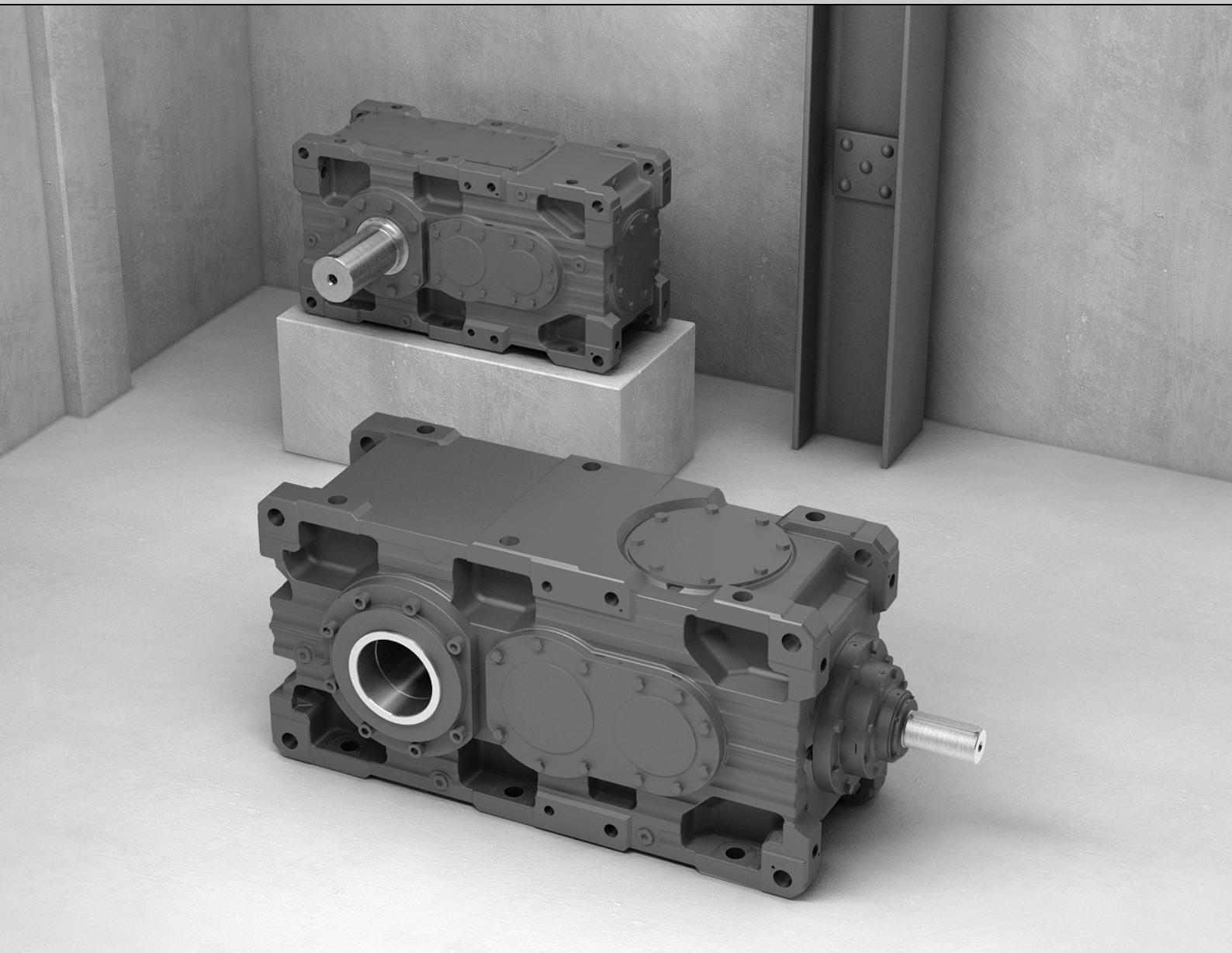




Addendum to the Assembly and Operating Instructions



Industrial Gear Units
Helical and Bevel-Helical Gear Units
X.. Series
Oil-Air Cooler for Pressure Lubrication /OAP



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1 Important information



INFORMATION

This addendum describes amendments to the "Industrial Gear Units, Helical and Bevel Gear Units" operating instructions. Please use the data specified in this document.

This document does not replace the detailed operating instructions.



2 Oil-air cooler for pressure lubrication /OAP

2.1 Structure/function

2.1.1 Structure

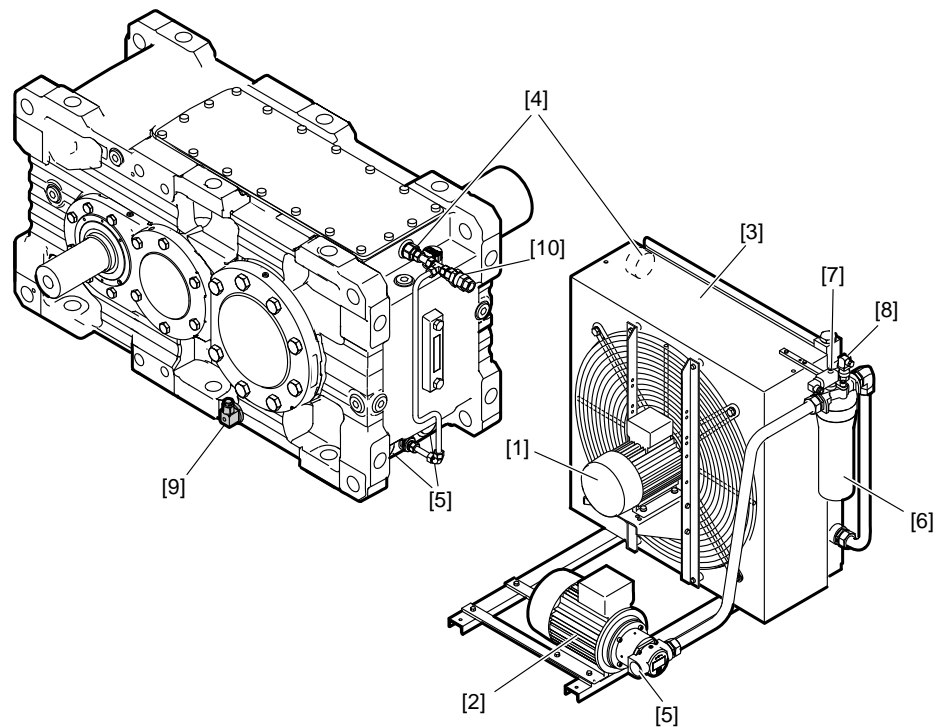
An oil-air cooling system can be used if the thermal rating of the naturally cooled gear unit or cooling using a fan on the input shaft is not sufficient.



INFORMATION

- The following designs apply to gear units with pressure lubrication.
- Also refer to the operating instructions of the cooling system manufacturer.

The following figure shows an example of the structure:

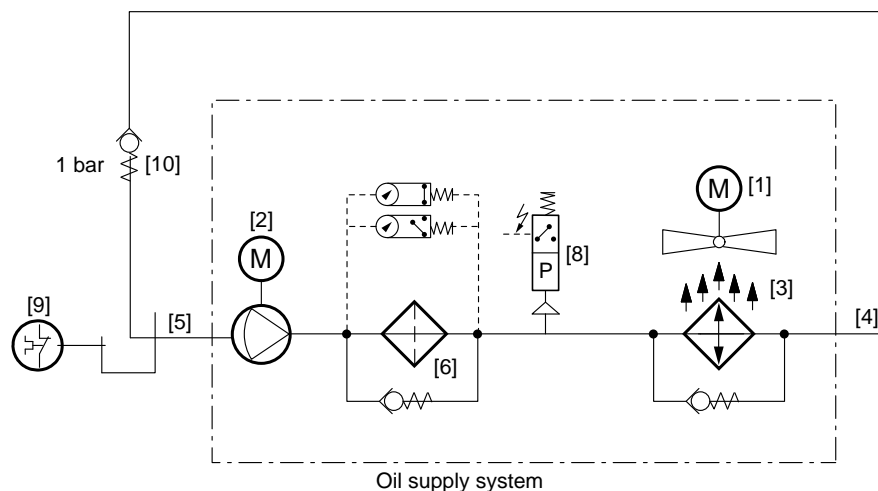


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- | | |
|------------------------------|---|
| [1] Fan motor | [6] Oil filter |
| [2] Pump motor | [7] Maintenance indicator |
| [3] Oil-air heat exchanger | [8] Pressure switch |
| [4] Pressure pipe connection | [9] Temperature switch with two switching points (TSK2) |
| [5] Suction pipe connection | [10] Check valve |



The following figure shows an example of the unit design.



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- | | |
|------------------------------|---|
| [1] Fan motor | [6] Oil filter |
| [2] Pump motor | [7] Maintenance indicator |
| [3] Oil-air heat exchanger | [8] Pressure switch |
| [4] Pressure pipe connection | [9] Temperature switch with two switching points (TSK2) |
| [5] Suction pipe connection | [10] Check valve |

2.1.2 General information

The cooling system is delivered as a complete unit on a mounting frame for separate installation but without electrical wiring and piping.

The standard design of the basic cooling system comprises:

- Pump with directly connected asynchronous motor (pump always running)
- Fan motor
- Oil-air heat exchanger
- Oil filter with filter element and electrical/optical maintenance indicator
- Pressure switch that monitors the pump pressure. Warning or switch-off signal when the oil pressure is < 0.5 bar
- Temperature switch with 2 switching points for
 - Controlled startup of the fan motor with an oil temperature > 60 °C
 - Monitoring of the cooling group, i.e. warning or gear unit shutdown when the oil temperature exceeds 90 °C.

The customer has to perform the following electrical wiring:

- Between temperature switch and fan motor
- Electrical maintenance indicator of the oil filter
- Pressure switch to customer evaluation unit
- Pump motor



INFORMATION

Provide for a low-vibration installation location and a maximum distance to the gear unit of about 1 meter.




2.1.3 Function

Observe the following control information for the individual components.

Pump

When the pump is operated, an pressure control valve in the cooler limits the plant pressure to 5 bar.

	STOP
	Do not change the default setting of the valve.

Oil-air cooling system

The gear unit is cooled by an oil-air cooling system.

- At $T > 60\text{ °C}$ → **COOLER ON**

Temperature switch /TSK2

The plant's temperature is monitored via a temperature switch connected to a display and monitoring unit.

- At $T > 60\text{ °C}$ → **COOLER ON**
- When $T > 90\text{ °C}$ → **GEAR UNIT STOP / WARNING**

Filter

The filter is monitored visually via a pressure deviation indicator, and electrically via a pressure deviation monitoring device.

At $\Delta p > 2.2\text{ bar}$ → **WARNING** (clean filter)

Bypass with filter

The maximum permitted pressure in the filter is limited to 3.5 bar. If the pressure in the system increases this limit value, the pressure control valve lets the excess pressure flow to the oil-air heat exchanger.

General information

The pressure sensor requires a 20 s delay.

Check valve

The check valve opens at a pressure of 1 bar.



2.1.4 Interlocking specifications

Gear unit enable The gear unit is enabled if the following condition is met:

- Oil temperature $T < 90\text{ °C}$
- Oil pressure $> 0.5\text{ bar}$ (startup delay of 20 s)

Gear unit stop / warning The gear unit is stopped if one of the following conditions is met:

- Oil temperature $T > 90\text{ °C}$
- Oil pressure $p < 0.5\text{ bar}$

2.1.5 Sizes, cooling capacity and selection

The power data of the standardized cooling systems is summarized in the following tables.

The specified cooling capacity levels apply to an air temperature of 40 °C , an oil temperature of 70 °C , and a line frequency of 50 Hz .

Cooling system size	Cooling system cooling capacity [kW]	Oil flow rate cooling system [l/min]	Connection power pump motor [kW]
OAP 005	4	16	1.1
OAP 010	5	29	1.5
OAP 020	9	29	1.5
OAP 025	12	29	1.5
OAP 030	14	59	4
OAP 040	22	61	4
OAP 050	30	61	6
OAP 060	45	168	7.5



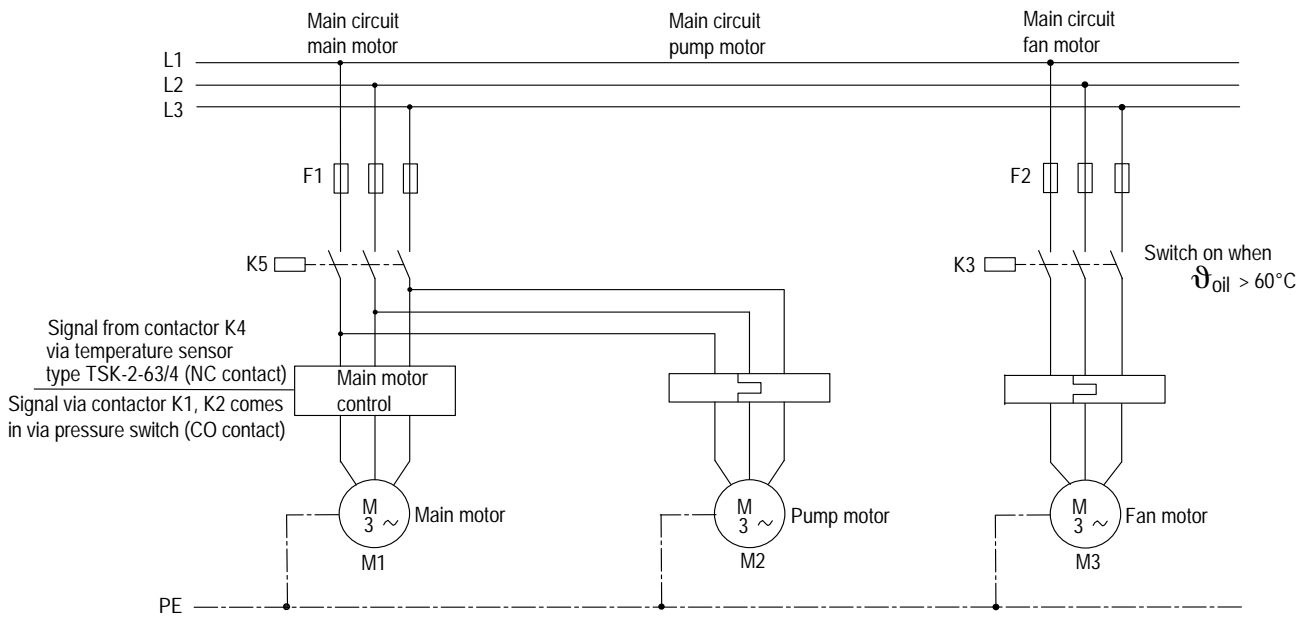
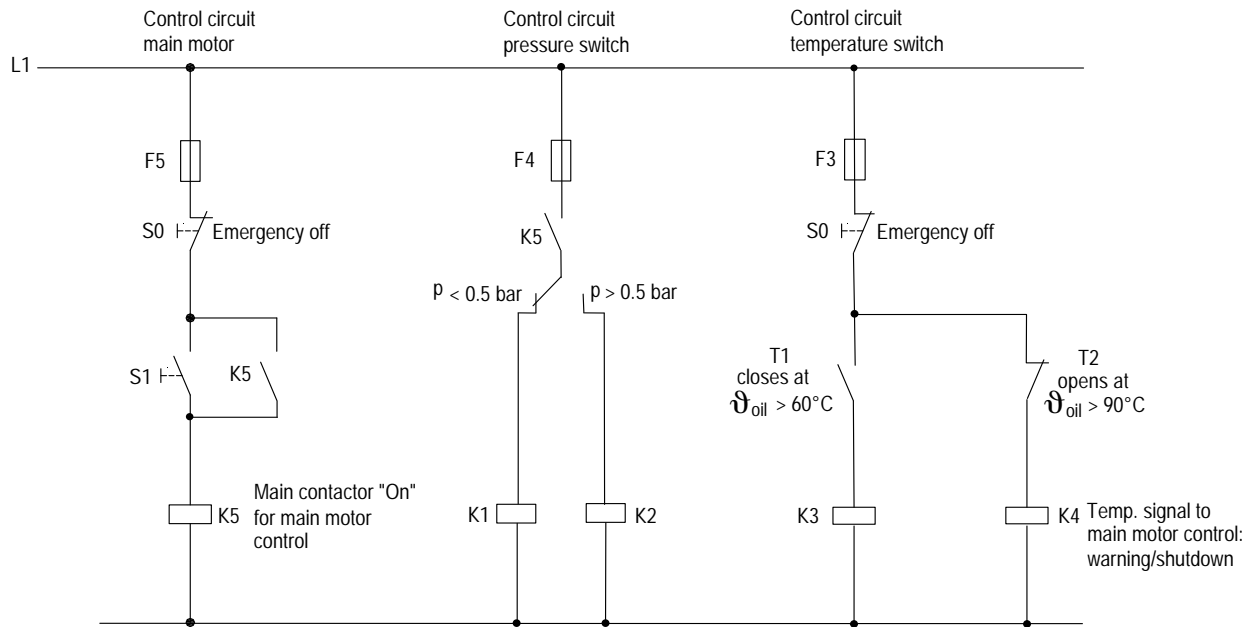
INFORMATION

The values differ slightly for operation with a line frequency of 60 Hz . Please consult SEW-EURODRIVE.



Oil-air cooler for pressure lubrication /OAP
Wiring diagram (schematic illustration)

2.2 Wiring diagram (schematic illustration)



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2.3 Installation/assembly

2.3.1 Mechanical connection

Connect the heat exchanger to the cooling circuit according to the identifying markings observing local regulations.

In this respect, observe the following:

- Do not reduce the indicated cable cross section.
- It is important that you choose the correct wall thickness and material when selecting pipes, hoses and screw fittings.

2.3.2 Electrical connection

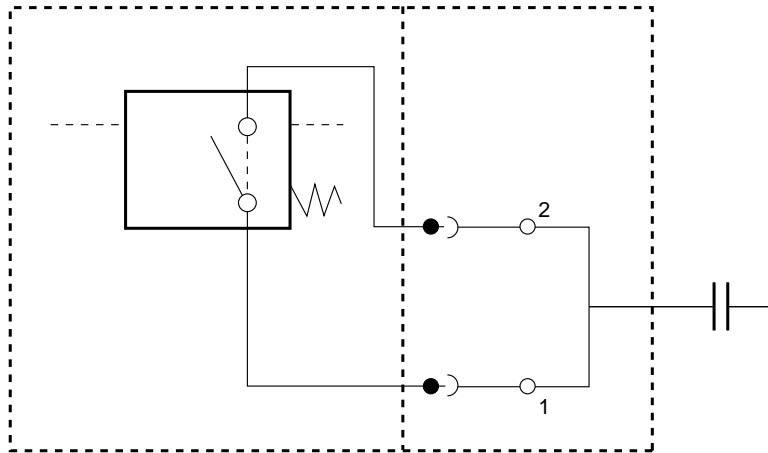
Make the electrical connections for the motors, temperature switch, pressure switch, and maintenance indicator of the filter according to local regulations.

- Make sure that the pump rotates in the correct direction.
- The pressure switch issues a warning signal when the pressure falls below 0.5 bar.
- The temperature switch should be integrated into the circuit in such a manner that:
 - The motor of the fan is switched on at the first switching point (at 60 °C oil temperature),
 - Either a warning signal is activated or the main drive is switched off at the second switching point (at 90 °C oil temperature).
- The maintenance indicator of the filter indicates when the filter element needs to be replaced.



2.3.3 Technical data of electrical/optical maintenance indicator

The following figure shows the wiring diagram:



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The following table shows the technical data:

Max. voltage	AC 250 V / DC 200 V
Max. switching current	1.0 A
Max. switching capacity	70 W
Degree of protection	IP 65 in plugged and secured condition
Contact type	NC contact / NO contact



2.3.4 Installation and connection information

The cooling system and the gear unit have to be set up separately as standard. As an option, the cooling system can be mounted to the gear unit as a complete unit. In this case, the cooling system is delivered with piping but without wiring.

Provide for a low-vibration installation location max. 1 meter from the gear unit. Install the cooling system at the same level or lower than the gear unit. If this is not possible, contact SEW-EURODRIVE.

The cooler must be installed in such a way that input and output air can flow unobstructedly. You have to provide for sufficient ventilation and protection against dirt.

Adhere to the following basic conditions when connecting the cooling system:

- Do not reduce the specified cable cross-sections.
- It is important that you choose the correct wall thickness and material when selecting pipes, hoses and screw fittings. Preferably use composite material seals for screw fittings.

SEW-EURODRIVE recommends the following cable cross-sections for connecting the cooling system to the gear unit and the cooling circuit:

Size Cooling system	Pump suction connection	Suction pipe ¹⁾	Cooler pressure connection	Pressure pipe ²⁾
OAP 005	G 1 1/4"	DN32	G 1"	DN25
OAP 010	G 1 1/4"	DN32	G 1"	DN25
OAP 020	G 1 1/4"	DN32	G 1"	DN25
OAP 025	G 1 1/4"	DN32	G 1"	DN25
OAP 030	G 1 1/2"	DN40	G 1"	DN32
OAP 040	G 1 1/2"	DN40	G 1 1/4"	DN32
OAP 050	G 1 1/2"	DN40	G 1 1/4"	DN32
OAP 060	SAE 2 1/2"	DN50	G 1 1/2"	DN40

1) max. length 1.5 m

2) max. length 2.5 m



INFORMATION

For the dimensions of the oil-air cooler, refer to the catalog. More detailed technical data of the several cooling systems are available from SEW-EURODRIVE on request.

2.4 Notes on checking the oil level

The oil supply system might influence the oil level (page 15). The fill quantities specified on the nameplate are guide values and refer only to the gear unit. The mark on the oil sight glass, oil level glass or oil dipstick is the decisive indicator for the correct oil level.

Observe the chapter "Checking the oil level" in the operating instructions for the X.. Series Industrial Gear Units.



2.5 Startup

2.5.1 Notes



NOTICE

Improper startup of gear units with pressure lubrication can damage the gear unit.

Possible damage to property.

- Note the following:
-
- Do not start up the gear unit if the pressure switch is not connected.
 - An oil heater is mandatory when operating the gear unit with motor pump at low temperatures. For further information refer to chapter "Limit temperature for gear unit startup" in the operating instructions for X.. series helical and bevel-helical gear units.
 - Before taking the gear unit into operation for the first time, run the oil-air cooler at least 15 minutes to ensure that all oil chambers are filled with oil. After 15 minutes, shutdown the oil-air cooler and check the oil level. If necessary, adjust the oil level.

2.5.2 Venting the motor pump



⚠ WARNING

Danger due to leaking and squirting gear unit oil.

Serious injury.

- You must wear safety goggles.
- Be very careful when you vent the motor pump.

If the pump does not supply oil when the oil supply system starts, do the following:

- Fill the pump with oil.
- Vent the oil supply system on the outlet end during the start, if possible at the highest point.



2.6 Inspection/maintenance

2.6.1 Inspection and maintenance intervals

Adhere to the following inspection and maintenance intervals.

Time interval	What is to be done?
<ul style="list-style-type: none"> Depending on the operating conditions, at least every 12 months 	<ul style="list-style-type: none"> Check the condition of the oil-air cooler /OAP. If necessary, replace the filter element.
<ul style="list-style-type: none"> Varying (depending on external factors) 	<ul style="list-style-type: none"> Check all hose pipes for any leaks

2.6.2 Check hose pipes



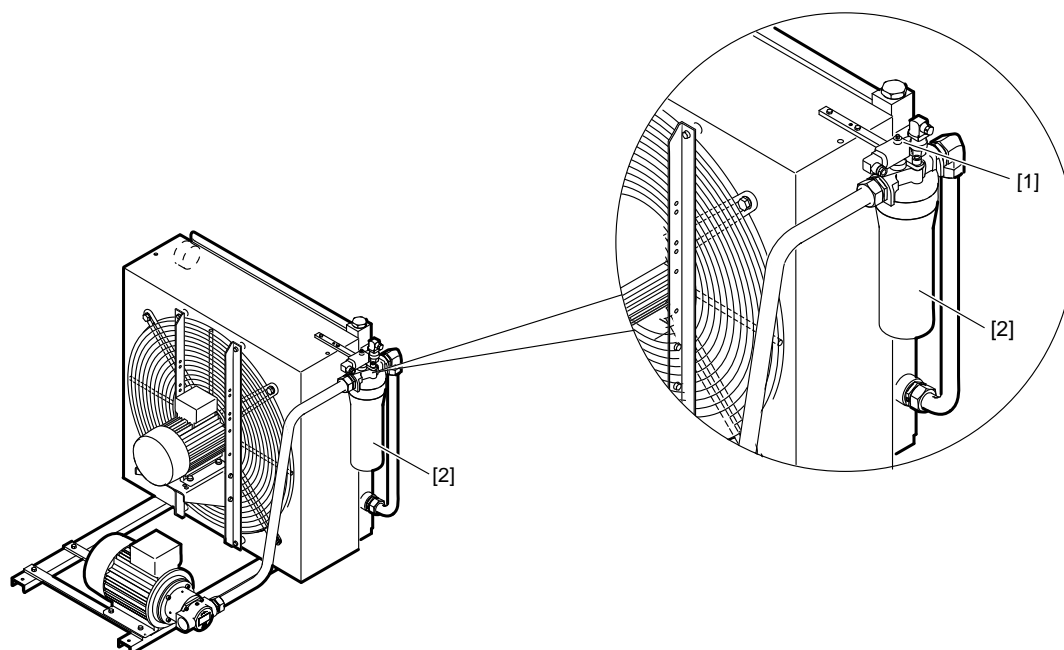
NOTICE

Hoses and hose pipes are subject to natural aging even if they are properly stored and used. This is why the period of use is limited.

Possible damage to property.

- Note the following:
-
- The period of use of hose pipes should not exceed 6 years from the date of manufacture printed on them.
 - The operator of the plant is responsible for making sure that hose pipes are replaced at adequate intervals even if they do not show any signs of safety-related defects.
 - Have hose pipes checked by a specialist at least once a year to ensure operational safety.

2.6.3 Electrical/optical maintenance indicator



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When starting up the gear unit in cold condition, the red button of the indicator [1] might come out.

Before pressing the red button [1] back in, wait until the gear unit has reached operating temperature. If it comes out again immediately, you have to change the filter element [2] as described in the next chapter.



2.6.4 Changing the filter (single filter)



⚠ WARNING

Risk of crushing if the drive starts up unintentionally.

Severe or fatal injuries.

- De-energize the motor before you start working on the unit.
- Secure the motor against unintended power-up.

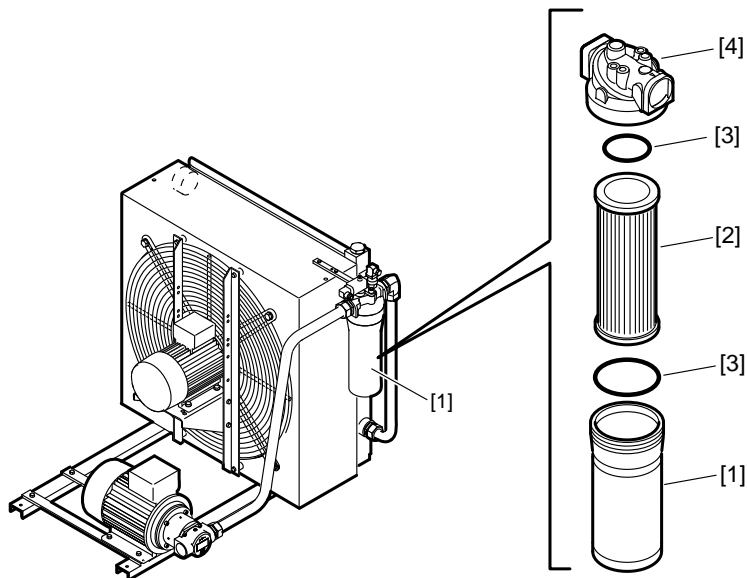


⚠ WARNING

Risk of burns due to hot gear unit and hot gear unit oil.

Serious injury.

- Let the unit cool down before you start working on it.



2712660491

1. Place a container underneath the oil filter housing [1].
2. Unscrew the filter housing [1] counterclockwise.
3. Clean the filter housing [1].
4. Remove the filter element [2] by turning it slightly to the left and right in downward direction.
5. Check the O-rings [3] and the filter head [4] for damage.
6. Push the new filter element with O-ring onto the filter head [4].
7. Screw the filter housing [1] with O-rings [3] onto the filter head [4].



2.7 Lubricant fill quantities

The following table shows the lubricant fill quantity which has to be filled into the gear unit additionally for the oil supply system (OSS).

Size	Fill quantity OSS [l]	max. fill quantity Suction pipe (1.5 m)		max. fill quantity Pressure pipe (2.5 m)		max. Total oil quantity [l]
		[DN] ¹⁾ /[mm] ²⁾	[l]	[DN] ¹⁾ /[mm] ²⁾	[l]	
OAP005	1.8	DN32 / Ø 35	1.2	DN25 / Ø 28	1.3	4.5
OAP010	1.8	DN32 / Ø 35	1.2	DN25 / Ø 28	1.3	4.5
OAP020	2.3	DN32 / Ø 35	1.2	DN25 / Ø 28	1.3	5.0
OAP025	3.1	DN32 / Ø 35	1.2	DN25 / Ø 28	1.3	5.5
OAP030	3.1	DN32 / Ø 35	1.2	DN25 / Ø 28	1.3	5.5
OAP040	5.4	DN40 / Ø 42	1.8	DN32 / Ø 35	2.0	9.0
OAP050	6.3	DN40 / Ø 42	1.8	DN32 / Ø 35	2.0	10.0
OAP060	8.2	DN50 / Ø 2"	3.0	DN40 / Ø 42	2.9	14.0

- 1) Size of hose pipes
2) Outer diameter of pipes

2.8 Malfunctions

Malfunctions	Possible cause	Remedy
No oil pump suction	<ul style="list-style-type: none"> Air in the pipes Motor not running Wrong direction of rotation of the motor Not enough oil in the gear unit Wrong oil grade 	<ul style="list-style-type: none"> Fill the suction line and oil pump with oil. Vent pressure pipe on startup Check electrical connections Check electrical connections Check oil level in gear unit Check oil grade (in particular when temperatures are low)
Delivery rate of oil pump not sufficient	<ul style="list-style-type: none"> Wrong motor speed Oil circulation clogged Negative pressure at pump suction side too high Wrong oil grade 	<ul style="list-style-type: none"> Check pump motor speed Open valves and plugs Increase cross section of suction line Decrease suction lift Check oil grade (in particular when temperatures are low)
Pump excessively loud	<ul style="list-style-type: none"> Negative pressure at pump suction side too high 	<ul style="list-style-type: none"> Increase cross section of suction line Decrease suction lift Avoid distortion of the suction line Avoid reductions in the suction pipes
The pump delivers foam	<ul style="list-style-type: none"> Leaky suction line Not enough oil in the gear unit 	<ul style="list-style-type: none"> Check screw fittings for leaks Check oil level in gear unit
Pressure switch does not switch	<ul style="list-style-type: none"> Air in the pipes Pressure switch connected incorrectly Pressure switch defective 	<ul style="list-style-type: none"> Fill the suction line and oil pump with oil. Vent pressure pipe on startup Check the connection Replace pressure switch
Cooling capacity is not reached	<ul style="list-style-type: none"> Air temperature higher than dimensioned 	<ul style="list-style-type: none"> Use larger cooler
Insufficient air flow	<ul style="list-style-type: none"> Lamella blocked Obstacles in the vicinity 	<ul style="list-style-type: none"> Clean cooler matrix Adhere to minimum clearance

Limit temperature for gear unit start

Limit temperature for gear unit start

The minimum permitted ambient temperature / oil temperature for gear unit starting depends on the viscosity of the oil used and the lubrication type of the gear unit.



NOTICE

Starting up the gear unit below the permitted minimum oil temperature may damage the unit.

Possible damage to property.

- Adhere to the specified starting temperatures for gear units.



INFORMATION

The following tables show the limit temperatures (minimum ambient temperatures) for gear unit startup without oil heater. Gear units and oil supply systems with heating elements can be heated to the required starting temperature if ambient temperatures are too low.

