

High-Pressure Pumps for Fire Fighting, type PAHF 20/25/32/40

with dedicated valves: relief valve (type VRHF), relief/bypass valve (type VPHF)
and check valve (type VCH)



Introduction

The PAHF pumps are especially designed for the high-pressure fire extinguishing industry. It is dedicated for the water mist market for both land and marine applications. The pumps are designed for operation on tap water and the size ranges from 20 ccm/rev to 40 ccm/rev and can provide a flow from 14 to 115 l/min (3,7 to 30,3 gpm).

Two types of valves are designed for direct mounting on the pump, depending on the

specific need: a check valve and a relief valve.

The axial piston principle provides very high efficiency, small and compact design and long service life. The Danfoss pumps are water lubricated and do not involve any other lubricant, making this unique pump maintenance free over its entire service life.

Features

- Very compact and light pump (can be installed with direct coupling to an electric motor/combustion engine)
- Generates insignificant pulsations in the pressure line
- No preventive maintenance required (no periodic service like eg change of lubricant and wear parts)
- Service life 500 hours
- All parts of the pump are made of noncorrosive material and the surface is easy to clean
- Few wearing parts
- Pumps can be directly boosted, without the need of a tank

Application examples

The PAHF pump can be used in both land and marine segments within the high-pressure water mist fire fighting market. For the marine based applications, our pump is suitable for eg:

- Machine room protection,
- Accommodations
- Local area protection
- etc.

For land based applications, our pump can be used almost anywhere eg:

- Airports
- Hotels
- Garages
- Tunnels
- Offices
- Warehouses
- Production sites
- Schools
- etc.

Technical data

| Pump size | 20 | 25 | 32 | 40 |
|---|-----------|-----------|-----------|-----------|
| Geometric displacement cm ³ /rev | 20 | 25 | 32 | 40 |
| Max. pressure cont., bar/psi | 160 | 160 | 160 | 160 |
| Boosted Max speed rpm | 3600 | 3600 | 3600 | 3000 |
| Tank supply Max. speed, rpm | 1800 | 1800 | 1800 | 1800 |
| Min. speed rpm | 700 | 700 | 700 | 700 |
| Weight, stainless kg/lbs | 15,6/34,4 | 15,6/34,4 | 15,6/34,4 | 15,6/34,4 |
| Typical 4-pole motor size at max. pressure in 1500 rpm (kW) | 11 | 15 | 15 | 18,5 |
| 1800 rpm (HP) | 15 | 20 | 25 | 30 |
| Typical 2-pole motor size at max. pressure in 3000 rpm (kW) | 18,5 | 30 | 30 | 37 |
| 3600 rpm (HP) | 30 | 40 | 50 | -- |

Motor dimensions

Required motor power:
From the following table you can determine the rpm of the pump at the desired flow.
Calculate as follows:

$$P \text{ [in kW]} = \frac{\text{Speed [in rpm]} \times \text{displacement per rev [in ccm]} \times \text{pressure [in bar]}}{600.000 \times \eta_{\text{mech}} \text{ (mechanical efficiency)}}$$

The required torque is calculated as follows:

$$M \text{ [in Nm]} = \frac{\text{Displacement [in ccm]} \times \text{pressure [in bar]}}{62.8 \times \eta_{\text{mech}} \text{ (mechanical efficiency)}}$$

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

The mechanical efficiency of the pump is estimated as follows:

| | |
|--------------------|-----|
| PAH 20, 25, 32, 40 | 0.9 |
|--------------------|-----|

Flow calculation

- Theoretical flow: $Q_{(th)}$ [l/min] = pump displacement in $cm^3 \times rpm / 1000$
- Flow at max. pressure: The flow at max. pressure $Q_{(p_{max})}$ is shown in the table.
- Flow at any pressure: At zero pressure the true flow equals the theoretical flow $Q_{(th)}$.
- The flow (Q_{eff}) at less than max. pressure (p_{max}) can be calculated with the following equation: $Q_{eff} = Q_{(th)} - [(Q_{(th)} - Q_{(p_{max})}) \times (p / p_{max})]$

Typical flow at different pressures in litres per minute

| 100 bar | PAHF 20 | PAHF 25 | PAHF 32 | PAHF 40 |
|-----------------------|---------|---------|---------|---------|
| Typical flow 1500 rpm | 28,6 | 36,1 | 45,9 | 56,8 |
| Typical flow 3000 rpm | 57,9 | 73,1 | 93,4 | 115,3 |
| Typical flow 3600 rpm | 70,0 | 88,1 | 112,0 | |

| 140 bar | PAHF 20 | PAHF 25 | PAHF 32 | PAHF 40 |
|-----------------------|---------|---------|---------|---------|
| Typical flow 1500 rpm | 28,0 | 35,4 | 45,6 | 56,7 |
| Typical flow 3000 rpm | 57,5 | 72,4 | 93,3 | 115,3 |
| Typical flow 3600 rpm | 69,0 | 87,1 | 112,0 | |

| 160 bar | PAHF 20 | PAHF 25 | PAHF 32 | PAHF 40 |
|-----------------------|---------|---------|---------|---------|
| Typical flow 1500 rpm | 27,5 | 35,2 | 45,4 | 56,3 |
| Typical flow 3000 rpm | 56,9 | 71,9 | 92,9 | 114,8 |
| Typical flow 3600 rpm | 68,4 | 87,2 | 111,5 | |

Inlet pressure

PAHF is designed to operate under boosted pressure supply conditions. The boost pressure is recommended to be between 1-6 bar (14,5-87 psi) (2-7 bar (43,5 - 101,5 psi) abs). Please make use of the integrated 1/4" gauge ports (inlet) with appropriate pressure switches for monitoring the supply pressure accordingly.

Short term inlet pressure peaks must not exceed 30 bar (435 psi).
 Max 10 bar (145 psi) during static standstill.
 It is recommended that the normal boost pressure is 1-6 bar (14,5-87 psi).

If the peak inlet pressure is unknown, a 15 bar (217,5 psi) safety relief valve should be installed on the inlet side of the pump.

