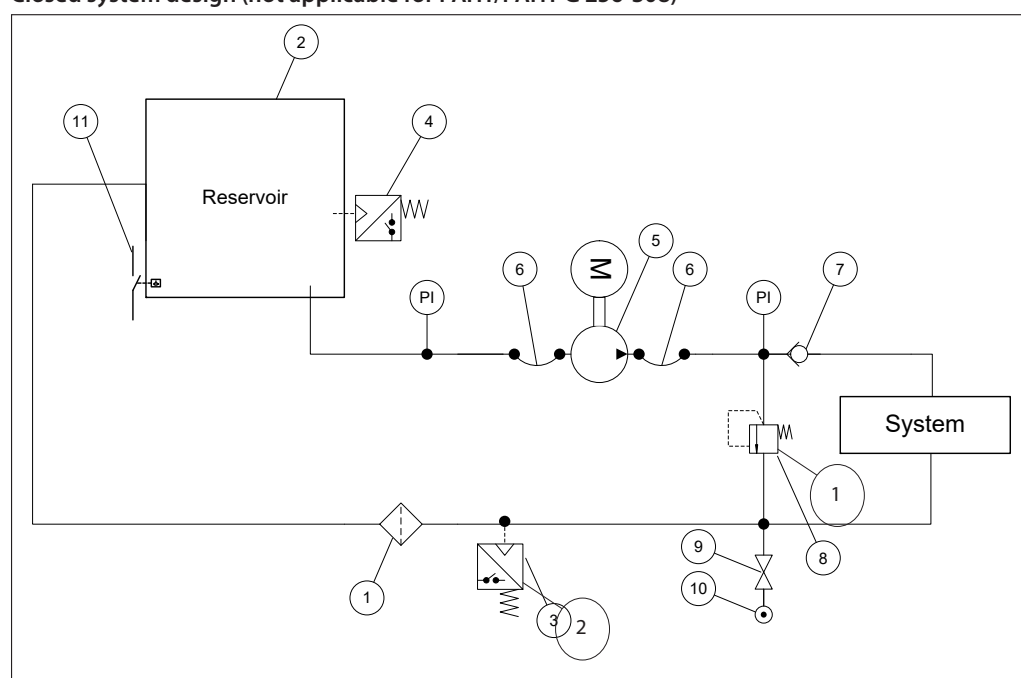
5.5 Local regulations

Commissioning must always be done in accordance with valid regulations and local standards.

Open system design



Closed system design (not applicable for PAHT/PAHT G 256-308)



5.6 Pre mounting checklist, based on Danfoss preferred system designs

Table 1: Check points when assembling and commissioning system

	Check points	Comment	OK ?
CP1	Ensure that the environmental conditions are safe.	See Arrival inspection, transportation, handling, lifting and storage, chapter 4.	
CP2	Minimum and maximum start-up temperature for fluid and pump.	See Data sheet or Instruction, appendices 1 and 2.	
CP3	Filtration condition (10µm absolute ($\beta_{10} \geq 5000$))	See Danfoss requirements in Data sheet and Instruction, appendices 1 and 2	
CP4	Power supply for electric motor and VFD.	See Data sheet for the used motor and VFD.	
CP5	Safety circuit / breaker must be sized for the motor and environment (corrosion and humidity)	See Data sheet for the used safety circuit.	
CP6	Bolts and screws must conform to environmental conditions as well as fluid and torque requirements.		
CP7	Instrumentation, pressure switch should be designed to conform to the environment (corrosion and humidity).	See Data sheet for the used equipment.	
CP8	Check the factory settings of the safety/relief valves or pressure relief valves (1).	See Data sheets for the used valves.	
CP9	Check the settings of the pressure transmitter/switch (2) set at min. inlet pressure.	See Data sheet or Instruction, appendices 1 and 2.	
CP10	Check that all pressure indicators (PI) are selected to be able to measure the system pressure range.	Scaling should at least be 1 Bar or more precise.	
CP11	Check coupling distance (air gab – movement of the spider)	3 – 5 mm	
CP12	Check correct connections on the pump (in & outlet)		
CP13	Check piping for possible air gaps.		



5.7 Lifting and positioning

Lift the pump unit onto base (Remember vibration dampers, if needed). Fasten the motor to the base.

See also chapter 4, Arrival inspection, transportation, handling, lifting and storage.

5.8 Mount the different equipment

(connections, pipes, tubes, check and safety/relief valves, etc.)

- The hard piping and flexible hoses used must be of proper design and must be installed in accordance with the manufacturer's recommendations.
- Misalignment of the hard pipes may give unintended stress on the pump port connection and may damage the pump.
- Prevent excessive external pipe load.
- Do not connect piping by applying external force (use of wrenches, crane, etc.) Piping must be aligned without residual stress.
- Do not mount expansion joints so that their force applies internal pressure on the pump connections.

5.9 Electrics

All electrical installation work must be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations. (see also Safety, chapter 2)

Turn off the safety circuit breaker and lock it.

Mount the power cable on the electric motor.

If a VFD is used, adjust the protective motor switch/VFD to the current limits found on name plate of the electric motor.

5.10 Instrumentation

The pressure switch/sensor should be mounted as close to the pump as possible. It is recommended to test the pressure/sensor switch via an instrumentation manifold.

Mount the pressure switch/sensors according to the manufacturer's instructions.

5.11 Connections

Mount and tighten connections and check valve(s) as specified.

5.12 Ensure free flow

Ensure free flow from relief valve (table 1, item 5.6, CP 8). A blocked relief valve can cause excessive build-up of pressure and thereby cause dangerous situations and damage to the whole system.

5.13 Verify setting of safety/relief valves

Make sure, the relief valve is placed correctly (see open system design, item 1).

Check the pressure settings on the name plate of the relief valve. If they are within specifications, you can continue.

5.14 Bleed and remove air from the pump

Open bleeding plugs. Keep the plugs open until the high-pressure pump is bled.

If the pump is submerged, remove all bleeding plugs before mounting in reservoir.

5.15 Verify direction of rotation

The direction of rotation must always follow the arrow. The arrow is placed on the pump or pump unit.

Check the direction of rotation before mounting the pump.

Unlock the safety circuit breaker. Start the motor for 1 second and observe the direction of rotation either looking on the fan of the motor or on the coupling through the hole in the bell housing (not available on all bell housings). If the motor is turning the wrong direction, switch two phases in the connection box of the motor or reprogram the direction in VFD.

When the motor is turning in the right direction, the pump can be mounted.

- Check the temperature switch/controls. The high-pressure pump must stop if temperature is above specified set point.
- Check the pressure switch/controls. The high-pressure pump must stop if pressure is below specified set point.
- If the system is running within the system design limits, the system is released for operation.

5.16.2 Closed system (not applicable for PAHT G 256-308)

- Check if the reservoir is clean.
- Check if filter element is present and mounted correctly.
- Fill water at the reservoir using the filling valve. Inspect immediately for leakage.
- Bleed high-pressure pump until only water leaves the high-pressure pump. Remember to close all bleeding and draining plugs.
- Adjust pressure relief valve to minimum setting.
- Check rotation of the high-pressure pump by description in 5.15.
- Start high-pressure pump for 2 minutes, to make sure all air is out of the system.
- Check reservoir low level switch/controls. The high-pressure pump must stop if low level switch is activated.
- Adjust pressure relief valve to working pressure.
- Check the temperature switch/controls. The high-pressure pump must stop if temperature is above specified set point.
- Check the filter pressure switch/controls. A warning must be given if pressure is above specified set point.
- If the system is running within the system design limits, the system is released for operation.



5.16 Commissioning

5.16.1 Open system

- Check if filter element is present and mounted correctly.
- Switch on the circuit breaker for both motor(s) and VFD(s).
- Check rotation of the feed pump.
- Start feed pump.
- Bleed high-pressure pump until only water leaves the high-pressure pump. Remember to close all bleeding and draining plugs.
- Adjust pressure relief valve to minimum setting.
- Check rotation of the high-pressure pump by description in 5.15.
- Start high-pressure pump for 2 minutes, to make sure all air is out of the system.
- Adjust pressure relief valve to working pressure.
- Check all fittings for leakage.

5.17 Check the filter condition

Evaluate contamination found in filter, replace elements, if necessary.



5.18 Instruct operator and maintenance personnel

Before using the pump/pump unit, the personnel must be instructed in using the pump/pump unit, its function, components, documentation and safety.

Danfoss offers commissioning and service at system manufacturer's location. Rate quotes are offered upon request.

6. Operation of motor pump unit



6.1 General safety information

Before inspecting the pump unit, read the Safety chapter 2 in this user manual.

6.2 What to listen and look for

If one or more of the following examples are observed, please act as indicated:

- A) Loose bolts – check all bolts and, if necessary, contact the maintenance department in order to have all bolts tightened to the specified torque(s).
- B) Leakage – if a small leakage from the bell housing is observed. Contact the maintenance department.
- C) Leakage – if there is a large leak, the unit should be stopped immediately. Contact the maintenance department.
- D) High frequency tones – safety/relief valves are either damaged or running very close to their design pressure, stop the unit immediately. Contact the maintenance department.
- E) Increased noise or vibration – requires the unit to be stopped immediately. Contact the maintenance department.
- F) Very high temperatures – may indicate that one or more parts are damaged inside the pump. The pump must be stopped immediately and inspected before it is

restarted. Contact the maintenance department.

- G) Drop in flow and/or pressure – may indicate wear on one or more parts inside the pump. The pump must be stopped immediately and inspected before it is restarted. Contact the maintenance department.
- H) Other observations or troubles, please see appendix 7, Right and Wrong or appendix 6, Trouble shooting guide. Both appendices give good advises on design, installation, wiring and troubleshooting.

If the pump is not stopped for inspection as recommended, it can lead to damage of the pump or break-down. See also service and warranty section in appendix 1, Data sheet and appendix 2, Instruction.

Danfoss offers service of the pump at the system manufacturer's location as well as we offer training in how to service the pump. Quotes are offered upon request.

Danfoss recommends simultaneously to check the filter and membrane condition and to evaluate contamination; filter and membrane elements must be replaced if necessary.

7. Maintenance and service of the pump unit



7.1 General safety information

Before servicing the pump unit, it is necessary to read and understand this user manual, especially the Safety, chapter 2. Remember to wear suitable safety equipment according to Safety, chapter 2.

7.2 Service and inspection interval for the pump

Maintenance and service intervals are depending on the cleanliness level of the water, hydraulic load and temperature of the pump unit. The most important parameter is the filtration of the water.

See the section Service and warranty in the appendix 1, Data sheet and appendix 2, Instruction.

For spare parts and service tools, please see appendix 4, Parts list.

Danfoss offers service of the pump at the system manufacturer's location and training in how to service the pump. Quotes are offered upon request.

7.3 Shut down of the system

- A) Stop the high-pressure pump.
- B) Release the pressure.
- C) Stop the feed pump if used.
- D) Switch off the safety circuit breaker for both the high-pressure pump, feed pump and VFD and lock them. Only personnel servicing the pump unit should be able to unlock/activate the switch again.
- E) Open bleeding and drain plugs. Wait until the pump and system are emptied for water.



- F) Slowly unscrew and remove the bolts and gaskets from the inlet/outlet hoses or pipes, be careful about jets of water. Be aware that the system can be pressurized.
- G) Attach the lifting equipment to the pump unit. For instructions on lifting the complete pump unit, see chapter 4, Arrival inspection, transportation, handling, lifting and storage.
- H) For the small pumps, unscrew the bolts holding the pump to the bell housing and for the bigger pumps, unscrew the bolts/nuts from the pump and bell housing to the motor and afterwards unscrew the bolts/nuts holding the pump and bell housing.
- I) Carefully pull the pump out of the bell housing by using lifting equipment, if necessary.
- J) Hold the pump in different positions above a drip tray; this should allow most of the water trapped in the pump to drain. Clean and dry the pump surface and plug the bleeding and draining plugs.
- K) Move the pump to a clean and safe location where the pump can be inspected/serviced.

7.4 Disassembling and assembling the pump unit

- A) Remove all connections from the pump.
- B) Disassemble the pump according to the Disassembling and Assembling Instruction (available at www.danfoss.high-pressurepumps.com). Clean all the parts and surfaces with a fluid compatible with the materials found in the pump. Wipe the parts clean and dry with a lint-free clothing.
- C) Inspect all parts including shaft seal and if necessary, replace them; see appendix 4, Parts list.
- D) If the pump is going to be returned to Danfoss for repair or a warranty claim, it is important to contact Danfoss in order to receive a return number and a form to fill out with product information. A copy of the form together with contact information and reason for returning should be sent to the email address on the form. The same documents should be attached to the shipment.

Product information (see label on product) Only 1 product on each report.		
Product type:	Code number	Serial number
Operational conditions		
Application:	Inlet pressure:	Rpm.(pump/motor only):
Hours of operation:	Outlet pressure:	Number of duty cycles (valves only):
Filtration (μ , absolute/nominal) :	Flow:	Water temperature:
Water type:	TDS	Pumps in parallel (yes/no):

Returns without a return number will be rejected !!!

7.5 Assembling the pump unit

Assemble the pump according to the Disassembling and Assembling Instruction (available at www.danfoss.high-pressurepumps.com).

7.6 Procedure for mounting the pump back onto electric motor



Mount the flexible coupling and bell housing according to appendix 2, Instruction.

7.7 Getting the pump unit back into operation

Find instructions of how to put the pump unit back into operation in chapter 4, Arrival inspection, transportation, handling, lifting and storage and Installation and commissioning, chapter 5.

7.8 Storage of the pump

If the pump has to be shut down for a longer period, instructions can be found in appendix 2, Instruction.

8. Troubleshooting and scrapping criteria



8.1 General safety information

Before inspecting the pump unit, it is necessary to read and understand this user manual, especially the Safety chapter 2.

Remember to wear suitable safety equipment according to Safety chapter 2.

8.2 Operational conditions which can cause pump failures

The following conditions can cause a pump failure :

- The pump is running dry.
- The inlet pressure is too high.
- The inlet pressure is too low.
- The temperature of the fluid is too high.
- The ambient temperature is too high.
- The pump is running against a blocked port/closed manual valve.
- The pump is operating at a pressure out of specification.
- The pump is running with a non-specified/ approved fluid.
- The pump is running in the wrong direction.
- The filtration is insufficient.
- There is excessive mechanical load on the shaft coupling and piping.



**Danger
Hot
Do not touch**

8.3 Mechanical failure

If the pump is running dry, the temperature will quickly increase which can cause burns.

If there is any leakage at start-up or during operation, a high pressure jet can cause eye or skin damage.

Leakage can result in flooding, which can cause slipping, tripping or falling.

If water is dripping into the electric motor; it can cause electric shock, fire, short of circuit or even death. When mounting the pump vertically, always mount the motor above the pump to avoid water leaking into the electric motor.



**Electrical
hazard**

8.4 Electrical failure

If the wiring of the electric motor is incorrect or the ground connection is missing, it can cause electric shock, burn damages, fire or even death.

If a VFD is used and wrongly programmed, it can damage the pump and lead to high temperatures or other dangers.

All electrical installation must be carried out by authorized personnel in accordance with EN60204-1 and/or local regulations.

8.5 Responsibility

Danfoss takes no responsibility for any abnormal injuries, risks or damages that could arise caused by abnormal conditions, vibrations, corrosion, abrasives, foreign objects or excessive temperatures and shall not be liable for any consequential or incidental damages.

8.6 Scrapping criteria

Whether the pump can be repaired or need to be scrapped, depends on in which conditions the internal parts are, or how damaged the whole unit is. Please use appendix 5, Trouble shooting guide as guideline or send the pump to Danfoss headquarter in Denmark for evaluation.

For other observations or troubles, please see appendix 6, Right and Wrong which gives good advises regarding design, installation, wiring and troubleshooting.

In case the pump needs to be scrapped, please follow your local environmental rules.

Operation guide

Appendices

PAHT G 256-308

Installation, Operation and
Maintenance Manual



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Data sheet

PAHT G pumps

PAHT G 2.0 - PAHT G 308

ATEX PAHT G 2.0 - PAHT G 308



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1. Introduction

The Danfoss range of PAHT G high-pressure pumps is specifically designed for use with technical water such as:

- Ultra-pure water that has undergone multiple reverse osmosis processes
- De-ionized water
- Demineralized water

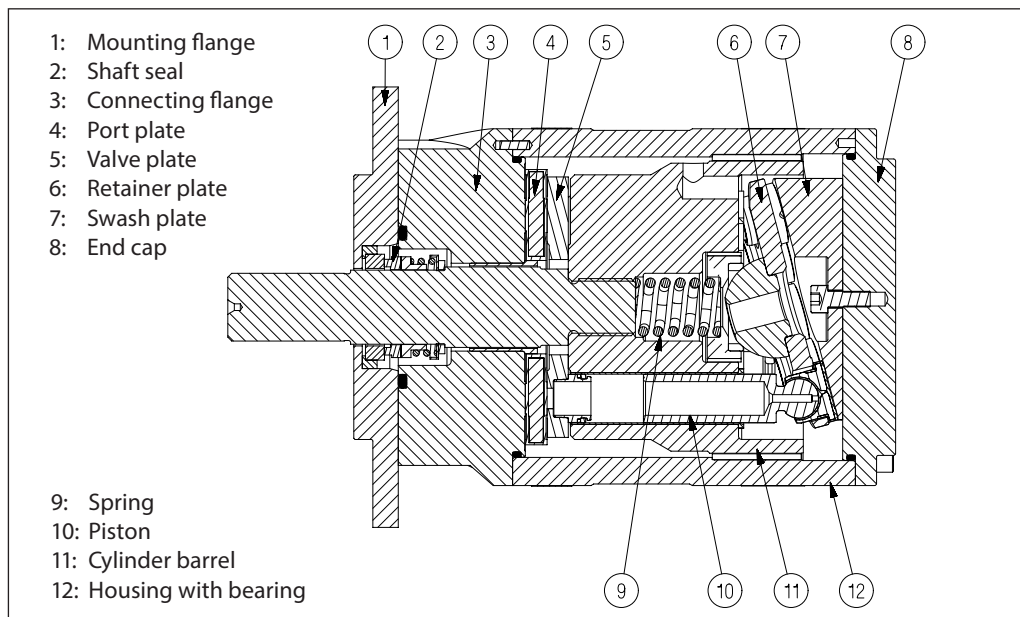
Danfoss PAHT G pumps are positive displacement pumps, with axial pistons that move a fixed amount of water in each cycle. Flow is proportional to the number of input shaft revolutions (rpm). Unlike centrifugal pumps, they produce the same flow at a given speed independently of no matter what the discharge pressure.