Mineral oil

Lowest permissible starting temperature for the gear unit

Lubrication type	Design	Lubricants		
		ISO VG320	ISO VG220	ISO VG150
Splash lubrication Oil bath lubrication	Initial temperature for gear unit start (minimum permitted oil bath temperature)	-12 °C	-15 °C	-20 °C
Pressure lubrication with Shaft end pump	Initial temperature for gear unit start (minimum permitted oil bath temperature)	+5 °C	0 °C	-5 °C
Pressure lubrication with motor pump	Initial temperature for gear unit start (minimum permitted oil bath temperature)	+15 °C	+10 °C	+5 °C

Synthetic oil

Lowest permissible starting temperature for the gear unit

Lubrication type	Design	Lubricants		
		ISO VG320	ISO VG220	ISO VG150
Splash lubrication Oil bath lubrication	Initial temperature for gear unit start (minimum permitted oil bath temperature)	-25 °C	-25 °C	-25 °C
Pressure lubrication with Shaft end pump	Initial temperature for gear unit start (minimum permitted oil bath temperature)	-5 °C	-8 °C	-15 °C
Pressure lubrication with motor pump	Initial temperature for gear unit start (minimum permitted oil bath temperature)	+8 °C	+3 °C	-3 °C

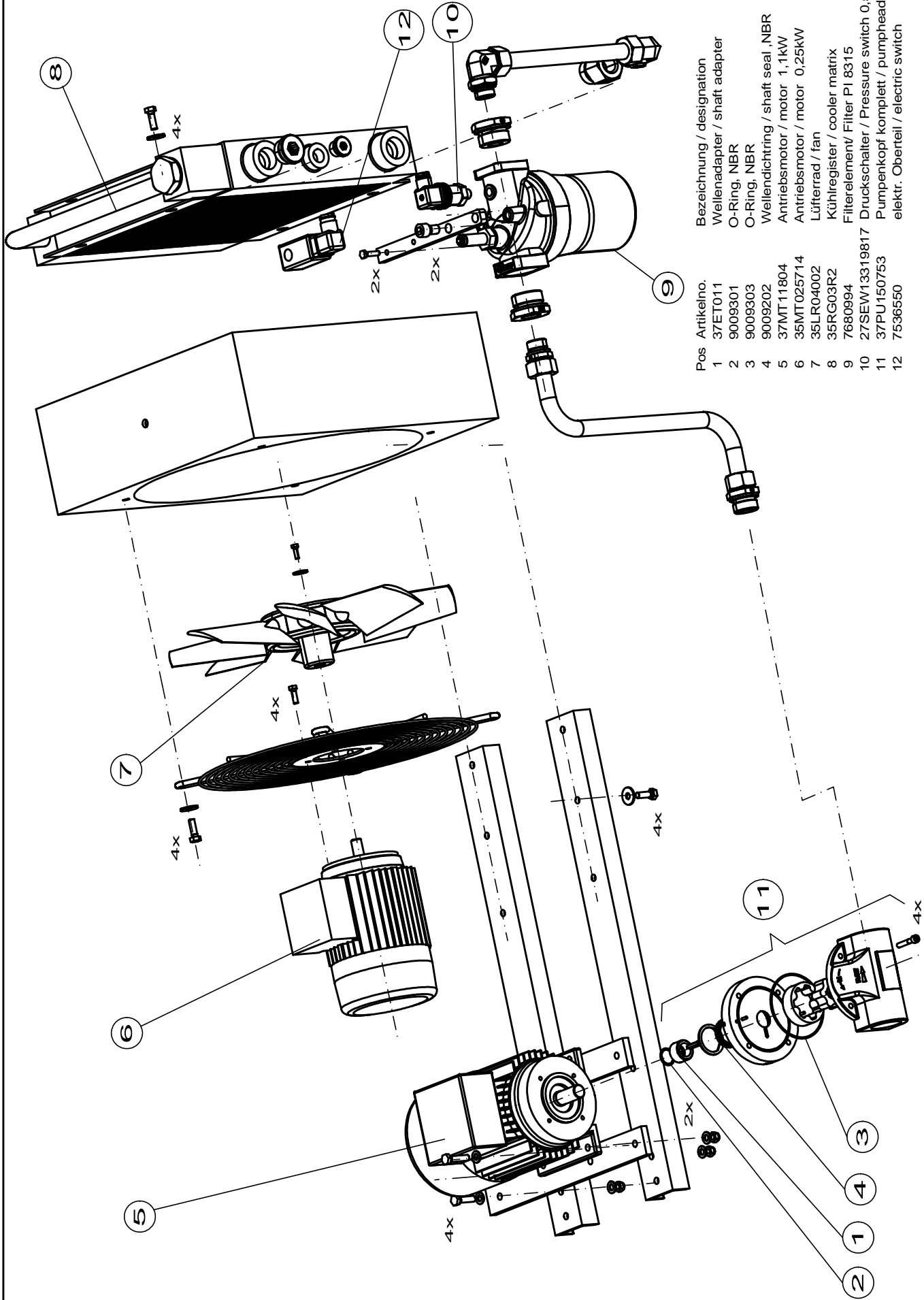


INFORMATION

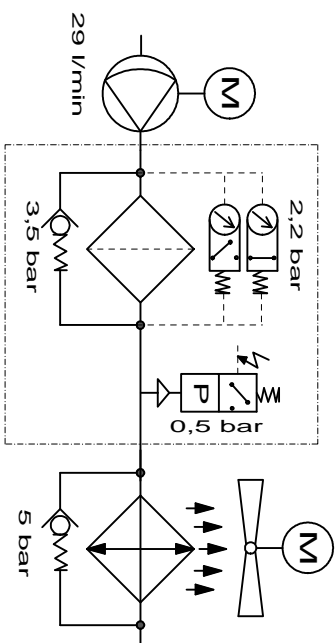
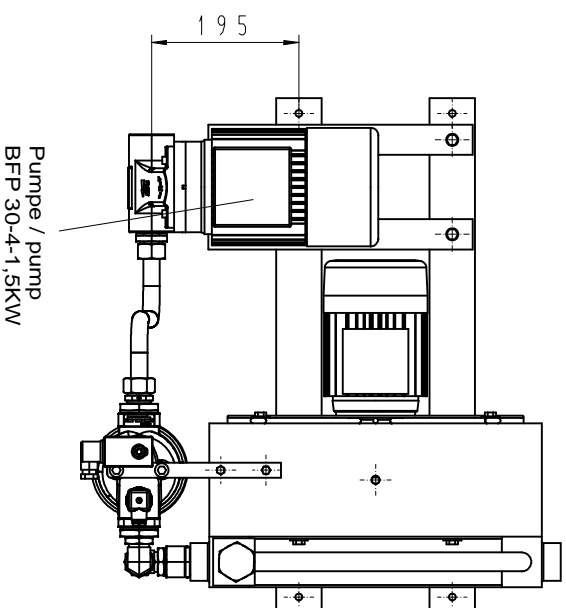
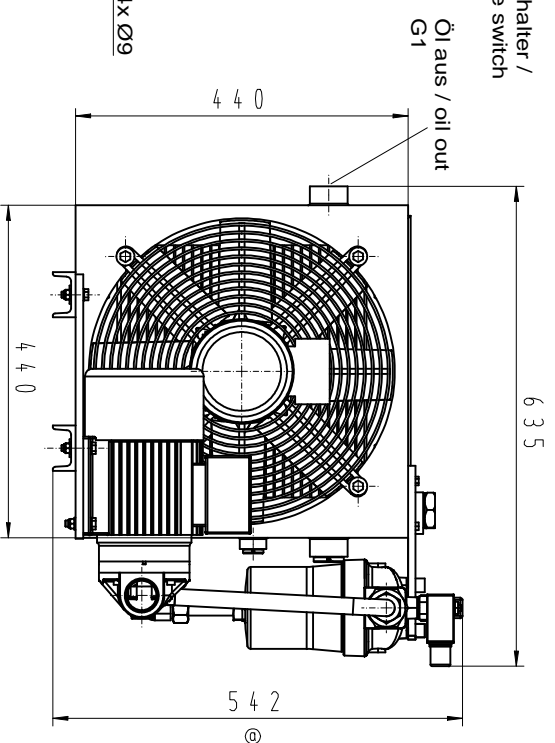
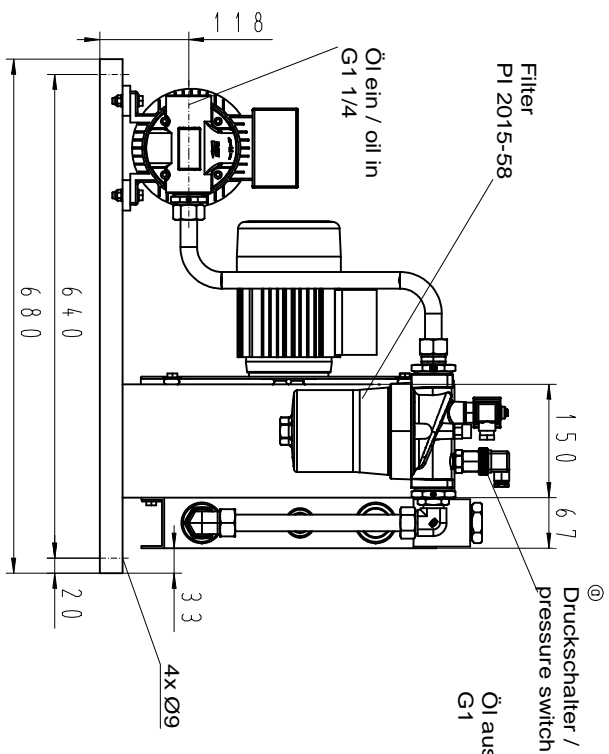
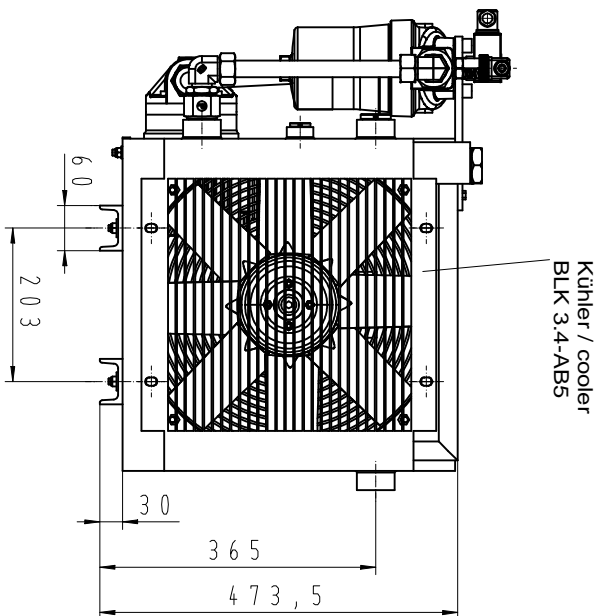
The specified temperatures refer to the average values of the permitted lubricants based on the lubricant table. In borderline cases, the permitted temperature of the lubricant that is actually being used must be verified. When planning the motor, observe the increased starting torque at low temperatures. It may be necessary to contact SEW-EURODRIVE.

3.0 Documentation of Suppliers





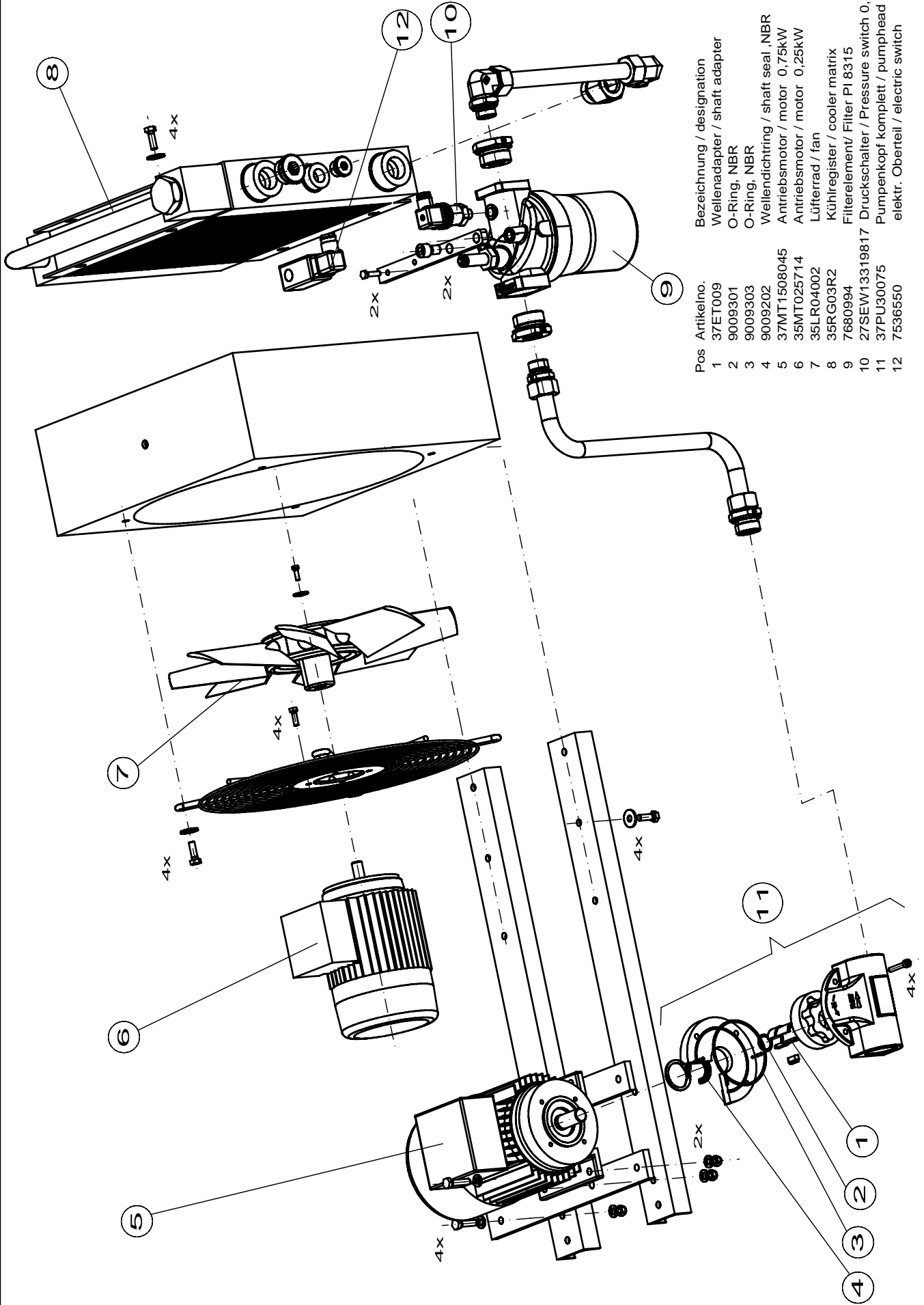
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1	37ET011	Weilenadapter / shaft adapter
2	9009301	O-Ring, NBR
3	9009303	O-Ring, NBR
4	9009202	Wellendichtung / shaft seal ,NBR
5	37MT11804	Antriebsmotor / motor 1,1kW
6	35MT025714	Antriebsmotor / motor 0,25kW
7	35LR04002	Lüfterrad / fan
8	35RG03R2	Kühlregister / cooler matrix
9	7680994	Filterelement/ Filter PI 8315
10	27SEW13319817	Druckschalter / Pressure switch 0,5 bar
11	37PU150753	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electric switch



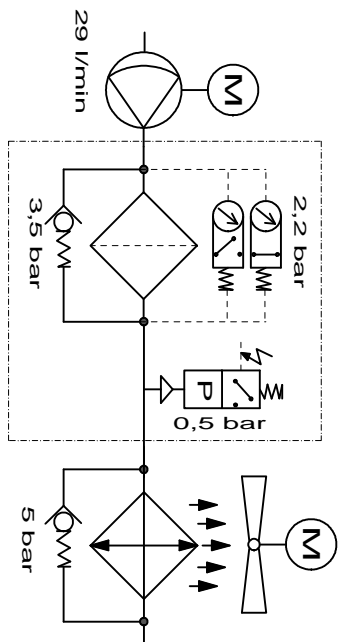
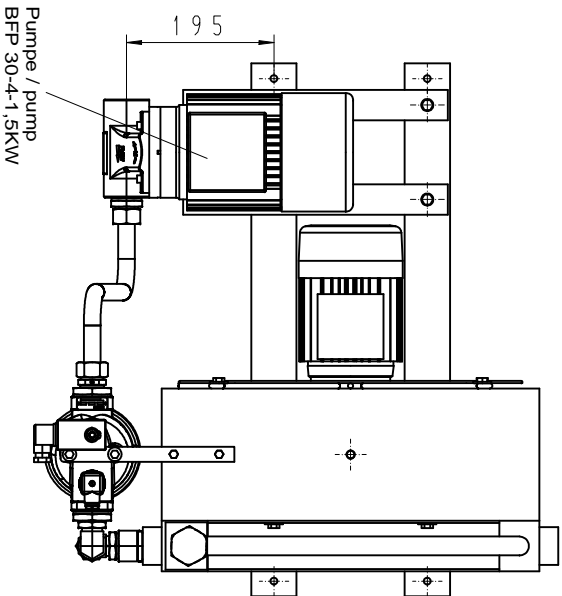
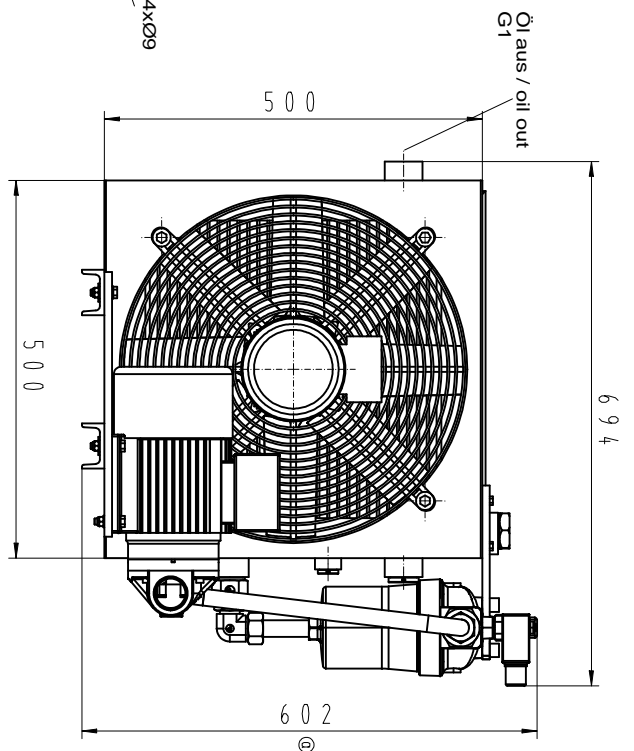
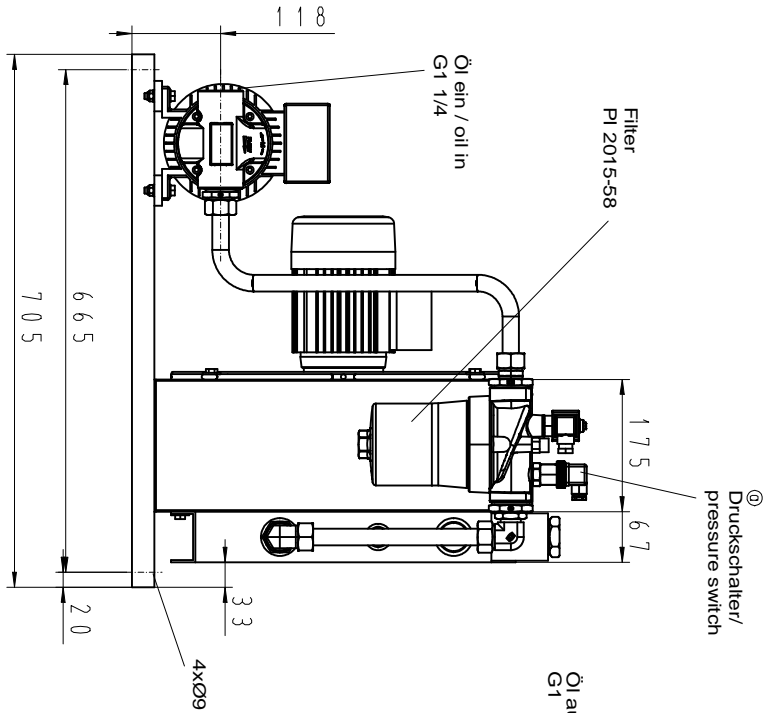
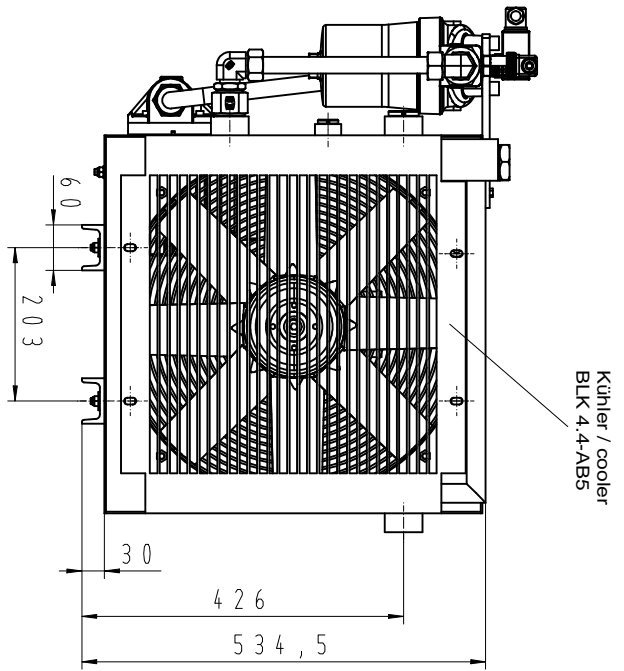
SEW-Sachnr.: 13284118
 FGSL 30/BLK 3.4-ABS/BFP 30-4-1,5kW/ PI 2015-58
 Motorspannung/motor voltage
 230/400V 50Hz +/-5%
 276/480V 60Hz +/-5%

Alle Konten großfrei	ALLE RECHTE VORBEHALTEN	Tolle ohne Ansprüche nach ISO 2768-MK	Herstell: Kühler	Herstell-Nr.: 1.5	(Gewicht)
Oberflächenbear- beitungszeichen			Datum: 17.11.08	Bezeichnung: Ölversorgungsanlage	
✓ = ✓ ✗ = ✗ ✓ = ✓ ✗ = ✗			Bezeichnung: Ölversorgungsanlage		
Z = Z	Zahl: Rnd.: 0	Datum: 28.07.00	Zeichn.-Nr.: 07/242-201-01-2R		
	Zahl: Rnd.: 2x	Datum: 28.07.00	Prüf.-Nr.: 27SEWOP0100S		
			Arbeitsnummer: 27SEWOP0100S		

Bezeichnung: Ölversorgungsanlage	Prüf.-Nr.: 27SEWOP0100S
Arbeitsnummer: 27SEWOP0100S	



Pos	Artikelnr.	Bezeichnung / designation
1	37ET009	Wellenadapter / shaft adapter
2	9009301	O-Ring, NBR
3	9009303	O-Ring, NBR
4	9009202	Wellendichtring / shaft seal, NBR
5	37MT1508045	Antriebsmotor / motor 0,75kW
6	35MT025714	Antriebsmotor / motor 0,25kW
7	35LR04002	Lüfterrad / fan
8	35RG03R2	Kühlregister / cooler matrix
9	7680994	Filterelement / Filter PI 8315
10	27SEW13319817	Druckschalter / Pressure switch 0,5 bar
11	37PU30075	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electric switch

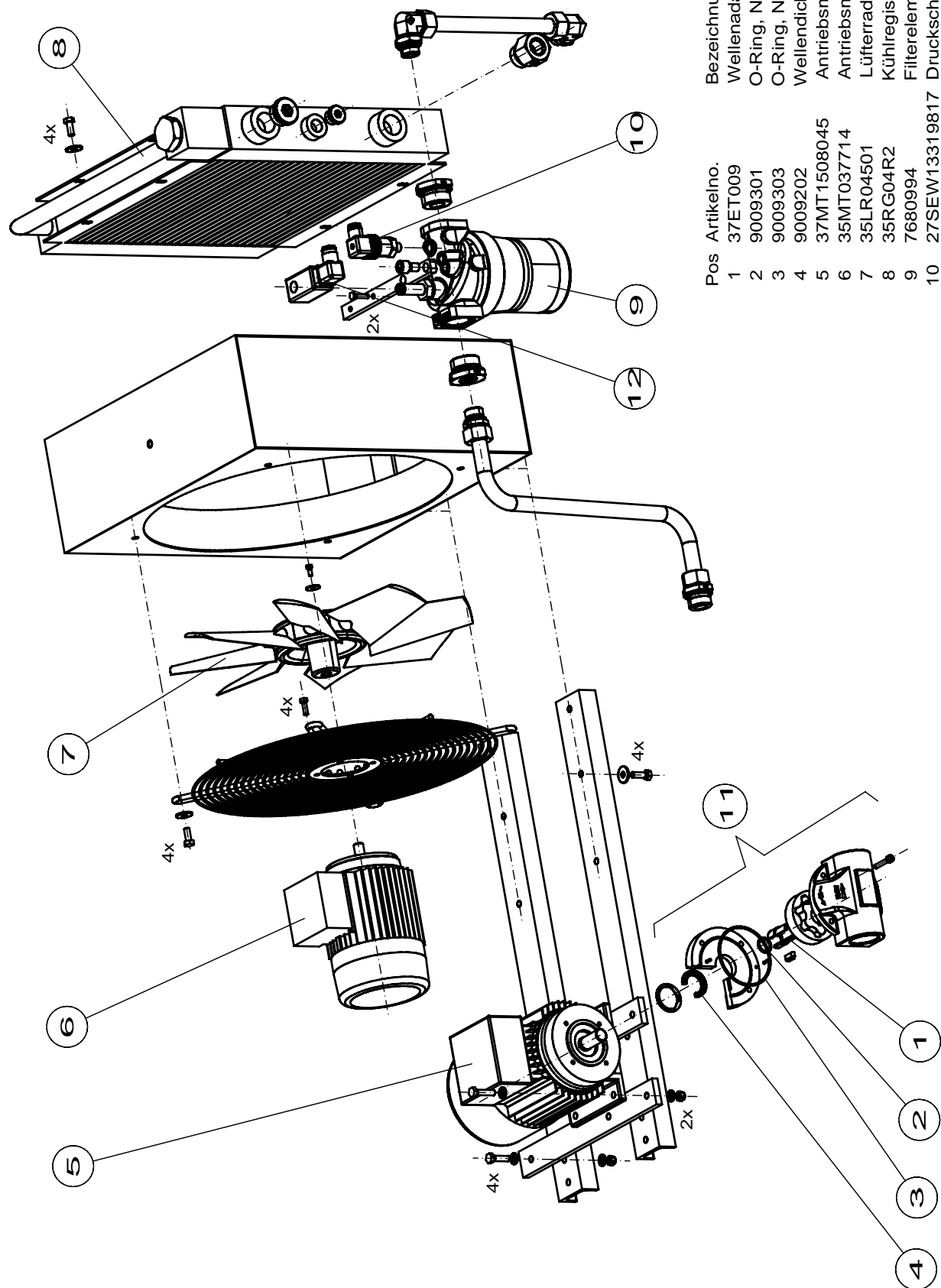


SEW Sachnr.: 13284126
 FGSL 30/ BLK 4,4-ABS/ BFP 30-4-1,5kW/ PI 2015-58
 Motorspannung/motor voltage
 230/400V 50Hz +/- 5%
 276/480V 60Hz +/- 5%

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✓ = ∇ ∇ 1,6		Bestell- Zeichnung-Nr.:	01L SUPPLU 0AP 020-0/S		
✓ = ∇ ∇ 1,4		Zahl. Rnd.:	24	Teil-Nr.:	27SEMOP02005
		Datum:	24.07.10	Arbeits- Zeichnung-Nr.:	07/243-201-01-2A
		Norm:	ISO	Arbeits- Zeichnung-Nr.:	27SEMOP02005
		Erst- Zeichnung-Nr.:	07/243-201-01-2A	Arbeits- Zeichnung-Nr.:	27SEMOP02005

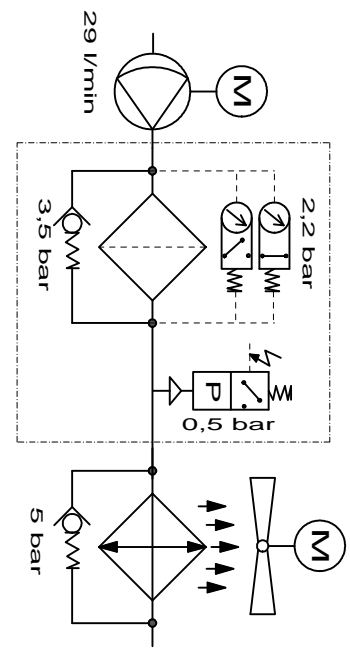
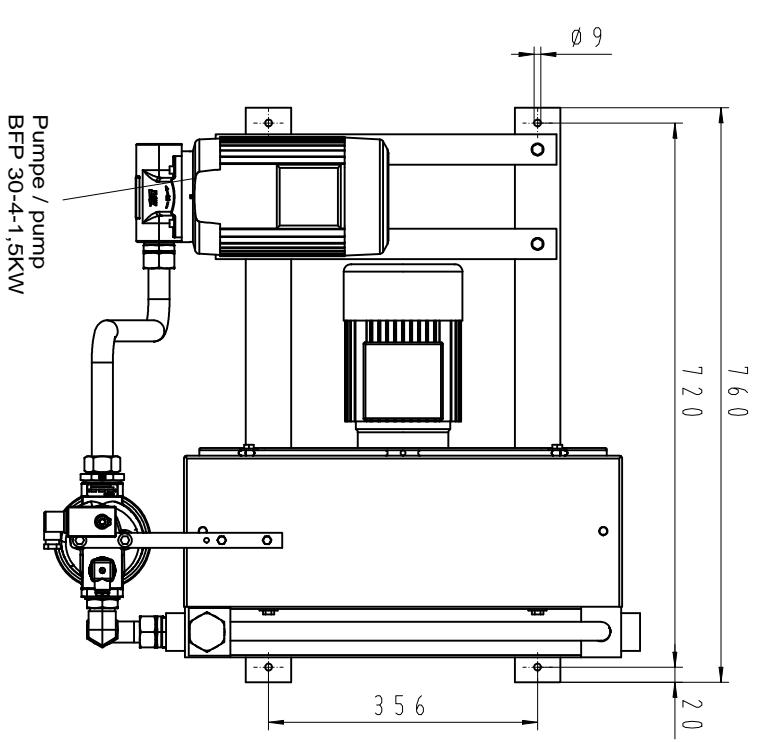
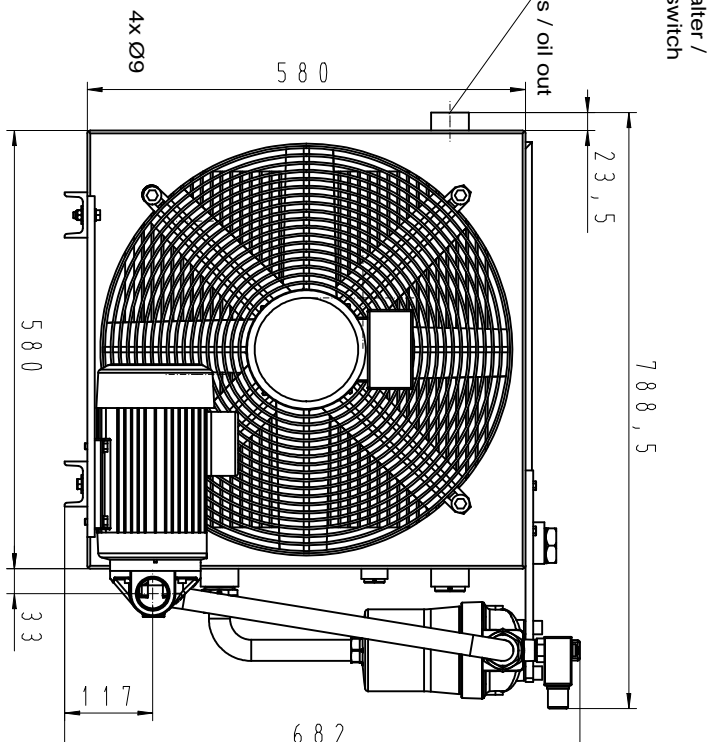
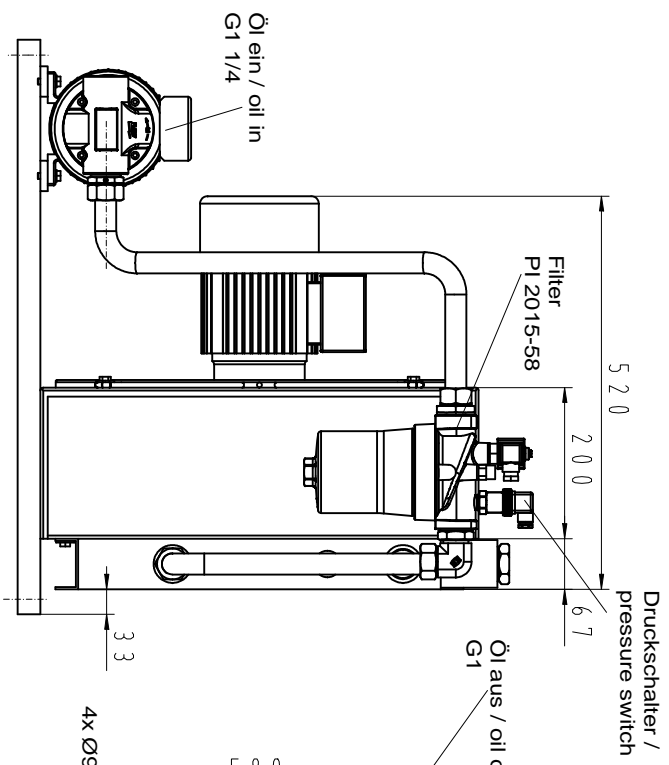
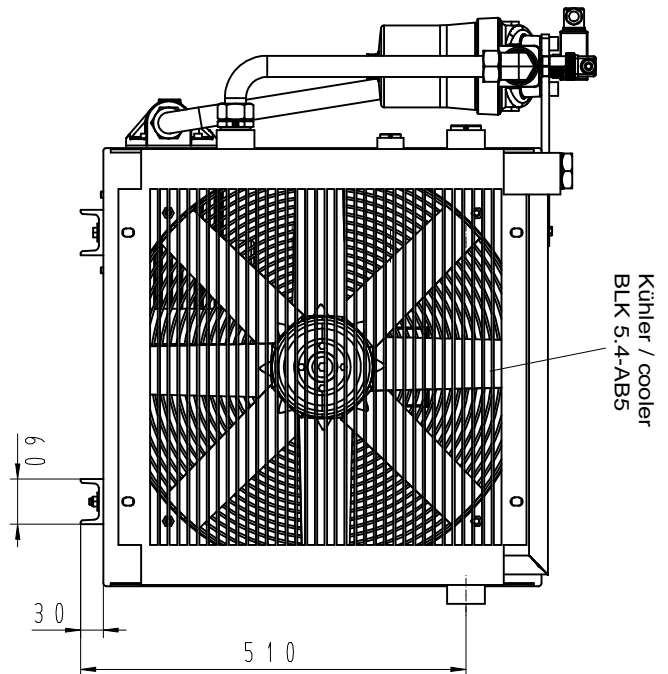


BÜHLER
 ARBEITSSCHÜSSUNG



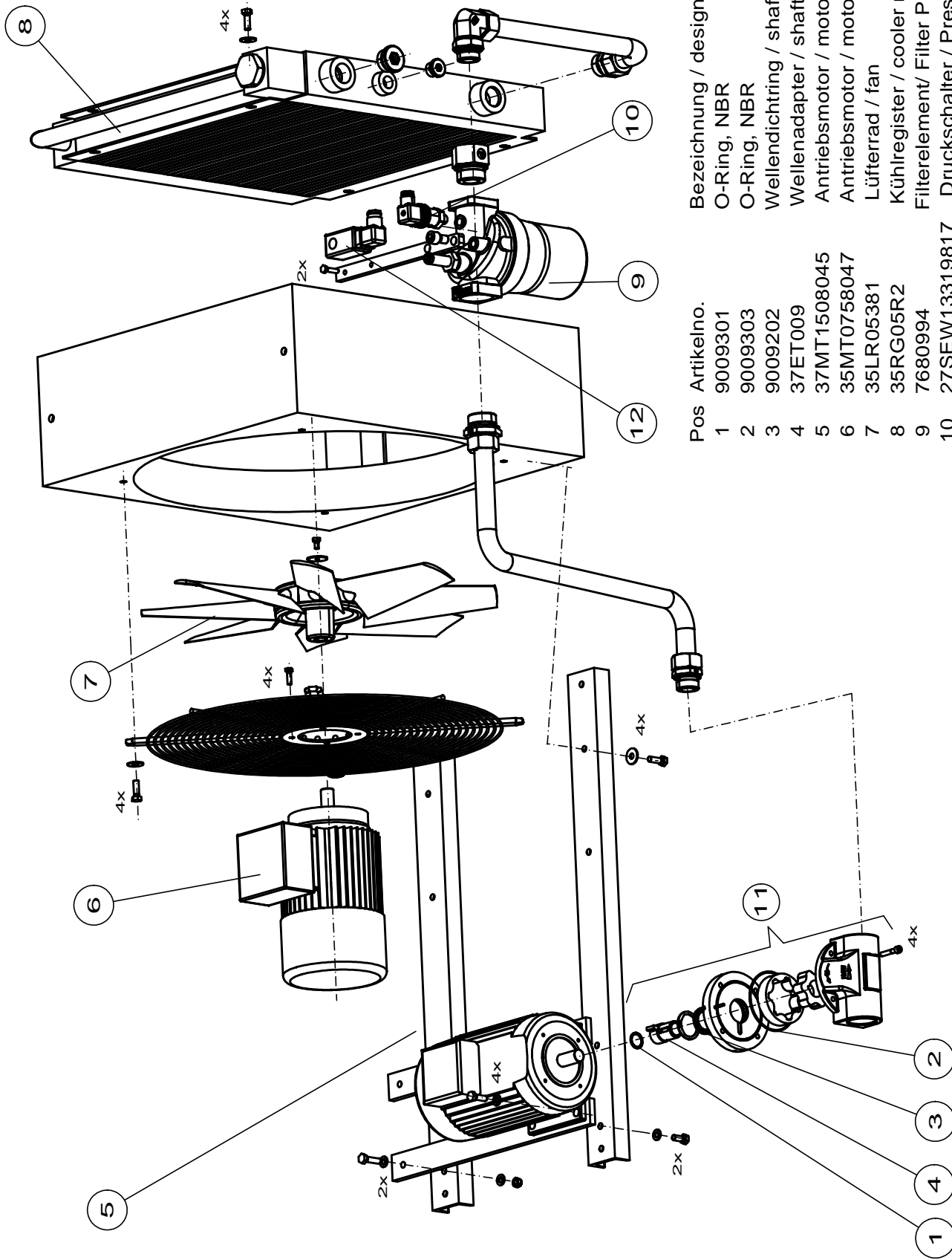
Pos	Artikelnr.
1	37ET009
2	9009301
3	9009303
4	9009202
5	37MT1508045
6	35MT037714
7	35LR04501
8	35RG04R2
9	7680994
10	27SEW13319817
11	37PU30075
12	7536550

Bezeichnung / designation
Wellenadapter / shaft adapter
O-Ring, NBR
O-Ring, NBR
Wellendichtung / shaft seal ,NBR
Antriebsmotor / motor 1,5kW
Antriebsmotor / motor 0,37kW
Lüfterrad / fan
Kühlregister / cooler matrix
Filterelement/ Filter PI 8315
Druckschalter / Pressure switch 0,5 bar
Pumpenkopf komplett / pumphead complete
elektr.Oberteil / electric switch