Outlet pressure
 Max. pressure on the pump's outlet line should be limited at 160 bar (2320 psi) continuously. Short-term pressure peaks (e.g. in connection with closing of a valve) of up to 200 bar (2900 psi) are acceptable.

It is recommended to have a check valve on the outlet side of the pump to protect the pump from high pressure going backwards into the pump when turned off; especially, when using flexible hose or more pumps are installed in the same system.

Temperature

Fluid temperature:

- Min. +3° C, max. 50° C at max. cont. pressure
- Min. +3° C, max. 60° C at max. 100 bar

Ambient temperature:

- Min. 0° C to max. 50° C

Storage temperature:

- Min. -40° C to max. 70° C

For operation at lower temperatures than +3°C, please see the paragraph on antifreeze protection and contact Danfoss High-Pressure Pumps sales organization for High-Pressure Pumps. For operation at higher temperatures, please contact the High-Pressure Pumps sales organization.

Shaft load

The pump is neither to be exposed to axial nor radial loads. We therefore recommend using a flexible coupling for connection to the electric motor or the combustion engine.

Noise level

Since the pump typically is mounted on a bell housing or frame, the noise level can only be determined for the complete unit (system). It is therefore very important that the pump is mounted correctly on a frame with dampers to minimize vibrations and noise. Furthermore, the pump discharge should be connected with the application ie with a flexible high-pressure hose.

The noise level is influenced by:

- The speed of the pump, high rpm creates more noise than low rpm.
- The discharge pressure, high pressure generates more noise than low pressure.
- Rigid mounting of the pump generates more noise than flexible mounting.
- Pipe mounting direct to the pump increases the noise level compared to a flexible hose.

Filtration

The applied water must be filtered through a 10 μ absolute, β10 value > 5000 filter. In open-ended systems (continuous supply of "fresh" water) the filter must be placed before the pump or the tank to ensure continuous filtration. For further filter details, please contact the High-Pressure Pumps Sales Organization.

Water Quality

Water of drinking water quality, confirming to the EEC directive 98/83/EC. Please contact Danfoss High-Pressure Pumps sales organization in case of doubt.

Corrosion and antifreeze protection

If the pump is exposed to temperatures below freezing, it must be protected against freezing. See also paragraph on *Operation Conditions*.

Danfoss recommends DOWCAL N or CHILLSAFE antifreezes both being a biologically degradable Mono Propylene Glycol.

(DOWCAL N is produced by POLO).
(CHILLSAFE is produced by ATCO).

Producers of DOWCAL N and CHILLSAFE recommend a mixture ratio of min. 30% DOWCAL N/ CHILLSAFE to prevent biofilm occurrence in the system due to DOWCAL N and CHILLSAFE being biologically de-gradable.

Corrosion protection

If the system is decommissioned for more than 4 weeks or in transportation, the pump must be preserved against corrosion. Never just drain the pump!

See instructions delivered with the pump.

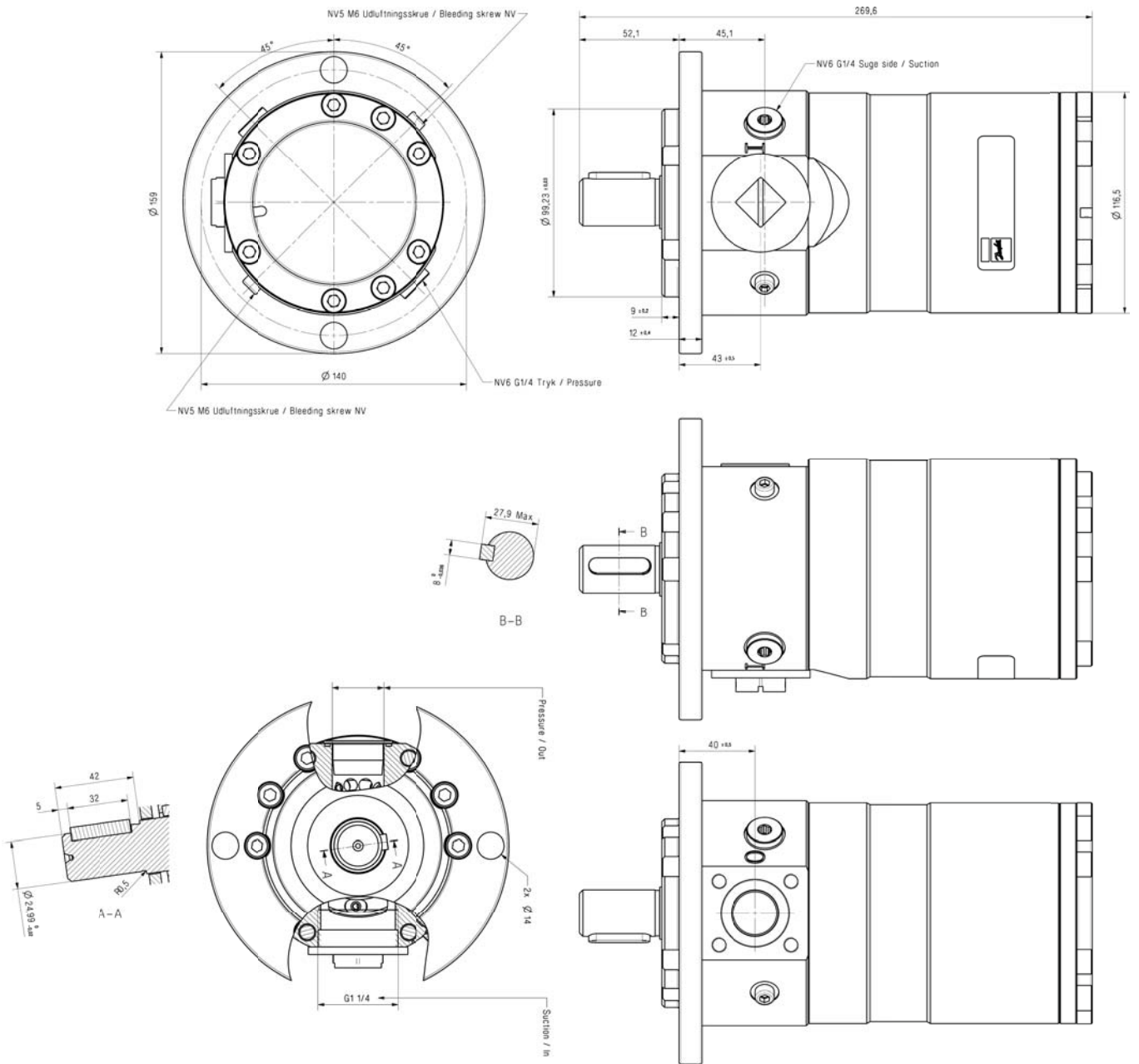
Service

The PAHF pumps are maintenance free over their entire service life. To achieve the maximum service life, proper water supply and filtration are mandatory.