The range of PAHT G pumps is based on the standard PAHT pump series. The PAHT G pumps are made with extra coatings that reduce the wear of the pump. This coating is particularly important for pumps used in gas turbine applications or other similar applications where the wear of the pumps is higher due to the ultra pure water quality.

The next pages will cover both PAHT G and PAHT G ATEX pumps.

ATEX certified pumps are indicated by Ex in the type designation - example PAHT G 12.5 Ex.

Below sectional drawing is an example of a PAHT G pump.



2. Benefits

- **Zero risk of lubricant contamination:**
 - Oil lubricants are replaced with the pumped medium, water, so there is no contamination risk from the pump.
- **Low maintenance costs:**
 - Efficient design and all-stainless steel construction ensure exceptionally long lifetime. When Danfoss specifications are met, service intervals of up to 8,000 hours can be expected. Service is easy, and can be carried out on site due to the simple design and few parts.
- **Low energy costs:**
 - The highly efficient axial piston design provides the lowest energy consumption of any comparable pump on the market.
- **Easy installation:**
 - The lightest and most compact design available.
- Pump can be installed horizontally or vertically.
- No pulsation dampeners necessary due to extremely low-pressure pulsation.
- Powered by electric motors or combustion engines.
- Suitable for both boosted inlet pressure and water supply from a tank.
- No need for cooling circuits due to very high mechanical efficiency.
- **Certified quality:**
 - Fulfills the stringent hygiene requirements, VDI 6022, HACCP.
 - Certificates: ISO 9001, ISO 14001
ATEX available
API available on request

3. Application examples

- High-pressure cleaning with ultra-pure water, as used in the manufacturing of flat-panel displays and many other electronic products.
- High-pressure cleaning with ultra-pure water, as used in the manufacturing of parts for the automobile industry.
- Adiabatic cooling systems to replace or supplement standard A/C systems in server rooms and factories.
- Humidification in office buildings, electronic component manufacturing, dairies, greenhouses, etc.
- Dust suppression and odor control systems, for example in paper, textile and wood production.
- Reduction of NOx emissions in diesel engines and gas turbines.
- Gas turbine by inlet fogging and fuel wash systems.

4. Technical data
4.4 PAHT G 256-308

Pump size		256	308
Code number PAHT G		180B6090	180B6091
Code number ATEX PAHT G		180B6190	180B6191
Housing material		AISI 316 or higher	AISI 316 or higher
Geometric displacement	cm ³ /rev	256	308
	in ³ /rev	15.6	18.8
Pressure			
Min. outlet pressure	barg	30	30
	psig	435	435
Max. outlet pressure	barg	120	120
	psig	1740	1740
Inlet pressure, continuous	barg	2-6	2-6
	psig	29-87	29-87
Max inlet pressure, peak ¹⁾	barg	10	10
	psig	145	145
Speed			
Min. speed	rpm	450	450
Min. speed, continuous	rpm	700	700
Max. speed	rpm	1250	1250
Typical flow - Flow curves available in section 5			
450 rpm at max. pressure	l/min	89.6	107.8
1250 rpm at max. pressure	l/min	294.4	354.2
450 rpm at max. pressure	gpm	23.3	28.0
1250 rpm at max. pressure	gpm	76.5	92.1
Typical motor size			
1000 rpm at max. pressure	kW 50 Hz	55	75
1200 rpm at max. pressure	hp 60 Hz	100	125
Torque at max. outlet pressure	Nm	549.6	661.3
	lbf-ft	405.6	448.0
Media temperature	°C	2-50	2-50
	°F	37-122	37-122
Ambient temperature	°C	0-50	0-50
	°F	32-122	32-122
Sound pressure level ²⁾	dB(A)	82	87
Weight	kg	105	105
	lbs	231	231

¹⁾ 1% per minute peak, 10% per minute during start up.

²⁾ Measurements according to EN ISO 3744: 2010 / dB(A) [L_{PA, 1m}] values are calculated. Measured at max pressure and rpm for a motor pump unit.

5. Flow

The flow (Q_{eff}) at various pressure (p_{max}) can be calculated with the following equation:

$$Q_{eff} = Q_{(th)} - [(Q_{(th)} - Q(p_{max})) \times (p / p_{max})]$$

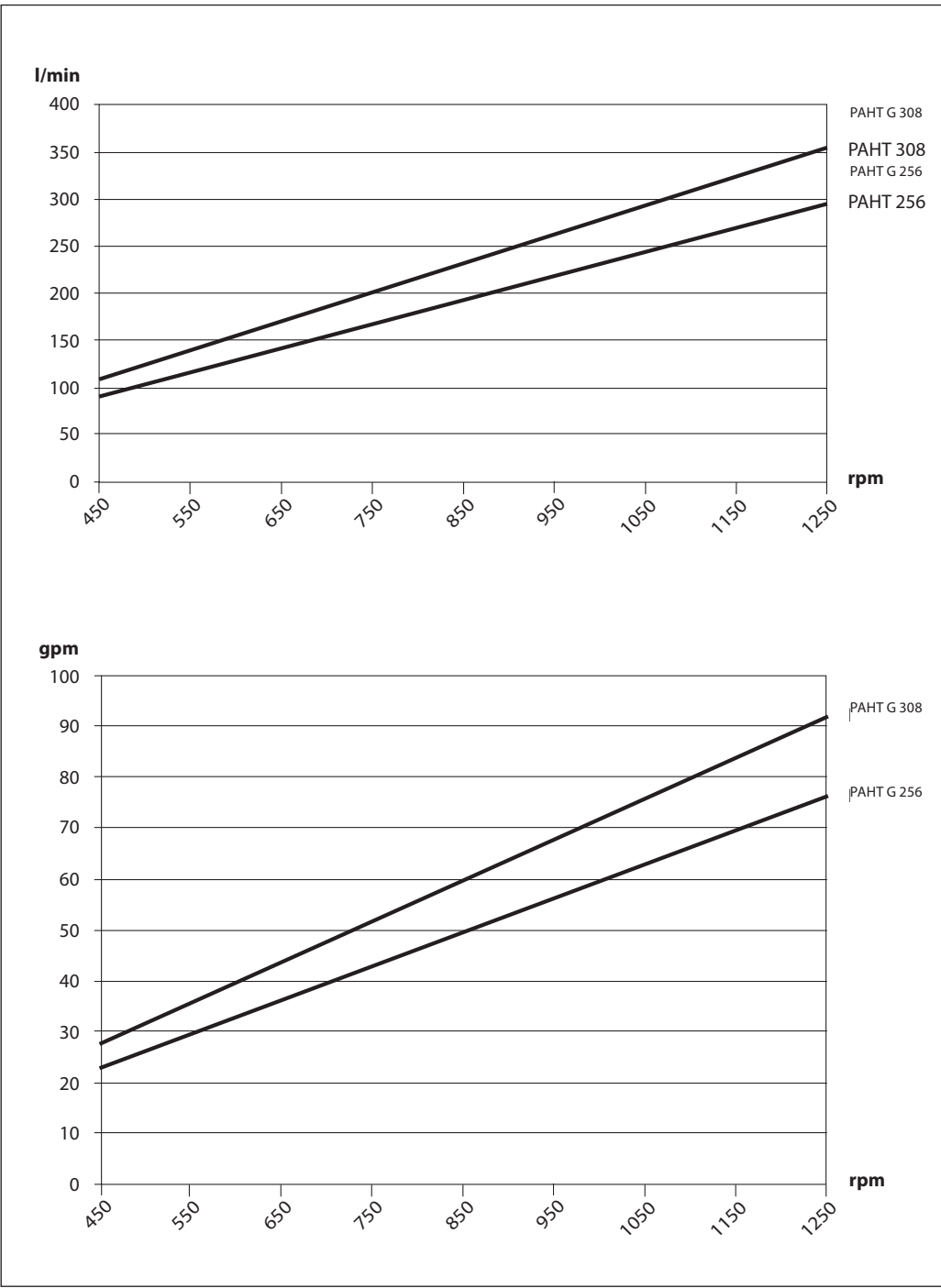
The theoretical flow can be calculated with the following equation:

$$Q_{(th)} = \frac{V \times n}{1000}$$

At zero pressure the true flow equals the theoretical flow $Q_{(th)}$.

$Q_{(th)}$:	Theoretical flow (l/min / gpm)
$Q(p_{max})$:	Flows at max. pressure (l/min and gpm), see 4.1-4.4
p_{max} :	Max pressure (barg / psig)
p :	Pressure (barg / psig)
V :	Displacement (cm ³ / rev.)
n :	Motor speed (rpm)

5.5 PAHT G 256-308 typical flow curves at max pressure



6. Motor requirements

The required motor power can be calculated by using the following equation:

$$P = \frac{n \times V \times p}{600.000 \times \eta}$$

P: Power (kW)
M: Torque (Nm)
 η : Mechanical efficiency
p: Pressure (barg)
n: Motor speed (rpm)
V: Displacement (cm³/rev.)

From the flow curves in item 5, you can determine the rpm of the pump at the desired flow.

The required torque is calculated as follows:

$$M = \frac{V \times p}{62.8 \times \eta}$$

To determine the correct motor size, both the power and torque requirement must be verified.

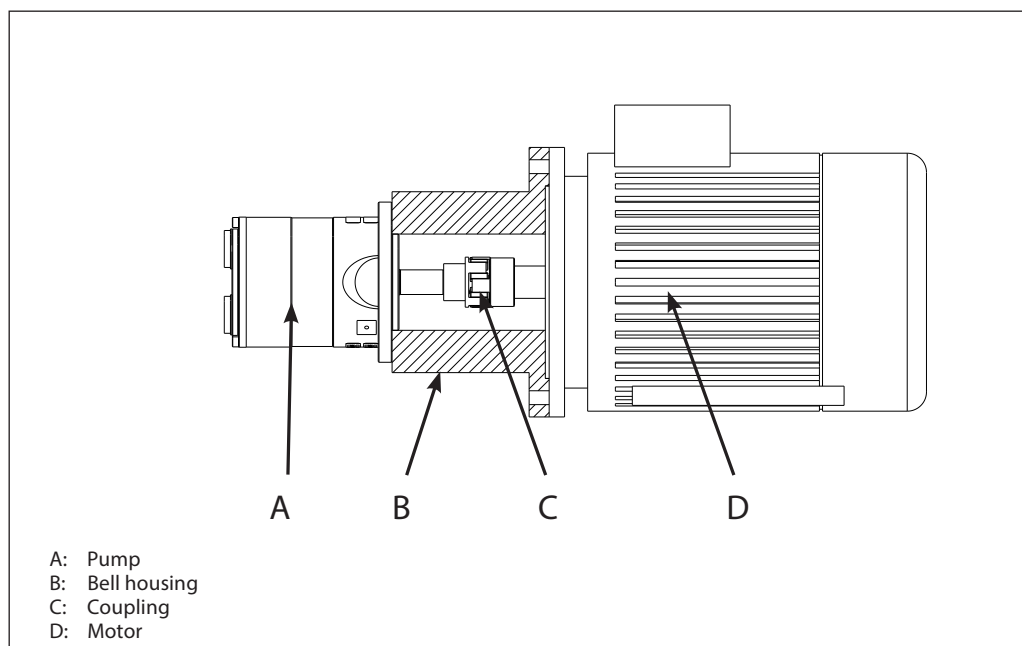
The mechanical efficiency of the pump, at max pressure, is as follows:

PAHT G 256, 308	0.95
-----------------	------

7. Installation

See the figure below for instructions on how to mount the pump and connect it to an electric

motor or combustion engine.



If alternative mounting is required, please contact your Danfoss sales representative for further information.

Note: Do not add any axial or radial loads to the pump shaft.

For more information on the importance of proper filtration, including explanation of filtration principles, definitions, and guidance on how to select the right filter for your pump, please consult our **Filtration** information and specifications (Danfoss document number 521B1009).

7.1 Filtration

Proper filtration is crucial for the performance, maintenance and warranty of your pump.

Protect your pump, and the application in which it is installed, by always ensuring that filtration specifications are met, and by always changing filter cartridges according to schedule.

Since water has very low viscosity, Danfoss PAHT G pumps have been designed with very narrow clearances in order to control internal leakage rates and improve component performance. **To minimize wear on the pump, it is therefore essential to filter inlet water properly.**

The main filter must have a filtration efficiency of 99.98% at 10 µm. We strongly recommend that you always use precision depth filter cartridges rated 10 µm abs. $\beta_{10} \geq 5,000$.

Please note that we do not recommend bag filters or string-wound filter cartridges, which typically have only 50% filtration efficiency. This means that out of 100,000 particles that enter such filters, 50,000 particles pass right through them; compare this to precision depth filters that are 99.98% efficient, and only allow 20 of the same 100,000 particles to pass through.

7.2 Noise

Since the pump unit is mounted on a frame, the overall noise level can only be determined for a complete system. To minimize vibrations and noise throughout the system, it is therefore very important to mount the pump unit correctly on a frame with dampers and to use flexible hoses rather than metal pipes where possible.

The noise level is influenced by:

- **Pump speed:**
High rpm makes more fluid/structure-borne pulsations/vibrations than low rpm.
- **Discharge pressure:**
High pressures make more noise than low pressures.
- **Pump mounting:**
Rigid mounting makes more noise than flexible mounting because of the structure-borne vibrations. Be sure to use dampers when mounting.
- **Connections to pump:**
Pipes connected directly to the pump make more noise than flexible hoses because of structure-borne vibrations.
- **Variable frequency drives (VFDs):**
Motors regulated by VFDs can produce more noise if the VFD does not have the right settings.

7.3 Open-system design

A Inlet line:

Dimension the inlet line to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/connections, fittings with small pressure losses and restrictions).

B Inlet filter:

Install the inlet filter (1) in front of the PAHT G pump (2). Please consult the Danfoss filter data sheet for guidance on how to select the right filter.

C Monitoring pressure switch:

Install the monitoring pressure switch (3) between the filter and the pump inlet. Set the minimum inlet pressure according to specifications described in item 4, technical data. The monitoring pressure switch stops the pump if inlet pressure is lower than the set minimum pressure.

D Monitoring temperature switch:

Install the monitoring temperature switch (4) between the filter and the pump, on either side of the monitoring pressure switch. Set the temperature value according to technical data, item 4. The monitoring temperature switch stops the pump if

inlet temperature is higher than the set value.

E Hoses:

Always use flexible hoses (5) to minimize vibrations and noise.

F Inlet pressure:

In order to eliminate the risk of cavitation and other pump damage, pump inlet pressure must be maintained according to specifications described in item 4, technical data.

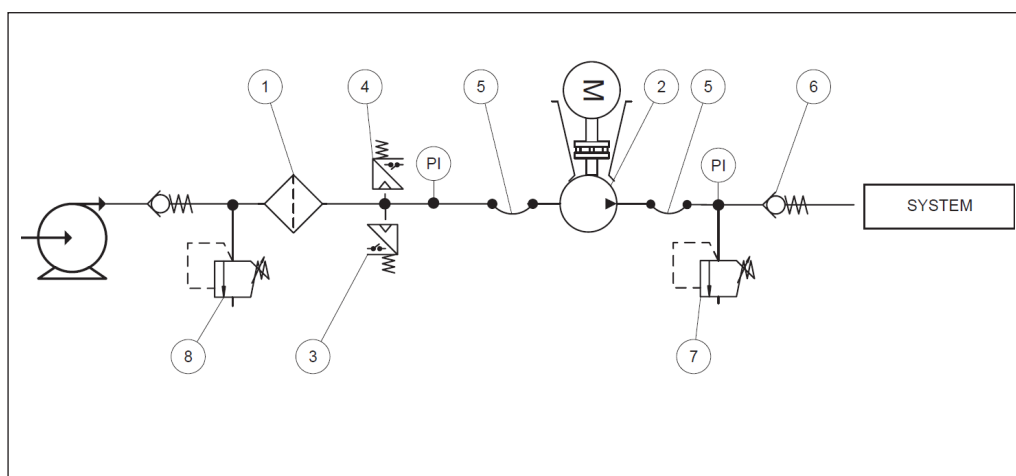
G Non-return valve (6):

Should be installed after the outlet to prevent pump backspin, which may ruin the pump.