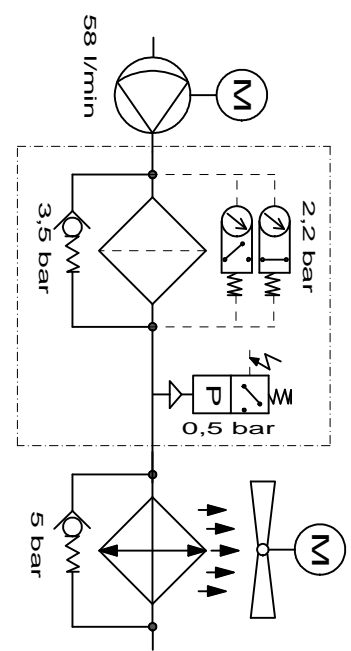
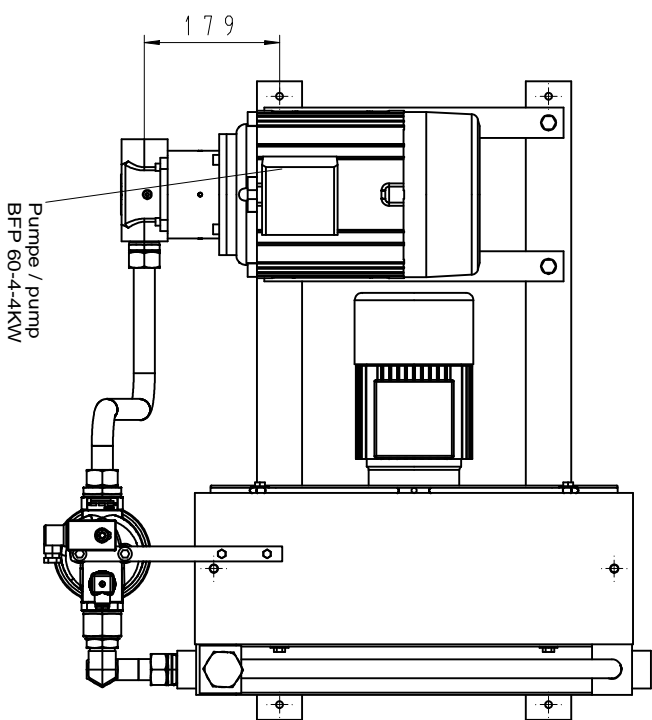
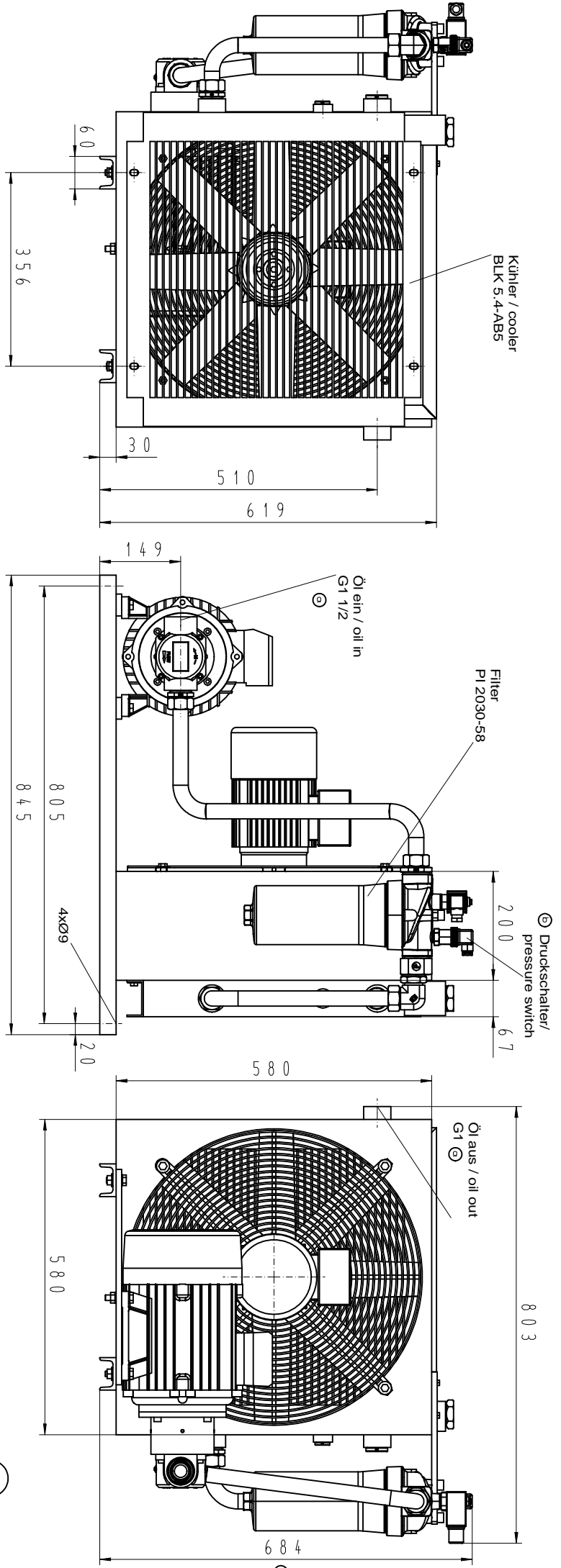


SEW-Sachnr.: 13318160
 FGSL 30/BLK 5.4-AB5/BFP 30-4-1.5KW/ PI 2015-58
 Motorspannung/motor voltage
 230/400V 50Hz +/-5%
 276/480V 60Hz +/-5%

alle Konten	ALLE RECHTE	Kolle ohne	Kollegat	1.5	[Gewicht]
größere	VORBEHALTEN	Herstellernach	Hersteller:		
Überlischensar-		belegungszeiten	Datum:	06.10.10	
			Bezugs:		
			Grav:		
			Namen:		
			Benennung:		
			Ölversorgungsanlage		
			Öl		
			supplu		
			ÖRP	025-0/5	
			Zeichn.-Nr.	27/026-201-01-2	
			Part.-Nr.	27SEWOP02505	
			ARBEITSRISIKO:		

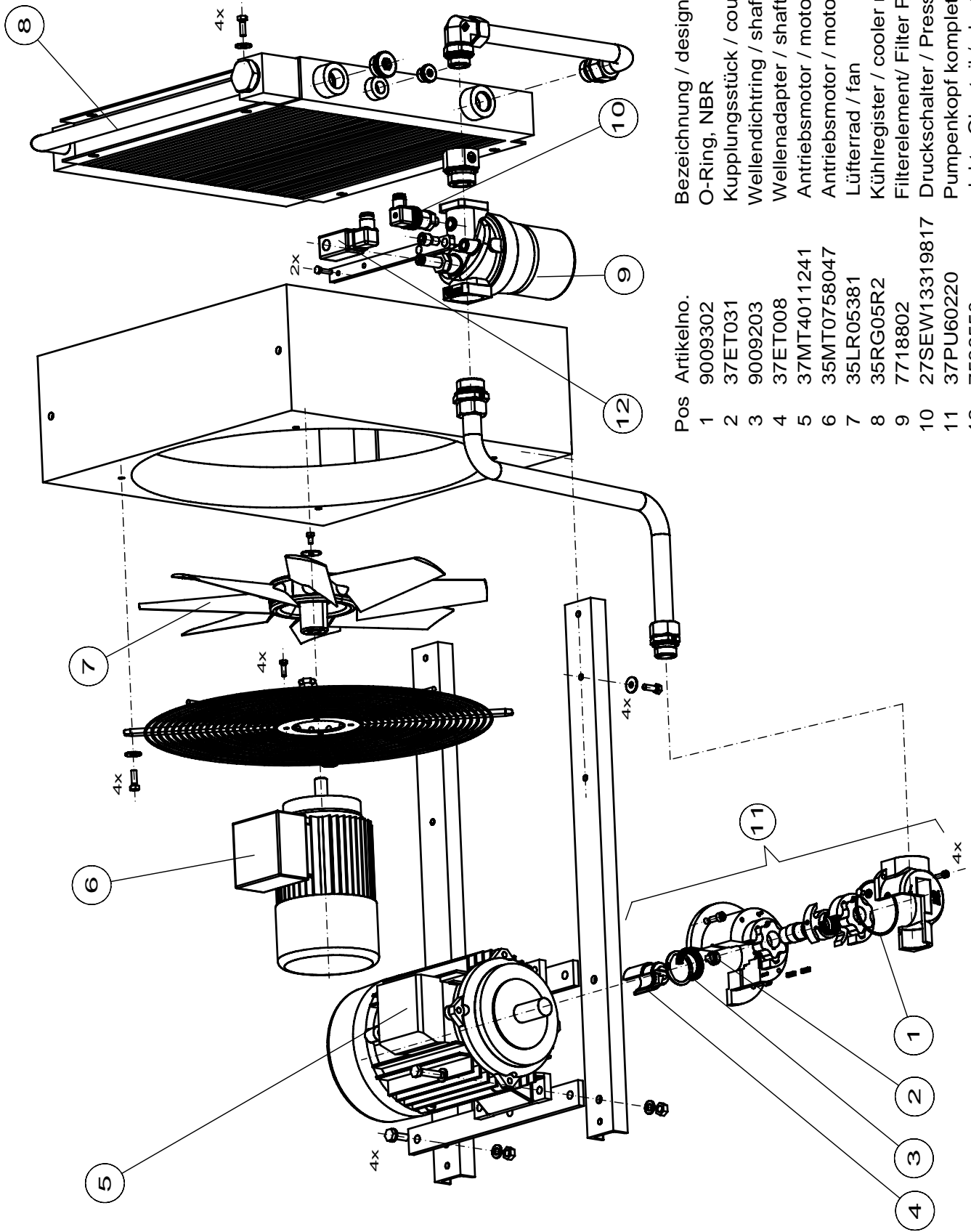


Pos	Artikelnr.	Bezeichnung / designation
1	9009301	O-Ring, NBR
2	9009303	O-Ring, NBR
3	9009202	Wellendichtring / shaft seal ,NBR
4	37ET009	Wellenadapter / shaft adapter
5	37MT1508045	Antriebsmotor / motor 1,5 kW
6	35MT0758047	Antriebsmotor / motor 0,75kW
7	35LR05381	Lüfterrad / fan
8	35RG05R2	Kühlregister / cooler matrix
9	7680994	Filterelement/ Filter PI 8315
10	27SEW13319817	Druckschalter / Pressure switch 0,5 bar
11	37PU30075	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electr. switch

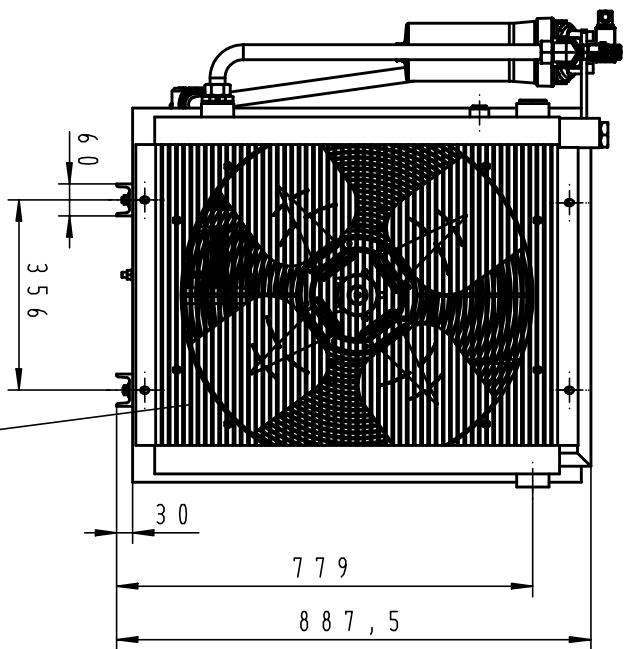


SEW Sachnr.: 13284134
 FGSL 60/BLK 5.4-AB5/BFP 60-4-4kW/PI 2030-58
 Motorspannung/motor voltage
 230/400V 50Hz +/-5%
 276/480V 60Hz +/-5%

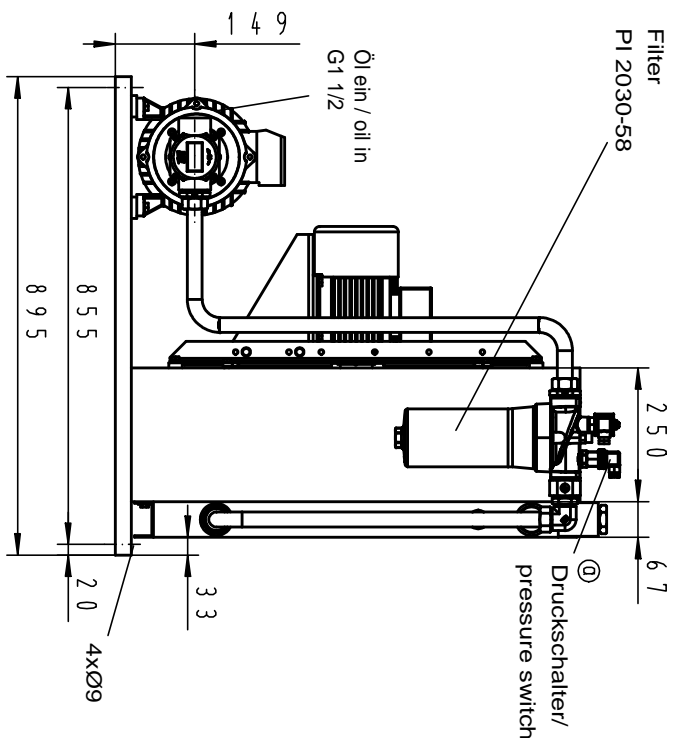
alle Konten gratfrei	Kolle ohne Tisch	Maßstab 1:5	(Gewicht)
Überlischene betriebszeiten	VORBEHALTEN nach ISO 2768-MK	Hersteller:	
✓ = ✓ ✓ = ✓ ✓ = ✓ ✓ = ✓	Datum 11.11.08	Benennung:	Ölversorgungsaggregat
✓ = ✓ ✓ = ✓ ✓ = ✓	Gepr. Name		Öl supplu
✓ = ✓ ✓ = ✓ ✓ = ✓	Zahl. Rnd. Datum		ÖRP 030-0/S
✓ = ✓ ✓ = ✓ ✓ = ✓	Normal Ers. für		Zeichn.-Nr. 07/244-201-01-2B
			Part.-Nr. 27SEW0P030005
			REBETTSMERKSUNG:



Pos	Artikelnr.	Bezeichnung / designation
1	9009302	O-Ring, NBR
2	37ET031	Kupplungsstück / coupling
3	9009203	Wellendichtring / shaft seal ,NBR
4	37ET008	Wellenadapter / shaft adapter
5	37MT4011241	Antriebsmotor / motor 4 kW
6	35MT0758047	Antriebsmotor / motor 0,75kW
7	35LR05381	Lüfterrad / fan
8	35RG05R2	Kühlregister / cooler matrix
9	7718802	Filterelement/ Filter PI 8330
10	27SEW13319817	Druckschalter / Pressure switch 0,5 bar
11	37PU60220	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electr. switch



Kühler / cooler
BLK 7.6-ABS

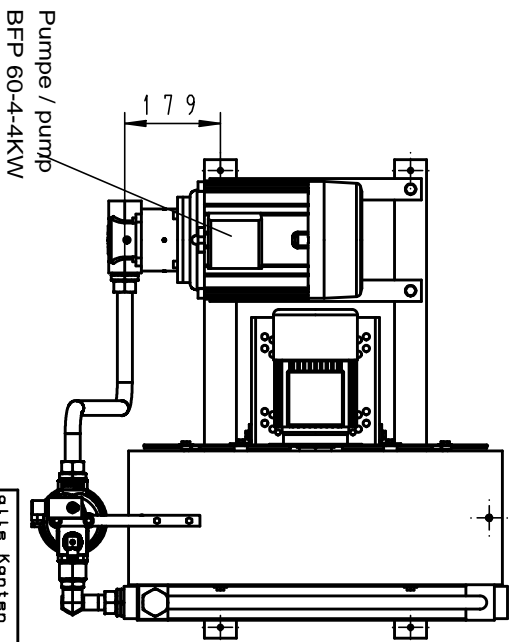
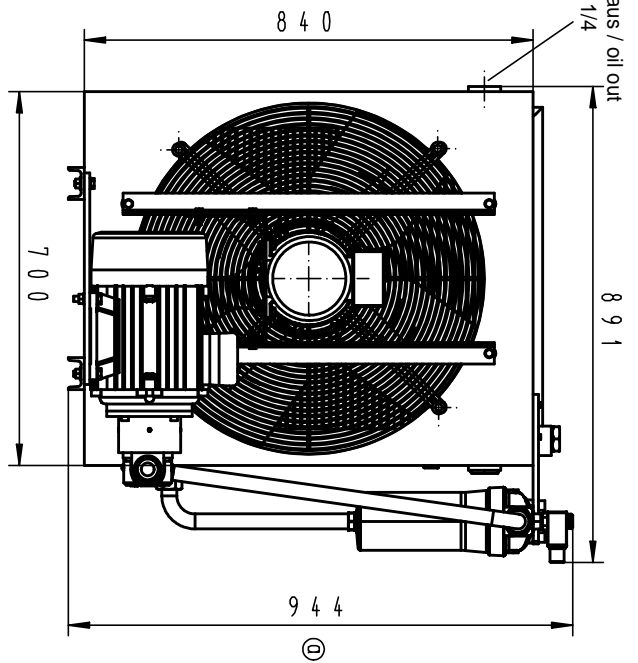


Filter
PI 2030-58

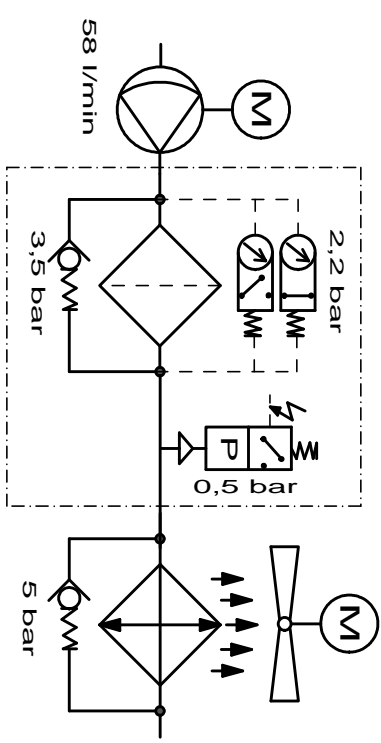
Ö ein / oil in
G1 1/2

Druckschalter/
pressure switch

Ö aus / oil out
G1 1/4

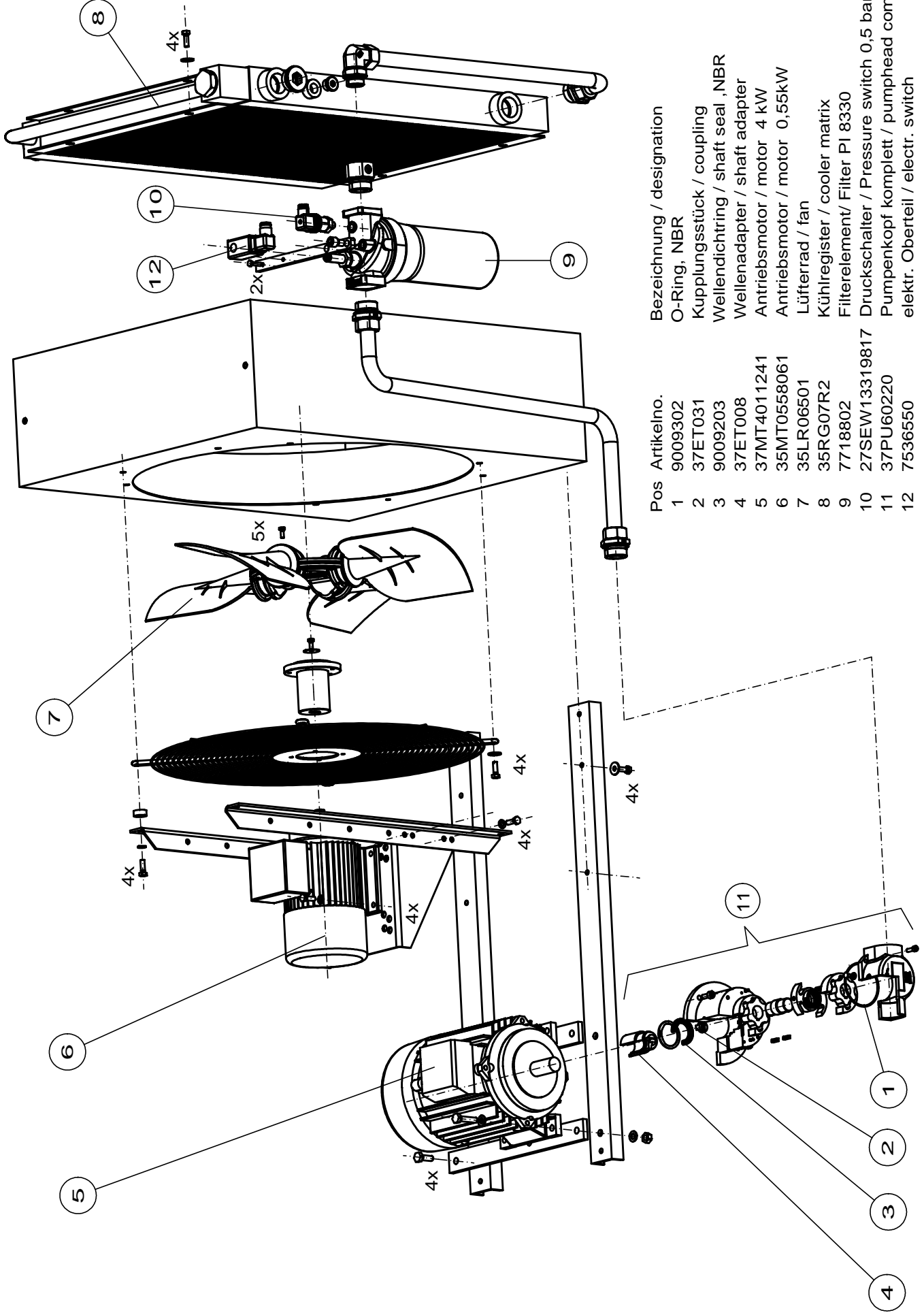


Pumpe / pump
BFP 60-4-4KW



alle Konten gratfrei	Maße ohne Toleranzangabe nach ISO 2768-mK	Maßstab 1:10 Merkstoff:	(Gewicht)
Oberflächenbear- beitungszeichen	ALLE RECHTE VORBEHALTEN	Datum 11.11.08 Name Muchow	
Beh.		Bearb. 11.11.08 Gepr.	
✓ = ✓ _{Rz 63}			
✓ = ✓ _{Rz 16}			
✓ = ✓ _{Rz 4}			
Z	Zuel. Hnd. Datum Name Ers für		
	0 2x 30.07.10 Sc		
		BÜHLER	
		Ar.-Nr. 27SEW0RP04000S	
		Arbeitsnummer: 07/245-Z01-01-3R	
		Benennung: Ölversorgungsanlage Oil supply OAP 040-00/S	
		Zeichnung-Nr. 07/245-Z01-01-3R	
		Arbeitsnummer: 27SEW0RP04000S	

SEW Sachnr.: 13284142
FGSL 60/BLK 7.6-ABS/BFP 60-4-4KW/PI 2030-58
Motorspannung/motor voltage
230/400V 50Hz +/-5%

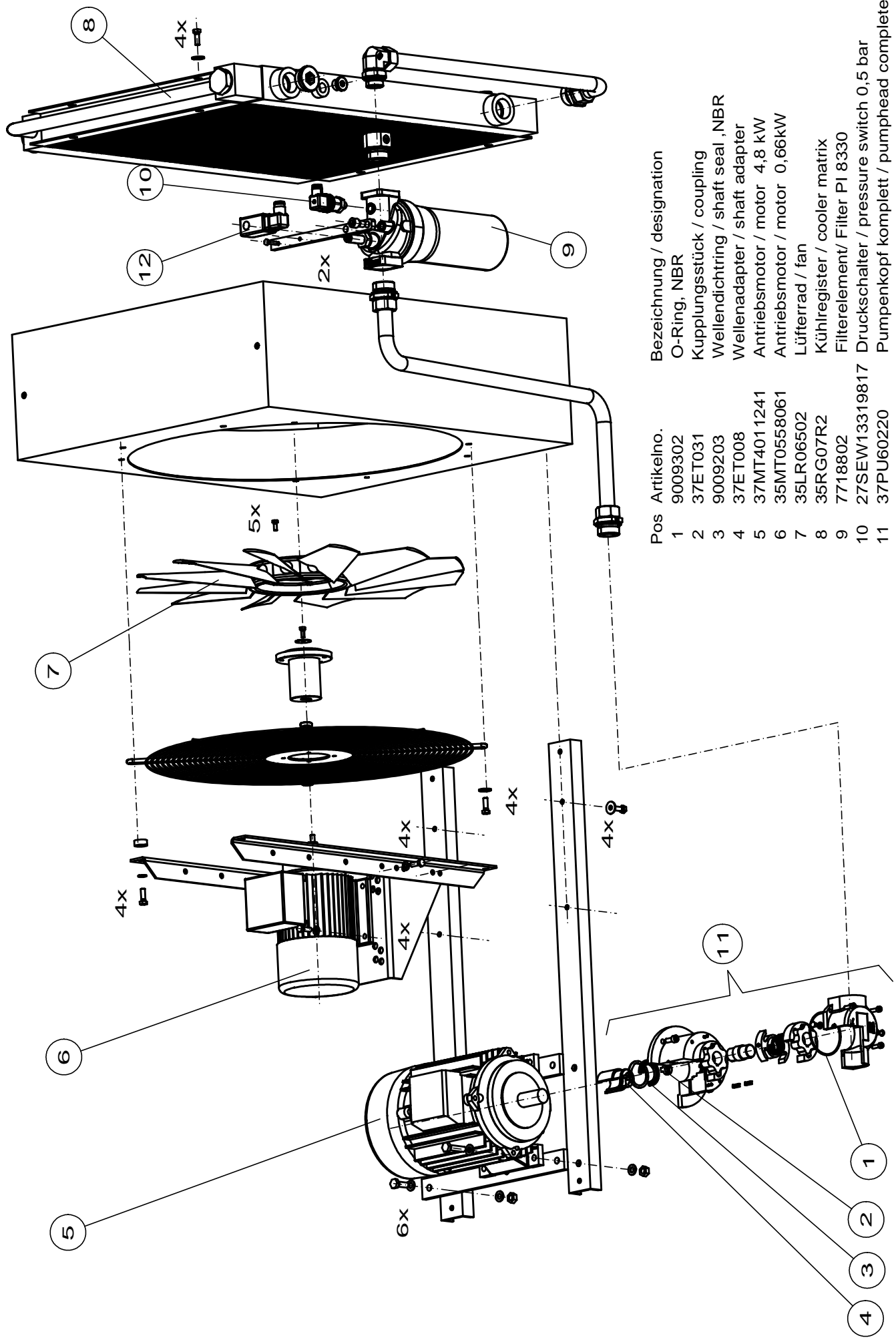


Pos	Artikelnr.	Bezeichnung / designation
1	9009302	O-Ring, NBR
2	37ET031	Kupplungsstück / coupling
3	9009203	Wellendichtring / shaft seal ,NBR
4	37ET008	Wellenadapter / shaft adapter
5	37MT4011241	Antriebsmotor / motor 4 kW
6	35MT0558061	Antriebsmotor / motor 0,55kW
7	35LR06501	Lüfterrad / fan
8	35RG07R2	Kühlregister / cooler matrix
9	7718802	Filterelement/ Filter PI 8330
10	27SEW13319817	Druckschalter / Pressure switch 0,5 bar
11	37PU60220	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electr. switch

Bezeichnung/designation
 Ersatzteilliste für Ölversorgungsanlage FGSL 60/BLK 7.6-AB5/BFP 60-4-4kW/ PI 2030-58
 Spare parts list for oil supply
 FGSL 60/BLK 7.6-AB5/BFP 60-4-4kW/ PI 2030-58

Motorspannung / motor voltage
 230/400V 50Hz +/-5%

SEW-Bezeichnung
OAP 040-00/S
 SEW-Sachnummer
13284142



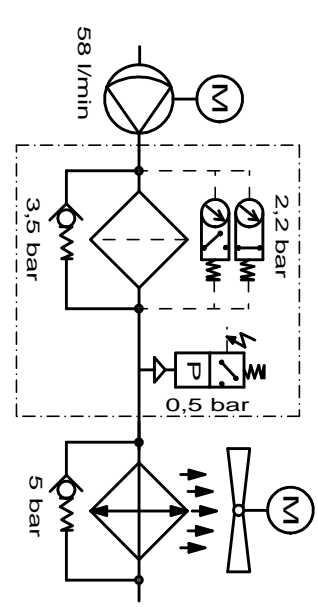
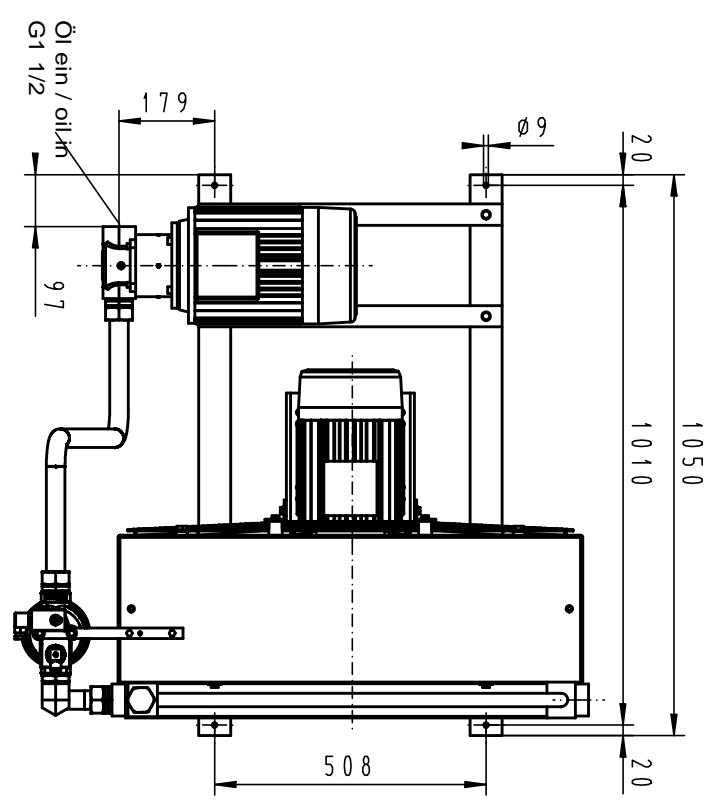
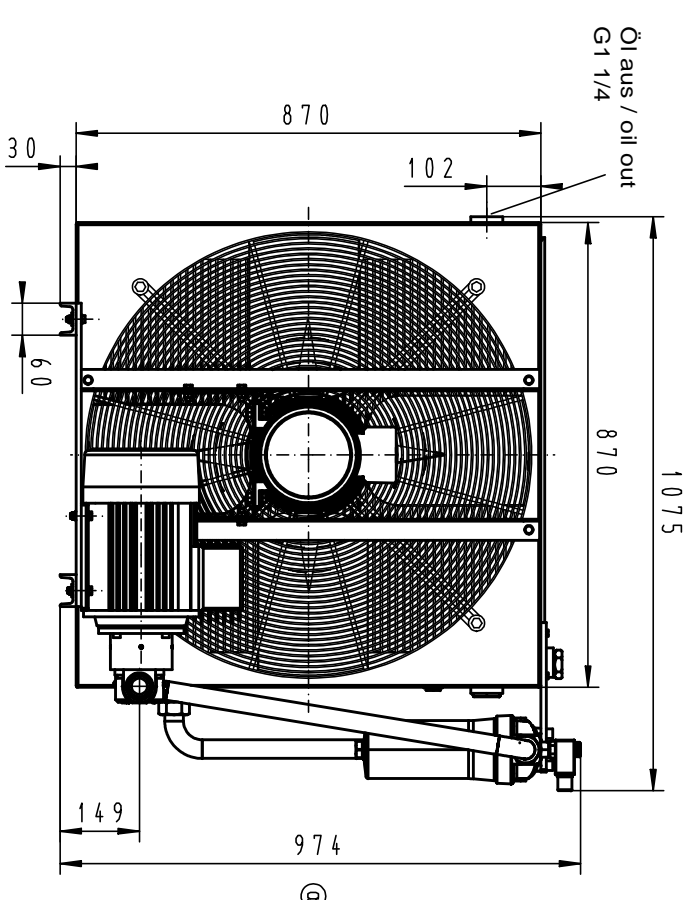
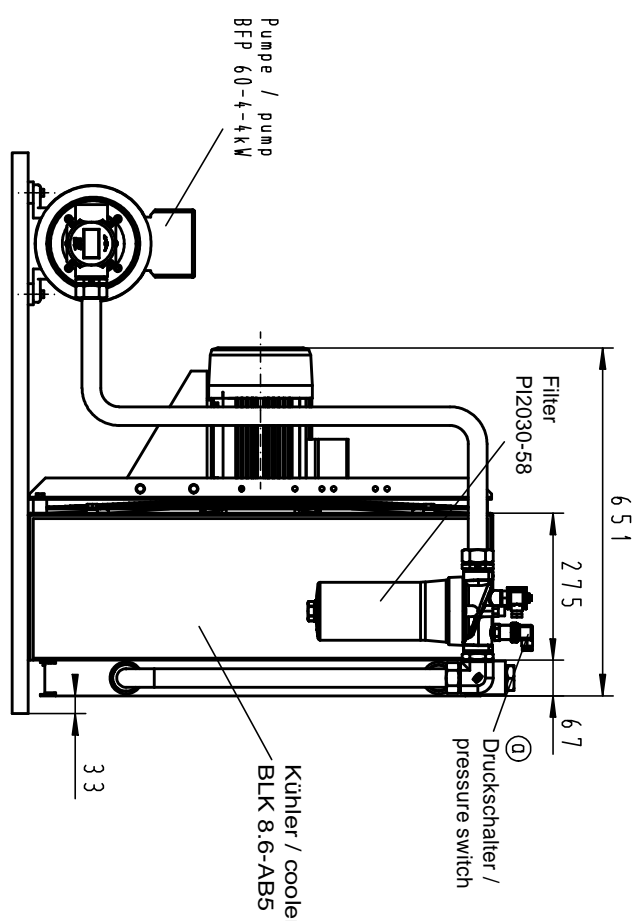
Pos Artikelno. Bezeichnung / designation

- | | | |
|----|---------------|---|
| 1 | 9009302 | O-Ring, NBR |
| 2 | 37ET031 | Kupplungsstück / coupling |
| 3 | 9009203 | Wellendichtring / shaft seal ,NBR |
| 4 | 37ET008 | Wellenadapter / shaft adapter |
| 5 | 37MT4011241 | Antriebsmotor / motor 4,8 kW |
| 6 | 35MT0558061 | Antriebsmotor / motor 0,66kW |
| 7 | 35LR06502 | Lüfterrad / fan |
| 8 | 35RG07R2 | Kühlregister / cooler matrix |
| 9 | 7718802 | Filterelement/ Filter PI 8330 |
| 10 | 27SEW13319817 | Druckschalter / pressure switch 0,5 bar |
| 11 | 37PU60220 | Pumpenkopf komplett / pumphead complete |
| 12 | 7536550 | elektr. Oberteil / electr. switch |

Bezeichnung/designation
 Ersatzteilliste für Ölversorgungsanlage FGSL 70/BLK 7.6-AB5/BFP 70-4-4,8kW/ PI 2030-58
 Spare parts list for oil supply
 FGSL 70/BLK 7.6-AB5/BFP 70-4-4,8kW/ PI 2030-58