Code number

| Pump size | Code number |
|-----------|-------------|
| PAHF 20 | 180B0092 |
| PAHF 25 | 180B0093 |
| PAHF 32 | 180B0094 |
| PAHF 40 | 180B0095 |

Dimensions



System design

Systems can be either:

- Open-ended systems with water supply from a tank.
- Open-ended systems with direct water-supply (boosted pressure).

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

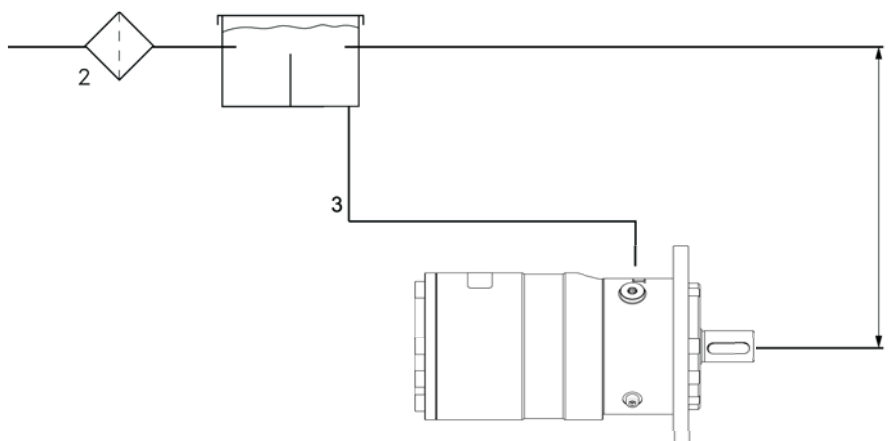
The minimum boost pressure is 1 bar (14,5 psi), and the maximum peak pressure is 30 bar (435 psi). The recommended normal boost pressure is 1-6 bar atm (14,5-87 psi). Max 10 bar (145 psi) during static standstill.

The inlet pressure of the pump must never exceed the outlet pressure. This may typically occur in boosted or open-ended systems with supply direct from the tap and where a bypass valve is activated.

Open-ended systems, water supply from tank

(The numbers 1- 3 refer to the drawing below)
In order to eliminate the risk of cavitation, observe the following guidelines:

- 1) Place the tank above the pump (water level in the tank should always be above the pump).
- 2) Place the inlet filter before the tank.



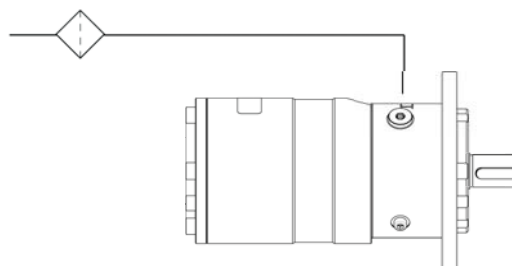
Water tank

Must be made of corrosion-proof material such as stainless steel or plastic and must be sealed to prevent entrance of impurities from the environment.

Automatic pressure equalization between tank and surroundings must be ensured. Inlet from the water supply (the return line) and inlet to the pump should be placed in opposite ends of the tank to calm and deaerate the water, and to ensure optimum opportunity for particles to settle.

Open-ended systems with direct water supply

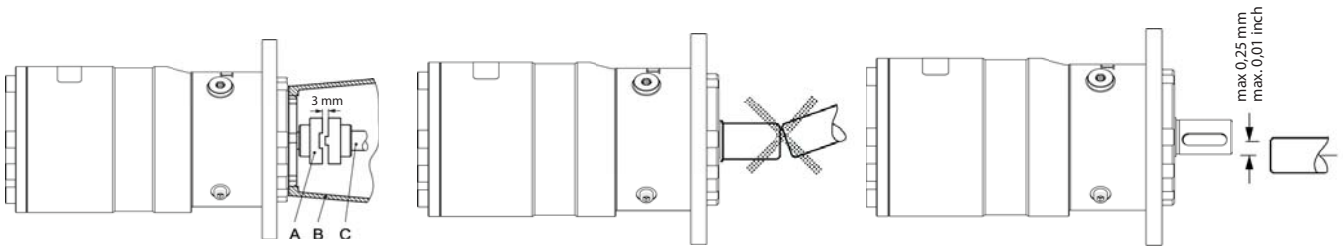
The pump is supplied with water direct from the water supply or from a booster pump. Recommended normal boost pressure is 1-6 bar (14,5-87 psi)



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

Building up the pump unit

Mounting



- A: Elastic coupling
- B: Bell housing
- C: Motor shaft

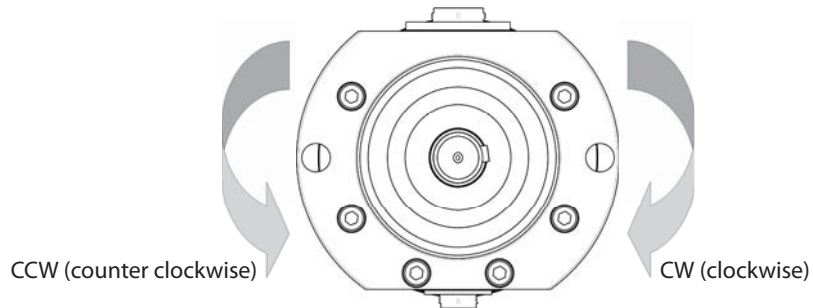
If alternative mounting is desired, please contact the Danfoss High-Pressure Pumps sales organization.