H Pressure relief valve:

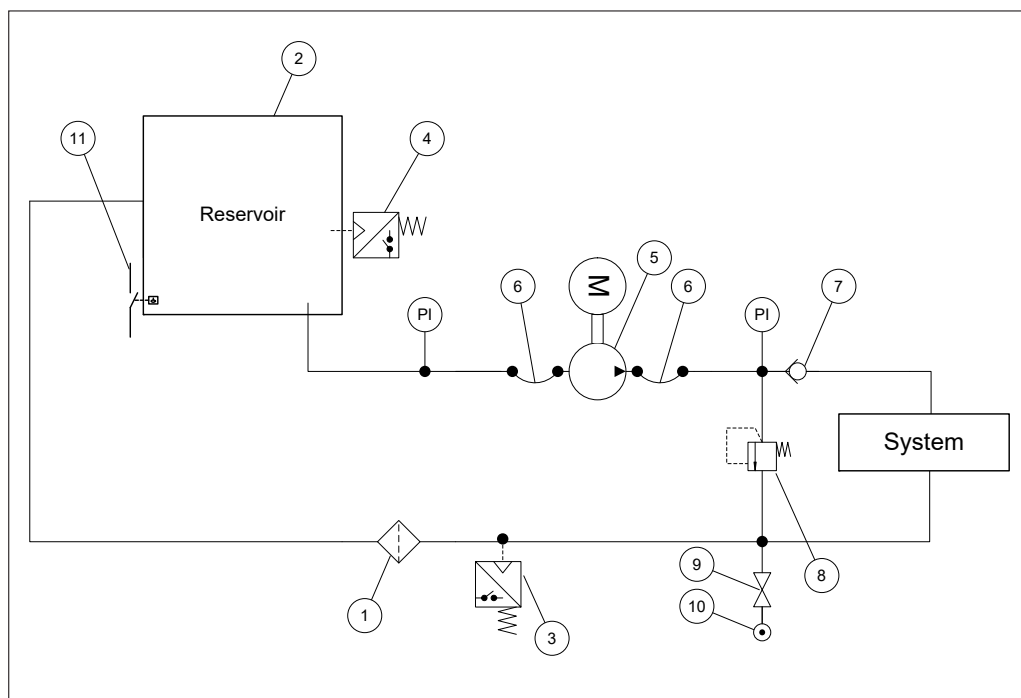
As the Danfoss PAHT G pump begins to create pressure and flow immediately after start-up regardless of any counter pressure, a pressure relief valve (7) should be installed to prevent system damage.

Note: If a non-return valve is mounted in the inlet line, a low-pressure relief valve is also recommended between the non-return valve (8) and the pump to protect against high-pressure peaks.



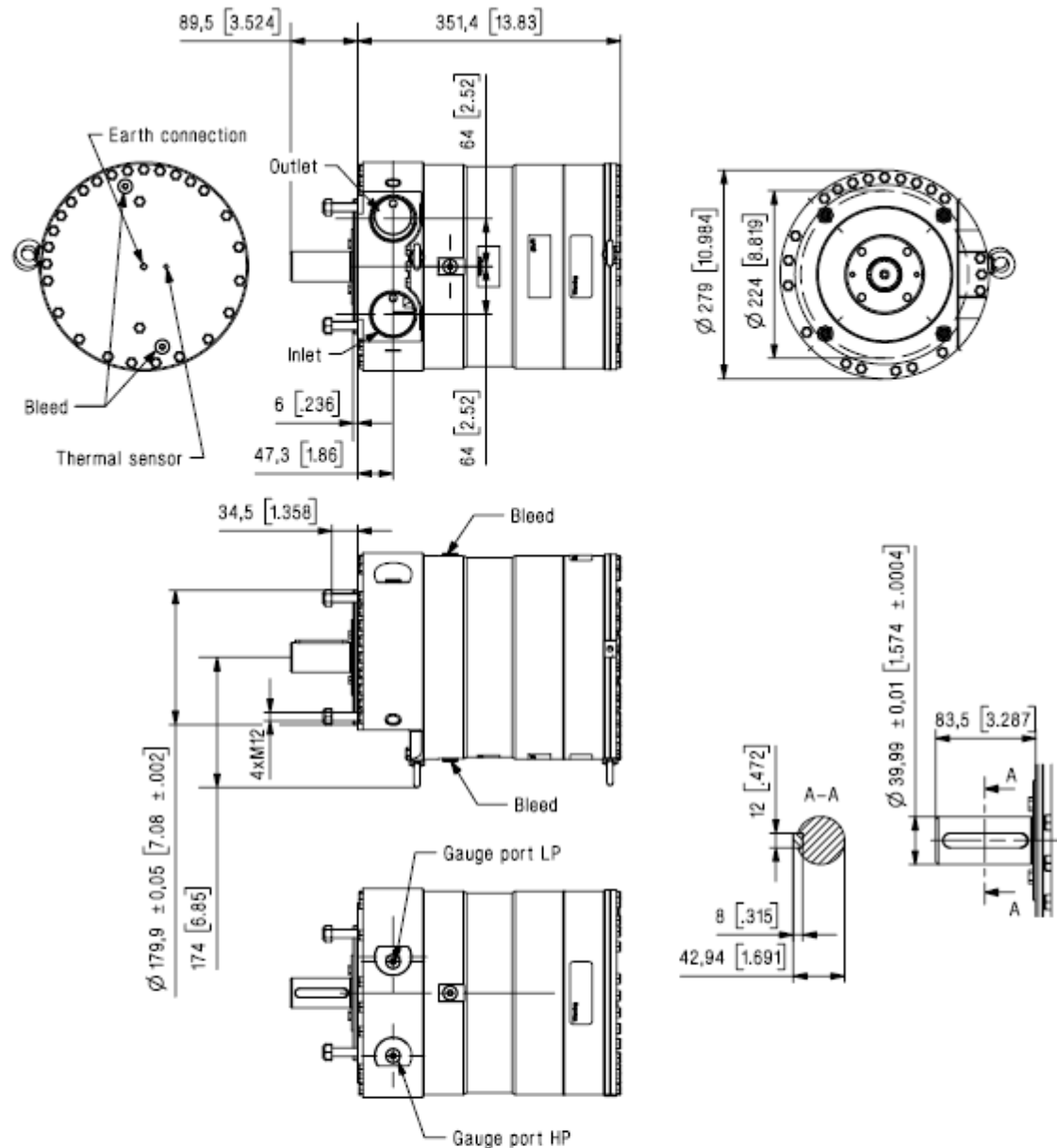
7.4 Closed-system design (not applicable for PAHT G 256-308)

- A Inlet line:**
Dimension the inlet line to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/connections, fittings with small pressure losses and restrictions).
- B Inlet filter:**
Install the filter (1) in front of the tank (2). Please consult the Danfoss filter data sheet for guidance on how to select the right filter.
- C Monitoring pressure switch:**
Install the monitoring pressure switch (3) in front of the filter (1). Set the maximum inlet pressure to 2 barg (29.0 psig). The monitoring pressure switch will stop the pump (5) if inlet pressure is higher than 2 barg (29.0 psig), indicating that the filter element must be changed.
- D Monitoring temperature switch:**
Install the monitoring temperature switch (4) in the tank. Set the temperature value according to technical data, item 4. The monitoring temperature stops the pump if inlet temperature is higher than the set value.
- E Hoses:**
Always use flexible hoses (6) to minimize vibrations and noise.
- F Inlet pressure:**
In order to eliminate the risk of cavitation and other pump damage, pump inlet pressure must be maintained according to specifications described in item 4, technical data.
- G Non-return valve (7):**
Should be installed after the outlet to prevent pump backspin, which may ruin the pump.
- H Pressure relief valve:**
As the Danfoss PAHT G pump begins to create pressure and flow immediately after start-up regardless of any counter pressure, a pressure relief valve (8) should be installed to prevent system damage.
- I System water filling:**
To ensure proper filtration of new water (10) supplied to the system, always use the filling valve (9).
- J Minimum level switch:**
Install the minimum level switch (11) above the outlet of the reservoir. The level switch must stop the pump if the water in the reservoir is below the switch, which indicates that the reservoir is empty.



8. Dimensions and connections

8.5 PAHT G 256-308



Dimensions without tolerances acc. to ISO 2768-1 designation C.

Description	PAHT/PAHT G 256-308
Parallel key, DIN 6885	12 x 8 x 70 mm 0.47 x 0.31 x 2.76 inch
Bleed	G 1/4"; hex key 6 mm
Inlet port	M60 x 1.5 depth 24 mm
Outlet port	M60 x 1.5 depth 24 mm
Gauge port	G 1/4" BSPP; depth 12 mm
Earth connection	M8, depth 11 mm
Thermal sensor	M6, depth 11 mm
Mounting flange	ISO 3019-2 180B4TW

9. Service

Danfoss PAHT G pumps are designed for long periods of service-free operation to ensure low maintenance and life cycle costs. Provided that the pump is installed and operated according to Danfoss specifications, Danfoss PAHT G pumps typically run up to 8,000 hours. However, the service schedule for your Danfoss PAHT G pump may vary according to the application and other factors.

The life of a pump may be greatly shortened if Danfoss recommendations concerning system design and operation are not followed.

In our experience, poor filtration is the number one cause of pump damage.

Other factors that affect pump performance and lifetime include:

- running the pump at speeds outside specifications
- supplying the pump with water at temperatures higher than recommended
- running the pump at inlet pressures outside specifications
- running the pump at outlet pressures outside the specifications.

We recommend that you inspect your pump after 8,000 hours of operation even if it is running without any noticeable problems. Replace any worn parts if necessary, including pistons and shaft seals, to keep your pump running efficiently and to prevent breakdown. If worn parts are not replaced, then our guidelines recommend more frequent inspection.



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Instruction

PAHT pumps

PAHT 256/PAHT 308

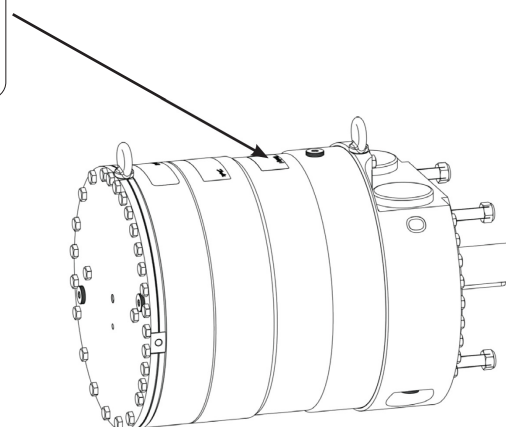
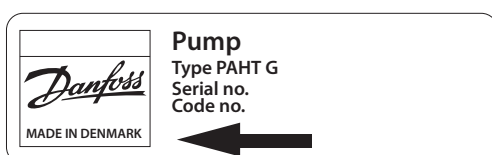


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1. Identification



2. System design

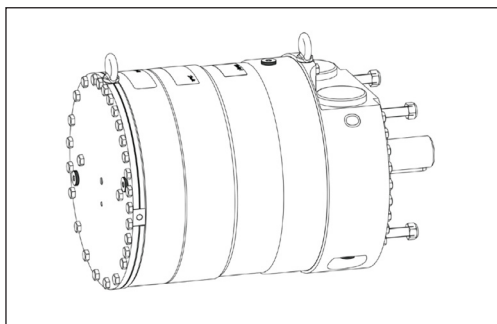
The design of the system must ensure that self-emptying of the pump during standstill is avoided.

The inlet pressure of the pump must never exceed the outlet pressure. This may typically occur in boosted or open-ended systems with direct water supply.

2.1 Open-ended systems with direct water supply

The pump is supplied with water direct from a feed pump.

The inlet pressure for PAHT 256/308 must be at least 2 barg (29 psig) and it must not exceed 6 barg (87 psig) continuously.



If it is unknown what the peak inlet pressure can be, then there should be a 10 barg (145 psig) safety valve on the inlet side of the pump.

specifications described in item 5. The monitoring switch stop the pump at pressures lower than minimum pressure.

Monitoring temperature switch:

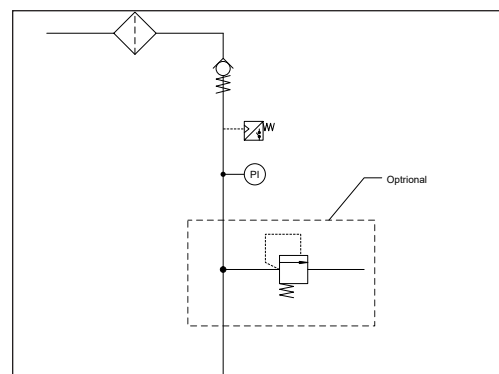
- D** Place a monitoring temperature switch (4) set between filter and pump, on either side of the monitoring pressure switch. Set the temperature value according to specifications described in item 5. The monitoring switch stops the pump at temperatures higher than set value.

Hoses

- E** Always use flexible hoses (5) to minimize vibrations and noise.

Inlet pressure:

- F** In order to eliminate the risk of damage and cavitation, a positive pressure at the inlet is always to be maintained at min. inlet pressure and max. inlet pressure.



2.2 Preferred system design and P&ID

Inlet line:

- A** Dimension the inlet line to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/connections, and fittings with small pressure losses).

Inlet filter:

- B** Place an inlet filter (1) in front of the PAHT pump (2). Please consult Danfoss filter datasheet for guidance on how to select the right filter. Thoroughly clean pipes and flush system prior to start-up.

Monitoring pressure switch:

- C** Place a monitoring pressure switch (3) between filter and pump inlet. Set the minimum inlet pressure according to

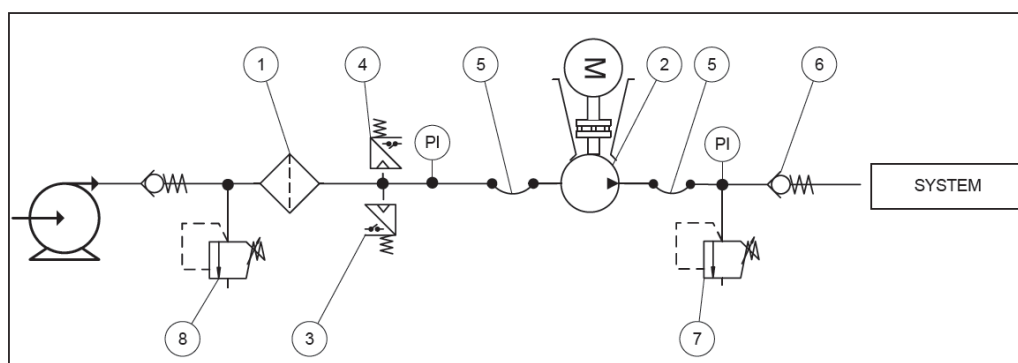
Non-return valve

- G** A non-return valve (6) after the outlet can be installed in order to avoid backspin of the pump.

Pressure relief valve:

- H** A pressure relief valve (7)) can be installed in order to avoid system damage as the Danfoss PAHT pump creates pressure and flow immediately after start-up, regardless of any counter pressure.

Note: If a non-return valve is mounted in the inlet line, a low pressure relief valve is also required between non return valve (8) and pump as protection against high pressure peaks.



2.3 Reversible pumps

If exposed to high pressure in the outlet while the electric motor is not energized, the pumps will start spinning backwards. This will not harm the pumps as long as the pressure in the inlet does not exceed the max. pressure peak of 10 barg (145 psig).

If a non-return valve is mounted in the inlet line, a low-pressure relief valve is also required as protection against high-pressure pulses and high pressure in general.

Alternatively a high-pressure check valve can be mounted in the pump discharge line to prevent the pump from reversing.

The dotted setup ensures that the inlet pressure does not exceed 10 barg (145 psig), when a non-return valve is mounted in the inlet.

In order to avoid the risk of cavitation, the inlet pressure at the pump must be min. 2 barg (29 psig).

The inlet line connection must be properly tightened, as possible entrance of air will cause cavitation.

A good filtration is vital to ensure a long and trouble free life of the pump.

As water has very low viscosity, the PAHT pumps have been designed with very narrow clearance in order to control internal leakage rates and improve component performance. Therefore it is important that the inlet water is filtered properly to minimize the wear of the pump.

The main filter must have a filtration efficiency of 99.98% at 10 µm. We recommend to use precision depth filter cartridges rated 10 µm abs. $\beta_{10} \geq 5000$ (equivalent to a filtration efficiency of 99.98%). Bag filters and string wound filter cartridges typically have only 50% filtration efficiency. This means that for each 100,000 particles reaching the filter, 50,000 particles pass through it compared to only 20 particles in a filter with an efficiency of 99.98%.

For more information on the importance of proper filtration, please consult our publication "Filtration" (code number 521B1009), which also will provide you with an explanation of filtration definitions and a guidance on how to select the right filter.