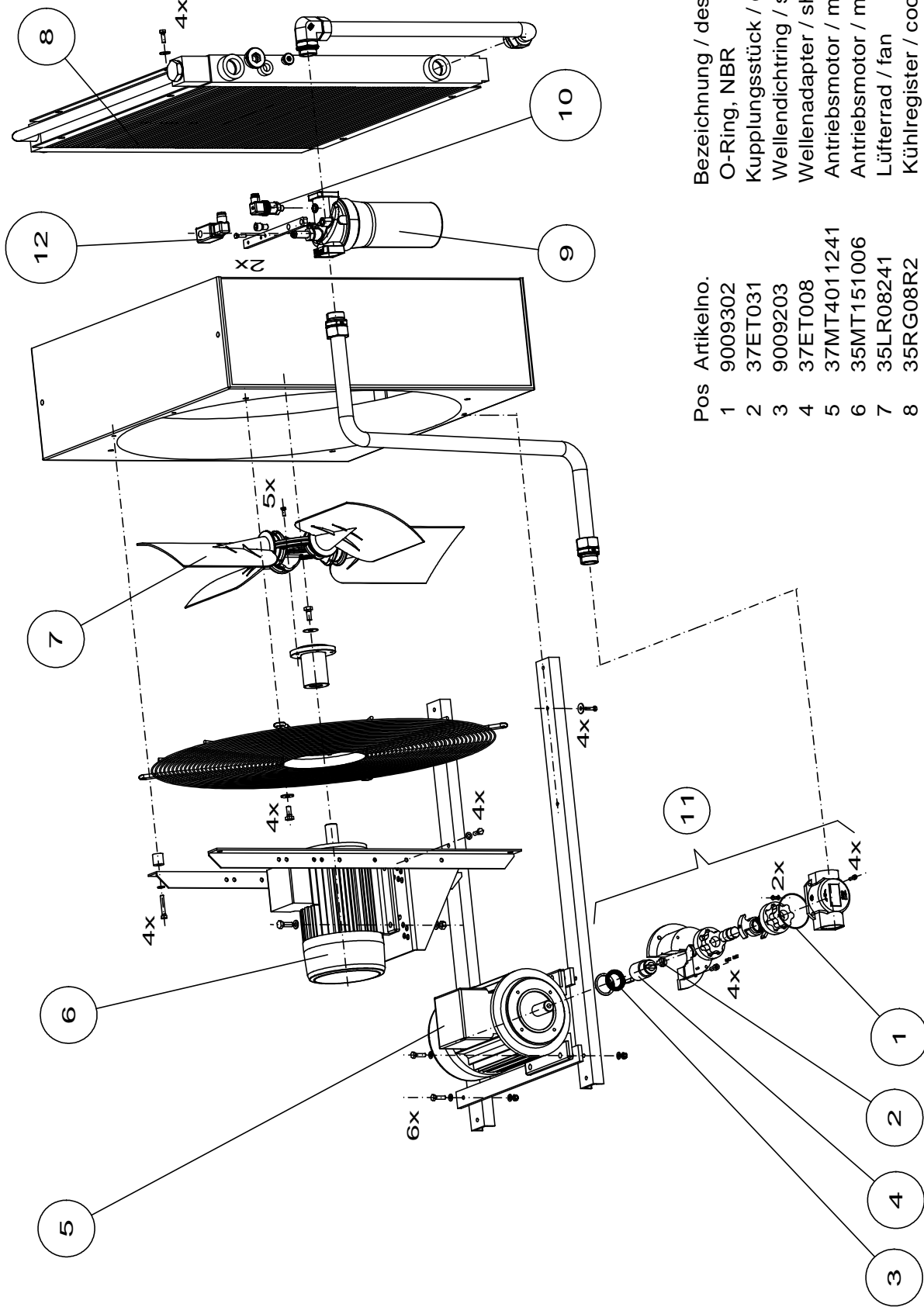
Spannung / voltage
 276/480V 60Hz +/-5%

SEW-Bezeichnung
OAP 040-01/S
 SEW-Sachnummer
13285610

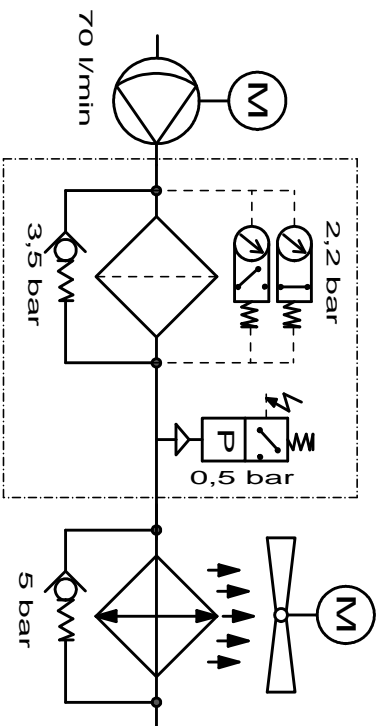
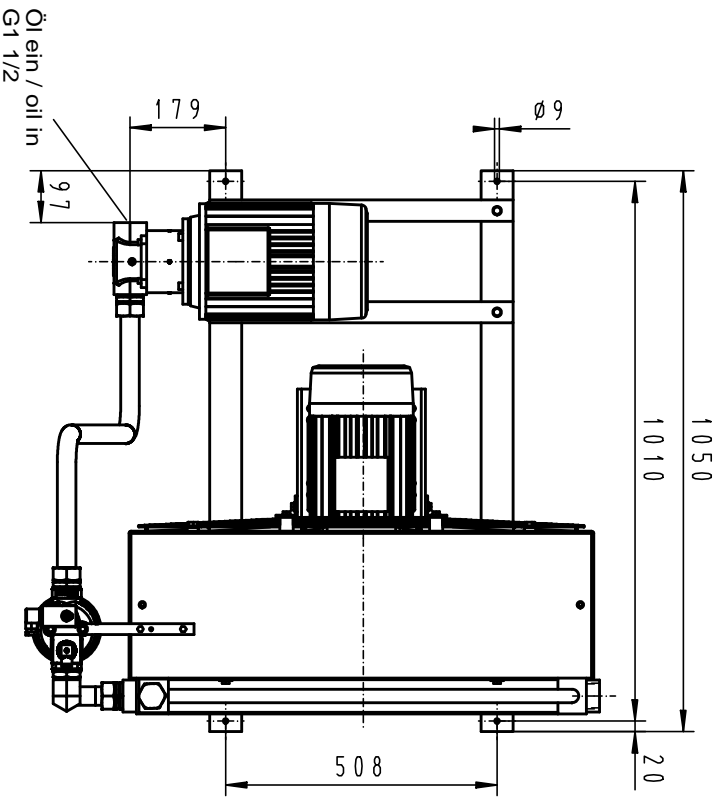
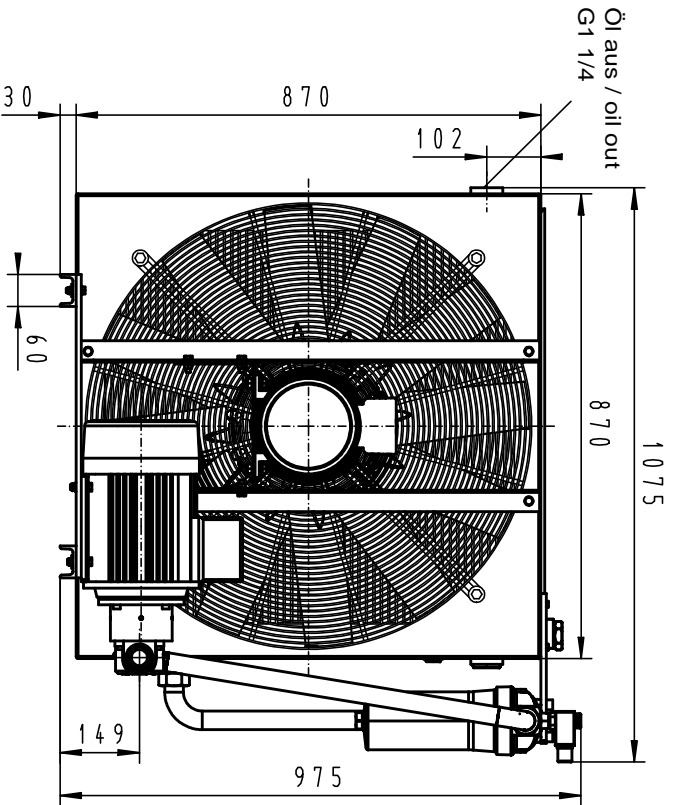
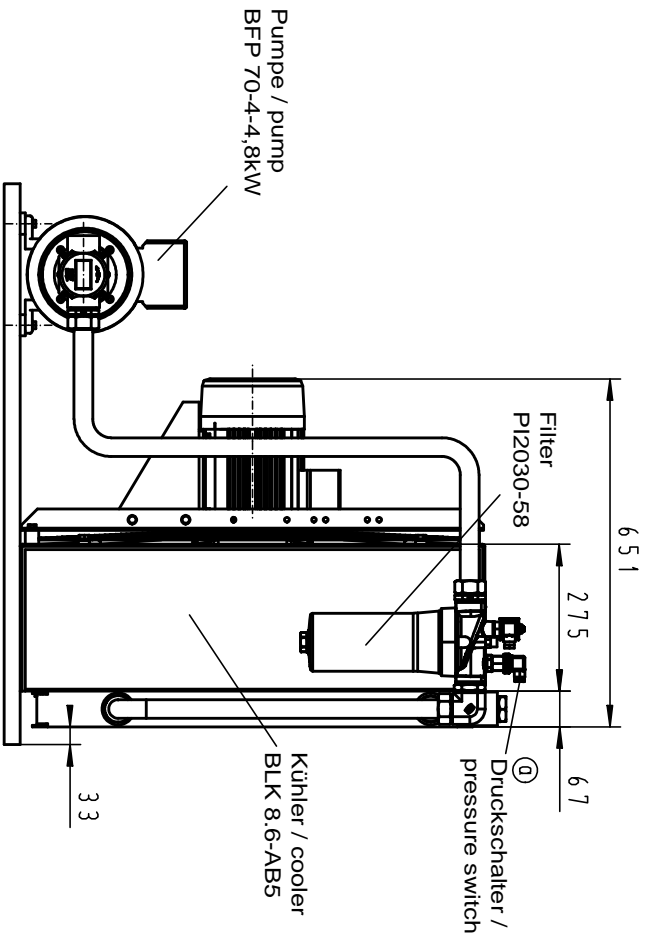


SEW-Nr. 13303228
 FGSL 60/PI 2030-58/BLK 8.6-ABS/BFP 60-4-4kW
 Motorspannung/ motor voltage
 230/400V 50Hz +/-5%

alle Konten gratfrei	ALLES RECHTE VORBEHALTEN	Maße ohne Toleranzangabe nach ISO 2768-mK	Maßstab 1:10 Herbstoff:	(Gewicht)
Oberflächenbear- beitungszeichen				
Beh.		Datum	Name	
✓ = ✓ _{Rz 63}		Bearb. 10.12.09	Vogl	
✓ = ✓ _{Rz 16}		Gepr.		
✓ = ✓ _{Rz 4}				
Z		Zust.	Ind.	Datum
		0	2x	30.07.10
				Sc
				Name
				Ers für
				BOHLER
				ARBEITSNHEISUNG:
				Ar.-Nr. 27SEW0AP050000S
				Zeichng.-Nr. 27/001-Z01-01-3R
				Benennung: Ölversorgungsanlage oil supply OAP 050-00/S



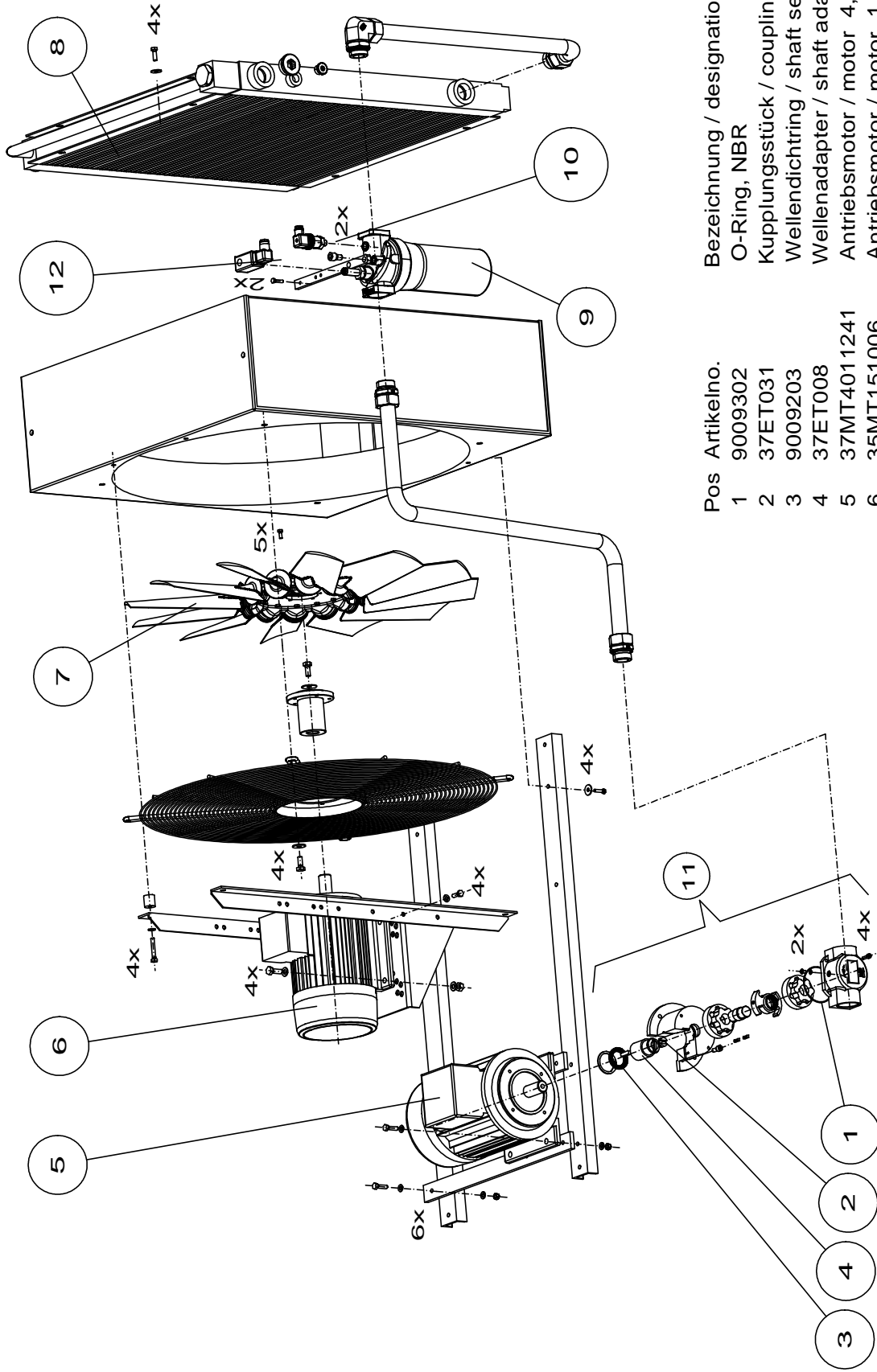
Pos	Artikelnr.	Bezeichnung / designation
1	9009302	O-Ring, NBR
2	37ET031	Kupplungsstück / coupling
3	9009203	Wellendichtring / shaft seal, NBR
4	37ET008	Wellenadapter / shaft adapter
5	37MT4011241	Antriebsmotor / motor 4 kW
6	35MT151006	Antriebsmotor / motor 1,5kW
7	35LR08241	Lüfterrad / fan
8	35RG08R2	Kühlregister / cooler matrix
9	7718802	Filterelement/ Filter PI 8330
10	27SEW13319817	Druckschalter / pressure switch 0,5 bar
11	37PU60220	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electr. switch



SEW-Nr. 13304046
 FGSL 70/PI 2030-58/BLK 8.6-AB5/BFP 70-4-4,8kW
 Motorspannung / motor voltage
 276/480V 60Hz +/-5%

alle Konten gratfrei	ALLE RECHTE VORBEHALTEN	Maße ohne Toleranzangabe nach ISO 2768-mK	Maßstab 1:10	(Gewicht)
Oberflächenbear- beitungszeichen			Herbststoff:	
Beh.		Datum	Benennung:	
✓ = ✓ _{Rz 63}		Bearb. 10.12.09	Ölversorgungsanlage	
✓ = ✓ _{Rz 16}		Gepr.	Oil supply	
✓ = ✓ _{Rz 4}			OAP 050-01/S	

Zuel.	0	Ziel. Hnd.	2x	Datum	30.07.10	Sc			
BÜHLER									
ARBEITSSINNEISUNG: 27SEW0AP050001S									



Pos Artikelno. Bezeichnung / designation

1	9009302	O-Ring, NBR
2	37ET031	Kupplungsstück / coupling
3	9009203	Wellendichtung / shaft seal ,NBR
4	37ET008	Wellenadapter / shaft adapter
5	37MT4011241	Antriebsmotor / motor 4,8 kW
6	35MT151006	Antriebsmotor / motor 1,8kW
7	35LR08242	Lüfterrad / fan
8	35RG08R2	Kühlregister / cooler matrix
9	7718802	Filterelement/ Filter PI 8330
10	27SEW13319817	Druckschalter / pressure switch 0,5 bar
11	37PU60220	Pumpenkopf komplett / pumphead complete
12	7536550	elektr. Oberteil / electr. switch

Bezeichnung/designation

Ersatzteilliste für Ölversorgungsanlage FGSL 70/BLK 8.6-AB5/BFP 70-4-4,8kW/ PI 2030-58

Spare parts list for oil supply FGSL 70/BLK 8.6-AB5/BFP 70-4-4,8kW/ PI 2030-58

Motorspannung/ motor voltage

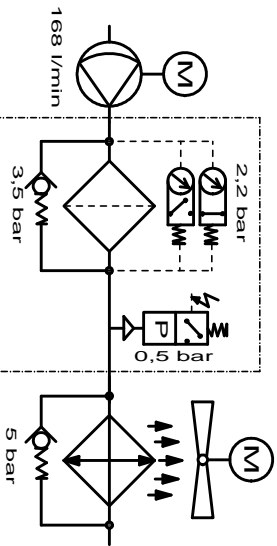
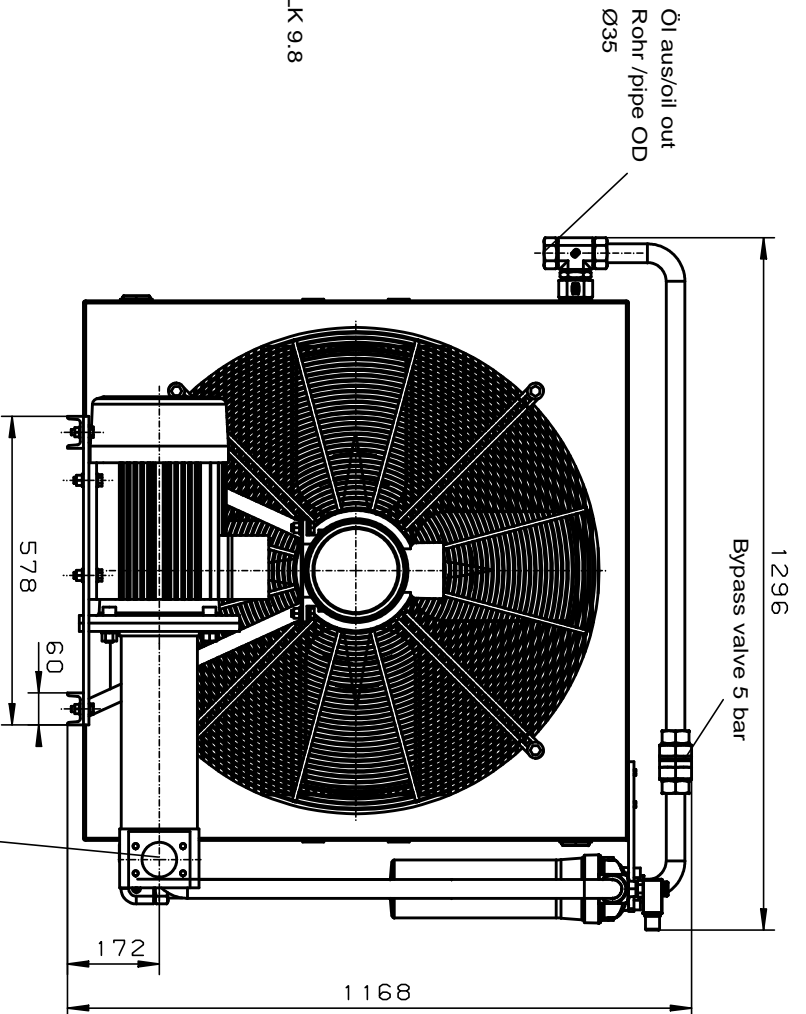
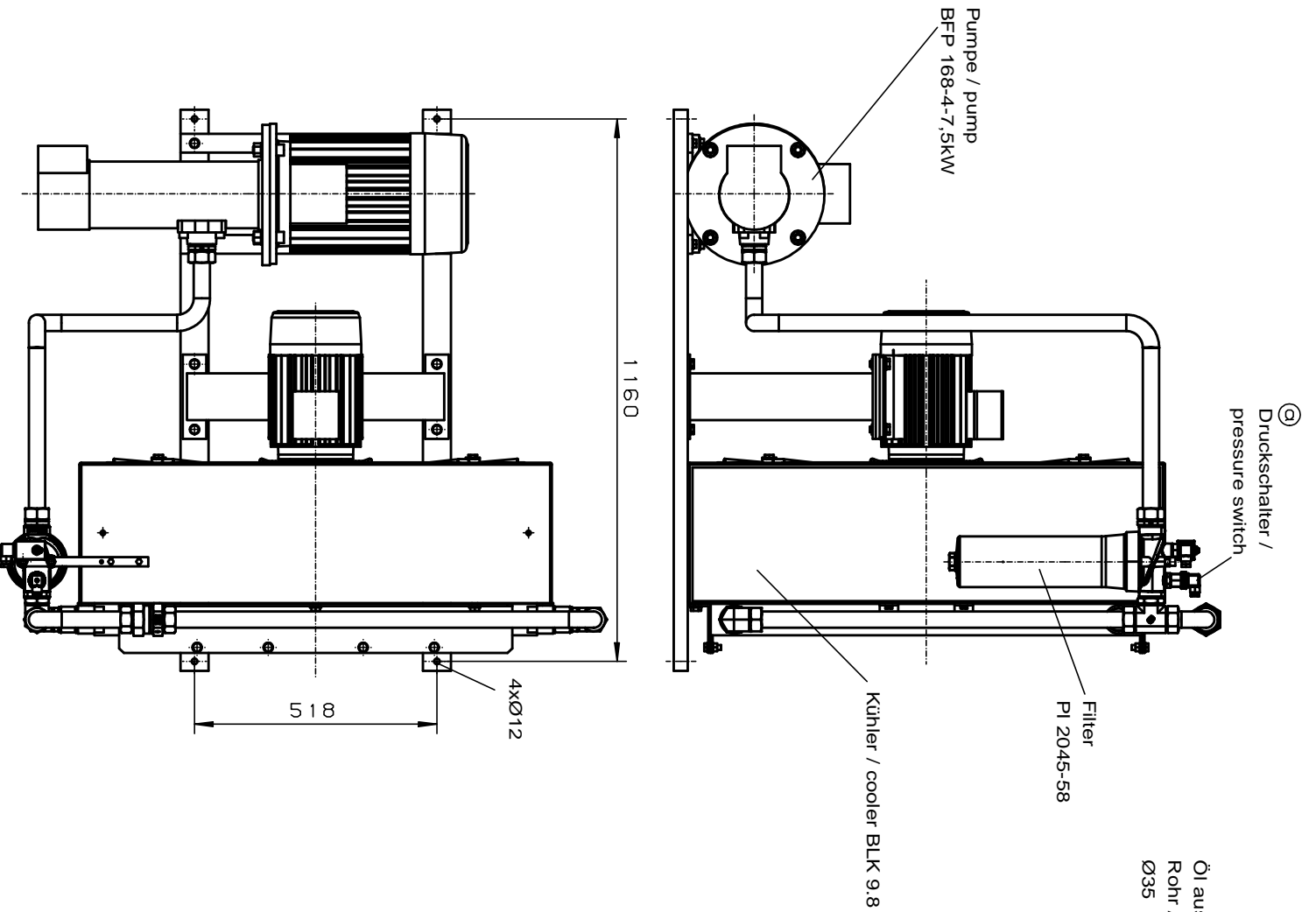
276/480V 60Hz +/-5%

SEW-Bezeichnung

OAP 050-01/S

SEW-Sachnummer

13304046

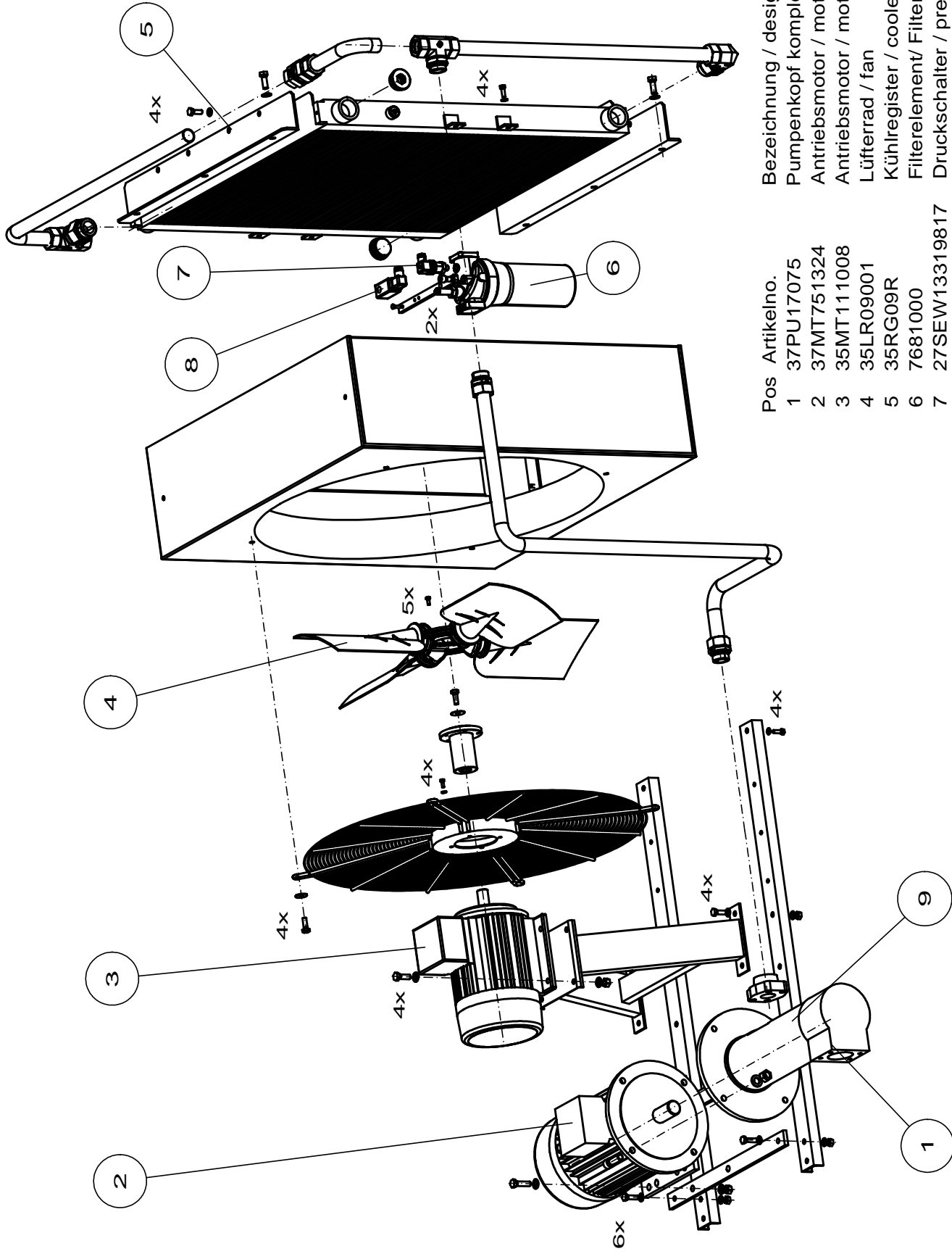


Ø ein/oil in
SAE2 1/2-3000psi
drehbar in 90°-Schritten
turnable in 90°-steps

SEW-Sachnummer 13303236
FGSL 168/PI 2045-58/BLK 9.8-ABS/BFP 168-4-7,5kW
Motorspannung / motor voltage
230/400V 50Hz +/-5%

alle Konten gratfrei	ALLE RECHTE VORBEHALTEN	Maße ohne Toleranzangabe nach ISO 2768-mK	Maßstab 1:10	(Gewicht)
Oberflächenbe- arbeitungs- zeichen		Datum	Herbststoff:	
✓ = R _h		14.01.10	Benennung:	
✓ = R _h 63			Ölversorgungsanlage	
✓ = R _h 16			oil supply	
✓ = R _h 4			ÖAP 060-00/S	

Ziel.	Ind.	Datum	Name	Ers für
0	1x	02.08.10	Sc	
Ar.-Nr. 27SEWÖAP060000S				
ARBEITSSCHNEIDUNG:				



Pos	Artikelnr.
1	37PU17075
2	37MT751324
3	35MT111008
4	35LR09001
5	35RG09R
6	7681000
7	27SEW13319817
8	7536550
9	37ET219

Bezeichnung / designation
Pumpenkopf komplett / pumphead complete
Antriebsmotor / motor 7,5 kW
Antriebsmotor / motor 1,1kW
Lüfferrad / fan
Kühlregister / cooler matrix
Filterelement/ Filter PI 8345
Druckschalter / pressure switch 0,5 bar
elektr. Oberteil / electr. switch
Dichtungssatz Pumpe / gasket set pump

Bezeichnung/designation

Ersatzteilliste für Ölversorgungsanlage FGSL 168/BLK 9.8-AB5/BFP 168-4-7,5kW/ PI 2045-58
 Spare parts list for oil supply FGSL 168/BLK 9.8-AB5/BFP 168-4-7,5kW/ PI 2045-58

Motorspannung / motor voltage 230/400V 50Hz +/-5%

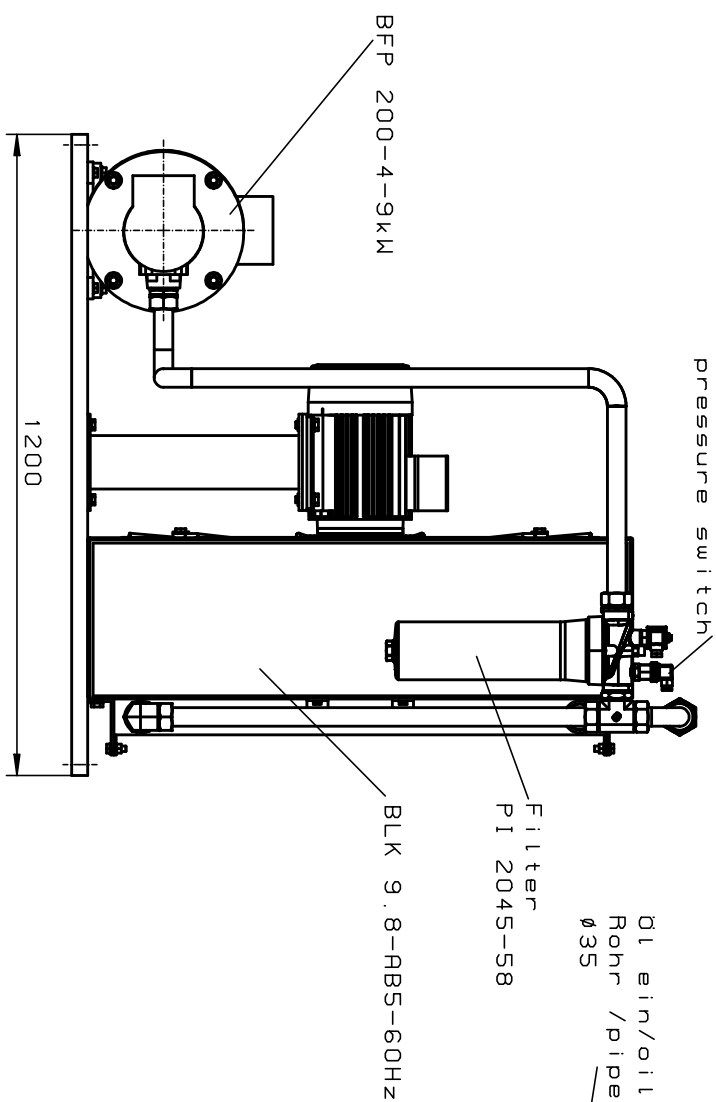
SEW-Bezeichnung

OAP 060-00/S

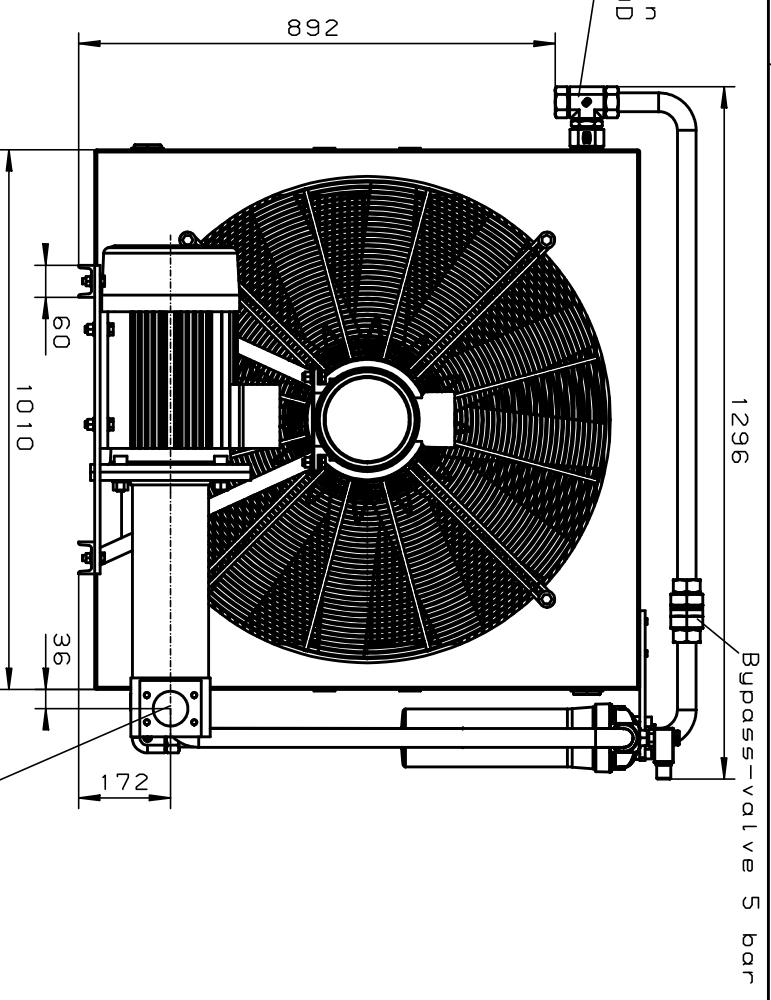
SEW-Sachnummer

13303236

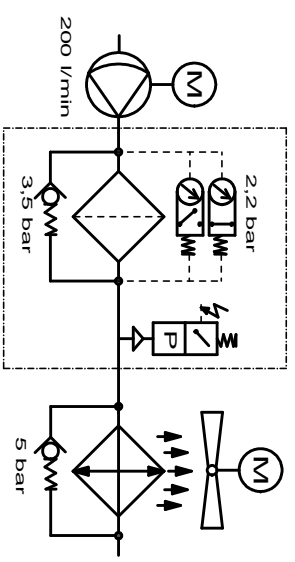
② Druckschalter /
pressure switch



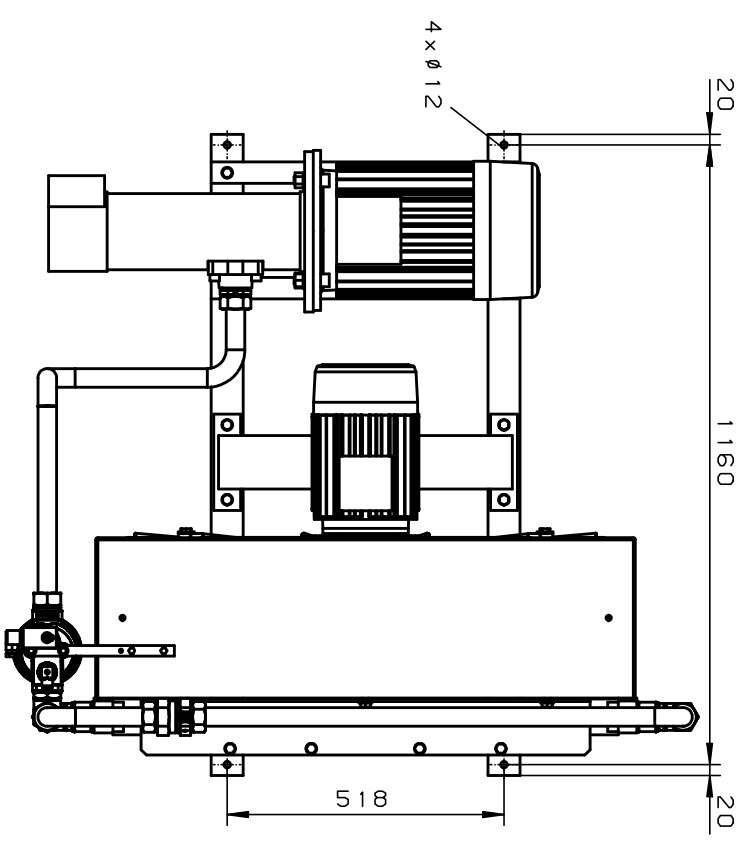
Öl ein/oil in
Rohr / pipe OD
Ø 35



Öl ein/oil in
SAE2 1/2-3000psi
drehbar in 90-Schritten
turnable in 90-steps

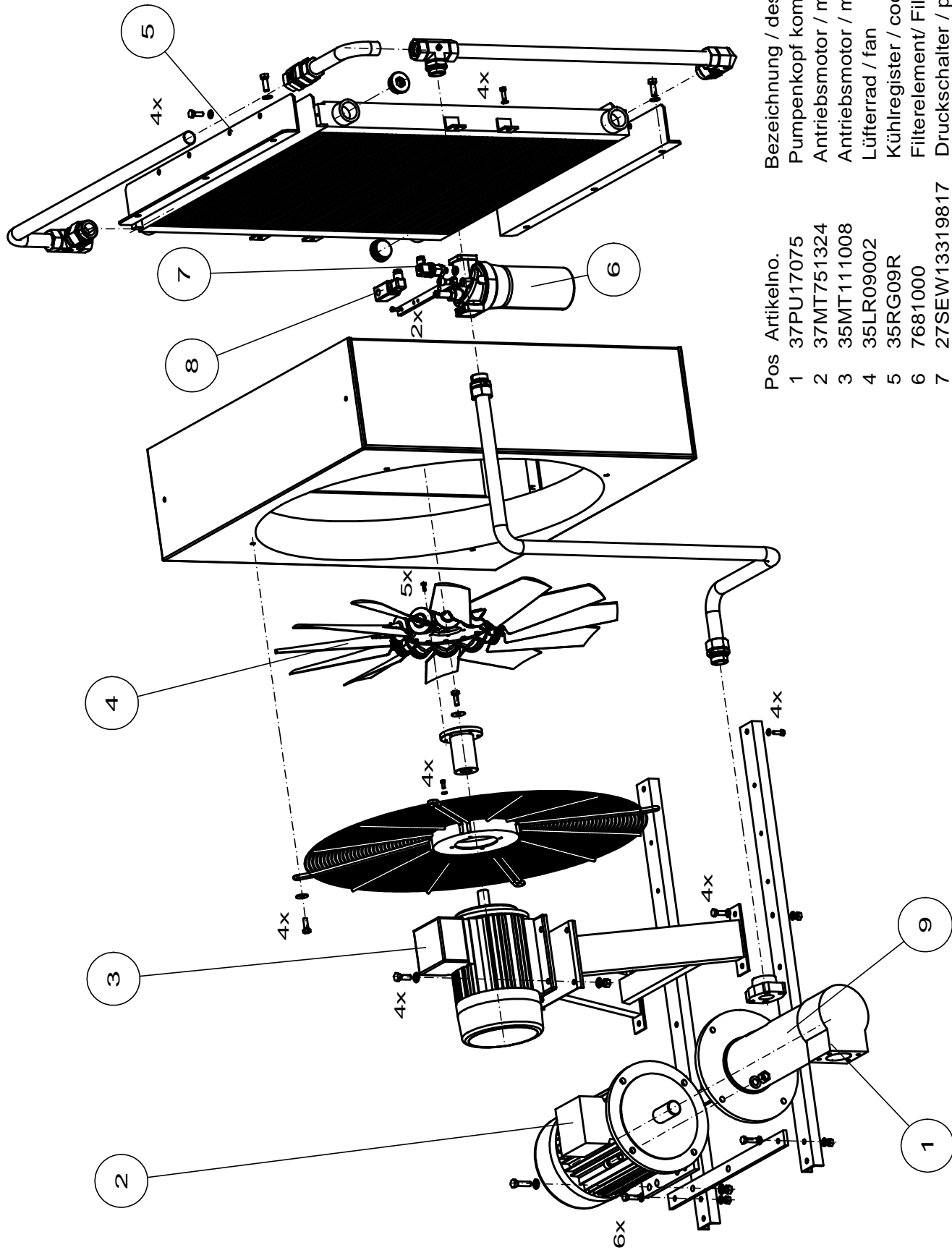


SEW-Sachnummer 13304054
FGSL 200/PI 2045-58/BLK 9.8-ABS-60HZ/BFP 200-4-9kW
Motorspannung / motor voltage
276/480V 60Hz +/-5%



alle Konten gratfrei	ALLES RECHTE VORBEHALTEN	Masse ohne Toleranzangabe nach ISO 2768-mK	Maßstab 1:10	(Gewicht)
Oberflächenbear- beitungszeichen			Kerbstoff:	
✓ = R _h		Datum	Benennung:	
✓ = R _h 63		Bearb. 14.01.10	Ölversorgungsanlage	
✓ = R _h 16		Gepr.	Oil supply	
✓ = R _h 4			OAP 060-01/S	
Z			Zeichnung-Nr. 27/004-Z01-01-3A	
			Arzt.-Nr. 27SEW0AP06001S	
			ARBEITSSPANNUNG:	





Bezeichnung / designation

Pumpenkopf komplett / pumphead complete
 Antriebsmotor / motor 9 kW
 Antriebsmotor / motor 1,3kW
 Lüfterrad / fan
 Kühlregister / cooler matrix
 Filterelement/ Filter PI 8345
 Druckschalter / pressure switch 0,5 bar
 elektr. Oberteil / electr. switch
 Dichtsatz Pumpe / gasket set pump

Pos Artikelno.