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 shaft will prevent the pump from generating pressure (and over time damage the pump).

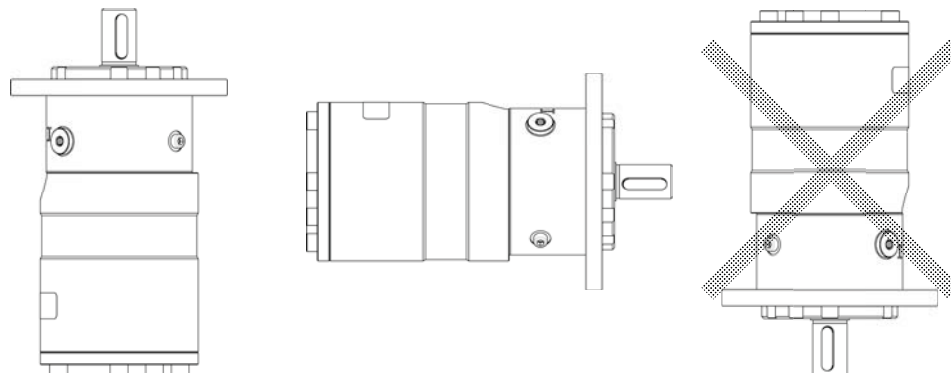
Direction of rotation

Is indicated by means of an arrow at the inlet side of the pump.



Orientation

The pump can be mounted/orientated in any horizontal position and it can be mounted/orientated in the vertical position with the shaft upwards. The pump cannot be vertically mounted/orientated with the shaft facing downwards.



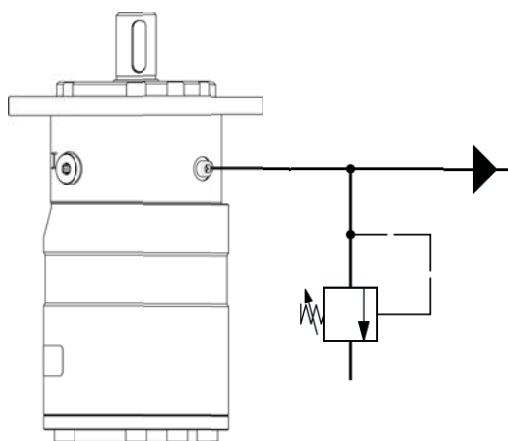
Protection from too high system pressures

Protection from too high system pressures

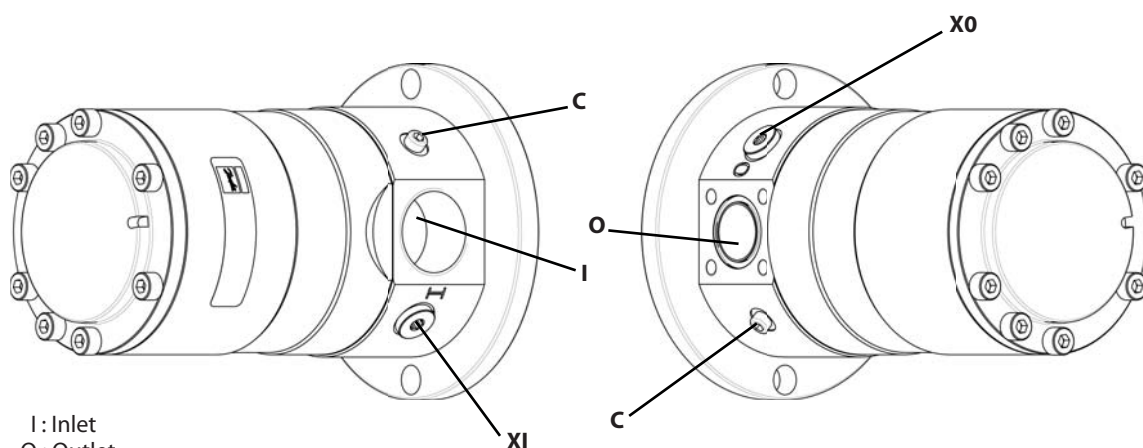
The pump should be protected against too high pressure by means of a pressure relief valve or a bypass/unloading valve placed on the pressure side

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 200 bar (2900 psi).



Connections



- I : Inlet
- O : Outlet
- C : Bleeding
- XI: Gauge port inlet *
- XO: Gauge port outlet**
- Parallel key: 8 × 7 × 32 DIN 6885

*There is one 1/4" ports on the inlet side for optional mounting of ie switches for low pressure and temperature.

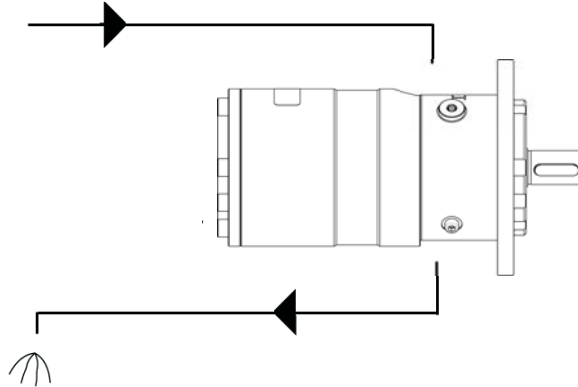
**There is one 1/4" port on the outlet for optional mounting of ie pressure transducer.

| | PAHF 20/25/32/40 | | | |
|--------------------|--|-----------------------------------|------------------------------|---------------------------------|
| | Outlet (O) | Inlet (I) | Bleeding (C) | Gauge |
| Thread, ISO | Use PAHF adaptor or VRHF100 Relief valve (thread size 3/4" BSPP) | 1 1/4" BSPP with 20mm long thread | M6 (width across flat = 5mm) | 1/4" BSPP with 15mm long thread |
| Max tighten torque | Screws for adaptor block valves: 4 pcs M8 30Nm | 150 Nm* (133 lb (f) ft) | 4Nm* (3 lb (f) ft) | 15 Nm* (11 lb (f) ft) |

- Recommended torque values refer to steel washers containing a rubber sealing element.