Monitoring

It is recommended to continuously monitor the following conditions:

- filter clogging
- pressure (inlet- and outlet side of the pump)

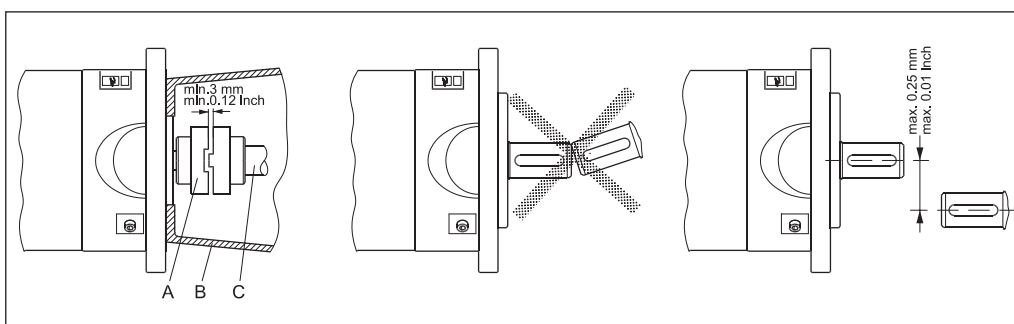
2.4 General comments on

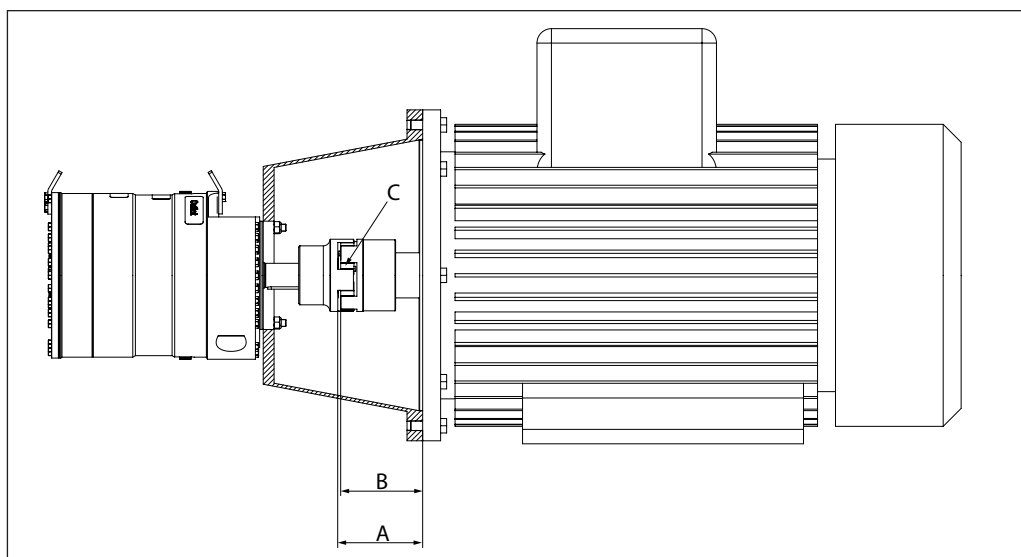
Filtration

3. Building up the pump unit

3.1 Mounting

- A: Elastic coupling
B: Bell housing
C: Motor shaft
D: Pump flange





1. Mount the coupling flush or maximum 1mm offset from the pump shaft end. Ensure an air gap between coupling and pump flange of min. 4 mm (0.16 in).
2. Mount the bell housing on pump. Secure nuts with the right torque.
3. Measure the longest distance "A" from top of bell housing to the button of coupling claw.
4. Mount the coupling on motor shaft. Ensure the coupling and motor flange are not in contact with each other.
5. Measure from motor flange to the top of the coupling. That measurement "B" shall be 3-5 mm (0.12 - 0.2 inch) shorter than the measurement "A".
6. Adjust respectively, verify the measurement, and secure both couplings with the right torques on the locking screws (see coupling operation & mounting instruction).
7. Mount the elastic gear ring and mount the bell housing/pump on the motor. After mounting it must be possible to move the elastic gear ring 3-5mm (0.12 - 0.2 in) axial "C". The check can be done through the inspection hole of bell housing. Secure flange bolts with the right torque.

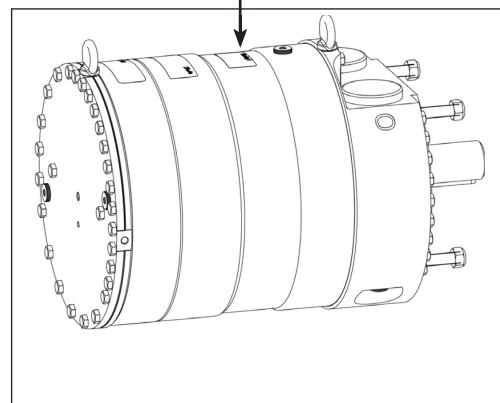
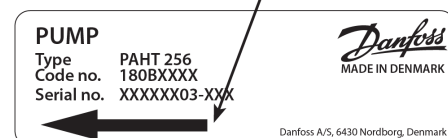
If alternative mounting is desired, please contact the Danfoss Sales Organization.

Choose proper tolerances to ensure an easy mounting of the elastic coupling without use of tools.

Please take care to observe the recommended length tolerances of the chosen coupling, as an axial force on the pump will damage the pump.

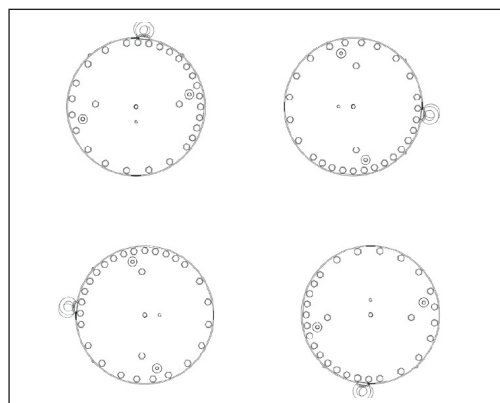
3.2 Direction of rotation

Is indicated by means of an arrow on the pump label.



3.3 Orientation

The pump can be mounted/orientated in any horizontal direction with the inlet and the outlet pointing upwards, downwards or to either side.



3.4 Protection from too high pressures

The pump should be protected against too high pressure by means of a safety valve or a pressure relief valve.

The valve should be placed as close to the pump as possible.

The opening characteristics of the valve must not result in peak pressures higher than 100 barg (1450 psig).

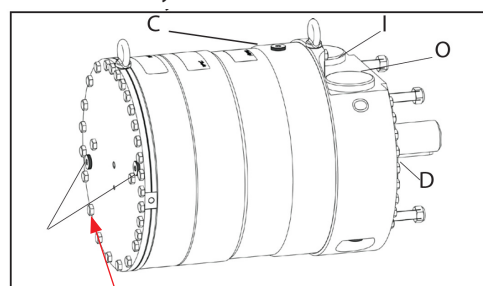
Both the inlet and outlet lines must be flexible soft hoses.

The valve outlet must not be connected directly to the pump suction line. It must be connected directly to the drain.

3.5 Connections

I: Inlet
O: Outlet
C: Bleeding

D: Parallel key



3.6 Grounding

To prevent stray current corrosion we recommend grounding of the pump and all other parts in the system. All parts in the system must be electrical potential equalized to a single reference point (grounding point). It is recommended that the electrical resistance in the grounding cable is equal to or below 0.25 Ohm towards the grounding point.

4. Initial start-up

1. Flush inlet line before connecting the pump, to remove possible impurities from pipes, hoses etc.
2. Loosen top bleeding plug "C" (see item 3.5) using an allen key (only plugs with internal hexagon sockets). Retighten the plug, when water appears from the bleeding plug.
3. Make sure that the direction of rotation of the electric motor corresponds to the direction of rotation of the pump (see label on pump)

4. Now the pump is ready for start-up.

WARNING:

Make sure that the direction of rotation of the electric motor corresponds to the direction of rotation of the pump (see label on pump). Otherwise the pump will be damaged if a check valve is placed between pump and feed pump.

5. Operation

5.1 Temperature

Fluid temperature:
Min. +2°C to max. +50°C
(Min. +35.6°F to max. +122°F)

Ambient temperature:
Min. +2°C to max. +50°C
(Min. +35.6°F to max. +122°F)

Storage temperature:
Min. -40°C to max. +70°C
(Min. -40°F to max. +158°F)

In case of lower operating temperatures, please contact the Danfoss Sales Organization.

5.2 Pressure

The inlet pressure for PAHT 256/308 must be min. 2 barg (29 psig) and max. 6 barg (87 psig). At lower pressures the pump will cavitate, resulting in damage of the pump.

Max. inlet pressure peak (e.g. in case the pump stops momentarily) up to 10 barg (145 psig) are acceptable. Max. pressure on the pump's outlet line should be limited at 120 barg (1740 psig) continuously.

NB: The pump unit should include a pressure gauge on the high pressure side.

5.3 Dry running

When running, the pump must always be connected to the water supply in order to avoid damage if it should run dry.

5.4 Disconnection

If the inlet line is disconnected from the water supply, the pump will be emptied of water through the disconnected inlet line. When starting up again, follow the bleeding procedure described under section 4, Initial start up.

5.5 Storage

When preparing the pump for long-term storage or for temperatures below the freezing point, flush the pump with an anti-freeze medium type monopropylene glycol to prevent internal corrosion or frost in the pump.

For further information on anti-freeze media, please contact the Danfoss Sales Organization.

Recommended procedure:

1. Disconnect the water supply to the pump.
2. Through the lower bleeding plug, empty the pump housing of water and close it again.
3. Connect the pump to a tank containing anti-freeze additive. Connect a hose to the

inlet port of the pump and via another hose return the flow from the outlet port to the tank with anti-freeze additives.

4. Quickly start and stop the pump. Make sure that the pump does not run dry. The pump is now protected against internal corrosion and frost.

6. Service

The Danfoss PAHT pumps are designed for long periods of service-free operation to provide customers with low maintenance and life cycle costs. Provided that the pumps are installed and operated according to Danfoss specifications, the Danfoss PAHT pumps typically run 8,000 hours between service routines. However, the service schedule for your PAHT pump may vary according to the application and other factors.

The life of a pump may be greatly shortened if Danfoss recommendations concerning system design and operation are not followed.

In our experience, poor filtration is the number one cause of pump damage.

Other factors that affect pump performance and lifetime include:

- running the pump at speeds outside specifications
- supplying the pump with water at temperatures higher than recommended
- running the pump at inlet pressures outside specifications
- running the pump at outlet pressures outside the specifications.

7. Recommended service intervals

7.1 General information

This guideline provides information on the recommended service intervals for the PAHT pumps. The recommendation is based upon good engineering practice and on experience gained from operation even under extreme conditions.

The recommendation is for guidance only.

7.2 Inspection of pump parts

Danfoss recommends to inspect the pumps after 8,000 hours. Typical signs of wear are seen on the contact/sliding surfaces in the pumps. If the pumps must run for additional 8,000 hours, the following parts will have to be inspected:

- Pistons
- Retainer plate, ball and bearing
- Valve plate
- Port plate
- Sealings

If there are any wear marks on the parts they need to be replaced.

If service inspection due to the application is complicated, the plant operator can decide to extend the service interval by evaluating the following deviations:

- Sound - does the pump have any unusual sounds?
- Electric motor power consumption and speed compared with measurement made in the past.
- Pressure/flow according to measurements made in the past?

We advise that the above mentioned parameter during the extended service interval is inspected for every 500-2,000 hours beyond the 8,000 hours. The pump must in any case be inspected after maximum 16,000 hours or 2 years.

7.3 How to inspect the pump

Service manuals are available on the internet hpp.danfoss.com



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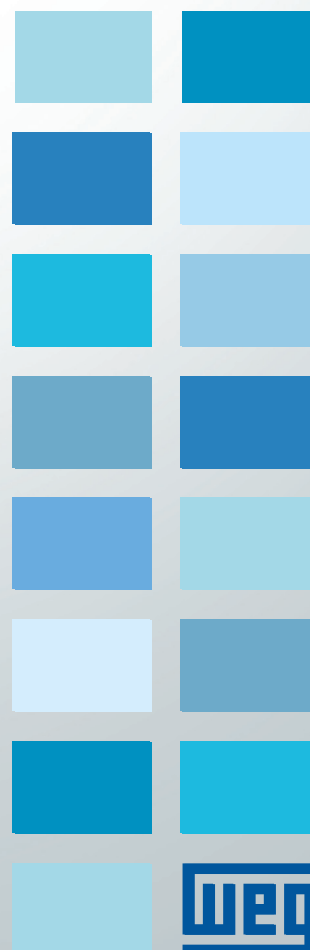
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NEMA motors

Extract from Installation, Operation
and Maintenance Manual from WEG

Installation, Operation and Maintenance Manual of Electric Motors

Manual General de Instalación, Operación y Mantenimiento de Motores Eléctricos



Introduction

This extract is based on information in the Installation, Operation and Maintenance Manual of Electric Motors from WEG:
"Cod: 50033244 | Rev: 02 | Date (m/y): 11/2011".

If you have any questions concerning the IOM or need further information, please contact your local WEG branch.
Contact Details can be found at: www.weg.net

2.2. Receiving Inspection

All motors are tested during the manufacturing process.

The motor must be checked when received for any damage that may have occurred during the transportation.

All damages must be reported in writing to the transportation company, to the insurance company and to WEG. Failure to comply with such procedures will void the product warranty.

You must inspect the product:

- Check if nameplate data complies with the purchase order;
- Remove the shaft locking device (if any) and rotate the shaft by hand to ensure that it rotates freely.
- Check that the motor has not been exposed to excessive dust and moisture during the transportation.

Do not remove the protective grease from the shaft, or the plugs from the cable entries. These protections must remain in place until the installation has been completed.



4.1. Lifting

Before lifting the motor ensure that all eyebolts are tightened properly and the eyebolt shoulders are in contact with the base to be lifted, as shown in Figure 4.1.

Figure 4.2 shows an incorrect tightening of the eyebolt.

Ensure that lifting machine has the required lifting capacity for the weight indicated on the motor nameplate.



Figure 4.1 - Correct tightening of the eyebolt



Figure 4.2 - Incorrect tightening of the eyebolt

4.1.1 Horizontal motors with one eyebolt



The center-of-gravity may change depending on motor design and accessories. During the lifting procedures the maximum allowed angle of inclination should never be exceeded as specified below.

For horizontal motors fitted with only one eyebolt, the maximum allowed angle-of-inclination during the lifting process should not exceed 30° in relation to the vertical axis, as shown in Figure 4.3.

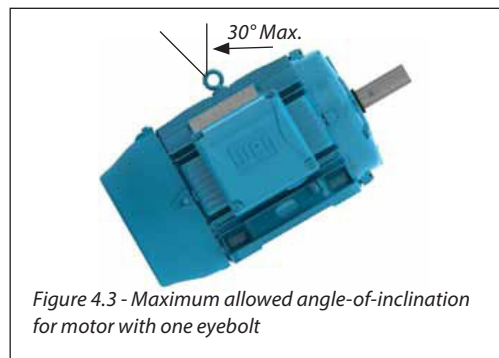


Figure 4.3 - Maximum allowed angle-of-inclination for motor with one eyebolt

4.1.3 Vertical motors

For vertical mounted motors, as shown in Figure 4.7, the use of a spreader bar is required for maintaining the lifting element (chain or rope) in vertical position and thus preventing damage to the motor surface.



Always use the eyebolts mounted on the top side of the motor, diametrically opposite, considering the mounting position.

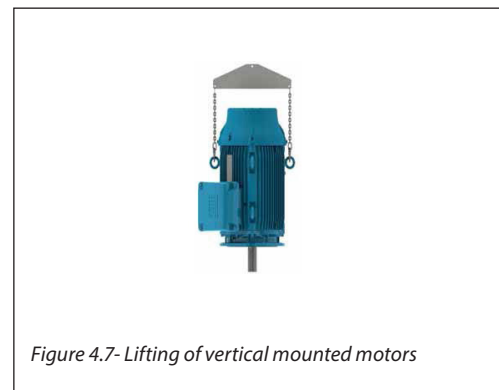


Figure 4.7 - Lifting of vertical mounted motors

5. Storage

If the motor is not installed immediately, it must be stored in a dry and clean environment, with relative humidity not exceeding 60%, with an ambient temperature between 5 °C and 40 °C, without sudden temperature changes, free of dust, vibrations, gases or corrosive agents. The motor must be stored in horizontal position, unless specifically designed for vertical operation, without placing objects on it. Do not remove the protection grease from shaft end to prevent rust.

If the motor are fitted with space heaters, they must always be turned on during the storage period or when the installed motor is out of operation. Space heaters will prevent water condensation inside the motor and keep the winding insulation resistance within acceptable levels. Store the motor in such position that the condensed water can be easily drained. If fitted, remove pulleys or couplings from the shaft end.