1 37PU17075
 2 37MT751324
 3 35MT111008
 4 35LR09002
 5 35RG09R
 6 7681000
 7 27SEW13319817
 8 7536550
 9 37ET219

Bezeichnung/designation

Ersatzteilliste für Ölversorgungsanlage FGSL 200/BLK 9.8-AB5/BFP 200-4-9kW/ PI 2045-58
 Spare parts list for oil supply FGSL 200/BLK 9.8-AB5/BFP 200-4-9kW/ PI 2045-58

Motorspannung / motor voltage
 276/480V 60Hz +/-5%

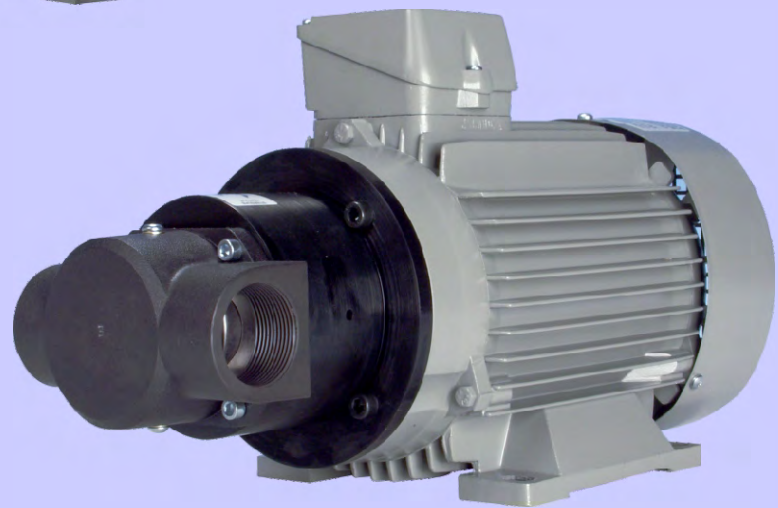
SEW-Bezeichnung

OAP 060-01/S

SEW-Sachnummer

13304054

Circulation pumps BFP

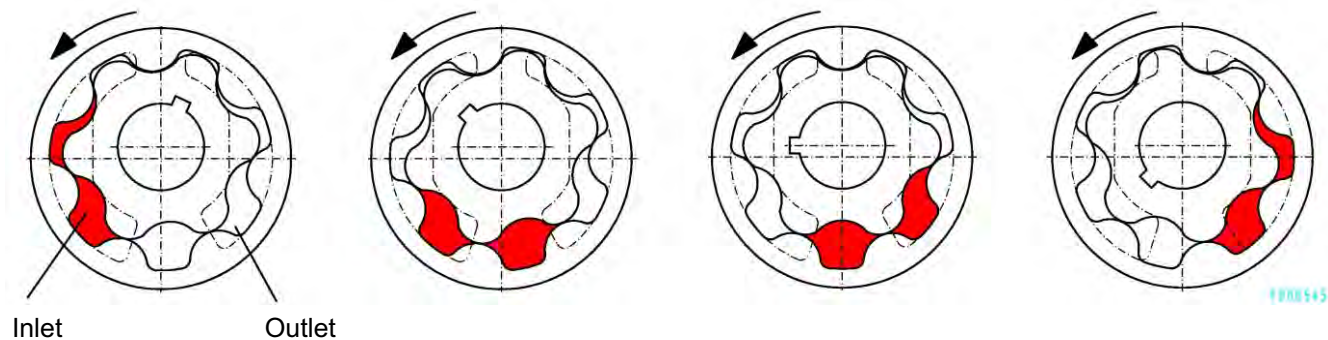


- Low noise emission
- High vol. efficiency
- Optimum suction
- Integrated bell housing
- Gerotor principle
- Resistant to contamination
- Reliable
- Well tested

Why a gerotor?

Numerous applications in hydraulic and lubrication systems just require the circulation of the fluid. In such cases low noise emissions and low pressure ripples are more important than highly efficient transmission of energy.

The gerotor is the ideal principle for such applications. The displacement mechanism consists of the inner and the outer rotor. The number of teeth of the inner rotor is always one less than the outer rotor. The rotation of the gerotor generates chambers of changing volumes between the inner and outer rotor. The variation of the volume follows a sinus curve with low amplitude resulting in a proportional flow with very low pressure ripples.



The relation between number of teeth, diameter and width of the gerotor has been chosen with the target for a very compact design featuring small physical dimensions, low weight and minimal loss in efficiency. The low differential of revolutions between the inner and outer rotor provides low vibration and long life. The internal design of the pump head reduces the loss of pressure and ensures good suction performance.

Why complete pump units?

Each additional component increases the physical volume of a system and results in higher space consumption and cost. Therefore the main target for the BFP-series was set to provide a compact solution. With the models BFP 5 up to 40 the gerotor is directly driven by the motor shaft. The larger pumps BFP 60 and 90 are driven with a special coupling where the motor shaft is integrated. This concept results in additional benefits like good cooling and lubrication.

Using standard IEC-motors the installation-ready pump unit is easy to integrate and saves administrative costs.

General Data

Pump body anodised and impregnated cast aluminum
Gerotor sintered steel

Operating fluids mineral oil according to DIN 51524
Fluid temperature max. 100°C
Sealing Perbunan (NBR)
on request: Viton (FPM)

Ambient temperature -20°C to + 40°C

Electric motors

Voltage 230/400 V, 50 Hz ±5%
276/480 V, 60 Hz ±5%

Protection class IP 55

Design three-phase asynchronous squirrel-cage induction motor,
totally enclosed fan cooled (TEFC)
Insulation Class F / temperature Class B

on request: other voltages
higher motor power for higher viscosity
UL or CSA- certified motors
higher protection class

All pumps are delivered without cable gland in the terminal box of the motor. The total length and height of the pump slightly differs depending on the motor brand.

Selection of pumps:

**Select the pump model by selecting the required motor power with respect to the viscosity of the oil used.
The stated motor power refers to the maximum oil viscosity at maximum working pressure.**

As an option pump models BFP 5 to BFP 40 can be equipped with an additional internal bypass valve opening at 6 bar. Dimensions are not affected.

Installation notes:

The pump head can be mounted for all models in rotating steps of 90° to align the connections to the piping layout. Regard the offset of the connection threads to the centerline of the motor. The threads are manufactured according to ISO 228. The sealing surfaces are machined and suitable for soft sealing. We recommend using thread ends according to ISO 1179-2.

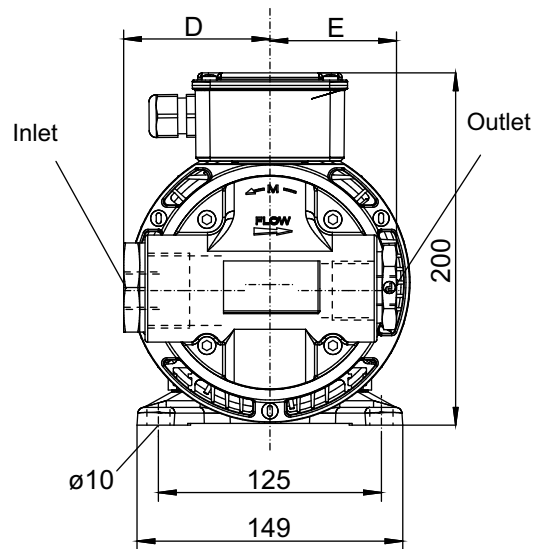
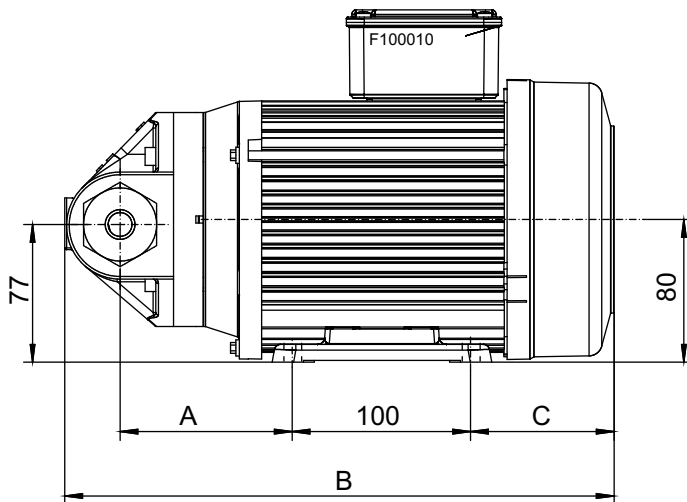
Note:

**Regard dimensioning of the suction line. The stated nominal cross-section should not be reduced. A high noise level normally indicates too low cross-section of the suction line.
Please take notice of the instructions in the manual.**

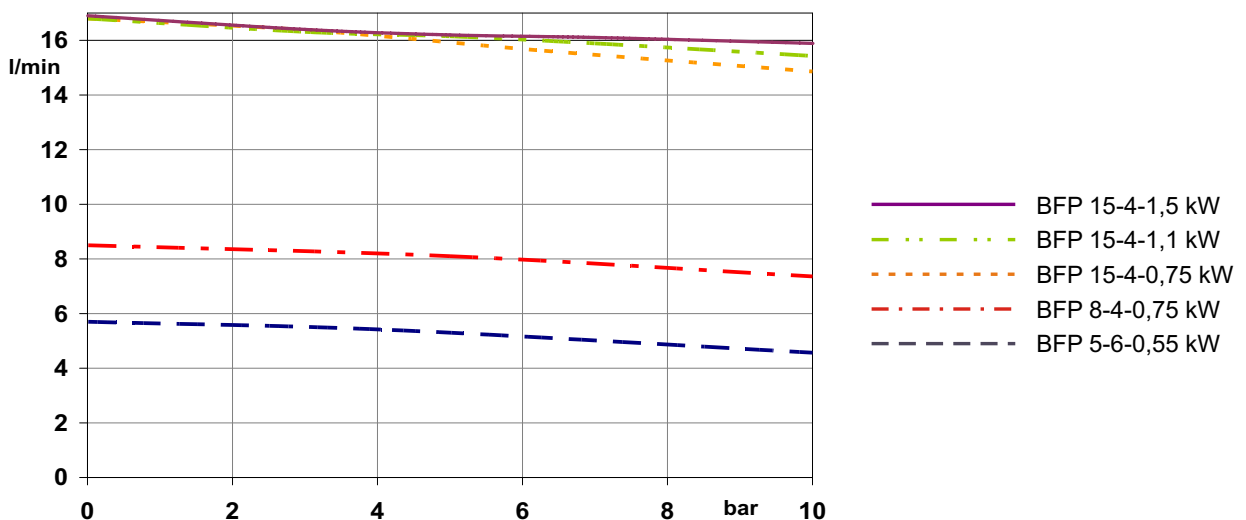
	BFP 5-6-0,55kW	BFP 8-4-0,75kW	BFP15-4-0,75kW	BFP15-4-1,1kW	BFP15-4-1,5kW
Part No.	3705055	3708075IE2	3715075IE2	3715110IE2	3715150IE2
Motor power	0,55 kW	0,75 kW	0,75 kW	1,1 kW	1,5 kW
Max. oil viscosity	1500 cSt	1500 cSt	300 cSt	1500 cSt	2000cSt
At max. working pressure	10 bar	10 bar	10 bar	10 bar	10 bar
Number of poles	6	4	4	4	4
Max. current consumption (400V/50Hz)*	ca. 1,8 A	ca. 2,1 A	ca. 2,1 A	ca. 2,7 A	ca. 3,5 A
Delivery volume nominal *	5,8 cm ³ /U	5,8 cm ³ /U	11,7 cm ³ /U	11,7 cm ³ /U	11,7 cm ³ /U
	5,5 l/min	8 l/min	16 l/min	16 l/min	16 l/min
Connection suction side	G1/2-DN16	G3/4/DN20	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32
Connection pressure side	G3/8-DN12	G1/2-DN16	G1-DN25	G1-DN25	G1-DN25
Suction pressure for all models temporarily up to	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar
Acoustic power acc. to ISO 3744*	52 dB(A)	56 dB(A)	59 dB(A)	59 dB(A)	59 dB(A)
Weight	10,8 kg	10,8 kg	10,9 kg	13,2 kg	16,2 kg
Dimensions (mm)					
A	96,5	96,5	96,5	96,5	96,5
B	308	308	308	346	368
C	80	80	80	118	140
D	82	82	70	70	70
E	71	71	60	60	60

* With 60 Hz versions, please multiply delivery volume and current consumption with 1.2. Acoustic emission increases by about 3 db.

BFP 5 / BFP 8 / BFP 15



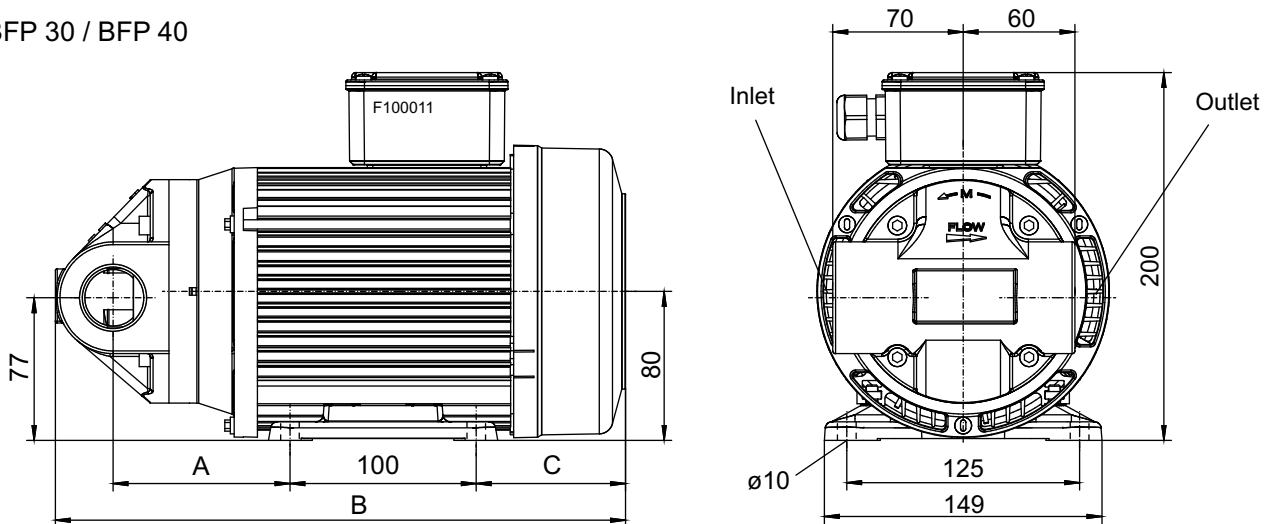
Flow rate BFP 5/ BFP 8/ BFP 15



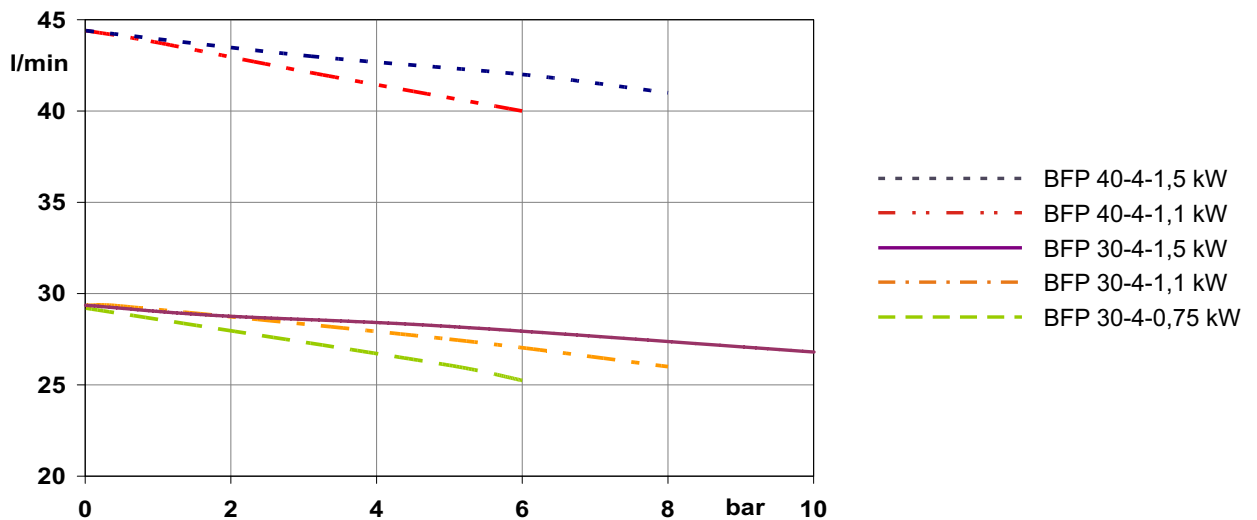
	BFP 30-4-0,75kW	BFP 30-4-1,1kW	BFP30-4-1,5kW	BFP40-4-1,1kW	BFP40-4-1,5kW
Part No.	3730075IE2	3730110IE2	3730150IE2	3740110IE2	3740150IE2
Motor power	0,75kW	1,1kW	1,5 kW	1,1kW	1,5kW
Max. oil viscosity	100 cSt	300 cSt	1000 cSt	100 cSt	700cSt
At max. working pressure	6 bar	8 bar	10 bar	6 bar	8 bar
Number of poles	4	4	4	4	4
Max. current consumption (400V/50Hz)*	ca. 2,1 A	ca. 2,7 A	ca. 3,5 A	ca. 2,7 A	ca. 3,5 A
Delivery volume nominal *	20,4 cm ³ /U	20,4 cm ³ /U	20,4 cm ³ /U	30,6 cm ³ /U	30,6 cm ³ /U
	29 l/min	29 l/min	29 l/min	42 l/min	42 l/min
Connection suction side	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32
Connection pressure side	G1-DN25	G1-DN25	G1-DN25	G1-DN25	G1-DN25
Suction pressure for all models temporarily up to	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar
Acoustic power acc. to ISO 3744*	61 dB(A)	61 dB(A)	61 dB(A)	62 dB(A)	62 dB(A)
Weight	11 kg	13,2 kg	16,2 kg	13,7 kg	16,7 kg
Dimensions (mm)					
A	95	95	95	104,5	104,5
B	306	344	366	354	376
C	80	118	140	118	140

* With 60 Hz versions, please multiply delivery volume and current consumption with 1.2. Acoustic emission increases by about 3 db.

BFP 30 / BFP 40



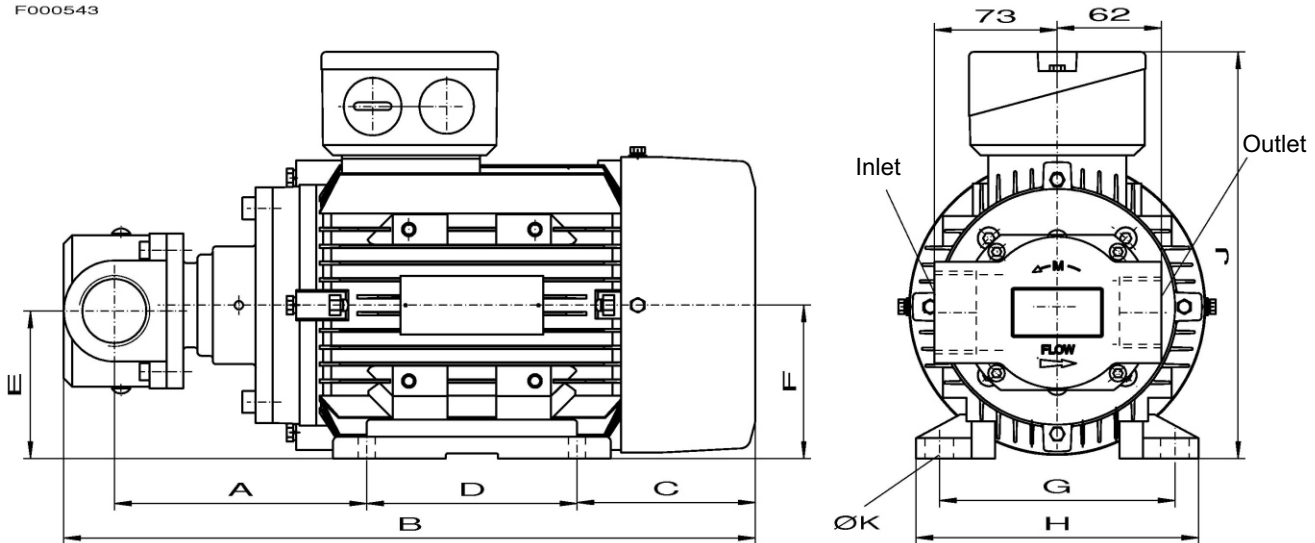
Flow rate BFP 30/ BFP 40



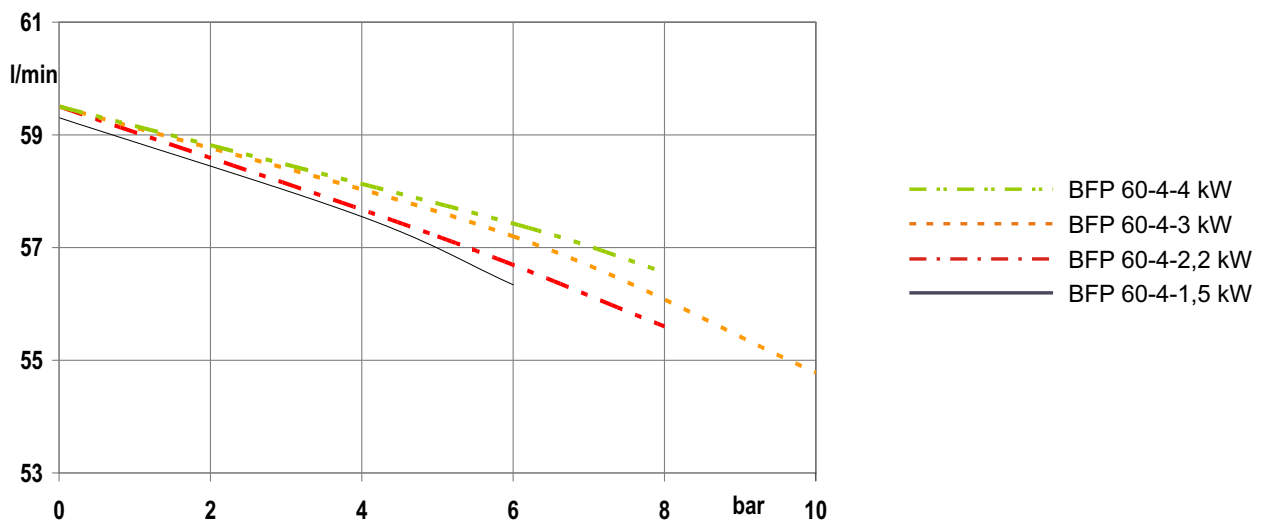
	BFP 60-4-1,5kW	BFP 60-4-2,2 kW	BFP 60-4-3kW	BFP 60-4-4kW
Part No.	3760150IE2	3760220IE2	3760300IE2	3760400IE2
Motor power	1,5 kW	2,2 kW	3 kW	4 kW
Max. oil viscosity	100 cSt	300 cSt	800 cSt	1500 cSt
At max. working pressure	6 bar	8 bar	10 bar	8 bar
Number of poles	4	4	4	4
Max. current consumption (400V/50Hz)*	ca. 3,6 A	ca. 4,9 A	ca. 6,4 A	ca. 8,3 A
Delivery volume nominal*	40,8 cm³/U	40,8 cm³/U	40,8 cm³/U	40,8 cm³/U
	58 l/min	58 l/min	58 l/min	58 l/min
Connection suction side	G1 1/2-DN40	G1 1/2-DN40	G1 1/2-DN40	G1 1/2-DN40
Connection pressure side	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32
"Suction pressure for all models temporarily up to"	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar
	-0,6 bar			
Acoustic power acc. to ISO 3744*	64 dB(A)	64 dB(A)	64 dB(A)	64 dB(A)
Weight	17,4 kg	23,2 kg	23,2 kg	32,6 kg
Dimensions (mm)				
A	150	172	172	179
B	410	448	466	476
C	104	105	123	126
D	125	140	140	140
E	87	97	97	109
F	90	100	100	112
G	140	160	160	190
H	175	198	198	222
J	226	248	248	276
K	10	12	12	12

* With 60 Hz versions, please multiply delivery volume and current consumption with 1.2. Acoustic emission increases by about 3 db.

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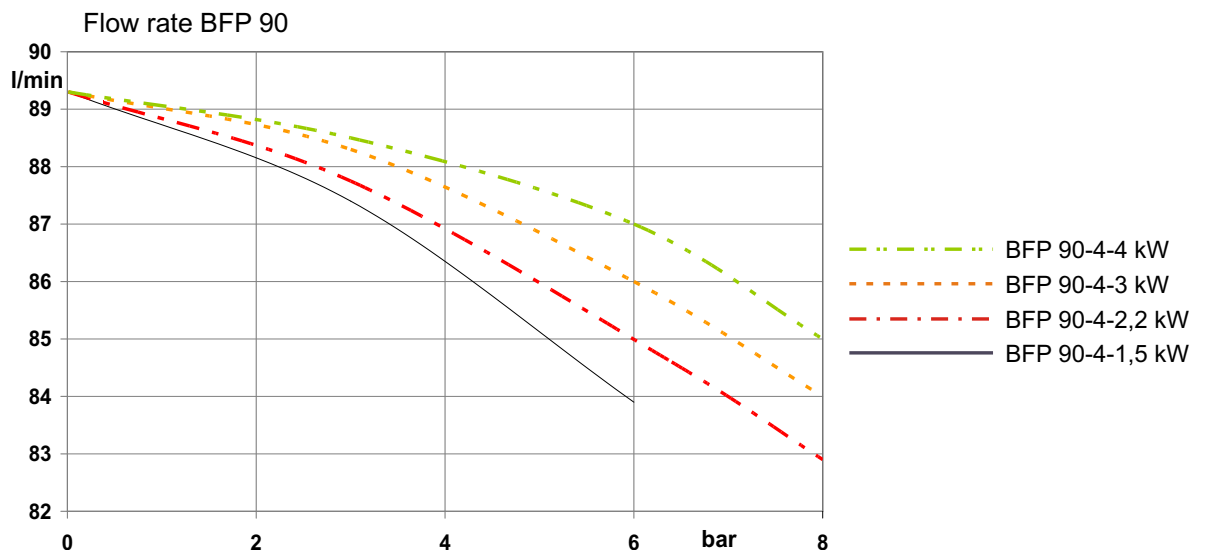
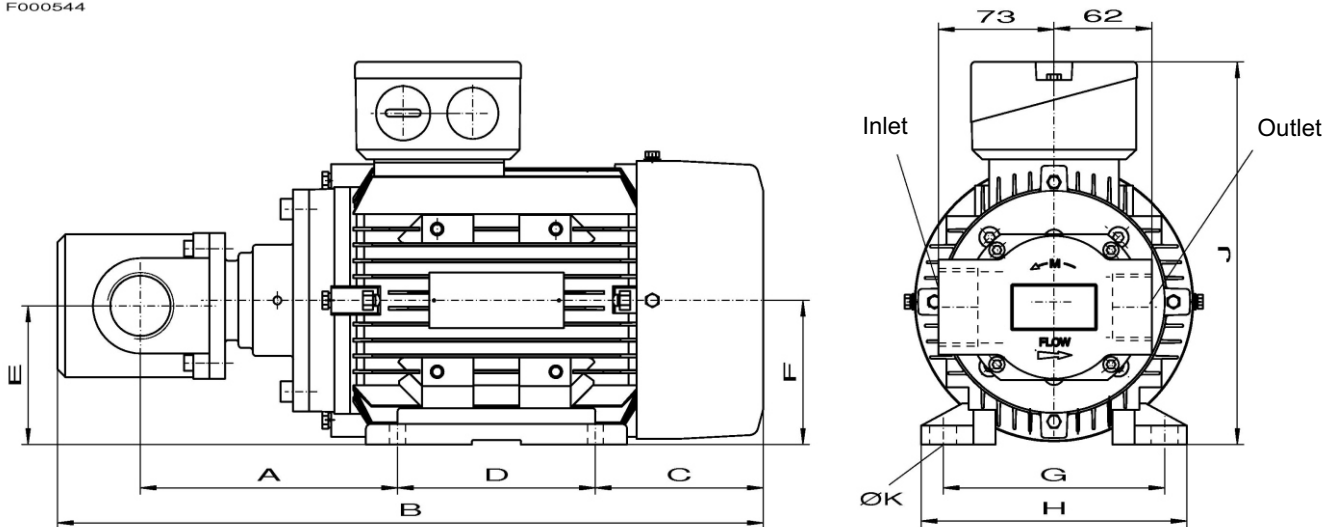
Flow rate BFP 60



	BFP 90-4-1,5kW	BFP 90-4-2,2 kW	BFP 90-4-3kW	BFP 90-4-4kW
Part No.	3790150IE2	3790220IE2	3790300IE2	3790400IE2
Motor power	1,5 kW	2,2 kW	3 kW	4 kW
Max. oil viscosity	46 cSt	100 cSt	300 cSt	1000 cSt
At max. working pressure	6 bar	8 bar	8 bar	8 bar
Number of poles	4	4	4	4
Max. current consumption (400V/50Hz)*	ca. 3,6 A	ca. 4,9 A	ca. 6,4 A	ca. 8,3 A
Delivery volume nominal*	61,2 cm³/U	61,2 cm³/U	61,2 cm³/U	61,2 cm³/U
	88 l/min	88 l/min	88 l/min	88 l/min
Connection suction side	G1 1/2-DN40	G1 1/2-DN40	G1 1/2-DN40	G1 1/2-DN40
Connection pressure side	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32	G1 1/4-DN32
"Suction pressure for all models temporarily up to"	-0,4 bar	-0,4 bar	-0,4 bar	-0,4 bar
	-0,6 bar			
Acoustic power acc. to ISO 3744*	65 dB(A)	65 dB(A)	65 dB(A)	65 dB(A)
Weight	19 kg	24,8 kg	24,8 kg	34,2 kg
Dimensions (mm)				
A	162,5	184,5	184,5	191,5
B	445	483	500	511
C	104	105	122	126
D	125	140	140	140
E	87	97	97	109
F	90	100	100	112
G	140	160	160	190
H	175	198	198	222
J	226	248	248	276
K	10	12	12	12

* With 60 Hz versions, please multiply delivery volume and current consumption with 1.2. Acoustic emission increases by about 3 db.

F000544



Recommendations for installation and operation

Place of installation

The place should be dry and clean and provide good air ventilation. The unit is fixed by four bolts.

Electrical connection

Make sure that the power supply corresponds with the data on the units type plate. Obey local safety regulations and standards. Make sure that the motor turns in the correct direction.

Hydraulic connection

Performance and efficiency of pumps depends highly on the proper design of the suction lines. Particularly in lubrication systems containing high viscous fluids the sufficient dimensions of pipes and fittings are very important. Whenever possible the suction line should be as short as possible. We recommend that detailed calculations are worked up for each application. Never go for lower dimensions of the suction tube then implicated by the respective suction port of the pump!