Initial start-up

Before start-up, loosen the upper bleeding plug.
When water appears from the bleeding plug, retighten the plug.



The piping/hose between inlet filter and pump must be flushed prior to initial start up of the pump to ensure that impurities are removed.

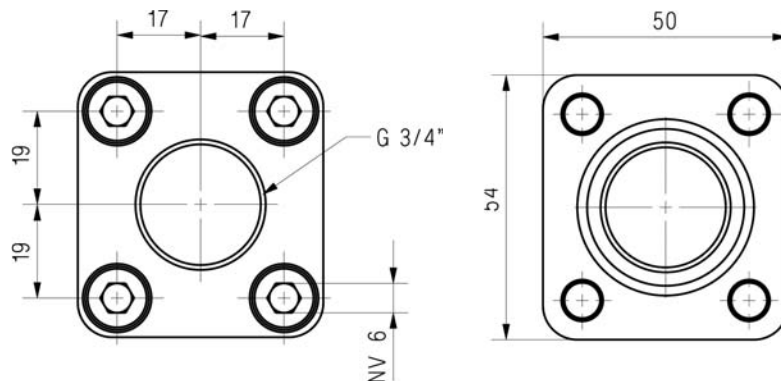
Warning:

Make sure that the direction of rotation of the electric motor corresponds to the direction of rotation of the pump.

Adaptor



This adaptor can be directly mounted on the PAHF 20-40 pumps, by the use of 4 M8 screws. It adds a thread to the pump and it has a size of 3/4".



Code number

| Type | Code number |
|---------|-------------|
| Adaptor | 180B0096 |

Type VRHF 100

Relief valve for mounting directly on the PAHF pumps



Design and function

This relief valve can be directly mounted on the PAHF 20-40 pumps, by the use of 4 M8 screws. It adds a thread to the pump and it has a size of 3/4". The relief valve is used for protecting the components of a system against overload as a result of a pressure peak. Further, the valve is designed for controlling/limiting the system pressure by draining off the surplus water from the pressure side. The valve is designed for tap water, ie without additives of any kind to the medium. (EU-drinking water directive 98/83/EC).

Features

- Excellent functional characteristics.
- Easy-to-clean surface.
- Corrosion-proof parts (stainless steel, AISI 304, W. No. 1.4301).

Fluid

The water must be clean (according to the EU drinking water directives 98/83/EC) and must be free from sediments.