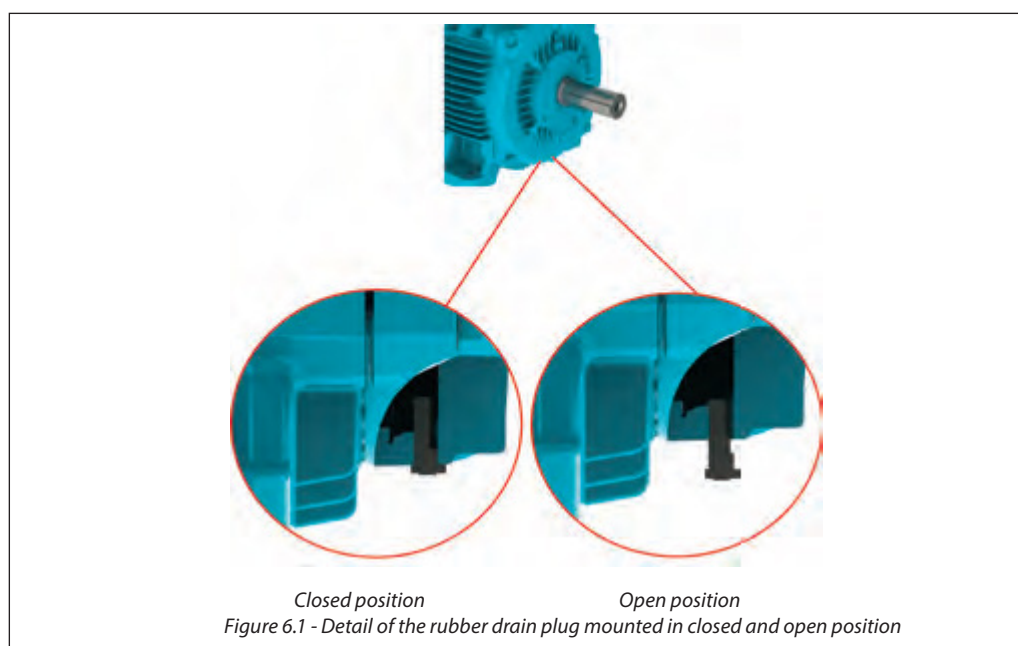
The space heaters should never be energized when the motor is in operation.

6. Installation



The insulation resistance must be measured in a safe environment.

1. Insulation resistance: must be within the acceptable limits.
2. Bearings:
 - a. Rolling bearings: oxidized bearings must be replaced. If no oxidation is detected, lubricate the bearings. If the motor is stored for a period of over two years, the bearings must be replaced before starting the motor.
 - b. Sleeve bearing: if sleeve bearing motors are stored longer than the recommended oil change interval, the oil must be changed before machine starting. Don't forget to remove the dehumidifiers when you drain the oil from the motor and to fill it again with new oil before starting the machine.
3. Operating conditions of the start capacitors: If single-phase motors are stored for a period of over two years, it is recommended to change the start capacitors before motor starting since they lose their operating characteristics.
4. Terminal box:
 - a. the inside of the terminal box must be clean and dry.
 - b. the contacts must be correctly connected and corrosion free.
 - c. the cable entries must be correctly sealed and the terminal box cover properly mounted in order to ensure the degree of protection indicated on the motor nameplate.
5. Cooling: the cooling fins, air inlet and outlet openings must be clean and unobstructed. The distance between the air inlet openings and the wall should not be shorter than $\frac{1}{4}$ (one quarter) of the diameter of the air inlet. Ensure sufficient space to perform the cleaning services. See Figure 7.1.
6. Coupling: remove the shaft locking device (where fitted) and the corrosion protection grease from the shaft end and flange just before installing the motor.
7. Drain hole: the motor must always be positioned so the drain hole is at the lowest position (If there is any indication arrow on the drain, the drain must be so installed that the arrow points downwards). Motors supplied with rubber drain plugs leave the factory in the closed position and must be opened periodically to allow the exit of condensed water. For environments with high water condensation levels and motor with degree of protection IP55, the drain plugs can be mounted in open position (see Figure 6.1). For motors with degree of protection IP56, IP65 or IP66, the drain plugs must remain at closed position (see Figure 6.1), being opened only during the motor maintenance procedures. The drain system of motors with Oil Mist lubrication system must be connected to a specific collection system.



6.9. Electrical connection

Consider the rated motor current, service factor, starting current, environmental and installation conditions, maximum voltage drop, etc. to select appropriate power supply cables and switching and protection devices.

All motors must be installed with overload protection systems. Three-phase motors should be fitted with phase fault protection systems.



Before connecting the motor, check if the power supply voltage and the frequency comply with the motor nameplate data. All wiring must be made according to the connection diagram on the motor nameplate. To prevent accidents, check if motor has been solidly grounded in accordance with the applicable standards.

If motors are supplied without terminal blocks, insulate the cable terminals with suitable insulation material that meets the power supply voltage and the insulation class indicated on the motor nameplate.

Ensure correct tightening torque for the power cable and grounding connections.

The clearance distance (see Figure 6.12) between non-insulated live parts with each other and between grounded parts must be as indicated in Table 6.2.

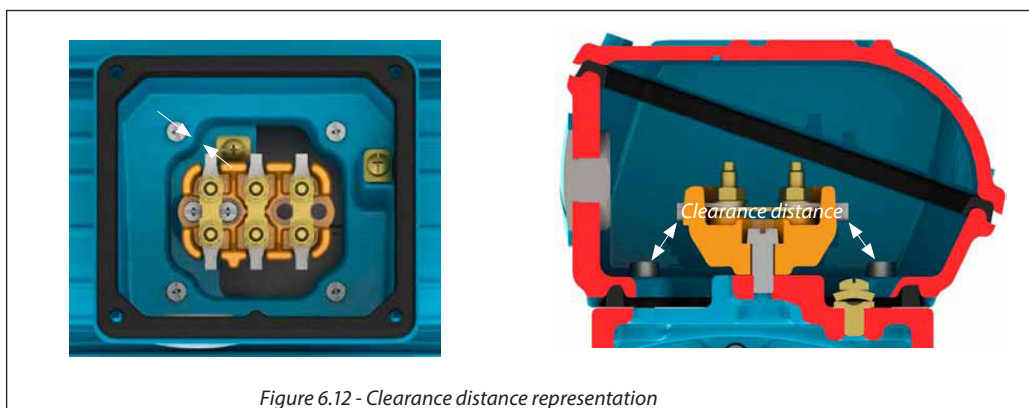


Figure 6.12 - Clearance distance representation

Voltage	Minimum clearance distance (mm)
$U \leq 440 \text{ V}$	4
$440 < U \leq 690 \text{ V}$	5.5

Tabel 6.2 - Minimum clearance distance (mm) x supply voltage



Even when the motor is off, dangerous voltages may be present inside the terminal box used for the space heater supply or winding energization when the winding is used as heating element. Motor capacitors will hold a charge even after the power has been cut off. Do not touch the capacitors and/or motor terminals, before discharging the capacitors completely.

After the motor connection has been completed, ensure that no tool or foreign body has been left inside the terminal box. Unused cable inlet holes in the terminal box must be properly closed to ensure the degree of protection indicated on the motor nameplate. The cable inlets used for power supply and control must be fitted with components (for example, cableglands and conduits) that meet the applicable standards and regulations in each country.

If the motor is fitted with accessories, such as brakes and forced cooling systems, these devices must be connected to the power supply according to the information provided on their nameplates and with special care as indicated above.

All protection devices, including overcurrent protection, must be set according to the rated machine conditions. These protection devices must protect the machine against short circuit, phase fault or locked rotor condition. The motor protection devices must be set according to the applicable standards.

Check the direction of rotation of the motor shaft. If there is no limitation for the use of unidirectional fans, the shaft rotation direction can be changed by reversing any two of the phase connections. For single-phase motor, check the connection diagram indicated on the motor nameplate.

6.10. Connection of the thermal protection devices

If the motor is supplied with temperature monitoring devices, such as, thermostat, thermistors, automatic thermal protectors, Pt-100 (RTD), etc., they must be connected to the corresponding control devices as specified on the accessory nameplates. The non-compliance with this procedure may void the product warranty and cause serious material damages.



Do not apply test voltage above 2.5 V on thermistors and current above 1 mA on RTDs (Pt-100) according to IEC 60751 standard.

Figure 6.13 and Figure 6.14 show the connection diagram of the bimetal thermal protector (thermostats) and thermistors, respectively.

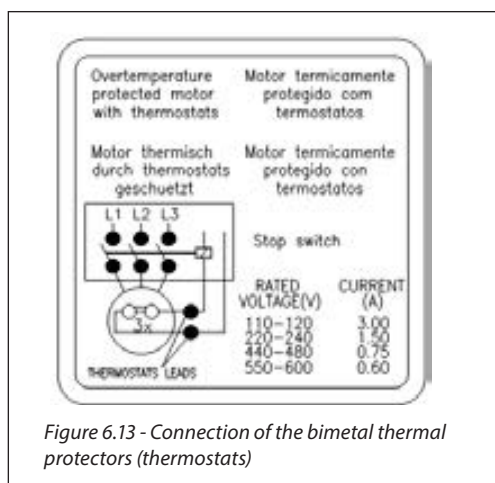


Figure 6.13 - Connection of the bimetal thermal protectors (thermostats)

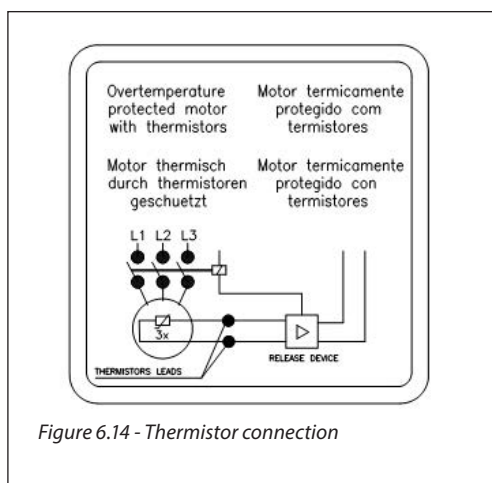


Figure 6.14 - Thermistor connection

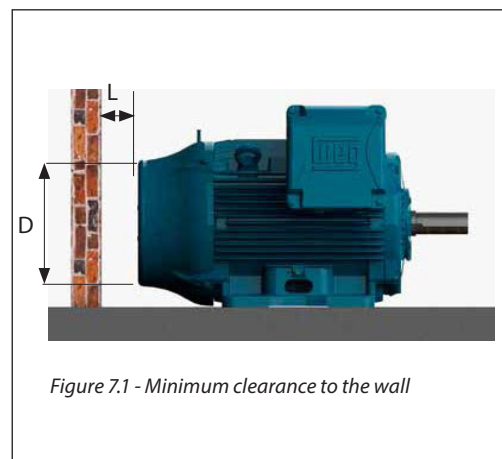
7. Commissioning

7.1. Initial Start-up

After finishing the installation procedures and before starting the motor for the first time or after a long period without operation, the following items must be checked:

- If the nameplate data (voltage, current, connection diagram, degree of protection, cooling system, service factor, etc.) meet the application requirements.
- If the machine set (motor + driven machine) has been mounted and aligned correctly.
- If the motor driving system ensures that the motor speed does not exceed the max. allowed speed.
- Measure the winding insulation resistance, making sure it complies with the specified values.
- Check the motor rotation direction.
- Inspect the motor terminal box for damage and ensure that it is clean and dry and all contacts are rust-free, the seals are in perfect operating conditions and all unused threaded holes are properly closed thus ensuring the degree of protection indicated on the motor nameplate.
- Check if the motor wiring connections, including grounding and auxiliary equipment connection, have been carried out properly..
- Check the operating conditions of the installed auxiliary devices (brake, encoder, thermal protection device, forced cooling system, etc.).
- Check bearing operating conditions. If signs of oxidation are detected, replace the bearings. If no sign of oxidation is detected, relubricate the bearings as described in item 8.2. If the motors are stored for more than two years, the bearings must be replaced before starting the motor.

- When motors are fitted with sleeve bearings, ensure:
 - correct oil level for the sleeve bearing. The oil level should be in the center of the sight glass
 - that the motor is not started or operated with axial or radial loads;
 - that if the motor is stored for a period equal or longer than the oil change interval, the oil must be changed before starting the motor.
- Inspect the capacitor operating condition, if any. If motors are installed for more than two years, but were never commissioned, it is recommended to change the start capacitors since they lose their operating characteristics.
- Ensure that the air inlet and outlet opening are not blocked. The minimum clearance to the nearest wall (L) should be at least $\frac{1}{4}$ of the fan cover diameter (D), see Figure 7.1. The intake air temperature must be at ambient temperature.



Please consider the minimum distances shown in the Table 7.1 as reference value

Frame size		Distance between the fan cover and the wall (L)	
IEC	NEMA	mm	Inches
63	-	25	0.96
71	-	26	1.02
80	-	30	1.18
90	143/5	33	1.30
100	-	36	1.43
112	182/4	41	1.61
132	213/5	50	1.98
160	254/6	65	2.56
180	284/6	68	2.66
200	324/6	78	3.08
225	364/5	85	3.35
250	404/5		

- ensure that all rotating parts, such as pulleys, couplings, external fans, shaft, etc. are protected against accidental contact.

Other tests and inspections not included in the manual may be required, depending on the specific installation, application and/or motor characteristics.

After all previous inspections have been carried out, proceed as follows to start the motor:

- Start the motor on no-load (if possible) and check the motor direction of rotation. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions.
- Ensure the motor starts smoothly. If any abnormal operating condition is noticed, switch off the motor, check the assembly system and connections before the motor is started again.
- If excessive vibrations are noticed, check if the motor mounting bolts are well tightened or if the vibrations are not generated and transmitted from adjacent installed equipment. Check the motor vibration periodically and ensure that the vibration limits are kept.
- Start the motor at rated load during a short time and compare the operating current with the rated current indicated on the nameplate.
- Continue to measure the following motor variables until thermal equilibrium is reached: current, voltage, bearing and motor frame temperature, vibration and noise levels.
- Record the measured current and voltage values on the Installation Report for future comparisons.

As induction motors have high inrush currents during start-up, the acceleration of high inertia load requires an extended starting time to reach full speed resulting in fast motor temperature rise. Successive starts within short intervals will result in winding temperature increases and can lead to physical insulation damage reducing the useful life of the insulation system. If the duty S1 is specified on the motor nameplate, this means that the motor has been designed for:

- two successive starts: first start from cold condition, i. e., the motor windings are at room temperature and the second start immediately after the motor stops.
- one start from hot condition, i. e., the motor windings are at rated temperature.

8. Maintenance

The purpose of the maintenance is to extend the useful life of the equipment. The non-compliance with one of these previous items can cause unexpected machine failures.

If motors with cylindrical roller or angular contact bearings are to be transported during the maintenance procedures, the shaft locking device must always be fitted. All HGF motors, regardless of the bearing type, must always be transported with the shaft locking device fitted.

All repairs, disassembly and assembly related services must be carried out only by qualified and well-trained personnel by using proper tools and techniques. Make sure that the machine has stopped and it is disconnected from the power supply, including the accessory devices (space heater, brake, etc.), before any servicing is undertaken.

The company does not assume any responsibility or liability for repair services or maintenance operations executed by non-authorized Service Centers or by non qualified service personnel. The company shall have no obligation or liability whatsoever to the buyer for any indirect, special, consequential or incidental loss or damage caused or arising from the company's proven negligence

8.1. General Inspection

The inspection intervals depend on the motor type, application and installation conditions. Proceed as follows during inspection:

- Visually inspect the motor and coupling. Check if abnormal noises, vibrations, excessive heating, wear signs, misalignment or damaged parts are noticed. Replace the damaged parts as required.
- Measure the insulation resistance.
- Clean the motor enclosure. Remove oil spills and dust accumulation from the motor frame surface to ensure a better heat transfer to the surrounding ambient.
- Check cooling fan condition and clean the air inlet & outlet openings to ensure a free air flow over the motor.
- Investigate the actual condition of the seals and replace them, if required.
- Drain the condensed water from inside the motor. After draining, reinstall the drain plugs to ensure the degree of protection as indicated on the motor nameplate. The motor must always be positioned so the drain hole is at the lowest position (see item 6).
- Check the connections of the power supply cables, ensuring the correct clearance distance between live and grounded parts, as specified in Table 6.2.

- Check if the tightening torque of the bolted connections and mounting bolts meets the specified tightening torque.
- Check the status of the cable passages, the cable gland seals and the seals inside the terminal box and replace them, if required.
- Check the bearing operating conditions. Check for the presence of any abnormal noise, vibration or other abnormal operating conditions, like motor temperature rise. Check the oil level, the lube oil condition and compare the workings hours with the informed life time.
- Record and file all changes performed on the motor.



Do not reuse damaged or worn parts. Damaged or worn parts must be replaced by parts supplied by the manufacturer and must be installed as if they were the original parts.

8.2.1. Grease lubricated rolling bearings



Excess grease causes bearing overheating, resulting in bearing failure.

The lubrication intervals specified in Table 8.1, consider a room temperature of 40°C, the motor running at rated speed, a motor mounted in horizontal position, greased with Mobil Polyrex EM grease. The lubrication intervals are determined according to the standard ISO 281 and they estimate for the basic rating life that 90% of a group of identical bearings will theoretically meet or exceed the calculated value with 90% reliability. Any variation of the parameters listed above must be evaluated.

8.2. Lubrication

Proper lubrication plays a vital role in the motor performance. Only use the grease or oil types, amounts and lubrication intervals recommended for the bearings. This information is available on the motor nameplate and the lubrication procedures must be carried out according to the type of lubricant (oil or grease). When the motor is fitted with thermal protection devices for bearing temperature control, consider the operating temperature limits. The grease and oil disposal should be made in compliance with applicable laws in each country.



Please contact WEG when motors are to be installed in special environments or used for special applications.