All pipes should be free of tension and vibration. Hoses on the suction line must be reinforced to prevent collapsing under suction pressure.

If the pump is not being used on a kidney loop filter unit, the oil should be maintained at a cleanliness class of 15/11 according to ISO 4406 for maximum longevity of the pump.

The specified suction pressure should only be exceeded temporarily. In some cases it can be necessary to fill the suction pipe prior to start up.

Prevent leakages or spills to protect the environment. Use dip pans or similar whenever appropriate.

The series BFP is a product designed by BÜHLER company

The company

BÜHLER Technologies GmbH, Ratingen was founded in 1969.

BÜHLER's corporate philosophy is to offer products and solutions representative of the state of the art.

BÜHLER also specialises in producing level and temperature measuring equipment, particularly for the fluid power industry.



The products

Our commitment to customers has given rise to a production program which comprises specialized products for fluid technology.

Although these products were initially developed entirely as specials many of them have now become industry standards.

Bühler quality

Bühler has achieved accreditation from Lloyd's register to be in compliance with ISO 9001 and therefore consider it our obligation to offer our customers not only excellent products, but also the best service possible.



FP000057

Lesen Sie die Bedienungsanleitung vor dem Gebrauch des Gerätes gründlich durch. Beachten Sie insbesondere die Hinweise unter Gliederungspunkt 2. Andernfalls könnten Gesundheits- oder Sachschäden auftreten. Die Bühler Technologies GmbH haftet nicht bei eigenmächtigen Änderungen des Gerätes oder für unsachgemäßen Gebrauch.

Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advice and safety instructions to prevent injuries. Bühler Technologies GmbH can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.



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1 Introduction

BFP circulation pumps are suited for the transportation of oils in hydraulic and lubrication systems. Their scope is given by their specifications. The use in other applications is not permitted without confirmation by Bühler Technologies GmbH.

2 Important advices

Please check before installation of the device that the technical data matches the application parameters. Also check that the delivery is complete.








Operation of the device is only valid if

- the product is used under the conditions described in the installation- and operation instruction, the intended application according to the type plate and the intended use,
- the performance limits given in the datasheets and in the installation- and operation instruction are obeyed,
- monitoring devices and safety devices are installed properly,
- service and repair is carried out by Bühler Technologies GmbH, unless described in this manual,
- only original spare parts are used.

This manual is part of the equipment. The manufacturer keeps the right to modify specifications without advanced notice. Keep this manual for later use.

2.1 General indication of risk

The following warning signs and signal words are used in this manual:

	Warning against hazardous situation		Warning against high pressure
	Warning against electrical voltage		Warning against rotating parts
	Warning against hot surface		Disconnect from mains
	Warning against environmental damage		

Signal words for warnings:

NOTE	Signal word for important information to the product.
CAUTION	Signal word for a hazardous situation with low risk, resulting in damaged to the device or the property or minor or medium injuries if not avoided.
WARNING	Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.
DANGER	Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided.

Installation of the device shall be performed by trained staff only, familiar with the safety requirements and risks.

Adhere to all relevant safety regulations and technical indications for the specific installation place. Prevent failures and protect persons against injuries and the device against damage.




The person responsible for the system must secure that:

- safety and operation instructions are accessible and followed,
- local accident prevention regulations and standards are obeyed,
- performance data and installation specifications are regarded,
- safety devices are installed and recommended maintenance is performed,
- national regulations for disposal of electrical equipment are obeyed.

Maintenance and repair

- Repairs on the device must be carried out by Bühler authorized persons only.
- Only perform modifications, maintenance or mounting described in this manual.
- Only use original spare parts.

During maintenance regard all safety regulations and internal operation instructions.

	 DANGER	
	<p>Electrical voltage</p> <p>Electrocution hazard.</p> <p>Before opening the cover or working on electrical components, disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally.</p> <p>Installation and maintenance must be carried out by trained staff only. Regard correct mains supply.</p>	

3 Placing and mounting

3.1 Transport

Secure pump safely for transportation.

3.2 Installation site requirements






Make sure that sufficient air flow is provided. Make sure that the hose on the suction side withstands under pressure, e.g. by using hoses with steel mesh.

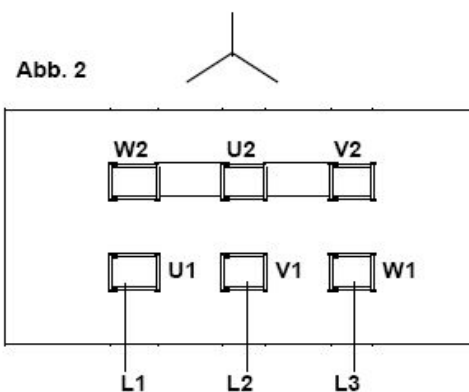
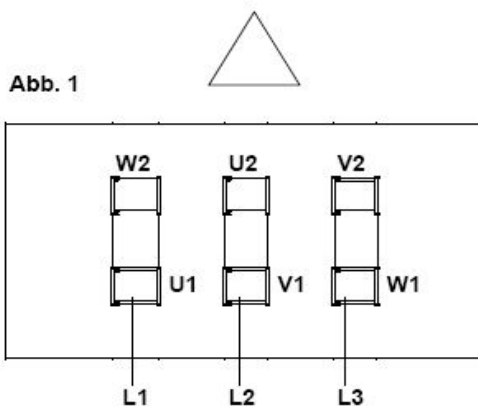
The pumps are mounted with four bolts through their mounting feet to an adequate support structure.

In order to protect pump and system from damage, the connections between pump and system should be stress and vibration free. The use of flexible hoses is highly recommended.

Please comply with local safety requirements and avoid any risk to the environment from oil spills etc. Use collecting pans if necessary.

3.3 Electrical connection

	 DANGER	
	<p>Electrical voltage</p> <p>Electrocution hazard.</p> <p>Before opening the cover or working on electrical components, disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally.</p> <p>Installation and maintenance must be carried out by trained staff only. Regard correct mains supply.</p>	
	<p> CAUTION</p> <p>Electrical voltage</p> <p>Wrong mains voltage may damage the device.</p> <p>Installation of the device shall be performed by trained staff only. Regard the voltage given on the type plate. Make sure that the cables have sufficient strain relief.</p> <p>Fusing</p> <p>Fusing has to be done due to local standards</p> <p>Polarity</p> <p>Take care of the directional rotation of the motor. The rotation direction is indicated on the motor housing "M" and an arrow.</p>	



The rotational direction is changed by exchanging the connection two phases.

For calculating the correct values of fuses and cross-section of connection wires, refer to local rules and standards. The motor and, if equipped, starting devices must be connected to protective earth.

Lead fuses protect the cables in case of a short cut, but are not sufficient to protect the motor coils from burning due to overload. Therefore, install an adequate motor circuit breaker with high precision range of adjustment for thermal protection to protect the motor against overload and operation with two phases.

Adjust the motor circuit breaker according to the nominal value given on the type plate of the motor. Operation out of the limits for mains voltage and frequency range is prohibited.

3.4 Hydraulic connections

The connecting line between pump and system should be free of tension and vibration. We recommend using flexible hoses which of course must be able to stand the negative pressure in the suction line. Use wire reinforced hoses for example.

Contaminated liquids reduce the life time of the pumps elements. Therefore we suggest filtering with a minimum of $\beta_{25} \geq 75$.

Make sure that the diameter of the suction line is not smaller than given in the technical data.

The pump produces a maximum suction pressure of 0.4 bar (5.8 psi). At first start-up, problems may occur with hydraulic systems with long suction lines because the suction line contains too much air. In this case, we recommend filling the suction line with oil and using a suction valve without spring.

3.5 Calculations

3.5.1 Formula to calculate the operational viscosity

Valid for VG-oil between 10 - 100 °C (50 - 212 °F) at an exactness of $\pm 5\%$.

definitions
 V_{40} = viscosity oil at 40°C (cst)
 T = temperature (°C)
 ν = viscosity (cst)

example for oil VG 46
 V_{40} = 46 cst
 T = 25°C (77 °F)

$$b = 159 \cdot \ln \frac{V_{40}}{0,23}$$

$$b = 159 \cdot \ln \frac{46}{0,23} = 842,4325$$

$$a = 0,23 \cdot e^{\frac{-b}{877}}$$

$$a = 0,23 \cdot e^{\frac{-842,4325}{877}} = 0,08801$$

$$\nu = a \cdot e^{\frac{b}{T+95,2}}$$

$$\nu = 0,08801 \cdot e^{\frac{842,4325}{25+95,2}} = 97,35 \text{ cst}$$

3.5.2 Table of operational viscosity for VG oil

	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C	90 °C
VG 46	264.45	131.96	73.58	46.00	29.13	20.04	14.43	10.78	8.32
VG 68	444.77	210.85	112.61	68.00	41.63	27.86	19.58	14.32	10.84
VG 220	2.120.17	861.60	404.31	220.00	121.71	74.99	49.00	33.61	24.01
VG 320	3.489.92	1 350.22	607.96	320.00	171.40	102.85	65.66	44.12	30.94

Specification: cst (mm²/s)

3.5.3 Formula to calculate the pressure loss

Valid for smooth straight piping per meter at laminar flow.

<i>definitions:</i>		<i>example:</i>	
ν	viscosity in cst	ν	= 97.35 cst
S	spec. gravity (kg/dm ³)	S	= 0,8817 kg/dm ³
DN	Pipe diameter (mm)	DN	= 20 mm
V	pressure loss (bar)	V	= 3.18 m/s (60 l/min for pipe DN 20)
PV	Velocity of flow (m/s)		

$$PV = \frac{0.32 \cdot \nu \cdot S \cdot V}{DN^2}$$

$$PV = \frac{0.32 \cdot 97.35 \cdot 0.8817 \cdot 3.18}{20^2} = 0.22 \text{ bar}$$

!

NOTE

Pressure loss increases significantly for bends and fittings.
It might be necessary in some cases to determine the final shape of the suction line on site under specific conditions.

Please do not hesitate to contact us for help to calculate the pressure loss of the suction line for you specific application.

!

NOTE






To avoid damage of the device, make sure that the maximum pump pressure is not exceeded. High pressure may occur if the system is shut off or throttled at the pressure side.

4 Operation and Maintenance

4.1 Before starting

- Check that all parts are free of damage.
- Check the correct connections of oil and power circuits according to chapter "placing and mounting".
- Make sure that all valves or other parts in the cooling circuit which have to be opened are opened.

4.2 At first start

	WARNING
	Hot surface Burning hazard Let the device cool down before maintaining or cleaning.
	CAUTION
	High pressure Risk of injury by flying parts / oil, environmental hazard by oil. Before starting maintenance or repairs on the oil circuit make sure that the device is depressurized. This is also valid for the locking screws.
	Avoid environmental pollution during cleaning or maintenance on the oil circuit. Use appropriate collecting vessels.

Check that the pump rotates counterclockwise. If not, change the electrical connection. An arrow and marking "M" on the front of the housing indicate the rotation direction of the pump.

5 Service and Disposal

Please tell us the type of pump and the serial number, which can both be found on the type plate. Returns of devices should be made to the address given under 5.1 with a description of the problem. Please mark it with repair or claim, whichever is the case.

5.1 Service

If the device shows irregularities see chapter 6.1 for troubleshooting.

If you need help or more information

call tel. no. +49 (0) 21 02 - 49 89 55 or your local agent.

If the device doesn't work correctly after elimination of failures and turning power on, the device must be checked by the manufacturer. Please ship the pump with suitable packing to






Buehler Technologies GmbH
Department repair
Halskestrasse 23
D-40880 Ratingen

5.2 Disposal

Regard the local regulations for disposal, especially for the disposal of electric and electronic equipment.

6 Troubleshooting and servicing

6.1 Safety instructions for the repair

	⚠ DANGER	
	<p>Electrical voltage Electrocutation hazard</p> <p>Disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally.</p> <p>The device must be opened by trained staff only.</p>	
	⚠ WARNING	
	<p>Hot surface Burning hazard</p> <p>Let the device cool down before maintaining or cleaning.</p>	
 	⚠ CAUTION	
	<p>High pressure Risk of injury by flying parts / oil, environmental hazard by oil.</p> <p>Before starting maintenance or repairs on the oil circuit make sure that the device is depressurized. This is also valid for the locking screws.</p> <p>Avoid environmental pollution during cleaning or maintenance on the oil circuit. Use appropriate collecting vessels.</p>	

6.2 Troubleshooting hints

Problem	Cause	Helping hints
No oil flow / oil flow too low	– Rotating direction false	– Connect correctly
	– Motor doesn't run	– Connect correctly
	– Oil flow too low	– Connect correctly
	– Oil circuit blocked	– Open all stopping valves
	– suction pressure too high	– Choose suction pipe/hose which is wide enough
		– reduce suction height
Pump is too loud	– suction pressure too high	– Choose suction pipe/hose which is wide enough
		– reduce suction height

7 Technical data

Fluids mineral oil according to DIN 51524

Operating temperature oil max. 100°C

Ambient temperature - 20°C to + 40°C

Mains voltage 230/400V, 50 Hz +/- 5%
 276/480V, 60 Hz +/- 5%

Protection class IP 55

	BFP 5	BFP 8	BFP 15	BFP 15	BFP 15	BFP 30	BFP 30	BFP 30	BFP 40	BFP 40
Power output	0.55 kW	0.75	0.75 kW	1.1 kW	1.5 kW	0.75 kW	1.1 kW	1.5 kW	1.1 kW	1.5 kW
Poles	6	4	4	4	4	4	4	4	4	4
Current (400 V 50 Hz)	~ 1,8 A	~ 2.0	~ 2.0	~ 2.7	~ 3.5	~ 2.0	~ 2.7	~ 3.5	~ 2.7	~ 3.5

	BFP 60	BFP 60	BFP 60	BFP 60	BFP 90	BFP 90	BFP 90	BFP 90
Power output	1.5 kW	2.2 kW	3.0 kW	4.0 kW	1.5 kW	2.2 kW	3.0 kW	4.0 kW
Poles	4	4	4	4	4	4	4	4
Current in A (400 V 50 Hz)	~ 3.6 A	~ 4.9 A	~ 6.4 A	~ 8.3 A	~ 3.6 A	~ 4.9 A	~ 6.4 A	~ 8.3 A

	BFP 5	BFP 8	BFP 15	BFP 30	BFP 40	BFP 60	BFP 90
Connection suction side	G ½	G ¾	G 1 ¼	G 1 ¼	G 1 ¼	G 1 ½	G 1 ½
Suction side hose	DN16	DN 20	DN 32	DN 32	DN 32	DN 40	DN 40
Connection pressure side	G ¾	G 1	G 1 ¼	G 1 ¼	G 1 ¼	G 1 ½	G 1 ½
Pressure side hose	DN 12	DN 16	DN 25	DN 25	DN 25	DN 32	DN 32
Pressure max.	10 bar	10 bar	10 bar	10 bar	10 bar	10 bar	8 bar

Pressure loss for smooth straight piping per meter at laminar flow: see chapter 9

8 Attached documents

- Declaration of Conformity KX370001

9 Druckverlust in geraden Rohrleitungen pro Meter bei laminarer Strömung

9 Pressure loss in straight pipes per metre at laminar flow

BFP 8 15/28 l/min - DN 32		VG 46	VG 68	VG 120	VG 160	VG 220	VG 320	VG 460	VG 680
10 °C	0.05	0.08	0.16	0.24	0.37	0.61	1.00	1.68	
20 °C	0.02	0.04	0.07	0.10	0.15	0.24	0.37	0.59	
30 °C	0.01	0.02	0.04	0.05	0.07	0.11	0.16	0.24	
40 °C	0.01	0.01	0.02	0.03	0.04	0.05	0.08	0.12	
50 °C	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.06	
60 °C	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	
70 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	
80 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
90 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

BFP 15 15/28 l/min - DN 32		VG 46	VG 68	VG 120	VG 160	VG 220	VG 320	VG 460	VG 680
10 °C	0.05	0.08	0.16	0.24	0.37	0.61	1.00	1.68	
20 °C	0.02	0.04	0.07	0.10	0.15	0.24	0.37	0.59	
30 °C	0.01	0.02	0.04	0.05	0.07	0.11	0.16	0.24	
40 °C	0.01	0.01	0.02	0.03	0.04	0.05	0.08	0.12	
50 °C	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.06	
60 °C	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	
70 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	
80 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
90 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

BFP 30 15/28 l/min - DN 32		VG 46	VG 68	VG 120	VG 160	VG 220	VG 320	VG 460	VG 680
10 °C	0.05	0.08	0.16	0.24	0.37	0.61	1.00	1.68	
20 °C	0.02	0.04	0.07	0.10	0.15	0.24	0.37	0.59	
30 °C	0.01	0.02	0.04	0.05	0.07	0.11	0.16	0.24	
40 °C	0.01	0.01	0.02	0.03	0.04	0.05	0.08	0.12	
50 °C	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.06	
60 °C	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	
70 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	
80 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
90 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

BFP 60 57 l/min - DN 40		VG 46	VG 68	VG 120	VG 160	VG 220	VG 320	VG 460	VG 680
10 °C	0.04	0.06	0.13	0.20	0.30	0.50	0.81	1.40	
20 °C	0.02	0.03	0.06	0.08	0.12	0.19	0.30	0.49	
30 °C	0.01	0.02	0.03	0.04	0.06	0.09	0.13	0.20	
40 °C	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.09	
50 °C	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	
60 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.03	
70 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	
80 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
90 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

BFP 90 86 l/min - DN 40		VG 46	VG 68	VG 120	VG 160	VG 220	VG 320	VG 460	VG 680
10 °C	0.06	0.09	0.20	0.30	0.46	0.76	1.25	2.10	
20 °C	0.03	0.04	0.09	0.13	0.19	0.29	0.46	0.76	
30 °C	0.02	0.02	0.04	0.06	0.09	0.13	0.20	0.30	
40 °C	0.01	0.01	0.02	0.03	0.05	0.07	0.10	0.14	
50 °C	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.08	
60 °C	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04	
70 °C	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	
80 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	
90 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	
100 °C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	

Der Druckverlust wird durch Rohrbögen und Eckverschraubungen etc. drastisch erhöht. Gegebenenfalls muss die endgültige Dimensionierung und Verlegung der Saugleitung in der Anlage empirisch ermittelt werden.

The real pressure loss might be increased by bends and fittings significantly. It might be necessary in some cases to determine the final shape of the suction line on site under specific conditions.

EG-Konformitätserklärung **EC-declaration of conformity**



Hiermit erklären wir, dass die nachfolgenden Produkte den wesentlichen Anforderungen der folgenden EG-Richtlinie in ihrer aktuellen Fassung entsprechen:

Herewith we declare that the following products correspond to the essential requirements of the following EC directive in its actual version:

2006/42/EG (Maschinenrichtlinie / *machinery*)

Folgende weitere Richtlinien wurden berücksichtigt / *the following directives were regarded*

2006/95/EG (Niederspannungsrichtlinie / *low voltage directive*)

2004/108/EG (EMV / *EMC*)

Produkte / *products*:

Förderpumpen

Circulation pumps

Typ(en) / *type(s)*:

BFP

Zur Beurteilung der Konformität wurden folgende harmonisierte Normen in aktueller Fassung herangezogen:

The following harmonized standards in actual revision have been used:

- EN 12100-1 **Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 1: Grundsätzliche Terminologie, Methodologie**
- EN 12100-2 **Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 2: Technische Leitsätze**
- EN 60204-1 **Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen**
- EN 55011 **Industrielle, wissenschaftliche und medizinische Geräte - Funkstörungen - Grenzwerte und Messverfahren**
- EN 61000-6-2 **Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche**

Dokumentationsverantwortlicher für diese Konformitätserklärung ist der Unterzeichnende mit Anschrift am Firmensitz.

The person authorised to compile the technical file is the one that has signed and is located at the company's address

Ratingen, den 14.07.2010

Stefan Eschweiler
Geschäftsführer – *general manager*



Oil / Air Cooler Series BLK



- Maintenance friendly design
- Compact dimensions
- Low noise emissions
- Broad performance range
- Rugged cooling matrix
- Comprehensive accessories

Why coolers?

There are basically two main concepts in the development of fluid power systems. One is to design systems without using a cooler, and if operational conditions show that the system needs a cooler, install it later at additional costs.

The other concept recognises that a system originally designed with an integrated cooler is more compact, needs less installation space and is more reliable due to the stabilized temperature of the fluid.

Why Bühler?

Today's requirements for an oil/air cooler demand for an effective and compact design with low noise emission and very easy maintenance.

The development of the new BLK series is based on over 30 years of experience in design and sales of air/oil-coolers. In particular the fatigue life of the cooling matrix was highlighted in the development as the matrix has to withstand pressure peaks in the return line.

Due to the exposure to the various ambient conditions air/oil cooler matrixes inevitably require some maintenance. Therefore the cooling matrix can be easily separated from the fan case without the need to dismantle the ventilator, the motor or any other parts.

If our comprehensive standard range of products does not have the solution for your application we will be pleased to find special solutions for your application.

The data contained in this leaflet should be sufficient to determine the right cooler for your application. However, we can offer you a computer program which makes this sizing easier for you.



BNK



BNF, BKF

Description

The BLK series consist of the following components:

- cooler matrix
- fan case with mounting feet
- fan motor assembly consisting of AC motor, fan and finger guard

The cooling matrix and fan can be separated from the fan case individually without the need to dismantle other components.

The cooling matrix of the BLK series is made from aluminium. The matrix is suitable for use with hydraulic fluids but is not suitable for water or water based fluids.

The cooling matrix can be equipped with by-pass valves of different configurations (see type code).

Please note the installation chapter.

Depending on the application or system requirements, off line filtration is often the appropriate solution. We recommend in these cases that you combine this off line circuit with an off line cooler. Suitable units can be found in our BNK series. These units are also suitable for upgrading existing systems.

Sizing the right Cooler

The determination of a cooler follows two steps:

- determination of cooler size
- determination of expected pressure loss

Definitions

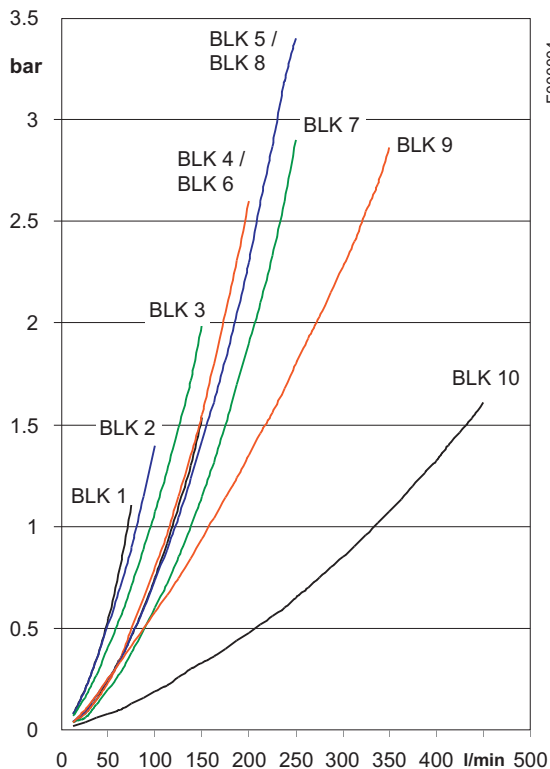
t_{OE} [°C]	inlet oil temperature
t_{LE} [°C]	inlet air temperature
ETD [K]	temperature differential: ETD = $t_{OE} - t_{LE}$
P_{spez} [kW / K]	specific cooling performance (see performance curves) $P_{spez} = P / ETD$
P [kW]	cooling performance in kW
Q [l/min]	oil flow rate
C_{oi} [kJ/kgK]	specific heat capacity of oil (approx. 2.0 kJ / kgK)
[kg/dm ³]	specific gravity of oil ≈ 0.9 kg/dm ³

Calculation Example:

Assumptions:

Tank capacity	(V)	ca. 200 l
Start up temperature of oil	(T_1)	15 °C
The oil is heated up approx.		
25 minutes to	(T_2)	45 °C
Required oil temperature	(t_{OE})	60 °C
Inlet air temperature	(t_{LE})	30 °C
Oil flow rate	(Q)	80 l/min

Pressure loss curves determined with an average viscosity of 30 cSt



Attention: If the coolers are used in open air or the oil has even higher viscosity the installation of by-pass valves may be necessary. Please check the section “functions schemes”.

Calculation

1. Calculation of P

$$P = \frac{200 \times 0.9 \times 2.0 \times (45-15)}{25 \times 60} = 7.2 \text{ kW}$$

2. $ETD = t_{OE} - t_{LE} = 60^\circ\text{C} - 30^\circ\text{C} = 30 \text{ K}$

3. Required specific performance:

$$P_{spez} = P / ETD = 7.2 \text{ kW} / 30 \text{ K} = 0.24 \text{ kW/K}$$

4. Using the graph, select a cooler at 80 l/min with:

$$P_{spez} 0.24 \text{ kW/K:}$$

There are two possibilities:

BLK 2.2, or alternatively BLK 3.4, this cooler is larger but has the lower noise emission

Temperature/viscosity table

Type of oil	at 50°C	at 60°C	at 70°C
VG 16	9,4	5,6	3,3 cSt
VG 22	15	11	8 cSt
VG 32	21	15	11 cSt
VG 46	29	20	14 cSt
VG 68	43	29	20 cSt
VG 120	68	44	31 cSt
VG 220	126	77	51 cSt
VG 320	180	108	69 cSt

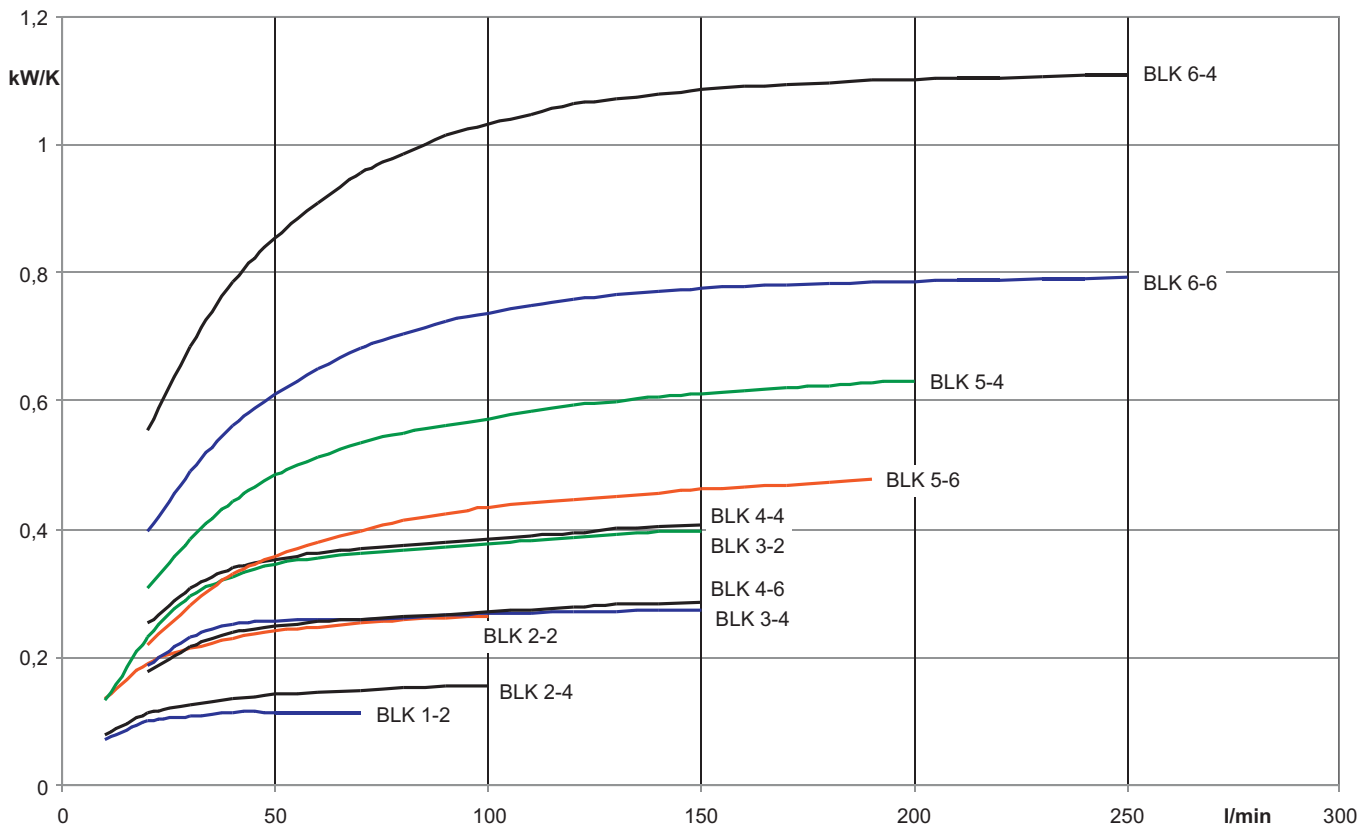
Correction factor k(visc)

viscosity (cSt)	k(visc)	viscosity (cSt)	k(visc)
10	0,6	60	1,6
20	0,8	80	2,1
30	1,0	100	2,7
40	1,2	150	4,2
50	1,4		

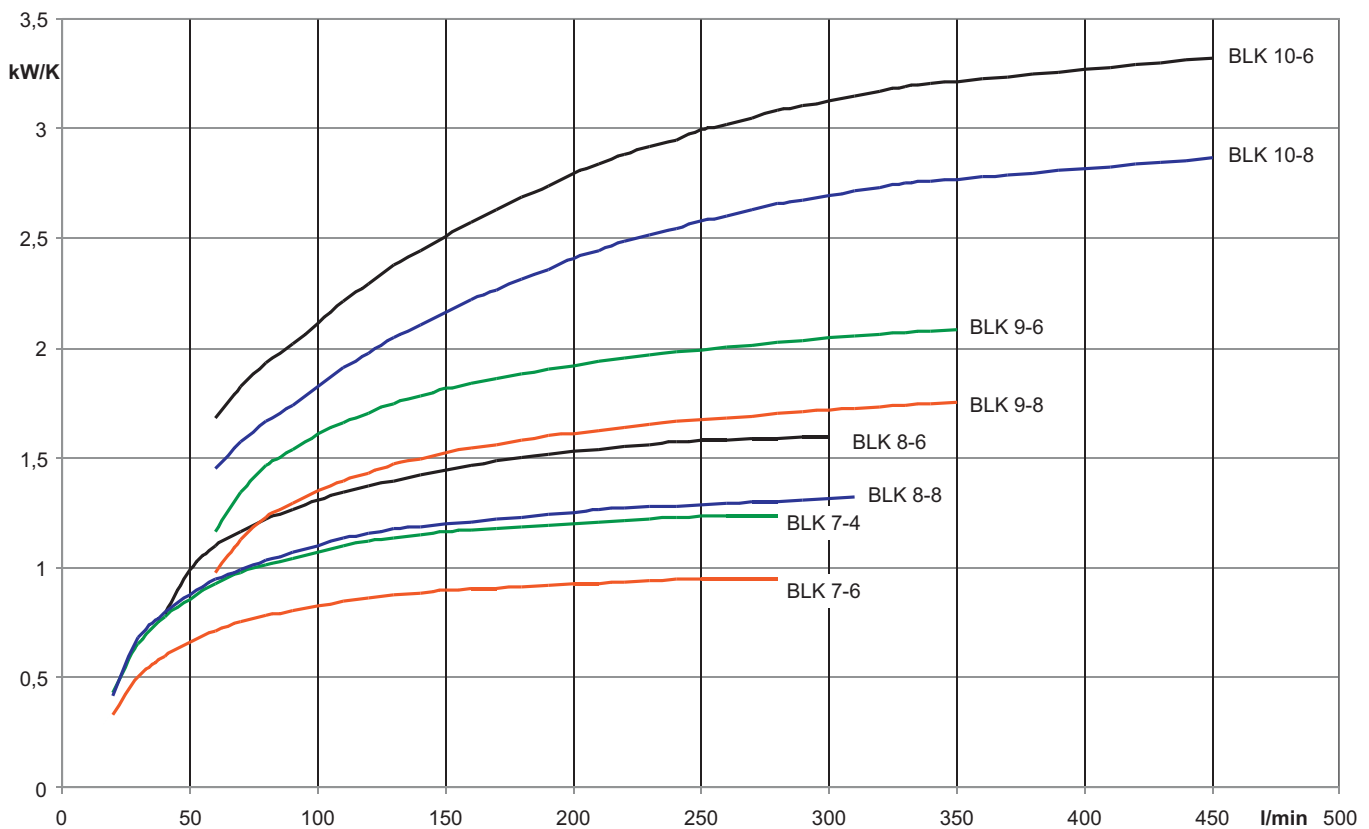
Determine of real pressure loss:

1. Select in graph the Δp at Q of a chosen cooler type
2. Determine real viscosity from temperature/viscosity table
3. Take correction factor k(visc) according to real viscosity and multiply with Δp in bar

Performance Curves BLK Size 1 to 6



Performance Curves BLK Size 7 to 10



General Data

Material / surface protection

Cooling matrix aluminium, varnished
 Fan case, finger guard and motor console mild steel powder coated

Colour RAL 7001

Fluids

Mineral oil according to DIN 51524
 Oil/water emulsion HFA /HFB according to CETOP RP 77 H
 Water glycol HFC according to CETOP RF 77 H
 Phosphate ester HFD-R according to CETOP RP 77 H

Operating pressure

static max. 21 bar

Operating temperature

Media max. 120°C
Max. viscosity 100 cSt average viscosity, higher viscosities upon request

Electrical motors

(others on demand):
 Voltage
 BLK 1.2 230 V 50Hz
 BLK 2.2 - BLK 10.8 230 / 400 V 50Hz ± 5%
 276 / 480 V 60Hz ± 5%
 Insulation class F
 Rise in temperature B
 Protection class IP 55
 Design according to IEC 34-1, IEC 72-1, DIN 57530, VDE 0530

Basic Data (at 50 Hz)

Part no.	Type	Motor power output	Full load current at 400V	Motor poles	Weight (kg)	Volume (l)	Noise emission db(A)*
3501200	BLK 1.2	0,25 kW	0,24A 230V	2	7	0,8	65
3502200	BLK 2.2	0,55 kW	1,42 A	2	23	1,3	81
3502400	BLK 2.4	0,25 kW	0,84 A	4	23	1,3	66
3503200IE2	BLK 3.2	1,1 kW	2,52 A	2	31	1,8	87
3503400	BLK 3.4	0,25 kW	0,84 A	4	28	1,8	71
3504400	BLK 4.4	0,37 kW	1,11 A	4	34	2,3	73
3504600	BLK 4.6	0,18 kW	0,6 A	6	34	2,3	63
3505400IE2	BLK 5.4	0,75 kW	1,8 A	4	45	3,1	79
3505600	BLK 5.6	0,25 kW	0,87 A	6	42	3,1	68
3506410IE2	BLK 6.4	2,2 kW	4,59 A	4	77	4,1	86
3506610	BLK 6.6	0,55 kW	1,65 A	6	60	4,1	74
3507410IE2	BLK 7.4	2,2 kW	4,59 A	4	87	5,4	89
3507610	BLK 7.6	0,55 kW	1,65 A	6	72	5,4	75
3508610IE2	BLK 8.6	1,5 kW	3,3 A	6	95	6,3	79
3508810	BLK 8.8	0,55 kW	1,85 A	8	91	6,3	73
3509610IE2	BLK 9.6	2,2 kW	4,85 A	6	159	8,2	86
3509810	BLK 9.8	1,1 kW	3,2 A	8	155	8,2	79
3510610IE2	BLK 10.6	5,5 kW	11,3 A	6	256	19	90
3510810	BLK 10.8	2,2 kW	5,96 A	8	241	19	84

The part numbers for BLK 2 -5 are 50/60 Hz versions, for BLK 6-10 the 50 Hz versions only, the 60 Hz versions are available upon request.