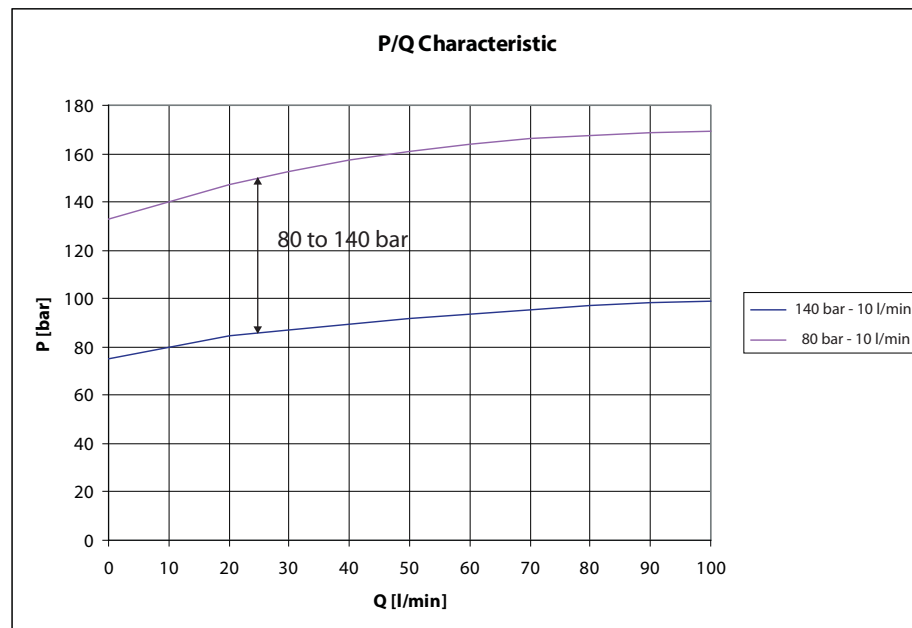
Code number

| Type | Code number |
|----------|-------------|
| VRHF 100 | 180G0011 |

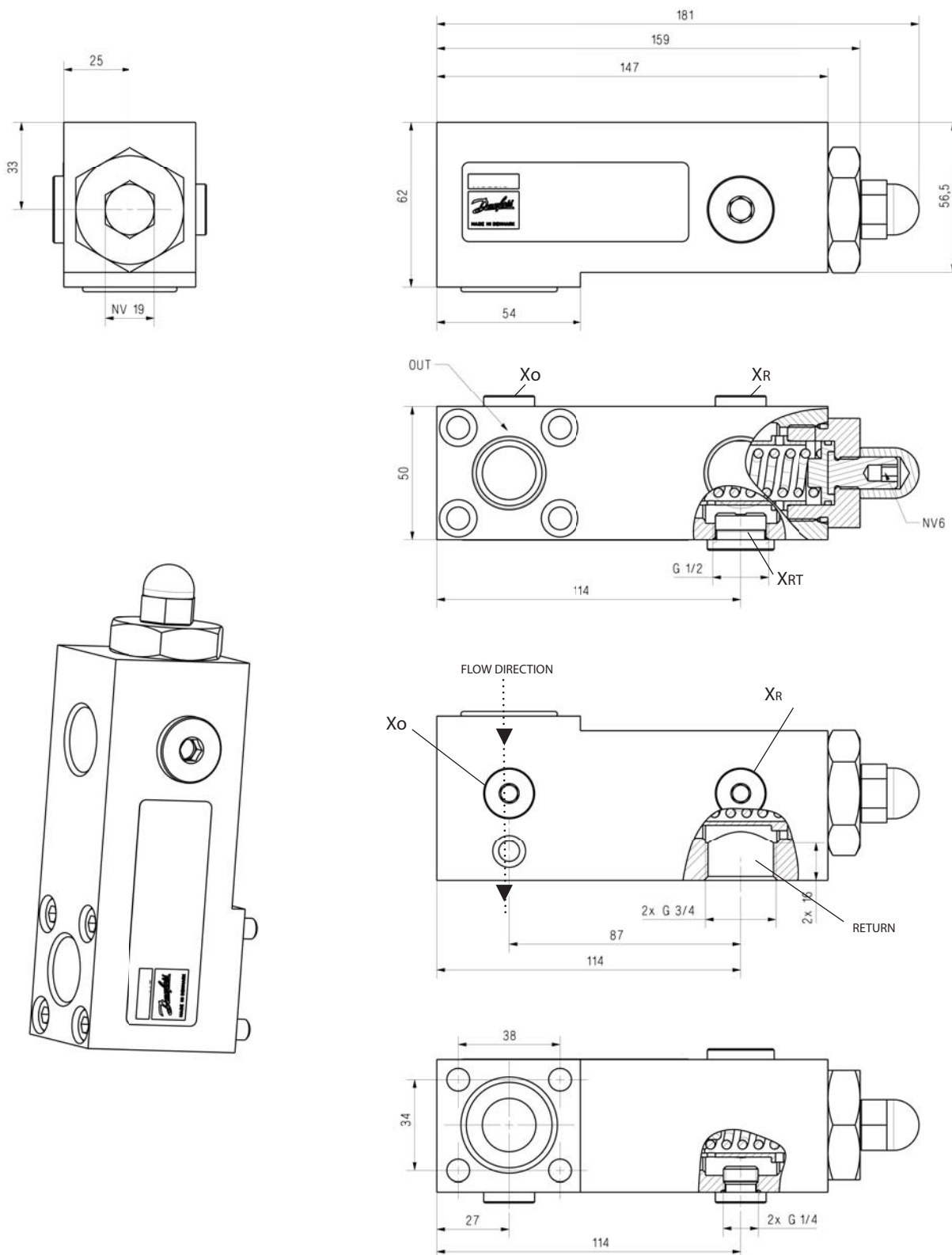
Technical data

| | Unit | VRHF100 |
|--|-------|--------------------|
| Pressure setting | bar | 80-140 |
| Setting screw, from min. to max. | mm | 6,2 |
| Flow (max.) | l/min | 100 |
| Temperature fluid (max. °C) | °C | 50 |
| Temperature ambient (max. °C) | °C | 50 |
| Internal leakage 20% below max. setting pressure | l/min | up to 1.0 |
| Filtration | | 10µ abs. β10 >5000 |
| Weight | kg | 2,8 |

Pressure setting range: 80 - 140 bar



Dimensions



| | Outlet (O) | Return | XO / XR | X RT |
|--------------------|------------|-----------|-----------|-----------|
| Thread, ISO | 3/4" BSPP | 3/4" BSPP | 1/4" BSPP | 1/2" BSPP |
| Max tighten torque | 150 Nm | 150 Nm | 15 Nm | 15 Nm |

Type VPHF 100

Relief/Bypass valve for mounting directly on the PAHF pumps



Design and function

This relief valve and bypass valve can be directly mounted on the PAHF 20-40 pumps, by the use of 4 M8 screws.
 It adds a thread to the pump and it has a size of 3/4".
 The relief valve is used for protecting the components of a system against overload as a result of a pressure peak. Further, the valve is designed for controlling/limiting the system pressure by draining off the surplus water from the pressure side.
 The bypass valve is used to start the pump unloaded. It is electrically activated by a coil.
 It is designed for tap water, ie without additives of any kind to the medium.
 (EU-drinking water directive 98/83/EC).

Features

- Excellent functional characteristics.
- Easy-to-clean surface.
- Corrosion-proof parts (stainless steel, AISI 304, W. No. 1.4301).

Fluid

The water must be clean (according to the EU drinking water directives 98/83/EC) and must be free from sediments.

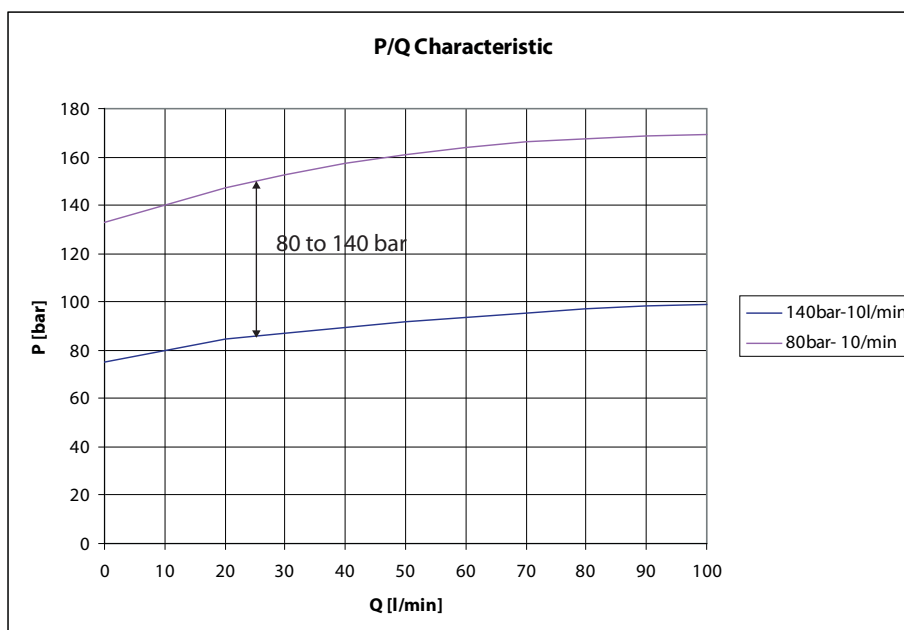
Code number

| Type | Code number |
|----------|-------------|
| VPHF 100 | 180G0010 |

**Technical data
- relief valve**

| | Unit | VPHF100 |
|--|--------------------|-----------|
| Pressure setting | bar | 80-140 |
| Setting screw, from min. to max. | mm | 6,2 |
| Flow (max.) | l/min | 100 |
| Temperature fluid (max. °C) | °C | 50 |
| Temperature ambient (max. °C) | °C | 50 |
| Internal leakage 20% below max. setting pressure | l/min | up to 1.0 |
| Filtration | 10µ abs. β10 >5000 | |
| Weight | kg | 7 |

Pressure setting range: 80 - 140 bar



Bypass valve

This Normally Closed (NC) 2/2 way bypass valve is based on our well tested and market proved standard VDHT valve programme. The directional valve is pilot operated On/Off – seat valve electrically activated by a coil – see the coil possibilities below. Coils must be ordered separately.