Frame		Poles	Bearing designation	Amount of grease (g)	Lubrication intervals (hours)					
					ODP (Open Drip Proof)		W21 TEFC (Totally enclosed Fan Cooled)		W22 TEFC (Totally Enclosed Fan Cooled)	
IEC	NEMA				50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
160	254/6	2	6309	13	20000	20000	18100	15700	22000	20000
		4					20000	20000	25000	25000
		6								
		8								
180	284/6	2	6311	18	20000	20000	13700	11500	17000	14000
		4					20000	20000	25000	25000
		6								
		8								

Table 8.1 - Lubrication intervals for ball bearings



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Parts list

PAHT G pumps

PAHT G 2/3.2/6.3 - PAHT G10/12.5 -
PAHT G 20/25/32 - PAHT G 50/63/70/80/90 -
PAHT G 256/308



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1. General

This parts list provides an overview of the content of the various service sets as well as exploded views for both non ATEX and ATEX certified pumps.

ATEX certified pumps are indicated by Ex in the designation.

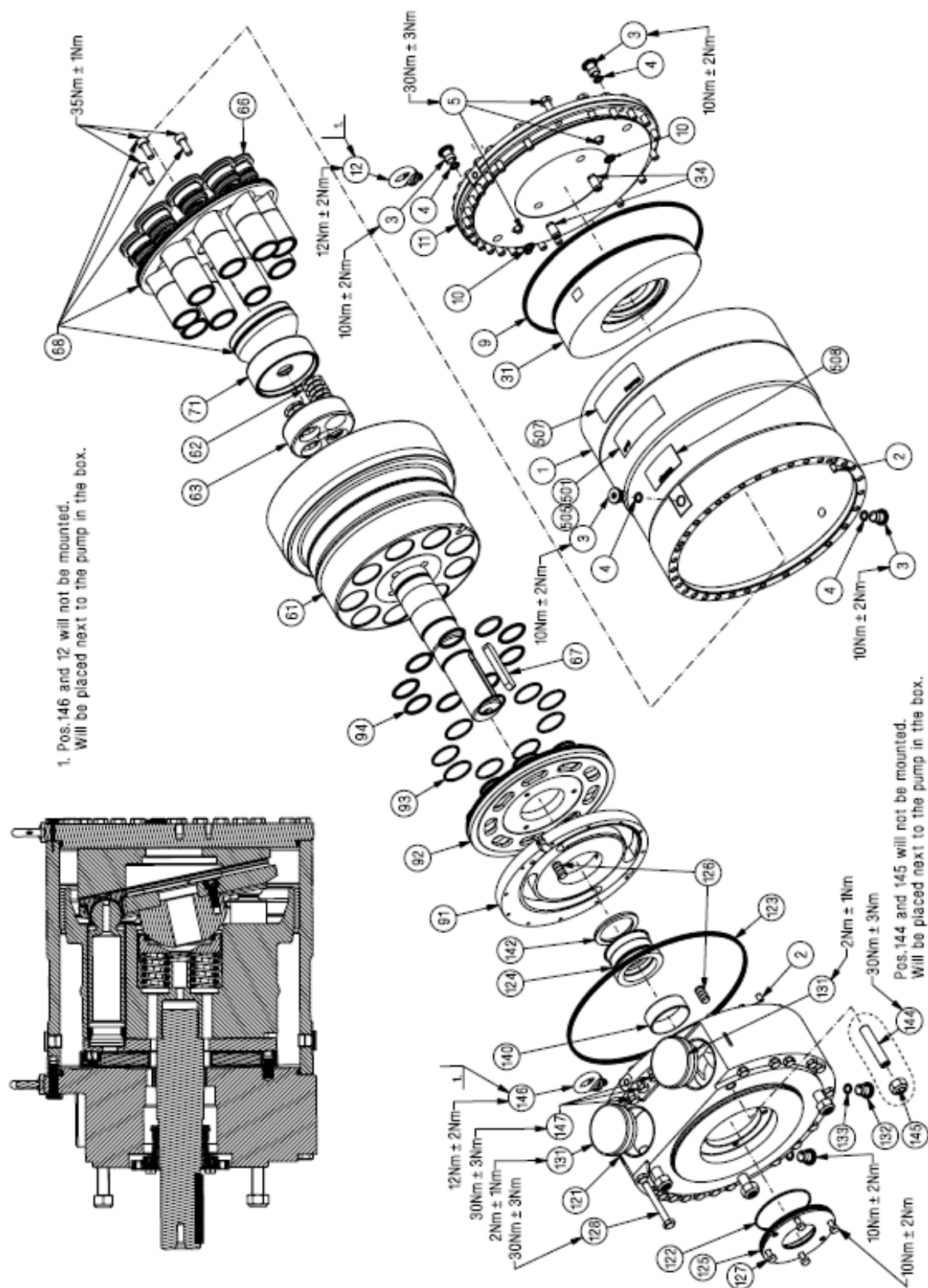
Non Atex	ATEX
PAHT G 256	PAHT G 256 Ex
PAHT G 308	PAHT G 308 Ex

In the following the pumps will be called PAHT G.

**14. Spare parts list for
PAHT G 256-308
Serial number 03 or higher**

Pos.	Qty.	Designation	Material	180B4370 - Screw & seal set (PAHT G 256-308)	180B4369 - Cylinder barrel set (PAHT G 256-308)	180B4367 - Valve plate set (PAHT G 256-308)	180B4366 - Retainer set (PAHT G 256-308)	180B4368 - Piston set (PAHT G 256-308)	180B4331 - Swash plate set (PAHT G 256)	180B4332 - Swash plate set (PAHT G 308)
1	1	Housing	Duplex / PEEK							
2	2	Pin $\varnothing 6 \times 10$	AISI 316	x						
3	4	Bleeding plug G 1/4"	Super duplex	x						
4	4	O-ring $\varnothing 11 \times 2$	NBR	x						
5	28	Screw M8 x 30	AISI 316	x						
9	1	O-ring $\varnothing 228 \times 4$	NBR	x				x	x	x
10	2	O-ring $\varnothing 9,19 \times 2,62$	NBR	x					x	x
11	1	End cover CW	Duplex							
13	3	Screw M8 x 16	AISI 316	x						
31	1	Swash plate	Super Duplex						x	x
34	2	Pin $\varnothing 10,5 \times 20$	Duplex	x					x	x
61	1	Cylinder barrel	Super duplex / PEEK		x					
62	4	Spring	Duplex				x			
63	1	Spring guide	Polypropylen				x			
64	1	Retainer Ball	Super duplex				x			
65	1	Retainer plate	Super duplex				x			
66	9	Piston	Super duplex / PEEK					x		
67	1	Key 12 x 8 x 70	AISI 316	x						
71	1	Retainer Guide	Super duplex / PEEK				x			
91	1	Port plate	Super duplex / PEEK			x				
92	1	Valve plate	Super duplex			x				
93	9	Back up ring	PTFE			x				
94	9	O-ring $\varnothing 30,2 \times 3$	NBR			x				
121	1	Port flange	Duplex							
122	1	O-ring $\varnothing 68 \times 2$	NBR	x						
123	1	O-ring $\varnothing 228 \times 4$	NBR	x						
124	1	Shaft sealing	Hasteloy C276	x						
125	1	Cover	Super duplex							
126	2	Pin $\varnothing 10,5 \times 20$	Super duplex	x		x				
127	4	Screw M6 x 16	AISI 316	x						
128	18	Screw M8 x 90	AISI 316	x						
132	2	Bleeding plug G 1/4"	Super duplex	x						
133	2	O-ring $\varnothing 11 \times 2$	NBR	x						
142	1	Washer for shaft seal	Polypropylen	x						
147	3	Screw M8 x 30	AISI 316	x						
	1	Service instruction		x	x	x	x	x	x	x

15. Exploded view for PAHT G 256-308 Serial number 03 or higher



[illegible]

17. Tool set for
PAHT G 256-308

Designation	180B4259 Tool set (PAHT 256-308)
Allen key, 6 mm	x
Adjustable pin wrench	x
Combination wrench, 10 mm	x
Combination wrench, 13 mm	x
Nut, M8 x 6.5 x 13	x
Guide bolt, M8 x 140	x
Shaft seal extractor, Ø45	x
Press bush, Ø45	x
Eye bolt, M8	x
Press bush for valve plate	x
Stop for retainer plate	x
Screw, M8 x 20	x
Screw, M8 x 70	x



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Guide line.

PAH / PAHT / PAHT C / PAHT G / pumps

Trouble shooting guide



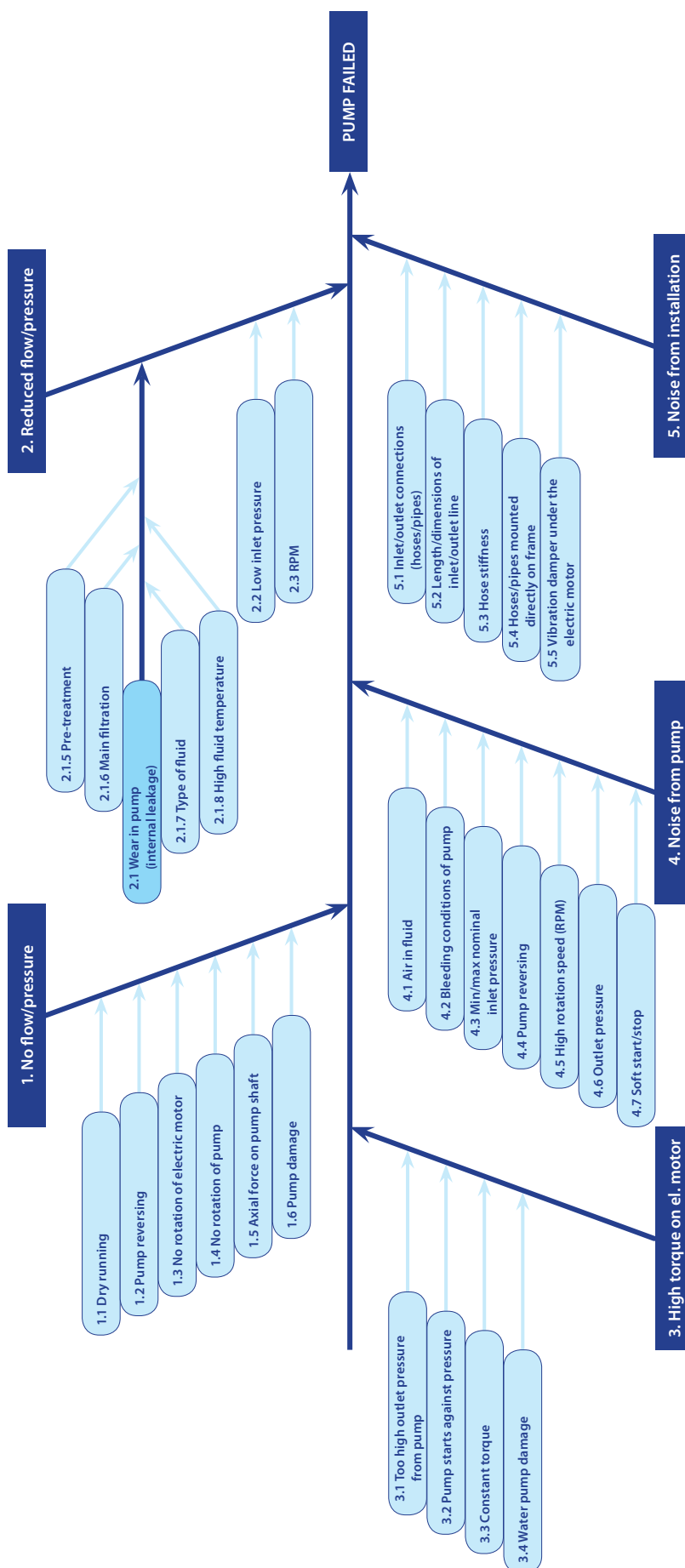
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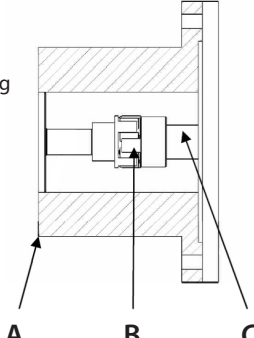
Validity

This document is covering the pumps PAH, PAHT PAHT C, PAHT G, PAHT 674 and PAH F for both non ATEX and ATEX certified. PAHT pumps are not ATEX certified.

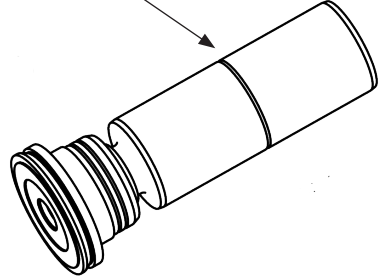
Trouble shooting fish bone chart



1. No flow/no pressure

Cause	Remedy	Comments
1.1 Dry running (no water supply to the pump)	If no water comes out of the pump: 1.1.1 Check that inlet valve is open. 1.1.2 Check that booster pump is running.	Mount a low pressure switch in front of the pump and check its set point/ function. The low pressure switch ensures that the pump does not start until the inlet pressure has reached minimum inlet pressure (see Data sheet).
1.2 Pump reversing (electric motor is running the wrong direction, i.e. counter-clockwise)	1.2.1 Change the phase on the electric motor to make it run clockwise. WARNING: - The pump must not run without water for more than a few seconds. - If the pump takes in water from the high-pressure outlet line, it builds up pressure in pump housing and will eventually break down.	Rotation direction for the pump is shown by an arrow on the label on the pump.
1.3 No rotation of electric motor	1.3.1 Check that main switch is switched on. 1.3.2 Check the electricity at the facility. 1.3.3 Ensure that motor relay is switched on. 1.3.4 Ensure that fuse is not blown. 1.3.5 Ensure that booster pump is started. 1.3.6 Check that the monitor switches are working correctly. 1.3.7 Disconnect pump from electric motor and check that the motor is capable of running with no load.	If motor-type relay or the electrical fuse is blown, check that electric motor is sized correctly.
1.4 No rotation of pump	1.4.1 Ensure that coupling between electric motor and pump is connected. 1.4.2 Check if coupling is damaged. 1.4.3 Check that electric motor is sized correctly. 1.4.4 Check that the electrical installation is correctly sized. 1.4.5 Contact Danfoss Sales office for guidelines in how to troubleshoot internal pump parts.	
1.5 Axial load on pump shaft (may cause high internal leakage) Only applying to PAH 2-12.5 PAHT 2-308 PAH F 20-40 PAHT C 2-308 PAHT G 2-308	1.5.1 Ensure that the air gap between the two coupling parts is min 5 mm. It should always be possible to move the plastic part on the coupling at least 3 mm.	To ensure easy mounting of the flexible coupling without using tools, the tolerances must be dimensioned accordingly. WARNING: Any axial and/or radial loads on the shaft must be avoided. Any axial or radial load will cause breakdown.  A - Bell housing B - Flexible coupling C - Motor shaft
1.6 Pump damage (the internal parts may be damaged)	1.6.1 Contact Danfoss sales office for guidelines in how to troubleshoot internal pump parts.	Instructions on internal elements are available on www.danfoss.high-pressurepumps.com

2. Reduced flow/reduced pressure

Cause	Remedy	Comments
2.1 Wear on pump Large internal leakage due to:	2.1.1 Dismantle the pump. 2.1.2 Check valve plate. Valve plate has marks/scratches on the surface facing the port plate. Minor wear on valve plate can cause large internal leakage. See Index 6.1. 2.1.3 Check port plate. Port plate has marks/scratches on the surface facing the valve plate. Minor wear on port plate can cause large internal leakage. See Index 6.2. 2.1.4 Check cylinder barrel. Liners in cylinder barrel may be scratched or worn. Insert a piston in the liner and check the fit. If there is any space (clearance) between liner and piston, liner or piston is worn. 2.1.5 Pre-treatment: Analyse fluid for content of particles. - Check that filters are OK and working correctly. 2.1.6 Main filtration: Check that the correct filter type is used (particles in fluid must not exceed 10 µm). Danfoss High Pressure Pumps supplies filters, please contact the sales office. 2.1.7 Fluid type: The PAH/PAH F (tapwater) and PAHT/PAHT G (ultra pure water) pumps are designed for water operation; for any other fluid, please contact Danfoss High Pressure Pumps sales office for further help. 2.1.8 High fluid temperature: If fluid temperature is above 50°C, stop the pump immediately. - Check internal parts (see above).	Typical signs of wear: Polished surface all over the swash plate. Normally, only half of the swash plate = the pressure side is polished. See index 6.3. If the ring is missing, the piston is very worn.  The filters can be bypassed, even if they are correctly mounted. Some filters can create channelling where particles can pass through the filter in tunnels. String wounded filters are typically channelling filters. A string wound filter may have a filtration efficiency of only 50%, which will cause internal wear and must always be followed by a main filter. Insufficient filtration means that too many or too large hard particles can pass the main filter because it is damaged, bypassed or simply too poor. Filtration efficiency must be 99.98% (Beta = 5000) at 10 µm to prevent abnormal wear of the pump. Temperature > 50°C will cause wear on internal pump parts. Mount a temperature switch and check its set point / function. The temperature switch will ensure that the pump stops at fluid temperatures > 50°C.
2.2 Low inlet pressure	2.2.1 Check that booster pump supplies the right pressure/flow. 2.2.2 Check if filters require replacement.	If the pressure drop across the filters is too high, the booster pump does not deliver sufficient flow/pressure. No pressure or low pressure results in cavitation and insufficient internal lubrication causing wear on internal pump parts. Mount a low-pressure switch in front of the pump and check its set point/ function. The low-pressure switch ensures that the pump does not start until the inlet pressure has reached 1 bar.
2.3 Rotation speed (rpm)	2.3.1 If VFD-operated, check frequency. 2.3.2 Check that rotation speed of the electric motor is as stated on name plate on electric motor. Check that the motor rotor winding is not damaged.	Speeds below minimum limit (see Data sheet) result in insufficient internal lubrication causing wear on the internal pump parts.