* DIN EN ISO 3744, class 3

Type code

BLK 4. 6-IBx - T50

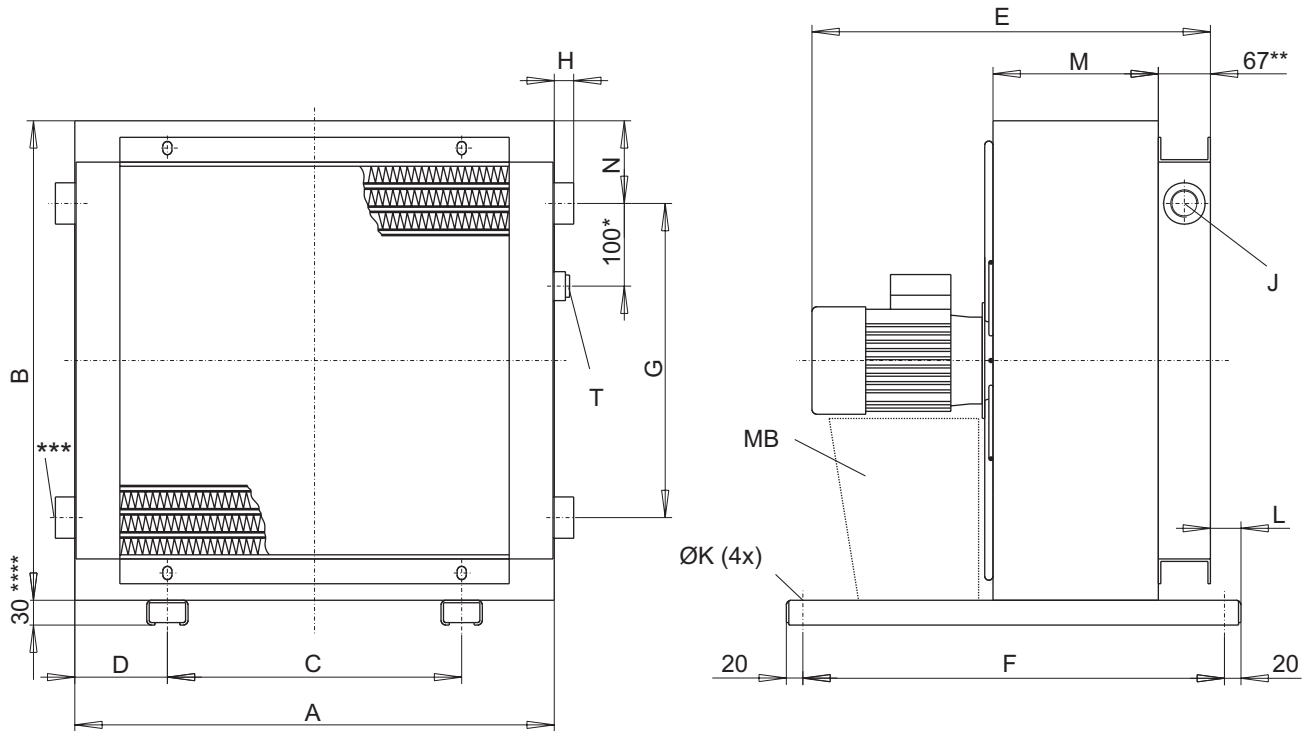
number of poles (see table)
 size (see table)

BLK 4. 6-IBx - T50

If the by-pass valve or if the temperature switch are needed the following codes have to be added:

By-pass version	AB IBx x ITB ATB	external by-pass integrated by-pass by-pass pressure 2; 5 or 8 bar integrated temperature operated by-pass 2 bar / 45°C external temperature operated by-pass 2 bar / 45°C
Temperature switch	T50,T60 T70,T80	figures stand for °C, details see separate data sheet

Dimensions



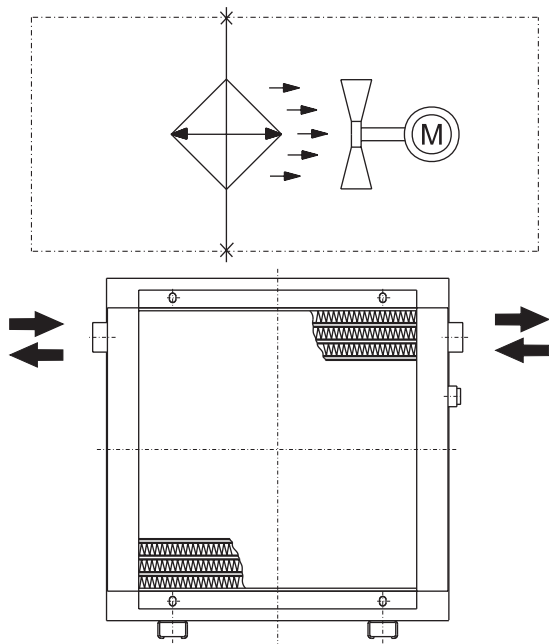
- MB some types have consoles to support motor
T connection G ½ for temperature switch
connection M14 x1,5 for temperature switch BLK 1
* BLK 9 and 10 = 150 mm
** BLK 1 = 45 mm
BLK 10 = 94 mm
*** connection only at BLK 9 and 10
**** BLK 1 = 15 mm

cooler type	A	B	C	D	E	F	G	H	J	K	L	M	N	MB
BLK 1.2	315	244	190	62,5	144	165	-	-	2x G1/2	7	20	50	33	-
BLK 2.2	370	370	203	83,5	415	510	-	25	2x G1	9	33	125	106	-
BLK 2.4	370	370	203	83,5	415	510	-	25	2x G1	9	33	125	106	-
BLK 3.2	440	440	203	118,5	477	510	230	25	3x G1	9	33	150	105	-
BLK 3.4	440	440	203	118,5	440	510	230	25	3x G1	9	33	150	105	-
BLK 4.4	500	500	203	148,5	465	510	230	25	3x G1	9	33	175	104	-
BLK 4.6	500	500	203	148,5	465	510	230	25	3x G1	9	33	175	104	-
BLK 5.4	580	580	356	112	523	510	305	23,5	3x G1	9	33	200	100	-
BLK 5.6	580	580	356	112	490	510	305	23,5	3x G1	9	33	200	100	-
BLK 6.4	700	700	356	172	605	510	410	9,5	3x G1 1/4	9	33	225	110	x
BLK 6.6	700	700	356	172	545	510	410	9,5	3x G1 1/4	9	33	225	110	x
BLK 7.4	700	840	356	172	630	510	590	9,5	3x G1 1/4	9	33	250	91	x
BLK 7.6	700	840	356	172	570	510	590	9,5	3x G1 1/4	9	33	250	91	x
BLK 8.6	870	870	508	181	644	510	585	11	3x G1 1/4	12	33	275	101,5	x
BLK 8.8	870	870	508	181	620	510	585	11	3x G1 1/4	12	33	275	101,5	x
BLK 9.6	1010	1020	518	246	713	510	822	3	4x G1 1/2	12	78	300	99	x
BLK 9.8	1010	1020	518	246	693	510	822	3	4x G1 1/2	12	73	300	99	x
BLK 10.6	1185	1185	600	292,5	830	910	940	5	4x SAE 2 1/2"	12	73	325	130	x
BLK 10.8	1185	1185	600	292,5	858	910	940	5	4x SAE 2 1/2"	12	73	325	130	x

Connection BLK 10 = SAE 2 ½" flange - 3000 psi

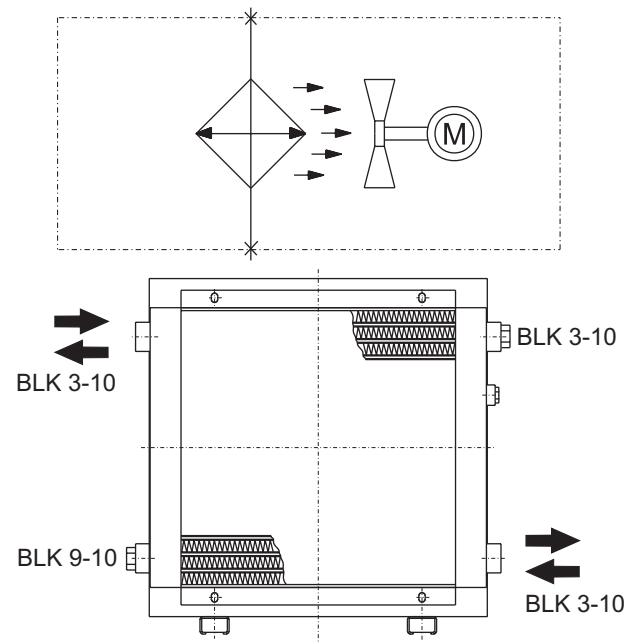
Function Schemes

Standard BLK 2



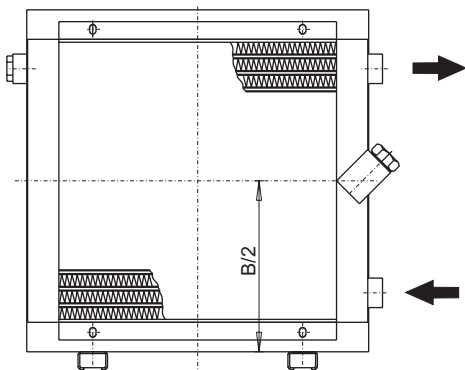
Flow direction optional from left to right or vice versa.

Standard BLK 1/3 to BLK 10



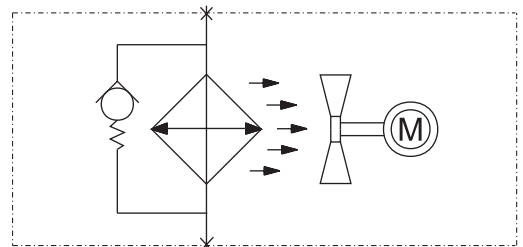
Flow direction optional from high left to low right or vice versa. Other ports must be plugged.

Internal by-pass IB/ITB (BLK 3-9)

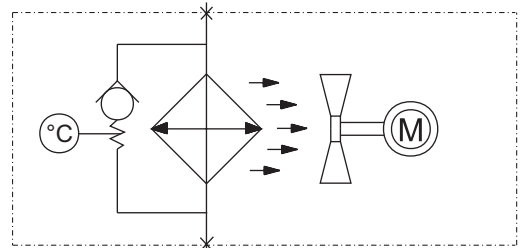


Oil inlet and outlet are always at the same side. Ports on opposite side must be plugged.

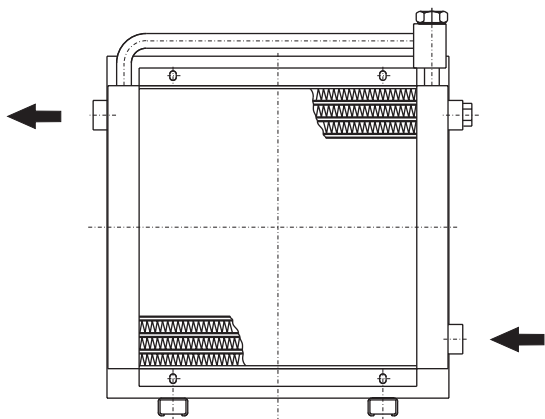
With by-pass valve



With temperature operated by-pass valve

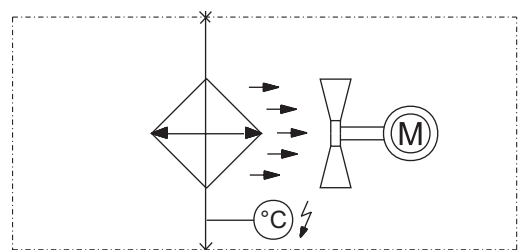


External by-pass AB (BLK 2-10)/ATB (BLK 2-9)



Oil inlet is always from low port, outlet on opposite side. Other ports must be plugged.

With temperature switch



Installation

Location

The cooler must be located in such a way that the air flowing through the matrix has free flow on entry and exit. The distance between air intake or air outlet to the nearest surrounding obstacle should be a minimum of half the height of the matrix (dimension B). Free air flow must be provided. If the cooler is to be sited near to working personnel the effect of hot draught and noise emissions must be taken into account.

If the ambient air is carrying impurities or other particulates the cooling matrix could become clogged thus reducing the cooling efficiency. If this situation is unavoidable we recommend cleaning the matrix on a regular basis (see operation manual).

If the cooler is located in open air the motors must be weather shielded.

Always provide good accessibility for inspection or maintenance.

Mounting

The BLK's are mounted with four bolts through their mounting feet to an adequate support structure. The cooler can be mounted over head or to walls with no restriction.

Connection of oil circuit

The connections from the cooler to the system should be stress and vibration free. The use of flexible hoses is highly recommended. Please comply with local safety requirements and avoid any risk to the environment from oil spills etc.

The series BLK is a product designed by BÜHLER company

The company

BÜHLER TECHNOLOGIES GmbH, Ratingen was founded in 1969.

BÜHLER's corporate philosophy is to offer products and solutions representative of the state of the art.

BÜHLER also specialises in producing level and temperature measuring equipment, particularly for the fluid power industry.



The products

Our commitment to customers has given rise to a production program which comprises specialized products for fluid technology.

Although these products were initially developed entirely as specials many of them have now become industry standards.

Bühler quality

Bühler has achieved accreditation from Lloyd's register to be in compliance with ISO 9001 and therefore consider it our obligation to offer our customers not only excellent products, but also the best service possible.

We reserve the right to amend specification

Off-Line Air / Oil Cooler Series BNK



- Maintenance friendly design
- Compact dimensions
- Low noise emissions
- Broad performance range
- Rugged cooling matrix
- Comprehensive accessories

Why coolers?

The off-line installation of an air/oil cooler is in many cases the most efficient and affordable cooling solution, while offering low installation space and costs. The inclusion of an off line filter can further increase efficiency by removing harmful impurities from the system fluid.

The BNK series is a comprehensive range of off-line air /oil coolers with an integrated circulation pump. The gerotor type pump guarantees low noise emissions and the flow rates and matrix sizes are selected to provide optimal solutions.

Where requested we can deliver the off-line coolers equipped with high quality filters.

Why Buhler?

Today's requirements for an oil/air cooler demand an effective and compact design with low noise emission and very easy maintenance.

The development of the new BNK series is based on over 30 years of experience in design and sales of air/oil-coolers. Fatigue life of the cooling matrix was a major consideration in the product development.

If our comprehensive standard range of products does not meet your requirements we will be pleased to find specific solutions for your application.

The data contained in this leaflet is sufficient to determine the right cooler for your application. However, we can offer you a software which makes sizing easier for you.



BLK



BNF, BKF

Description

The BNK series consist of the following components:

- cooler matrix
- fan case with mounting feet
- fan motor assembly consisting of an AC motor carrying circulation pump and fan with finger guard motor console

The cooling matrix and fan can be separated from the fan case individually without the need to dismantle other components.

The cooling matrix of the BNK series is made from aluminium. The matrix is suitable for use with hydraulic fluids.

The cooling matrix can be equipped with by-pass valves of different configurations (see type code).

Please note the installation chapter.

General Data

Material / surface protection

Cooling matrix aluminium, varnished
Vent housing, protection grid and motor console mild steel, powder coated

Colour RAL 7001

Fluids

Mineral oil according to DIN 51524

Operating pressure

static max. 10 bar
suction pressure max. -0,4 bar

Operating temperature

Media max. 100°C (higher temperature upon request)

Max. viscosity

100 cSt average viscosity, (higher values upon request)

Electrical motors

(others on demand)
Voltage 230 / 400 V 50 Hz ± 5%
276 / 480 V 60 Hz ± 5%
Insulation class F
Rise in temperature B
Protection class IP 55
Design according to IEC 34-1, IEC 72-1, DIN 57530, VDE 0530

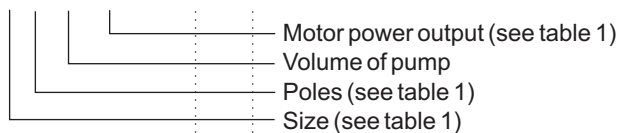
Basic Data (at 50 Hz Frequency)

Part No.	Type	Spec. cooling performance kW/K	Cooling performance ETD = 40K (kW)	Max. flow rate (l/min)	Power output Poles Full load at 400V	Weight (kg)	Volume (l)	Noise emission db(A) *
3601406IE2	BNK 1.4-7,5-0,75kW	0,04	1,6	7,5	0,75 kW /4/ 1,94 A	25	0,7	64
3601401IE2	BNK 1.4-15-0,75kW	0,07	2,8	15	0,75 kW /4/ 1,94 A	25	0,7	64
3602401IE2	BNK 2.4-15-0,75kW	0,09	3,6	15	0,75 kW /4/ 1,94 A	30	1,3	66
3602402IE2	BNK 2.4-30-0,75kW	0,13	5,0	28	0,75 kW /4/ 1,94A	33	1,3	66
3602407IE2	BNK 2.4-40-1,1kW	0,16	6,4	42	1,1 kW /4/ 2,74 A	35	1,3	66
3603401IE2	BNK 3.4-15-0,75kW	0,15	6,0	15	0,75 kW /4/ 1,94 A	35	1,8	71
3603402IE2	BNK 3.4-30-0,75kW	0,24	9,6	28	0,75 kW /4/ 1,94 A	38	1,8	71
3603407IE2	BNK 3.4-40-1,1kW	0,28	11,2	42	1,1 kW /4/ 2,74 A	40	1,8	71
3604402IE2	BNK 4.4-30-0,75kW	0,32	12,8	28	0,75 kW /4/ 1,94 A	43	2,3	73
3604407IE2	BNK 4.4-40-1,1kW	0,34	13,6	42	1,1 kW /4/ 2,74 A	45	2,3	73
3604403IE2	BNK 4.4-60-1,5kW	0,36	14,4	57	1,5 kW /4/ 3,4 A	51	2,3	73
3604404IE2	BNK 4.4-90-2,2kW	0,38	15,2	86	2,2 kW /4/ 4,59 A	61	2,3	73
3604605IE2	BNK 4.6-40-1,1kW	0,24	9,6	38	1,1 kW /6/ 2,54 A	51	2,3	63
3604603IE2	BNK 4.6-60-1,1kW	0,26	10,4	57	1,1 kW /6/ 2,54 A	61	2,3	63
3605403IE2	BNK 5.4-60-2,2kW	0,51	20,4	57	2,2 kW /4/ 4,59 A	71	3,1	79
3605404IE2	BNK 5.4-90-2,2kW	0,56	22,4	86	2,2 kW /4/ 4,59 A	73	3,1	79
3605605IE2	BNK 5.6-40-1,5kW	0,33	13,2	36	1,5 kW /6/ 3,31 A	70	3,1	68
3605603IE2	BNK 5.6-60-1,5kW	0,38	15,2	55	1,5 kW /6/ 3,31 A	72	3,1	68
3606413IE2	BNK 6.4-60-3,0kW	0,90	36,0	57	3,0 kW /4/ 6,33 A	87	4,1	86
3606414IE2	BNK 6.4-90-3,0kW	1,01	40,4	86	3,0 kW /4/ 6,33 A	88	4,1	86
3606613IE2	BNK 6.6-60-2,2kW	0,65	26,0	58	2,2 kW /6/ 4,85 A	86	4,1	74
3607413IE2	BNK 7.4-60-3,0kW	0,93	37,2	58	3,0 kW /4/ 6,33 A	99	5,4	89
3607414IE2	BNK 7.4-90-3,0kW	1,05	42,0	86	3,0 kW /4/ 6,33 A	100	5,4	89
3607613IE2	BNK 7.6-60-2,2kW	0,71	28,4	58	2,2 kW /6/ 4,85 A	98	5,4	75
3608613IE2	BNK 8.6-60-3,0kW	1,13	45,2	58	3,0 kW /6/ 6,6 A	118	6,3	79

*DIN EN ISO 3744, Class 3

Type code

BNK 4.4-30-0,75kW-IBx-T50



If the by-pass valve or if temperature switch are needed the following codes have to be added:

BLK 4.4-30-0,75kW-IBx-T50

By-pass version

AB

external by-pass

IB

integrated by-pass

ITB

integrated temperature operated by-pass 2 bar / 45°C

ATB

external temperature operated by-pass 2 bar / 45°C

x

by-pass pressure **2 bar**

Temperature switch

T50, T60

figures stand for °C, details see data sheet

T70, T80

Definitions and Example

t_{OE} [°C]	inlet oil temperature
t_{LE} [°C]	inlet air temperature
ETD [K]	temperature differential: $ETD = t_{OE} - t_{LE}$
P_{spez} [kW / K]	specific cooling performance (see performance curves) $P_{spez} = P / ETD$
P [kW]	cooling performance in kW
Q [l/min]	oil flow rate
C_{oi} [kJ/kgK]	specific heat capacity of oil (approx. 1,8 kJ / kgK)
ζ [kg/dm ³]	specific gravity of oil = 0,89 kg/dm ³

Calculation sample:

Assumptions:

tank capacity	(V)	ca. 200 l
start up temperature of oil	(T_1)	15 °C
the oil is heated up approx. 25 minutes to	(T_2)	45 °C
required oil temperature	(t_{OE})	60 °C
inlet air temperature	(t_{LE})	30 °C

Calculation

1. Calculation of P

$$P = \frac{200 \times 0,9 \times 2,0 \times (45-15)}{25 \times 60} = 7,2 \text{ kW}$$

2. $ETD = t_{OE} - t_{LE} = 60^\circ\text{C} - 30^\circ\text{C} = 30 \text{ K}$

3. required specific performance:

$$P_{spez} = P / ETD = 7,2 \text{ kW} / 30 \text{ K} = 0,24 \text{ kW/K}$$

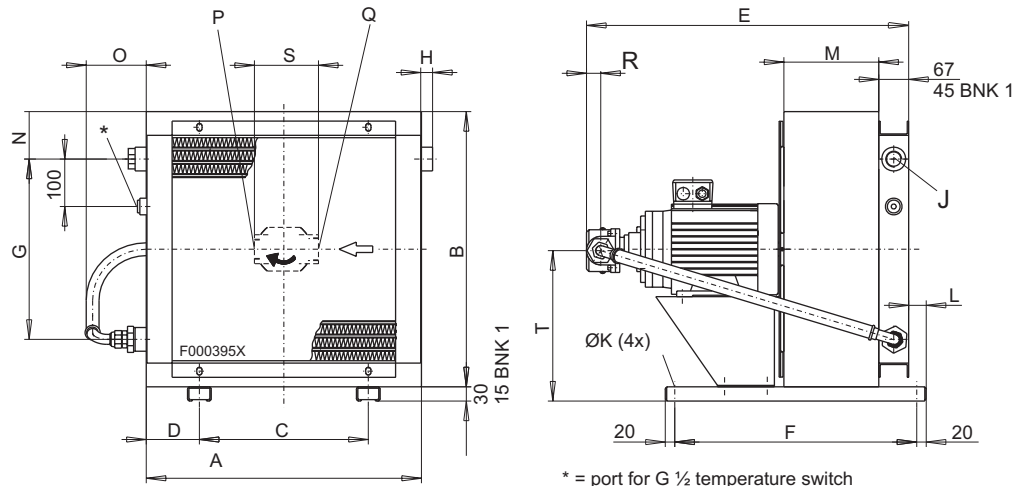
4. From the table, select a cooler with:

$$P_{spez} 0,24 \text{ kW/K:}$$

There is only one possibility:

BLK 3.4 with 30 l pump

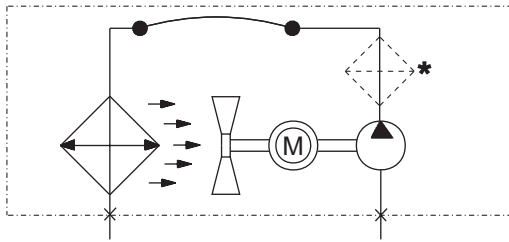
Dimensions



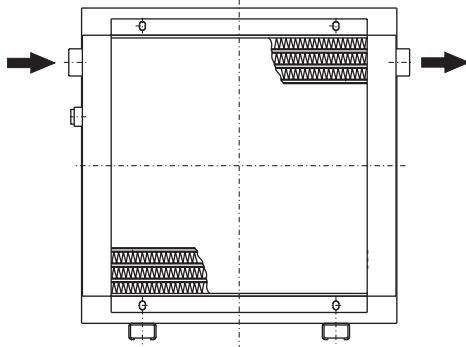
Model	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
BNK 1.4-7,5-0,75kW	315	243	190	62.5	417	340	-	-	2x G 1/2	9	40	52	-	-	G1	G 3/4	30	144	130
BNK 1.4-15-0,75kW	315	243	190	62.5	417	340	-	-	2x G 1/2	9	40	52	-	-	G1	G1 1/4	30	130	130
BNK 2.4-15-0,75kW	370	370	203	83.5	476	510	-	25	2x G1	9	33	125	106	119	G1	G1 1/4	30	130	212
BNK 2.4-30-0,75kW	370	370	203	83.5	474	510	-	25	2x G1	9	33	125	106	119	G1	G1 1/4	30	130	212
BNK 2.4-40-1,1kW	370	370	203	83,5	524	510	-	25	2x G1	9	33	125	106	119	G1	G1 1/4	30	130	212
BNK 3.4-15-0,75kW	440	440	203	118.5	501	510	230	25	3x G1	9	33	150	105	119	G1	G1 1/4	30	130	247
BNK 3.4-30-0,75kW	440	440	203	118.5	499	510	230	25	3x G1	9	33	150	105	119	G1	G1 1/4	30	130	247
BNK 3.4-40-1,1kW	440	440	203	118,5	548	510	230	25	3x G1	9	33	150	105	119	G1	G1 1/4	30	130	247
BNK 4.4-30-0,75kW	500	500	203	148.5	524	510	230	25	3x G1	9	33	175	104	119	G1	G1 1/4	30	130	277
BNK 4.4-40-1,1kW	500	500	203	148.5	574	510	230	25	3x G1	9	33	175	104	119	G1	G1 1/4	30	130	277
BNK 4.4-60-1,5kW	500	500	203	148.5	617	510	230	25	3x G1	9	33	175	104	135	G1 1/4	G1 1/2	30	135	277
BNK 4.4-90-2,2kW	500	500	203	148.5	688	510	230	25	3x G1	9	33	175	104	135	G1 1/4	G1 1/2	53	135	277
BNK 4.6-40-1,1kW	500	500	203	148.5	617	510	230	25	3x G1	9	33	175	104	135	G1 1/4	G1 1/2	30	135	277
BNK 4.6-60-1,1kW	500	500	203	148.5	652	510	230	25	3x G1	9	33	175	104	135	G1 1/4	G1 1/2	53	135	277
BNK 5.4-60-2,2kW	580	580	356	112	678	510	305	23.5	3x G1	9	33	200	100	134	G1 1/4	G1 1/2	30	135	317
BNK 5.4-90-2,2kW	580	580	356	112	713	510	305	23.5	3x G1	9	33	200	100	134	G1 1/4	G1 1/2	53	135	319
BNK 5.6-40-1,5kW	580	580	356	112	678	510	305	23.5	3x G1	9	33	200	100	134	G1 1/4	G1 1/2	30	135	317
BNK 5.6-60-1,5kW	580	580	356	112	713	510	305	23.5	3x G1	9	33	200	100	134	G1 1/4	G1 1/2	53	135	317
BNK 6.4-60-3,0kW	700	700	356	172	719	510	410	9,5	3x G1 1/4	9	33	225	110	132	G1 1/4	G1 1/2	30	135	377
BNK 6.4-90-3,0kW	700	700	356	172	754	510	410	9,5	3x G1 1/4	9	33	225	110	132	G1 1/4	G1 1/2	53	135	377
BNK 6.6-60-2,2kW	700	700	356	172	751	510	410	9,5	3x G1 1/4	9	33	225	110	132	G1 1/4	G1 1/2	53	135	377
BNK 7.4-60-3,0kW	700	840	356	172	744	510	590	9,5	3x G1 1/4	9	33	250	91	132	G1 1/4	G1 1/2	30	135	447
BNK 7.4-90-3,0kW	700	840	356	172	779	510	590	9,5	3x G1 1/4	9	33	250	91	132	G1 1/4	G1 1/2	53	135	447
BNK 7.6-60-2,2kW	700	840	356	172	776	510	590	9,5	3x G1 1/4	9	33	250	91	132	G1 1/4	G1 1/2	53	135	447
BNK 8.6-60-3,0kW	870	870	508	181	795	510	585	11	3xG1 1/4	9	33	275	101.5	134	G1 1/4	G1 1/2	53	135	462

Function schemes

Standard BNK 2

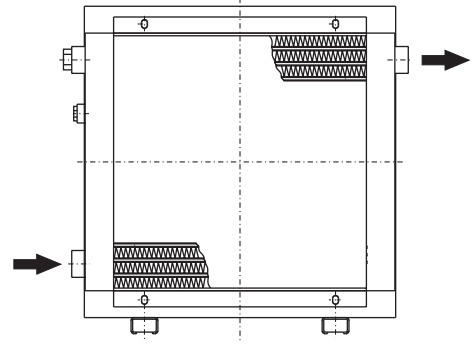
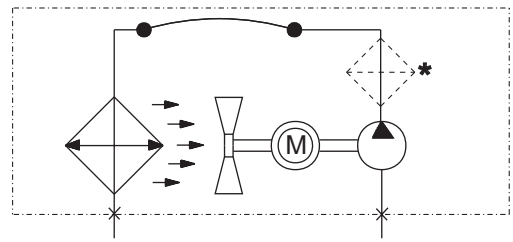


* recommended position of an additional oil filter



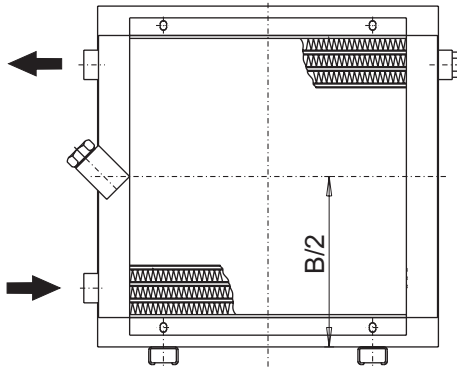
Flow direction from left to right. Other ports must be plugged.

Standard BNK 1/3 to BNK 8



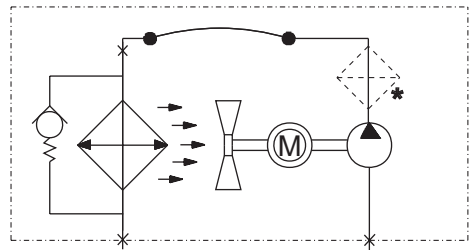
Flow direction from lower left to upper right. Other ports must be plugged.

Internal by-pass IB/ITB (BNK 3-8)

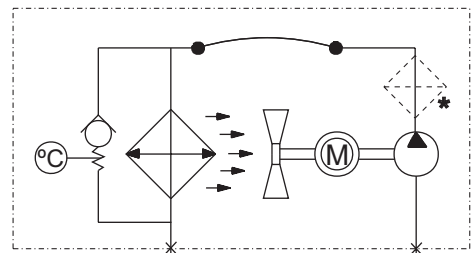


Oil inlet and outlet are at the same side. Ports on opposite side must be plugged.

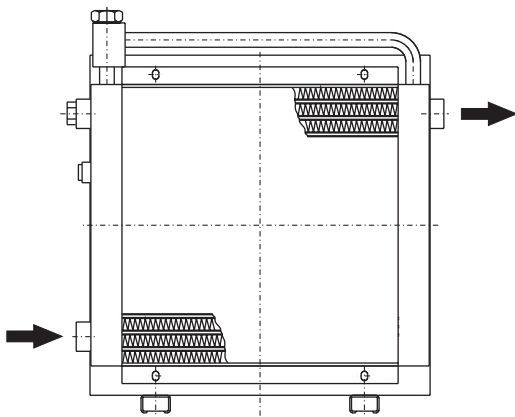
With by-pass valve



With temperature operated by-pass valve

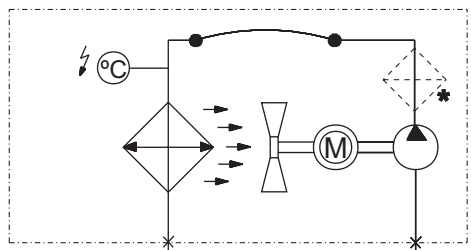


External by-pass AB/ATB (BNK 2-8)



Oil inlet always from lower left port, outlet on opposite side. Other ports must be plugged.

With temperature switch



* optional mounted filter available

Installation

Location

The cooler must be located in such a way that the air flowing through the matrix has free flow on entry and exit. The distance between air intake or air outlet to the nearest surrounding obstacle should be a minimum of half the height of the matrix (dimension B). Free air flow must be provided. If the cooler is to be sited near to working personnel the effect of hot draught and noise emissions must be taken into account.

If the ambient air is carrying impurities or other particulates, the cooling matrix could become clogged thus reducing the cooling efficiency. If this situation is unavoidable, we recommend cleaning the matrix on a regular basis (see operation manual).

If the cooler is located in open air the motors must be weather shielded.

Always provide good accessibility for inspection or maintenance.

Mounting

The BNK's are mounted with four bolts through their mounting feet to an adequate support structure.

Connection of oil circuit

The connections from the cooler to the system should be stress and vibration free. The use of flexible hoses is highly recommended. Please comply with local safety requirements and avoid any risk to the environment from oil spills, etc.

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The company

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Our commitment to customers has given rise to a production program which comprises specialized products for fluid technology.

Although these products were initially developed entirely as specials many of them have now become industry standards.

Bühler quality

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Off-line filter / cooler unit FGSL 15 / FGSL 30



The Reliability and the life time of hydraulic oil and components primarily depend on the cleanliness of the fluid and the limitation of the operating temperature.

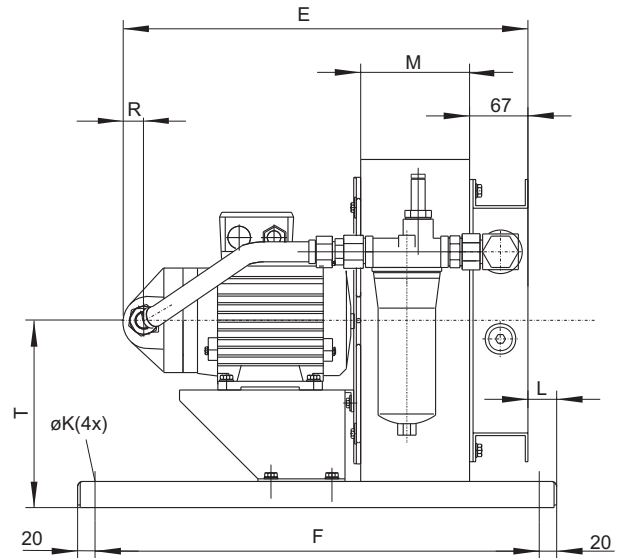
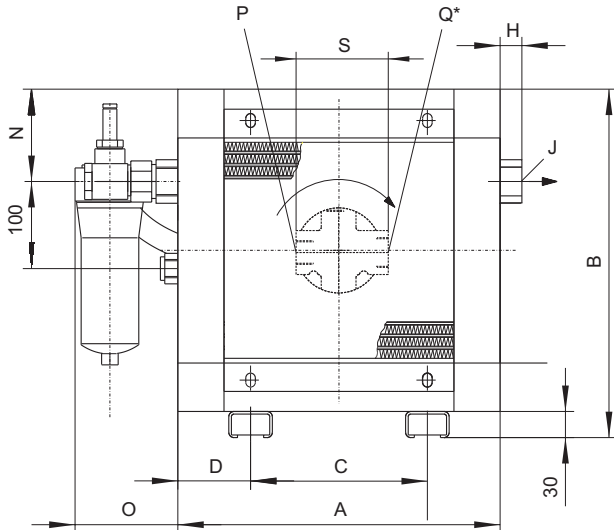
For systems with varying flow rates off-line filter/cooler units are the most appropriate solution.

Due to its compact design, the Bühler FGSL range of off-line units fit well into that segment of applications. Easy integration even allows upgrading of existing systems.

The unit is based on a Bühler BNK off-line air blast cooler with integrated circulation pump. Its low noise emission and easy maintenance are further advantages.