Some of the main benefits of the design:

- Corrosion-proof
- Easy-to-clean surfaces
- Reliability
- Dirt tolerant
- The seat valve design prevents leakage

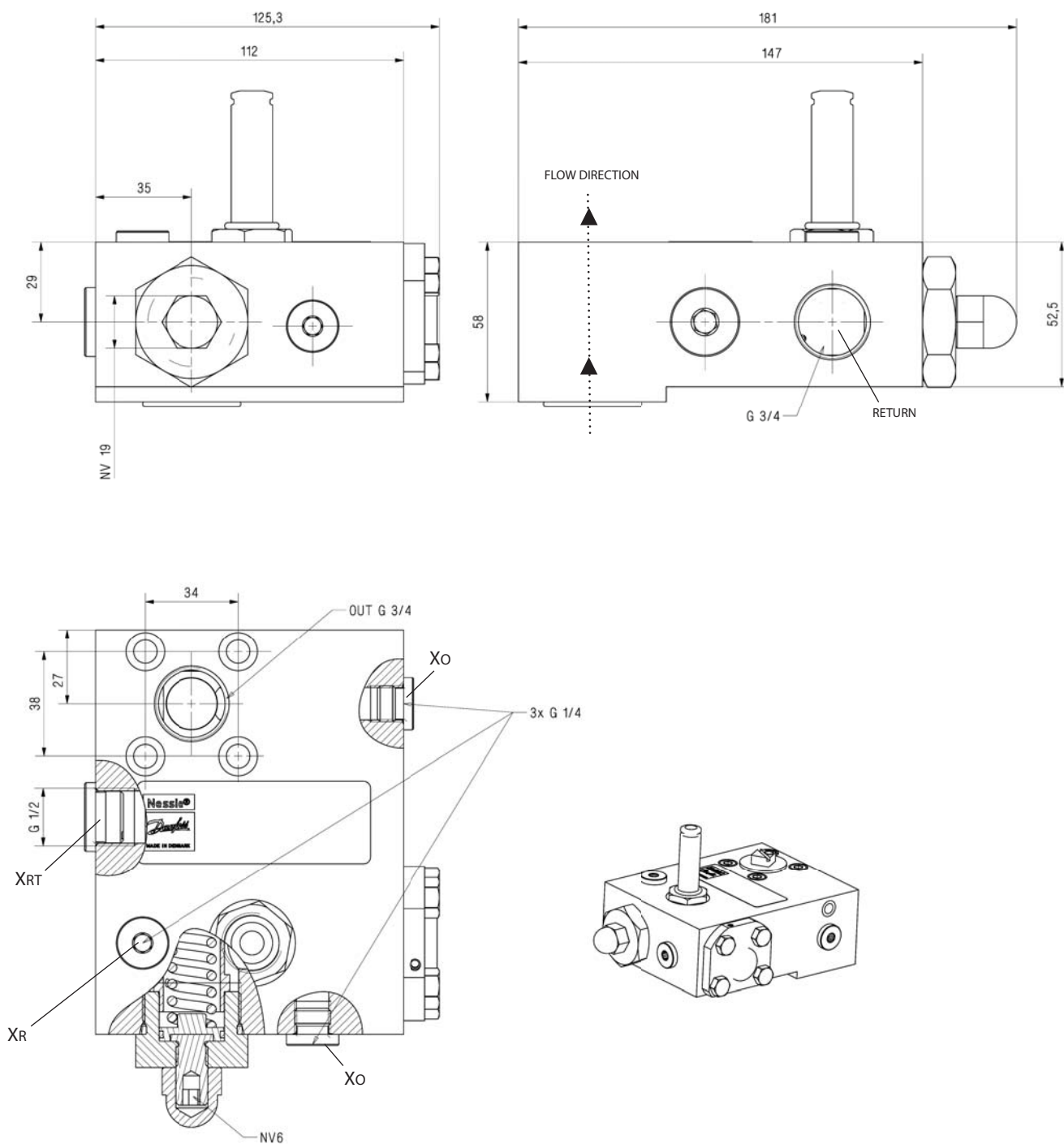
The maximum pressure loss of the bypass valve is 10 bar at max flow. For unloaded start, activate the coil before starting the pump. Closing time app. 1000 ms.

Coils

| Coils | Voltage | Code number |
|-----------------------------|----------------|--------------------|
| 10 W a.c. with terminal box | 24V 50Hz | 018F7920 |
| 10 W a.c. with terminal box | 220V 50Hz | 018F7921 |
| 10 W a.c. with terminal box | 240V 50Hz | 018F7924 |
| 10 W a.c. with terminal box | 24V 60Hz | 018F7922 |
| 10 W a.c. with terminal box | 110V 50/60Hz | 018F7923 |
| 18 W d.c. with terminal box | 12V DC | 018F7913 |
| 18 W d.c. with terminal box | 24V DC | 018F7914 |
| 18 W d.c. with terminal box | 24V 50Hz | 018F7928 |