3. High torque on electric motor

Cause	Remedy	Comments
3.1 Too high outlet pressure from pump	3.1.1 Check for blocked nozzles or a faulty adjusted relief valve.	Pressure changes due to flow restrictions. This will also cause high motor torque.
3.2 Pump starts against pressure	3.2.1 Check that electric motor is correctly sized. 3.2.2 Check internal parts (see item 2.1). 3.2.3 Systems with more than one electric motor installed: Start motors simultaneously.	Pumps run in parallel with cascade start, may switch off the motor relay due to too high torque caused by high outlet pressure.
3.3 Constant torque	3.3.1 Please contact Danfoss High Pressure Pumps sales office.	If the electric motor is too small for the pump, it cannot provide sufficient torque.
3.4 Water pump damage	3.4.1 Dismantle pump and check for wear.	Too heavy damage in the pump will increase friction causing a high torque (see item 6, Typical signs of wear).

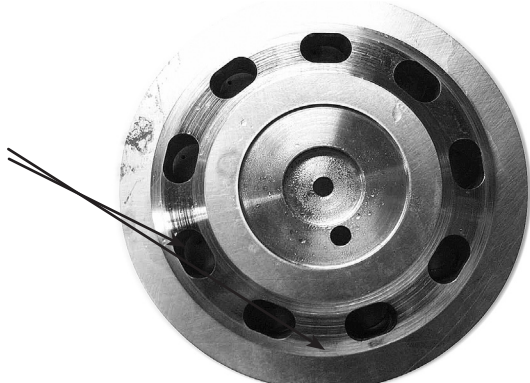
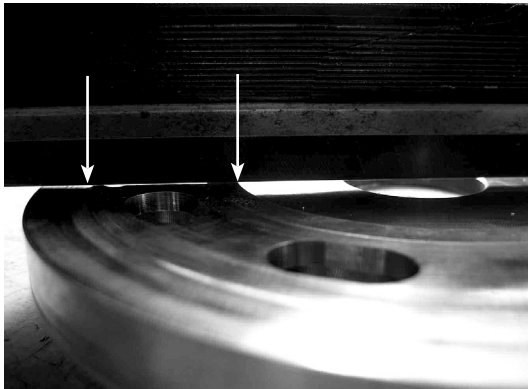
4. Noise from pump

Cause	Remedy	Comments
4.1 Air in fluid	4.1.1 Ensure that the entire inlet line is bled before starting up the system. 4.1.2 Ensure that air cannot enter into the inlet line.	Small air bubbles will accumulate and create large bubbles causing internal cavitation and thus making the pump very noisy. WARNING: The pump can only run few minutes with air in the fluid without being damaged.
4.2 Bleeding conditions of pump	4.2.1 Follow the instructions "Initial start-up" supplied with the new pump. 4.2.2 Ensure that the pump is completely bled before start-up.	The pump and the inlet line must be completely bled before start-up, otherwise the pump will cavitate and make high noise. WARNING: The pump can only run few minutes with air in the fluid without being damaged.
4.3 Min/max nominal inlet pressure	4.3.1 Ensure that inlet pressure is within the limits specified in the Data sheet. 4.3.2 Check the pump for internal damage.	Too high inlet pressure causes too high pressure inside the pump damaging the pistons and eventually the pump. Inlet pressure below min. limit causes cavitation and insufficient internal lubrication resulting in wear on internal pump parts. Mount a low-pressure switch in front of the pump and check its set point/ function. The low-pressure switch will ensure that the pump does not start until the minimum inlet pressure has been reached.
4.4 Pump reversing	4.4.1 Dismantle pump and check if anything is broken or worn (See "1. No flow", item 1.2 Pump reversing"). WARNING: The pump must not run without water for more than a few seconds. If the pump takes in water from the high-pressure outlet line, it builds up pressure and will eventually be damaged.	If pump rotates in wrong direction, it will take in water from the high-pressure outlet line. Pressure will be built up inside the pump and it will eventually be damaged.
4.5 High rotation speed (rpm)	4.5.1 If electric motor rpm is too high, dismantle pump and check for damage. 4.5.2 If the rpm is within the specified range of the pump data sheet and abnormal noise remains, dismantle pump and check for damage.	Higher rpm than specified in the pump data sheet results in wear of the pistons, i.e. pistons may be damaged. High rpm will also increase pressure pulsations from the pump, and the noise level will increase. If rpm is changed, noise frequency will also change.
4.6 Outlet pressure	4.6.1 If outlet pressure is too low, check set point of outlet pressure valve. 4.6.2 If outlet pressure is lower than mentioned in the pump data sheet, please contact Danfoss High Pressure Pumps technical support. 4.6.3 If outlet pressure has exceeded its maximum, check set point of outlet pressure valve. 4.6.4 Check internal parts for wear/damage.	At too low outlet pressure, the pump will create higher pressure pulsations and thus make noise. Too low pressure also causes insufficient internal lubrication and wear on internal parts. Pump may eventually be damaged. Too high outlet pressure may damage the pump.
4.7 Soft start/stop	4.7.1 Check if noise is normal when the pump is running at operation speed. 4.7.2 If noise is abnormal at operation speed, check internal parts (see above).	Noise frequency changes during soft start-up/ stop.

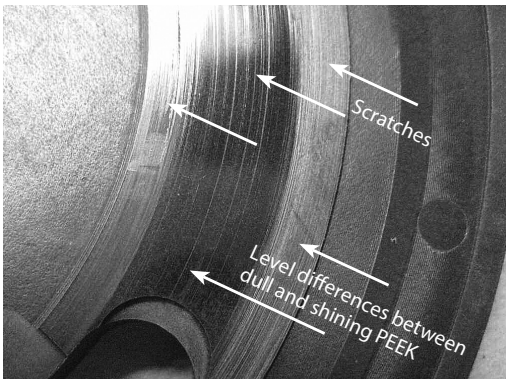
5. Noise from installation

Cause	Remedy	Comments
5.1 Inlet/outlet connections (hoses/pipes)	5.1.1 Use flexible hoses at inlet/outlet connections. 5.1.2 Mount the connections to the frame by a vibration dampener mounting plate.	Non-flexible connections mounted directly on the frame will cause even small pressure pulsations from pump and create vibrations in the system/plant.
5.2 Length/dimension of inlet/outlet line	5.2.1 Increase pipe diameter and/or reduce the number of bends.	Too small pipes or too many bends may create too fast flow/turbulence through the pipes and thus increase the noise level.
5.3 Hose stiffness	5.3.1 Use a more flexible hose.	Too stiff hoses cannot dampen the small pressure pulsations from the pump, and subsequently vibrations occur in the system/plant.
5.4 Hoses/pipes mounted directly on frame	5.4.1 Mount the connections to the frame by a vibration dampener mounting plate.	If the hoses are mounted directly on the frame, the small pressure pulsations from the pump can be transferred to the frame and the rest of the system/plant.
5.5 Vibration dampener under the electric motor	5.5.1 Mount a vibration dampener below the motor/pump.	When no dampener is installed below the electric motor, vibrations from the motor and pump may be transferred to the frame and the rest of the system/plant.

6. Typical signs of wear 6.1 Valve plate

Picture 1 	A normally worn valve plate has no marks/scratches but only a slightly polished surface. No scratches or marks should be felt. The surface must be flat and level.
Picture 2 Scratches 	A worn valve plate has scratches, and/or a polished surface. Even small scratches will give a loss of flow.
Picture 3 	A good way to identify a worn valve plate is to hold a straight knife edge over the valve plate. When holding it up to the light, it will be possible to see any space between the knife edge and the valve plate. See picture 3. If any light can be seen between the two arrows on the picture, the valve plate is worn. If any scratches or marks can be felt by running a fingernail over the surface, the valve plate is worn. The valve plate on picture 3 is highly damaged.

6.2 Port plate

Picture 1 	If the port plate has scratches, level differences or both between the arrows, the port plate must be replaced. Even small scratches or wear will cause loss of flow. To check: See item 6.1, picture 3

6.3 Swash plate

Picture 1 	If the swash plate is polished 360°, it is an indication of insufficient filtration. The surface of the swash plate must be plane and even at same level all over. To check this, please see item 6.1, picture 3. If the surface has any marks/scratches, it is worn/damaged and a new one is required. Please contact Danfoss High Pressure Pumps sales office for further information.



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ENGINEERING
TOMORROW

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Service guide

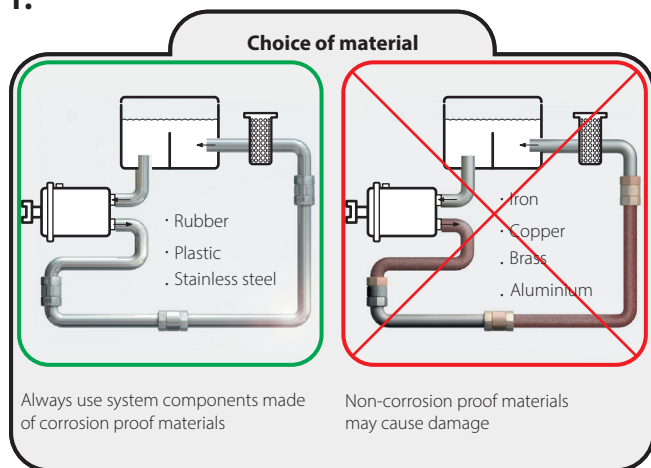
Right and wrong

Trouble shooting guide for
water hydraulic systems

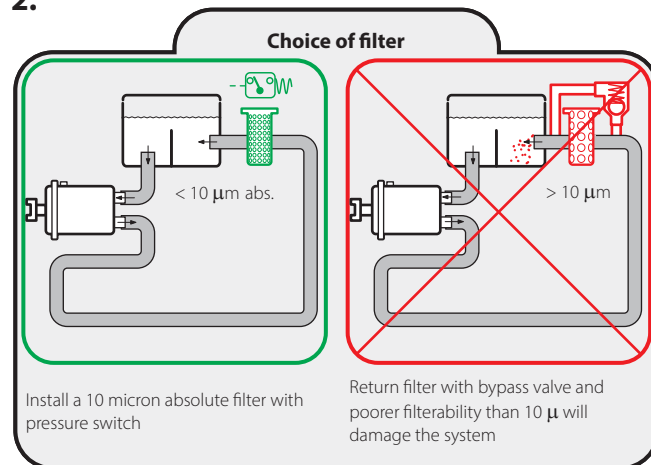


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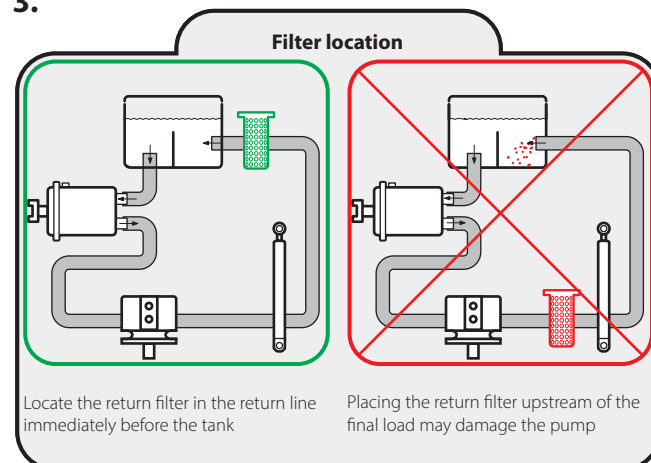
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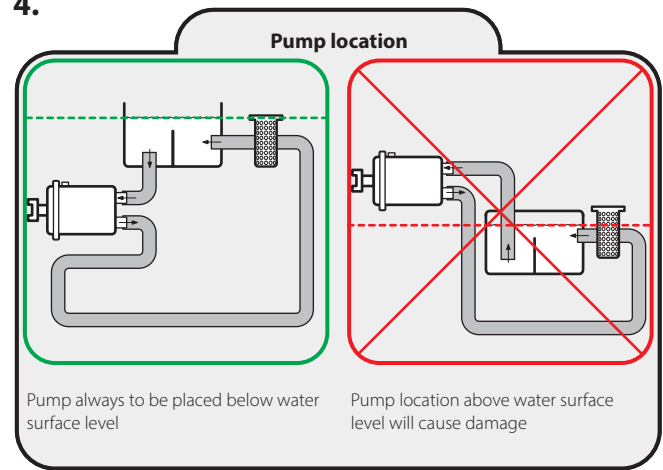
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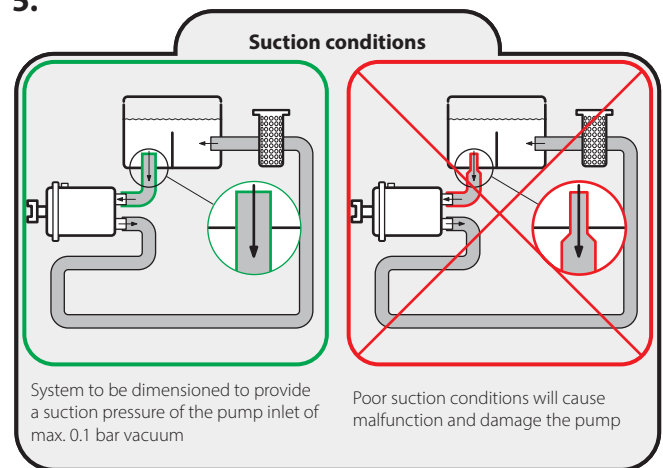
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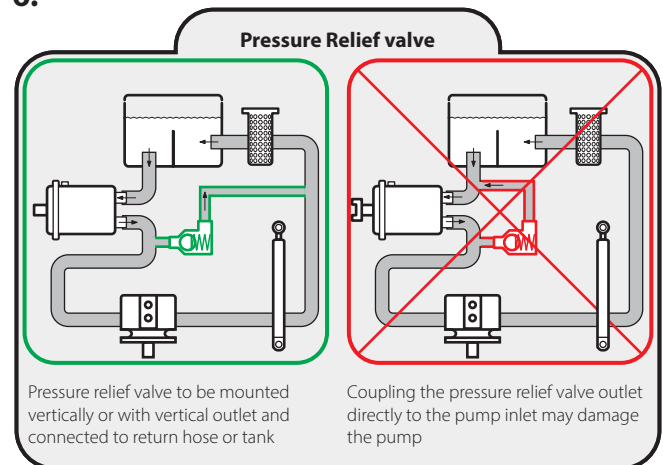
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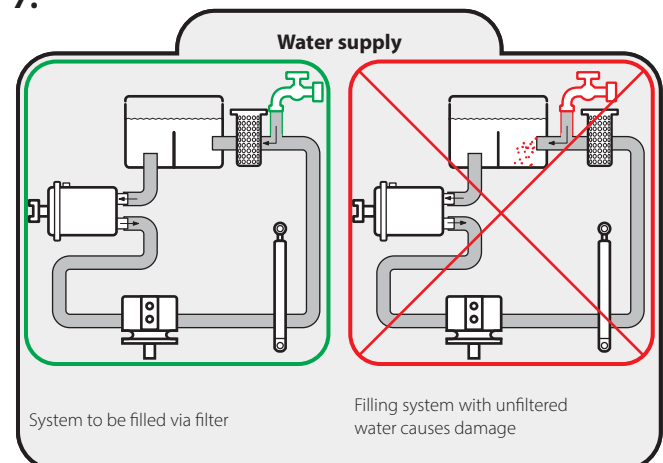
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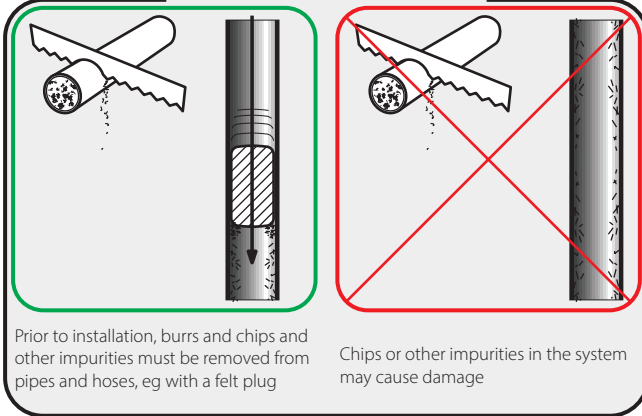
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Installation

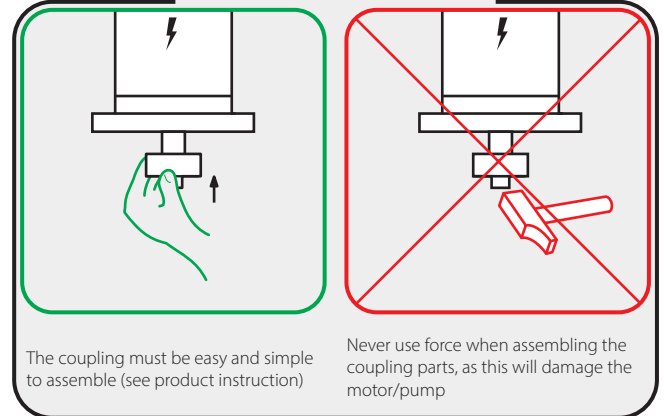
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Impurities