For other voltages, please contact Danfoss High-Pressure Pumps

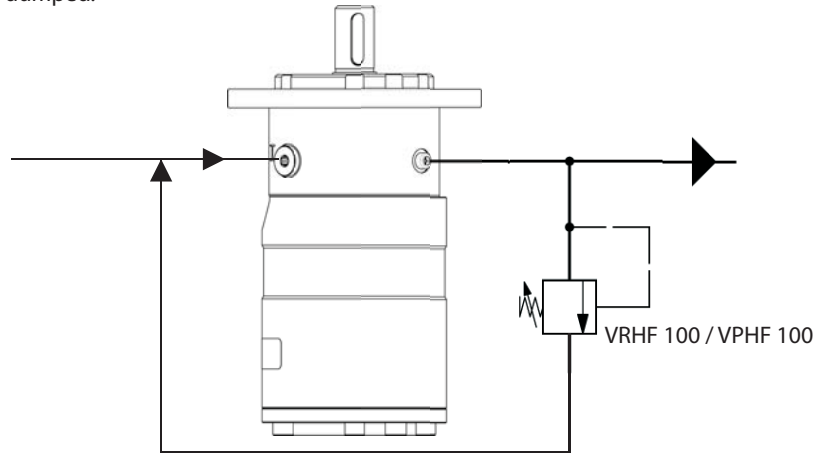
Dimensions



| | Outlet (O) | Return | XO / XR | X RT |
|--------------------|------------|-----------|-----------|-----------|
| Thread, ISO | 3/4" BSPP | 3/4" BSPP | 1/4" BSPP | 1/2" BSPP |
| Max tighten torque | 150 Nm | 150 Nm | 15 Nm | 15 Nm |

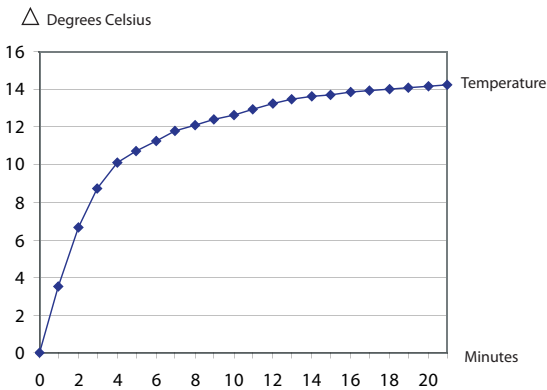
Temperature control and minimum flow consumption (during system test)

To keep the pump from overheating under continued operation when water is recirculated, it is important to ensure a use of minimum 24 liter/min. (eg by dumping/discharging the water, if there is no use). The following graphs show the temperature development over time. The limit is highly affected by the temperature of the supply water. The colder, the less water needs to be dumped.

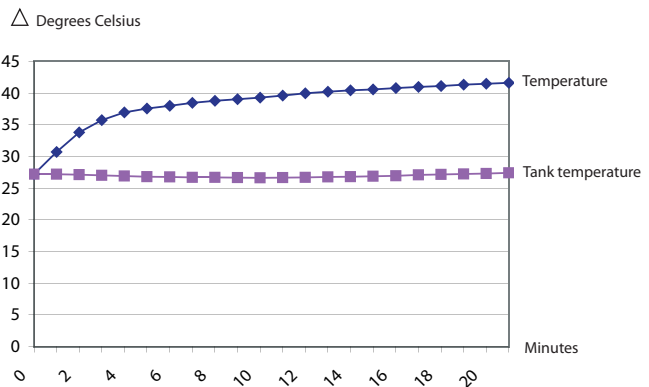


The following schemes show the temperature development at different system settings. The temperature is measured at the pump inlet port. We recommend to keep a minimum distance of 0.5 metres between the relief valve and the inlet port of the pump.

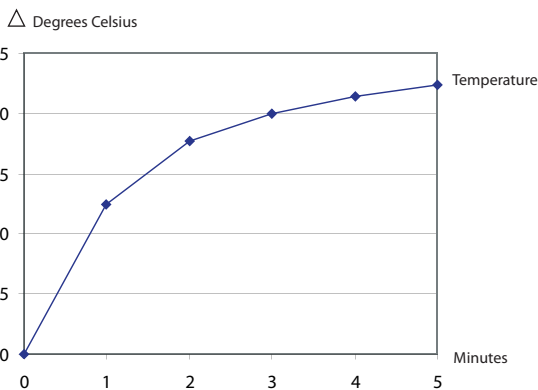
PAHF 40
3000 rpm, 105 bar
consumption: 24 l/min.



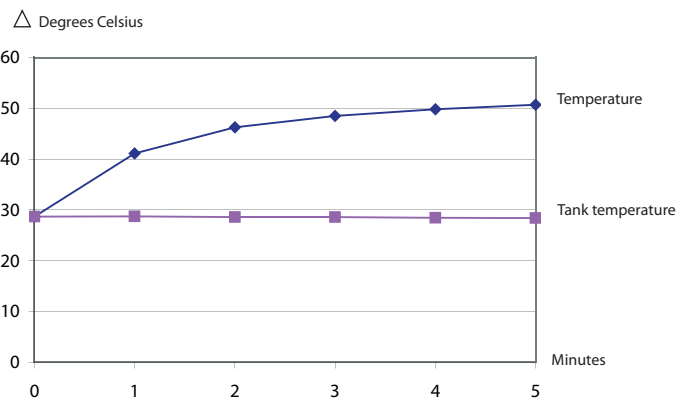
PAHF 40
3000 rpm, 105 bar
consumption: 24 l/min.



PAHF 40
3000 rpm, 105 bar
consumption: 12 l/min.

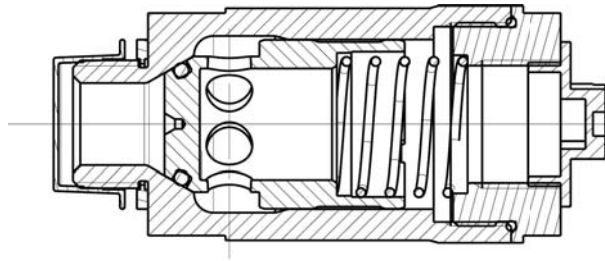


PAHF 40
3000 rpm, 105 bar
consumption: 12 l/min.



Check valve type VCH

This valve is able to handle flows up to 150 l/m. It has port sizes of 3/4" both in and out and it has a very low pressure loss of max. 2 bar.



A - A

Code numbers

| Type | Code number |
|------|-------------|
| VCH | 180H0117 |

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DK-6430 Nordborg
Denmark