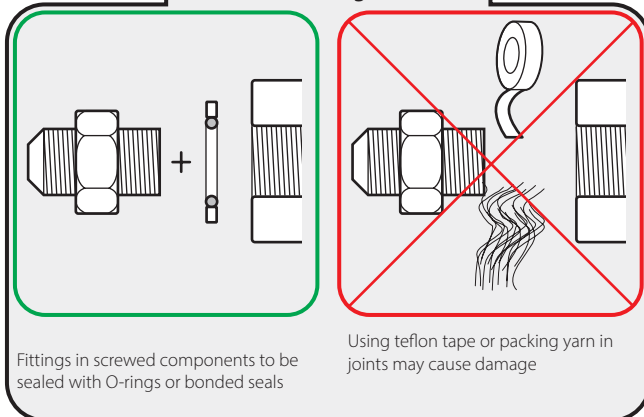
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Assembly of coupling



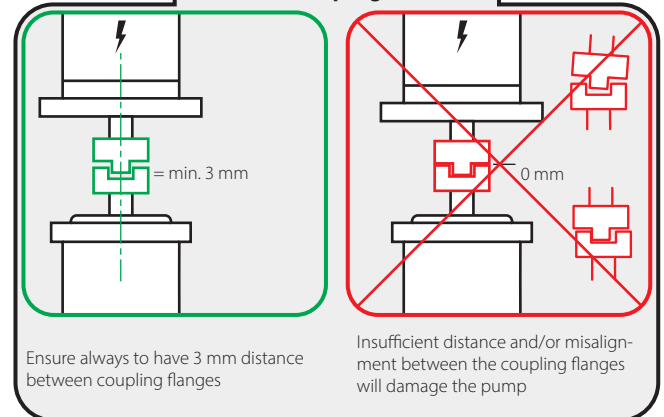
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Sealing



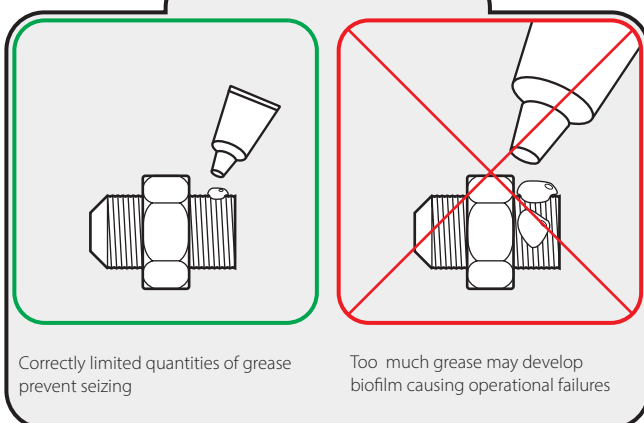
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Coupling



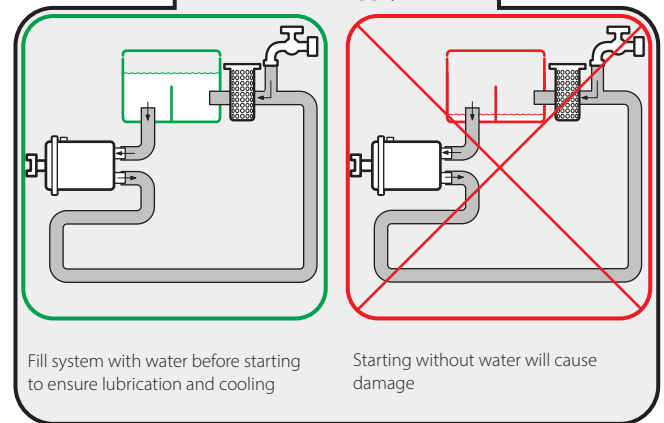
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Grease



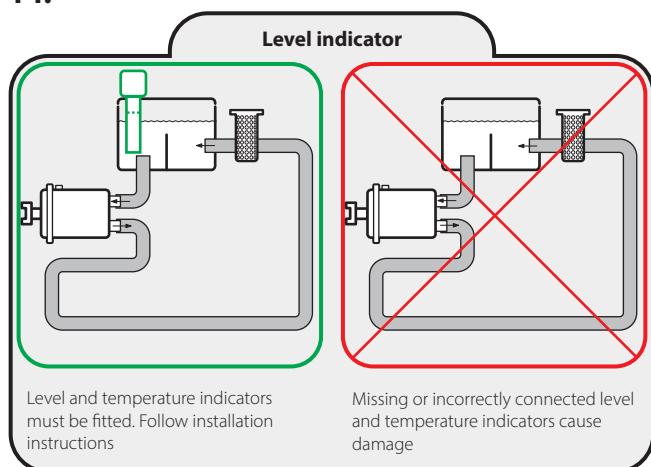
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Water supply

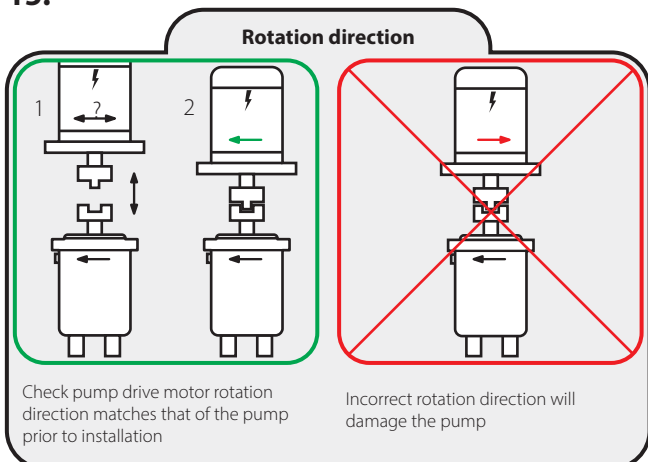


Wiring

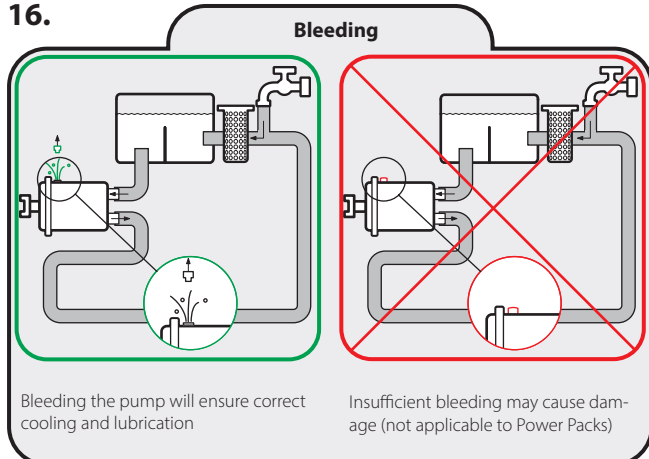
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15.



16.



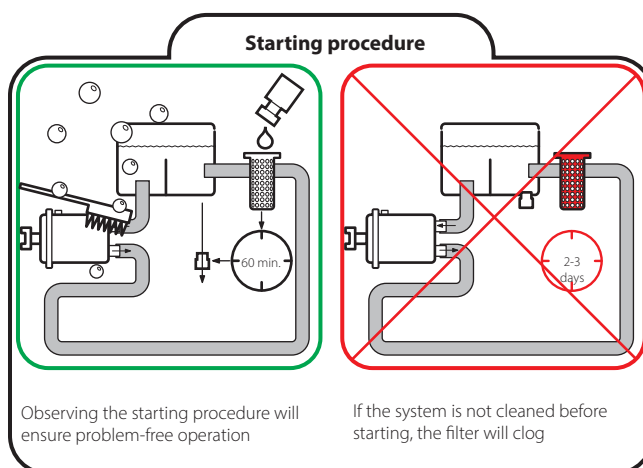
Starting procedure

Cleaning procedure

1. Fill cold water into the system via the return filter and bleed the pump (Power Packs PPH 4 - 6.3 - 10 and 12.5 are self-bleeding)
2. Start and bleed the system -without pressure by opening the bypass valve
3. Add the cleaning agent to give 3% agent/water solution
4. Run the system for 60 min. and activate all components as often as possible to ensure effective flushing with the cleaning agent
5. Empty the system of the cleaning agent solution

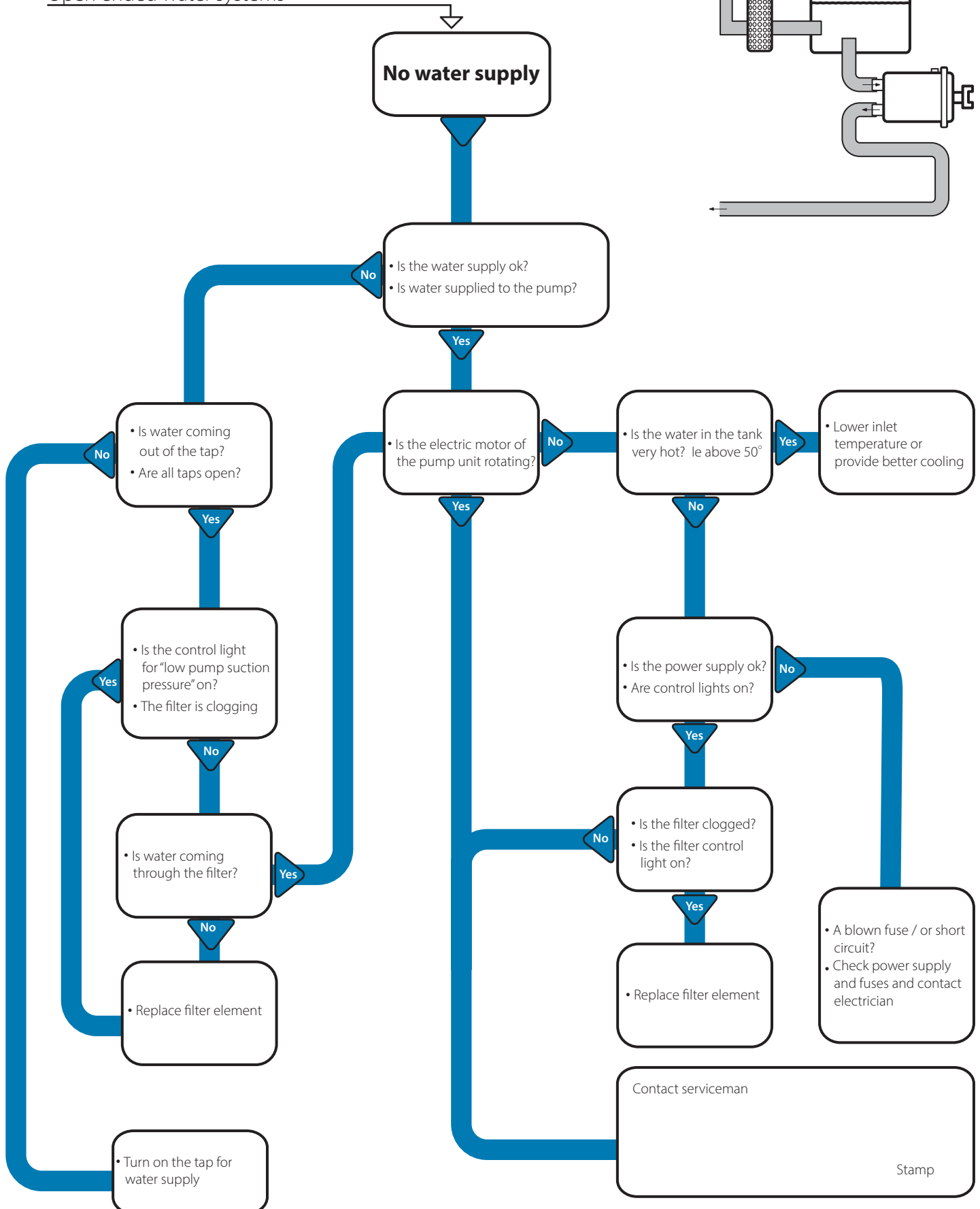
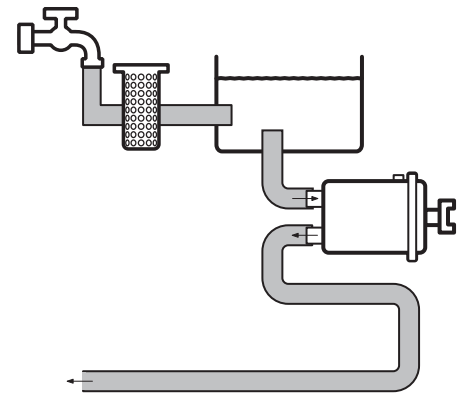
Flushing procedure

6. Fill cold water through the return filter and bleed the pump (Power Packs PPH 4 - 6.3 - 10 and 12.5 are self-bleeding)
7. Run the system for 30 min. and activate all components as often as possible
8. Empty the system of the water
9. Alternatively the system may be flushed by running the unit without the return hose while continuously filling up water. The flushing should continue until there is no trace of cleaning agent in the return water
10. Change the return filter element, fill cold water through the return filter and bleed the pump during start up
11. The system is now ready for operation



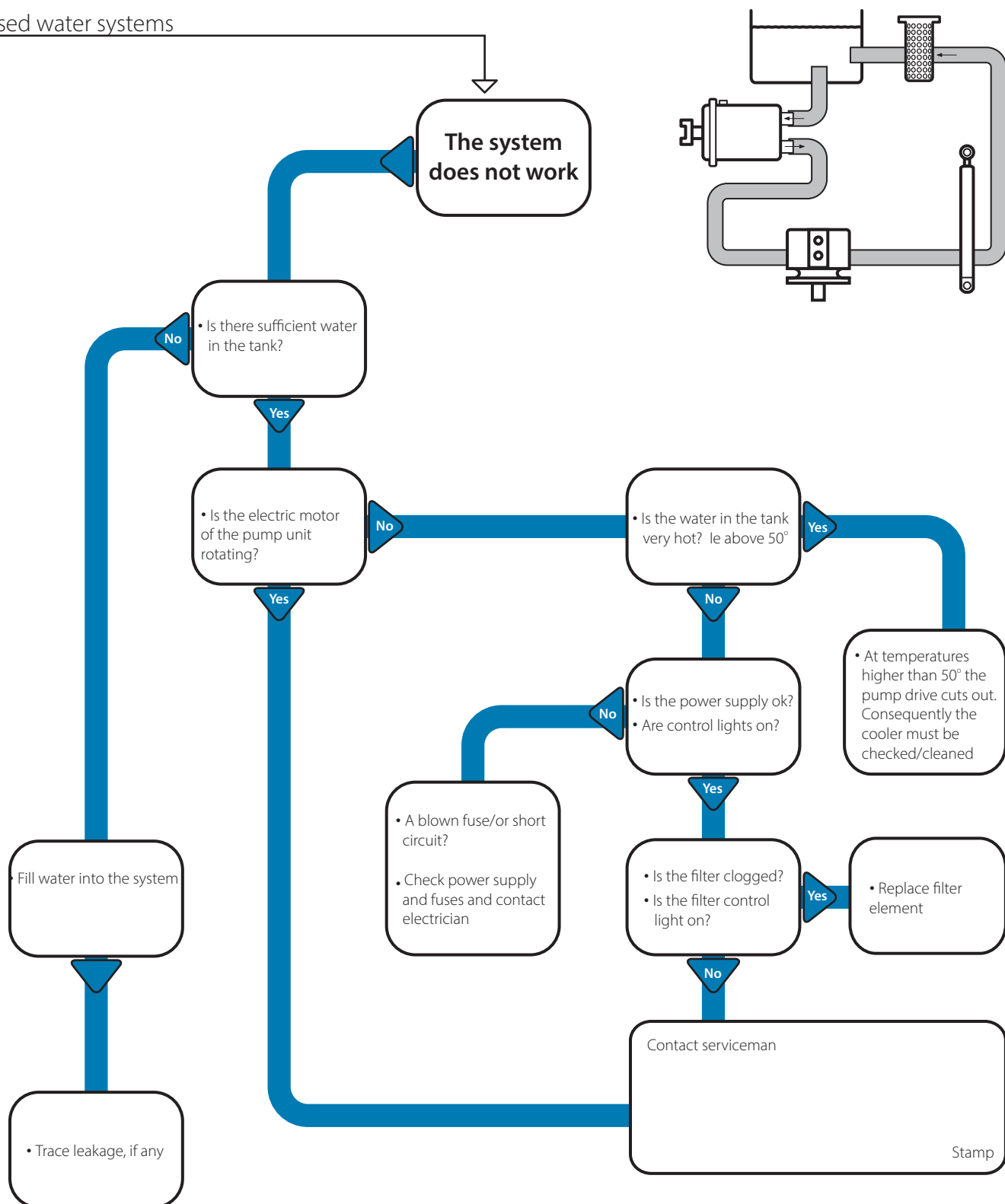
Trouble shooting

Open ended water systems



Trouble shooting

Closed water systems



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