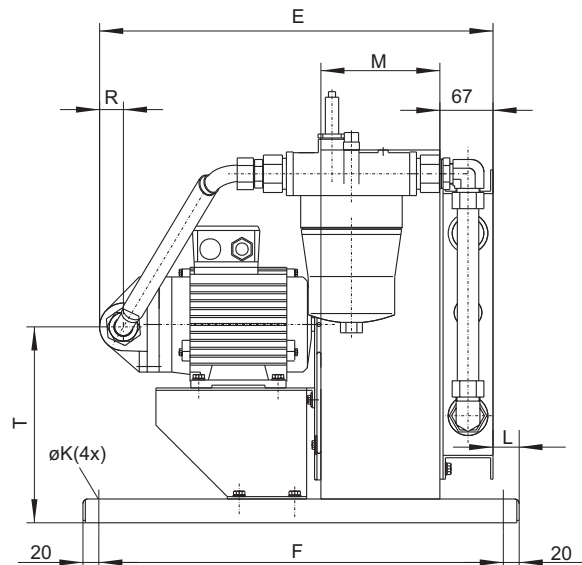
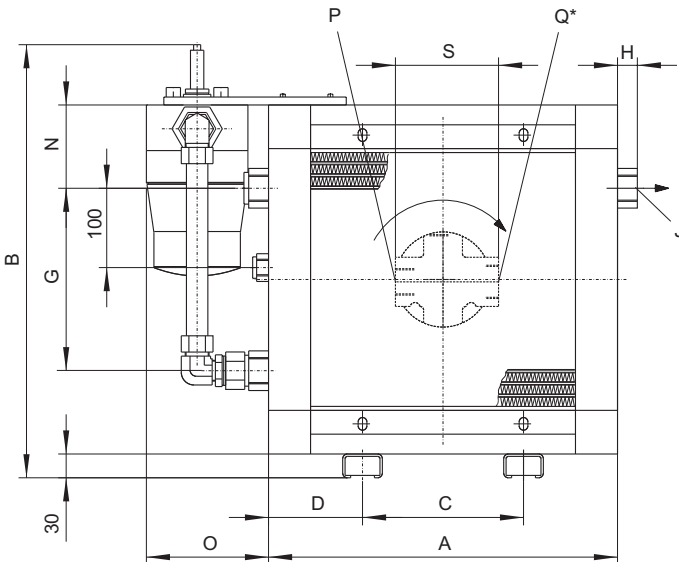
A qualified low pressure filter with broad retention spectrum ensures the required cleanliness class.

FGSL 15



F000005D Q* = Suction side

FGSL 30



F000006D Q* = Suction side

General Data

Part No.	Model	Spec. cooling performance (kW/K)	Cooling performance ETD=40K (kW)	Max. flow rate (l/min)	Power output Poles Full load at 400V	Weight (kg)	Volume (l)	Noise emission db(A)*
27004124IE2	FGSL 15/PI2008-57/BNK 2.4-15	0,09	3,6	15	0,75 kW / 4 / 1,94 A	32	2,3	66
27004086IE2	FGSL 30/PI2008-57/BNK 2.4-30	0,13	5,0	28	0,75 kW / 4 / 1,94 A	35	2,3	66
27004083IE2	FGSL 30/PI2015-57/BNK 3.4-30	0,24	9,6	28	0,75 kW / 4 / 1,94 A	40	2,8	71
27004088IE2	FGSL 30/PI2015-57/BNK 4.4-30	0,32	12,8	28	0,75 kW / 4 / 1,94 A	45	3,3	73

*DIN EN ISO 3744, Class 3

Dimensions (mm)

Model	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
FGSL 15/PI2008-57/BNK 2.4-15	370	400	203	83,5	476	510	-	25	2xG1	9	33	125	106	118	G1	G1 ¼	30	130	199
FGSL 30/PI2008-57/BNK 2.4-30	370	400	203	83,5	474	510	-	25	2xG1	9	33	125	106	118	G1	G1 ¼	30	130	212
FGSL 30/PI2015-57/BNK 3.4-30	440	546	203	118,5	499	510	230	25	3xG1	9	33	150	105	154	G1	G1 ¼	30	130	247
FGSL 30/PI2015-57/BNK 4.4-30	500	595	203	148,5	524	510	230	25	3xG1	9	33	175	104	154	G1	G1 ¼	30	130	277

Accessories:

Filter elements and electrical contamination indicators are not included. Please ask for assistance.



Lesen Sie die Bedienungsanleitung vor dem Gebrauch des Gerätes gründlich durch. Beachten Sie insbesondere die Hinweise unter Gliederungspunkt 2. Andernfalls könnten Gesundheits- oder Sachschäden auftreten. Die Bühler Technologies GmbH haftet nicht bei eigenmächtigen Änderungen des Gerätes oder für unsachgemäßen Gebrauch.

Read this instruction carefully prior to installation and/or use. Pay attention particularly to all advice and safety instructions to prevent injuries. Bühler Technologies GmbH can not be held responsible for misusing the product or unreliable function due to unauthorised modifications.

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1 Introduction

BLK Oil-Air-Coolers and BNK off line air/oil coolers are suited for cooling oils in hydraulic and lubrication systems. Their scope is given by their specifications. The use in other applications is not permitted without confirmation by Bühler Technologies GmbH.

1.1 Important advice

Please check prior to installation of the device that the technical data matches the application parameters. Check that the delivery is complete as well.








Operation of the device is only valid if

- the product is used under the conditions described in the installation- and operation instruction, the intended application according to the type plate and the intended use. In case of unauthorized modifications done by the user Bühler Technologies GmbH cannot be held responsible for any damage,
- the performance limits given in the datasheets and in the installation- and operation instruction are obeyed,
- monitoring devices and safety devices are installed properly,
- service and repair is carried out by Bühler Technologies GmbH, unless described in this manual,
- only original spare parts are used.

This manual is part of the equipment. The manufacturer keeps the right to modify specifications without advanced notice. Keep this manual for later use.

1.2 General safety advice

The following warning signs and signal words are used in this manual:

	Warning against hazardous situation		Warning against environmental hazard
	Warning against electrical voltage		Warning against high pressure
	Warning against hot surface		
	Warning against rotating parts		disconnect from mains

Signal words for warnings:

NOTE	Signal word for important information to the product
CAUTION	Signal word for a hazardous situation with low risk, resulting in damage to the device or the property or minor or medium injuries if not avoided.
WARNING	Signal word for a hazardous situation with medium risk, possibly resulting in severe injuries or death if not avoided.
DANGER	Signal word for an imminent danger with high risk, resulting in severe injuries or death if not avoided

Installation of the device shall be performed by trained staff only, familiar with the safety requirements and risks.

Adhere to all relevant safety regulations and technical indications for the specific installation place. Prevent failures and protect persons against injuries and the device against damage.




The person responsible for the system must secure that:






- safety and operation instructions are accessible and followed,
- local accident prevention regulations and standards are obeyed,
- performance data and installation specifications are regarded,
- safety devices are installed and recommended maintenance is performed,
- national regulations for disposal of electrical equipment are obeyed.

Maintenance and repair



- Repairs on the device must be carried out by Bühler authorized persons only.
- Only perform modifications, maintenance or mounting described in this manual.
- Only use original spare parts.


During maintenance regard all safety regulations and internal operation instructions.

	 DANGER	
	<p>Electrical voltage</p> <p>Electrocution hazard.</p> <p>Before opening the cover or working on electrical components, disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally.</p> <p>Installation and maintenance must be carried out by trained staff only. Regard correct mains supply.</p>	

	 WARNING
	<p>Hot surface</p> <p>Burning hazard</p> <p>Let the device cool down before maintaining.</p>
 	 CAUTION
	<p>High pressure</p> <p>Hazard of injury due to flung off parts or oil, environmental hazard due to oil</p> <p>Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well.</p> <p>Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit. Use drip pans.</p>

2 Operation

	WARNING	
	Hazard due to rotating fan Injury of hands and fingers To avoid injuries, do not reach into the running fan.	

	NOTE
	Abrupt flow variation can lead to pressure peaks that may damage the cooler matrix. Make sure that the specifications are not exceeded in this case. Regard notes given in chapter 3.3 of this manual.

3 Installation and connection

3.1 Transport

Secure cooler safely for transportation.

For transportation, models of size 2 to 10 have lifting screws M10 on top of the cooler housing.

On top of the cooler housing you find lifting screws M10 for transporting. These points are not always above the center of gravity so that the cooler might swing when lifted. **The threads M8 in the cooling elements are not allowed to be used for lifting the entire unit.**

3.2 Requirements of the installation site, installing the cooler

The cooler must be located in such a way that the air flowing through the matrix has free flow on entry and exit. The distance between air intake or air outlet to the nearest surrounding obstacle should be at minimum half the height of the matrix. Free air flow must be provided. If the cooler is to be sited near to working personnel, the effect of hot draught and noise emissions must be taken into account.

The cooler is mounted with four bolts to the mounting rails on an adequate support structure.

If the cooler is installed in closed space, ensure sufficient air circulation. Avoid back flow of warmed air. If necessary, the room must be vented.

If the device is installed outdoors, regard the protection class of the motor (IP55 is standard). Due to lower temperatures with respect to closed rooms, the cooling capacity raises, but on the other hand higher start up pressure may result due to higher oil viscosity. In this case, consider a bypass valve and / or a heating.

The connections from the cooler to the system should be stress and vibration free. The use of flexible hoses is highly recommended.

Avoid leakage in the oil circuit. If necessary, place drip pans. Comply with local safety requirements and avoid any risk to the environment from oil spills etc.

The rotating fan might lead to static charging. Therefore sensitive equipment like electronics should be kept away from the device.

3.3 Hydraulic connection

Carry out the hydraulic connections as describe in the attached data sheet. Connect the tubes stress and vibration free, use flexible hoses if possible.

Contaminated liquids reduce the life time of the cooling element. Therefore we suggest filtering with a minimum of $\beta_{25} \geq 75$.

If your oil system is equipped with shut off valves, please protect the cooler from pressure peaks and use pressure relieve valves. No pressure relieve valves are supplied with the standard version.

In return lines, high pressure peaks might occur due to rapid changes of oil flow. These peaks are not reduced or dampened by safety valves. If the peaks exceed 15 bar or occur very frequently, you should consider an off line cooler alternatively.

3.4 Additional advices for offline oil/air coolers type BNK

The distance from the BNK to the reservoir should be as short as possible. Especially the suction pipe should be short and of sufficient inner diameter.

We suggest mounting the BNK in the same height as the liquid level. Mounting below the liquid level is possible as well.

If the only possible mounting solution is above the liquid level, the regular limit of 0.4 bar (5.8 psi) (atmosphere) suction pressure of the pump has to be considered. The possible height difference is influenced by oil viscosity and temperature. As a first rule you may take a height difference of 2 m / 6.7 ft.

Until the oil has reached operation temperature, a suction pressure of 0.6 bar (8.7 psi) for a short time is allowed.

The diameter of the suction line should not be smaller than given in the data sheet. We recommend a flow rate of 1.5 m/s (4.9 ft/s) at maximum.

At first startup, problems may occur with hydraulic systems with long suction lines because the suction line contains too much air. In this case, we recommend filling the suction line with oil and using a suction valve without spring.

At the factory, the pump housing is filled with oil. This is necessary in order to tighten the gerotor against the housing by the oil film. Due to long storage, oil may be lost and the remaining oil quantity may not be sufficient to ensure tightness if the pump is turned on. In this case, the pump may not produce enough suction pressure. We recommend refilling a little amount of oil into the pump housing prior to installing the suction line.

The maximum suction pressure of the pump must not exceed 0.5 bar (7.25 psi).

The following chapter introduces some formulas for dimensioning the tubes.

3.5 Calculations

3.5.1 Calculating viscosity

Valid for VG – oil between 10 – 100 °C at an exactness from ± 5%.

Definitions
 V_{40} = oil viscosity at 40°C in cst
 T = temperature in °C
 ν = viscosity in cst

Example: oil VG 46

V_{40} = 46 cst
 T = 25°C

$$b = 159 \cdot \ln \frac{V_{40}}{0,23}$$

$$b = 159 \cdot \ln \frac{46}{0,23} = 842,4325$$

$$a = 0,23 \cdot e^{\frac{-b}{877}}$$

$$a = 0,23 \cdot e^{\frac{-842,4325}{877}} = 0,08801$$

$$\nu = a \cdot e^{\frac{b}{T+95,2}}$$

$$\nu = 0,08801 \cdot e^{\frac{842,4325}{25+95,2}} = 97,35 \text{ cst}$$

3.5.2 Table of operational viscosity for VG oil

	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C	90 °C
VG 46	264,45	131,96	73,58	46,00	29,13	20,04	14,43	10,78	8,32
VG 68	444,77	210,85	112,61	68,00	41,63	27,86	19,58	14,32	10,84
VG 220	2.120,17	861,60	404,31	220,00	121,71	74,99	49,00	33,61	24,01
VG 320	3.489,92	1.350,22	607,96	320,00	171,40	102,85	65,66	44,12	30,94

Viscosity given in cst (mm²/s)

3.5.3 Calculating the pressure loss

Valid for smooth straight piping per meter at laminar current.

Definitions:

ν	viscosity in cst
ρ	spec. gravity in kg/dm ³
DN	tube diameter in mm
V	flow in m/s
PV	pressure loss in bar

Example:

ν	= 97,35 cst
ρ	= 0,8817 kg/dm ³
DN	= 20 mm
V	= 3,18 m/s (60 l/min for tube DN 20)

$$PV = \frac{0,32 \cdot \nu \cdot \rho \cdot V}{DN^2}$$

$$PV = \frac{0,32 \cdot 97,35 \cdot 0,8817 \cdot 3,18}{20^2} = 0,22 \text{ bar}$$



NOTE

Pressure loss increases significantly for bends and fittings.
It might be necessary in some cases to determine the final shape of the suction line on site under specific conditions.



Please do not hesitate to contact us for help to calculate the pressure loss of the suction line for you specific application.



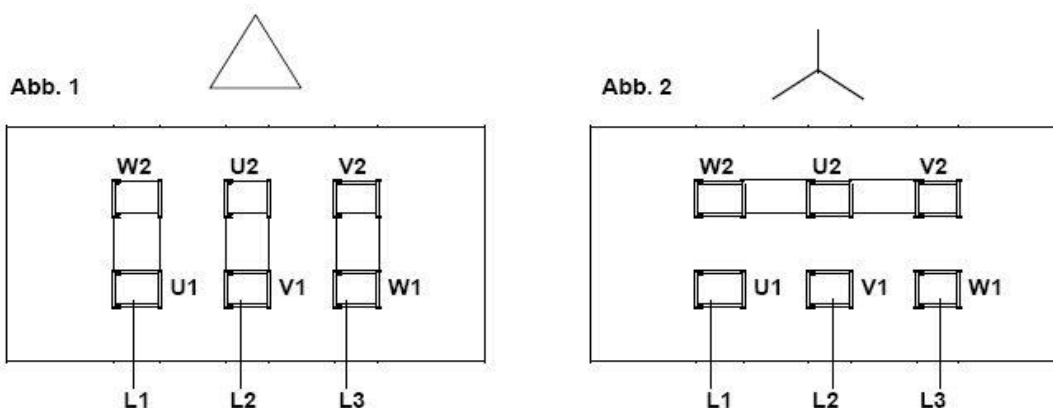
NOTE

To avoid damage of the BNK-cooler, make sure that the maximum pump pressure is not exceeded. High pressure may occur if the system is shut off or throttled at the pressure side.

3.6 Electrical connection

	 CAUTION
	Electrical voltage Wrong mains voltage may damage the device. Installation of the device shall be performed by trained staff only. Regard the voltage given on the type plate. Make sure that the cables have sufficient strain relief.
	Fusing Fusing has to be done due to local standards
	Polarity Take care of the directional rotation of the motor. The fan rotates counter clockwise when regarded from the motor's side!

For model BLK 1.2-AC, refer to the special wiring on page 42.



The rotational direction is changed by exchanging the connection two phases.

For calculating the correct values of fuses and cross-section of connection wires, refer to local rules and standards. The motor and, if equipped, starting devices must be connected to protective earth.

Lead fuses protect the cables in case of a short cut, but are not sufficient to protect the motor coils from burning due to overload. Therefore, install an adequate motor circuit breaker with high precision range of adjustment for thermal protection to protect the motor against overload and operation with two phases.

Adjust the motor circuit breaker according to the nominal value given on the type plate of the motor. Operation out of the limits for mains voltage and frequency range is prohibited.

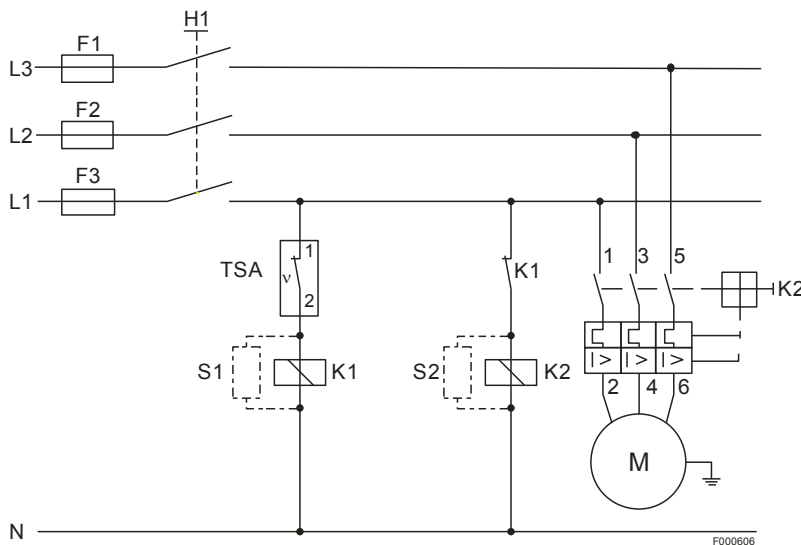
If the cooling matrix has an optional temperature contact type TSA (not advisable for BNK), the maximum values (see below) must not be exceeded. If connecting it to a relay, a free wheel circuit has to be added. Carry out the connection according to the following specifications (numbering inside the connector):

Terminal 1 – 2	Contacts
Terminal 3	Not used (except for BLK 1)
Terminal PE	Protective earth (not BLK 1)

Temperature switch TSA-	T50	switching temperature	50 °C
	T60		60 °C
	T70		70 °C
		max. voltage	230 V AC/D
		max. switching current	2 A, contact load max. 100 VA
		switching function	NC
		Hysteresis	ca. 10 °C
	protection class	IP 65	

Temperature switch TS-BLK1-	T50	switching temperature	50 °C
	T60		60 °C
	T70		70 °C
	T80		80 °C
		voltage / switching current	12 V DC / 10 A
			24 V DC / 5 A
		switching function	NO
		Hysteresis	ca. 5 °C
	protection class	IP 20	

Example wiring with temperature switch



F1, F2, F3: fuses
H1: mains switch
K1: relay
K2: circuit breaker
S1, S2: protecting devices
K1, K2, S1, and S2 are not part of the delivery.

4 Operation

4.1 Before starting

- Check that all parts are free of damage, especially the cooling element and protective grating. Do not put a damaged device into operation.
- Check if the two warning labels (rotating parts) on the cooler's housing are fitted.
- Check the correct connections of oil and power circuits according to chapter 3.
- Make sure that all valves or other parts in the cooling circuit, which have to be opened, are opened.

4.2 During starting

First, check that the fan rotates counter clockwise when looking from the motor's side.

Noise level: our BNK coolers are supplied with a low noise pump. If the noise level increases significantly check if the suction line has the right dimension and if the pump works in the appropriate temp/viscosity range. Ask Bühler Technologies GmbH for technical advice.

At first startup, problems may occur with hydraulic systems with long suction lines because the suction line contains too much air. In this case, we recommend filling the suction line with oil and using a suction valve without spring.

5 Maintenance of the cooler matrix






The outer parts of the motor, especially the cooling fins and the cooling ducts must be kept as clean as possible to ensure sufficient heat dissipation.

Keep in mind the protection class for dust and humidity. Cleaning the device with high pressure cleaners is only allowed if the motor has the respective protection class.

The motor is equipped with on both sides with sealed ball bearings. The greasing is designed for the total lifetime. Maintenance (subsequent greasing) is not necessary.

The bearings must be replaced by trained staff only.

5.1 Cleaning the cooler matrix

	<p>⚠ DANGER</p> <p>Electrical voltage Electrocutation hazard.</p> <p>Before opening the cover or working on electrical components, disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally.</p> <p>Installation and maintenance must be carried out by trained staff only. Regard correct mains supply.</p>	
	<p>⚠ WARNING</p> <p>Hot surface Burning hazard</p> <p>Let the device cool down before maintaining.</p>	
 	<p>⚠ CAUTION</p> <p>High pressure Hazard of injury due to flung off parts or oil, environmental hazard due to oil</p> <p>Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well.</p> <p>Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit. Use drip pans.</p>	

Due to the design of the cooling fins, the cooler has low susceptibility to dust and dirt. Normally, it is sufficient to clean the front surface with a brush. If the ambient air is loaded with higher amounts of oil or dust, it may be necessary to clean the cooling matrix in regular intervals.

First, let the cooling matrix cool down. Then disconnect the motor from the mains and secure it against reconnecting.

Depressurize the system and disconnect the piping. Place an oil drip pan below the cooling matrix to collect leaking oil.

Close all connections with plugs to avoid further oil leakage.

Protect the cooling matrix from falling down.

Dismantle the cooling matrix from the fan case by loosening the fastening bolts and take it to the cleaning area. Be careful not to damage the fins during transport and cleaning.

Cover the motor before you start cleaning the matrix. Clean the matrix by blowing pressurized air from the rear side through the fin rows in parallel.

If dirt is wet and sticky use steam cleaner and /or some washing agent. In this case, rinse the cooler matrix with pure water.

Remount the cooling matrix in reverse order.

5.2 Cleaning the cooler matrix inside

If the matrix gets clogged from the inside due to impurities it should be rinsed with a cleaning liquid.

Dismantle the cooling matrix as described in chapter 5.1.

Fill in a degreasing agent and plug the cooling matrix.

After some reaction time, empty the cooling matrix and rinse it with clean duty oil. Dispose the degreasing agent and the cooling oil according to National regulations.

Remount the cooling matrix in reverse order as described in chapter 5.1.

5.3 Cleaning the fan case

Due to the design, dust and dirt will not deposit in a large amount inside the fan case. Nevertheless, any deposits of dirt should be blown out each time the cooler is cleaned.

6 Service and disposal

If you have any request, please hold cooler model and serial number ready. You find this information on the type plate. Please send any devices for repair or service to the address given in section 6.1. Please indicate the shipment as – Repair / Reparatur – or – Complaint / Reklamation –.

6.1 Service address

If the device shows irregularities see chapter 7 for troubleshooting.

If you need help or more information

call +49(0)2102-498955 or your local agent.

If the device doesn't work correctly after elimination of failures and turning power on, the device has to be checked by the manufacturer. Please ship the device with suitable packing to

Bühler Technologies GmbH
- Service -
Harkortstraße 29
40880 Ratingen
Germany

In Addition, attach the filled in and signed Declaration of Decontamination status to the packing. Otherwise, your repair order cannot be processed! The form can be requested by e-mail to **service@buehler-technologies.com**.

6.2 Disposal






Regard the local regulations for disposal of electric and electronic equipment (motor, temperature switch) and for cooling agents.

7 Troubleshooting and maintenance

7.1 Troubleshooting

Problem / Failure	Possible cause	Solution
Cooling capacity not sufficient	- Ambient air temperature is higher than specified	- Select larger model
	- Motor's rotation direction wrong	- Correct connection, see 3.6
	- Motor doesn't start	- Correct connection, see 3.6
	- Air flow too low	- Correct connection, see 3.6
	- Fins clogged	- Clean cooler matrix, see 5.3
	- Near obstacles	- Regard minimum distance
	- Oil flow too low	- Correct connection, see 3.6
	- Oil channel clogged	- Cleaning, see 5.3
	- Oil circuit blocked	- Open valves and cocks
	- Suction pressure too high	- Select suction hose with sufficient diameter
		- Reduce suction height
No or too low oil flow	- See above, oil flow too low	
	- Not enough oil inside pump housing due to long standstill or storage	- Refill some oil into the pump housing before connecting the suction hose, see 3.3
Pump too noisy	- Suction pressure too high	- Select suction hose with sufficient diameter
		- Reduce suction height

7.2 Safety advice for maintenance

	<p>⚠ DANGER</p> <p>Electrical voltage Electrocutation hazard. Before opening the cover or working on electrical components, disconnect the device from power supply. Make sure that the equipment cannot be reconnected to mains unintentionally. Installation and maintenance must be carried out by trained staff only. Regard correct mains supply.</p>	
	<p>⚠ WARNING</p> <p>Hot surface Burning hazard Let the device cool down before maintaining.</p>	
 	<p>⚠ CAUTION</p> <p>High pressure Hazard of injury due to flung off parts or oil, environmental hazard due to oil Before starting any maintenance or repair to the oil circuit, make sure that the device is depressurized. This applies to the locking screws as well. Avoid environmental pollution (oil spills) during cleaning or maintenance of the oil circuit. Use drip pans.</p>	

7.3 Replacing the cooling matrix

- Wait until the cooler matrix has cooled down.
- Disconnect the motor from the mains and protect it from being re-connected unintentionally.
- Depressurize the system and place a drip pan below the cooling matrix to collect spilling oil.
- Secure the cooling matrix from falling.
- Unscrew the hoses.
- After loosening the four fixing bolts, the cooling matrix can be demounted from the case (BLK 9 and BLK 10: from the mounting brackets). Models BLK 6 to BLK 10 provide threads for M8 eye bolts for lifting the cooling matrix with hoisting devices.
- Remount the new cooling matrix in reverse order. Make sure that the connecting sleeves fit tightly.

7.4 Replacing fan parts

- Disconnect the motor from the mains and protect it from being re-connected unintentionally.
- Now remove the mains cable.

Models without motor brackets:

- Secure the fan unit against falling.
- Then loosen the four fixing bolts at the case on top of the grid.
- Now you can pull out the fan unit carefully to the back.
- Remount the new fan in reverse order. If the fan is replaced, insert the screw adding with glue.

Models with motor brackets:

- Loosen the screws fixing the bracket to the coolers feet about two revolutions.
- Unscrew the four screws connecting the fan unit to the housing at the tips of the protection grid.
- The fan unit can now be pulled out carefully to the back.
- Remount the new fan in reverse order. If the fan is replaced, insert the screw adding with glue.

8 Attached Documents

- Declaration of Conformity KX350001
- Declaration of Contamination status

9 Daten

Betriebsmedien für BNK und BLK	Mineralöle nach DIN 51524 Getriebeöl nach DIN 51517-3 Phosphorsäureester HFD-R nach CETOP RP 77 H
Betriebsmedien nur für BLK	Öl-/Wasser-Emulsionen HFA und HFB nach CETOP RP 77 H* Wasserglykol HFC* nach CETOP RF 77 H
Betriebsdruck	
statisch:	max. 21 bar (BLK), max. 10 bar (BNK)
dynamisch:	bei 5 Mio. Lastwechsel, 3 Hz: 15 bar*
Betriebsöltemperatur:	max. 120°C (BLK) max. 100°C (BNK) - höhere Temperaturen auf Anfrage
max. Viskosität:	100 cSt mittlere Viskosität (siehe Viskositätstabellen), höhere auf Anfrage
Elektromotoren:	(andere auf Anfrage lieferbar)
Spannungsbereiche:	BNK 230 / 400 V 50Hz ± 5% 276 / 480 V 60Hz ± 5% BLK 1.2 230 V 50 Hz BLK 2.2 - BLK 10.8 230 / 400 V 50Hz ± 5% 276 / 480 V 60Hz ± 5%
Wärmebeständigkeit:	Isolierstoffklasse F, Ausnutzung nach Klasse B
Schutzart:	IP55

Die Motoren entsprechen den Normen IEC 34-1, IEC 72-1, DIN 57530, VDE 0530

*nur BLK ; ** 230 V 50Hz beim BLK 1.2

9 Specifications

Fluids for BNK and BLK	mineral oil according to DIN 51524 Gear lubricant oil according to DIN 51517-3 phosphate ester HFD-R according to CETOP RP 77 H
Fluids only for BLK	oil/water emulsion HFA and HFB according to CETOP RP 77 H* water glycol HFC according to CETOP RF 77 H*
operating pressure	
static:	max. 21 bar (BLK), max. 10 bar (BNK)
dynamic:	15 bar at 5 mio. cycles, 3 Hz*
operating temperature media:	max. 120°C (BLK) max. 100°C (BNK) - higher temperatures upon request
max. viscosity	100 cSt average viscosity, higher viscosities upon request
electrical motors:	(others on demand)
voltage:	BNK 230 / 400 V 50Hz ± 5% 276 / 480 V 60Hz ± 5% BLK 1.2 230 V 50 Hz BLK 2.2 - BLK 10.8 230 / 400 V 50Hz ± 5% 276 / 480 V 60Hz ± 5%
insulation class:	F
rise in temperature:	B
protection class:	IP55

design according to: IEC 34-1, IEC 72-1, DIN 57530, VDE 0530

*BLK only ; ** 230 V 50Hz at BLK 1.2

9.1 Grunddaten BNK

9.1 Basic datas BNK

Artikel-Nr.	Kühlertyp	Spezifische Kühlleistung	Kühlleistung bei ETD=40K (kW)	Max. Umwälzleistung (l/min)	Motorleistung Polzahl Nennstrom bei 400 V	Masse (kg)	Füllmenge (l)	Geräusch db(A)*
part no.	type	spec. cooling performance kW/K	cooling performance ETD=40K (kW)	max. flow rate (l/min)	power output Poles Full load at 400V	Weight (kg)	Volume (l)	Noise emission db(A)*
3601406IE2	BNK 1.4-7,5-0,75kW	0,04	1,6	7,5	0,75 kW /4/ 1,94 A	25	0,7	64
3601401IE2	BNK 1.4-15-0,75kW	0,07	2,8	15	0,75 kW /4/ 1,94 A	25	0,7	64
3602401IE2	BNK 2.4-15-0,75kW	0,09	3,6	15	0,75 kW /4/ 1,94 A	30	1,3	66
3602402IE2	BNK 2.4-30-0,75kW	0,13	5,0	28	0,75 kW /4/ 1,94 A	33	1,3	66
3602407IE2	BNK 2.4-40-1,1kW	0,16	6,4	42	1,1 kW /4/ 2,74 A	35	1,3	66
3603401IE2	BNK 3.4-15-0,75kW	0,15	6,0	15	0,75 kW /4/ 1,94 A	35	1,8	71
3603402IE2	BNK 3.4-30-0,75kW	0,24	9,6	28	0,75 kW /4/ 1,94 A	38	1,8	71
3603407IE2	BNK 3.4-40-1,1kW	0,28	11,2	42	1,1 kW /4/ 2,74 A	40	1,8	71
3604402IE2	BNK 4.4-30-0,75kW	0,32	12,8	28	0,75 kW /4/ 1,94 A	43	2,3	73
3604407IE2	BNK 4.4-40-1,1kW	0,34	13,6	42	1,1 kW /4/ 2,74 A	45	2,3	73
3604403IE2	BNK 4.4-60-1,5kW	0,36	14,4	57	1,5 kW /4/ 3,4 A	51	2,3	73
3604404IE2	BNK 4.4-90-2,2kW	0,38	15,2	86	2,2 kW /4/ 4,59 A	61	2,3	73
3604605IE2	BNK 4.6-40-1,1kW	0,24	9,6	38	1,1 kW /6/ 2,54 A	51	2,3	63
3604603IE2	BNK 4.6-60-1,1kW	0,26	10,4	57	1,1 kW /6/ 2,54 A	61	2,3	63
3605403IE2	BNK 5.4-60-2,2kW	0,51	20,4	57	2,2 kW /4/ 4,59 A	71	3,1	79
3605404IE2	BNK 5.4-90-2,2kW	0,56	22,4	86	2,2 kW /4/ 4,59 A	73	3,1	79
3605605IE2	BNK 5.6-40-1,5kW	0,33	13,2	36	1,5 kW /6/ 3,31 A	70	3,1	68
3605603IE2	BNK 5.6-60-1,5kW	0,38	15,2	55	1,5 kW /6/ 3,31 A	72	3,1	68
3606413IE2	BNK 6.4-60-3,0kW	0,90	36,0	57	3,0 kW /4/ 6,33 A	87	4,1	86
3606414IE2	BNK 6.4-90-3,0kW	1,01	40,4	86	3,0 kW /4/ 6,33 A	88	4,1	86
3606613IE2	BNK 6.6-60-2,2kW	0,65	26,0	58	2,2 kW /6/ 4,85 A	86	4,1	74
3607413IE2	BNK 7.4-60-3,0kW	0,93	37,2	58	3,0 kW /4/ 6,33 A	99	5,4	89
3607414IE2	BNK 7.4-90-3,0kW	1,05	42,0	86	3,0 kW /4/ 6,33 A	100	5,4	89
3607613IE2	BNK 7.6-60-2,2kW	0,71	28,4	58	2,2 kW /6/ 4,85A	98	5,4	75
3608613IE2	BNK 8.6-60-3,0kW	1,13	45,2	58	3,0 kW /6/ 6,6 A	118	6,3	79

* DIN EN ISO 3744, Klasse 3 / Class 3

9.2 Grunddaten BLK

9.2 Basic datas BLK

Artikel-Nr.	Kühlertyp	Motorleistung	Nennstrom bei 400 V	Motor Polzahl	Masse (kg)	Füllmenge (l)	Geräusch db(A) *
part no.	type	Motor power output	Full load current at 400 V	Motor poles	Weight (kg)	Volume (l)	Noise emission db(A)*
3501200	BLK 1.2	0.25 kW	1.42 A 230 V	2	7	0.8	65
3502200	BLK 2.2	0.55 kW	0.84 A	2	23	1.3	81
3502400	BLK 2.4	0.25 kW	2.52 A	4	23	1.3	66
3503200IE2	BLK 3.2	1.1 kW	2.49 A	2	31	1.8	87
3503400	BLK 3.4	0.25 kW	0.84 A	4	28	1.8	71
3504400	BLK 4.4	0.37 kW	1.11 A	4	34	2.3	73
3504600	BLK 4.6	0.18 kW	0.6 A	6	34	2.3	63
3505400IE2	BLK 5.4	0.75 kW	1.8 A	4	45	3.1	79
3505600	BLK 5.6	0.25 kW	0.87 A	6	42	3.1	68
3506410IE2	BLK 6.4	2.2 kW	4.59 A	4	77	4.1	86
3506610	BLK 6.6	0.55 kW	1.65 A	6	60	4.1	74
3507410IE2	BLK 7.4	2.2 kW	4.59 A	4	87	5.4	89
3507610	BLK 7.6	0.55 kW	1.56 A	6	72	5.4	75
3508610IE2	BLK 8.6	1.5 kW	3.3 A	6	95	6.3	79
3508810	BLK 8.8	0.55 kW	1.85A	8	91	6.3	73
3509610IE2	BLK 9.6	2.2 kW	4.85 A	6	159	8.2	86
3509810	BLK 9.8	1.1 kW	3.2 A	8	155	8.2	79
3510610IE2	BLK 10.6	5.5 kW	11.3 A	6	256	19	90
3510810	BLK 10.8	2.2 kW	5.96 A	8	241	19	84

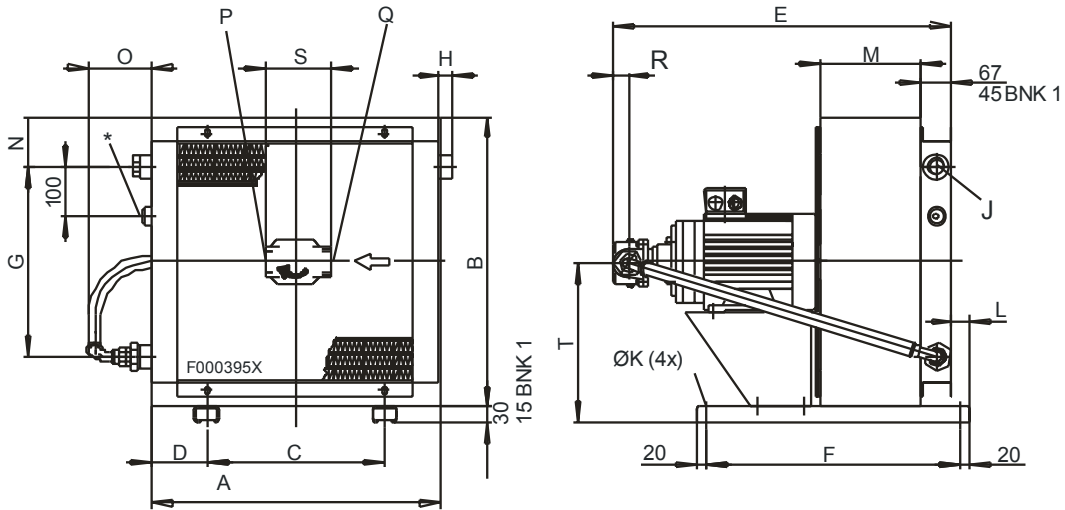
Die Artikelnummern für BLK 2.2-5.6 sind 50/60 Hz-Versionen, für BLK 6.4-10.8 nur die 50Hz Version, die 60 Hz-Version bitten wir anzufordern.

The part numbers for BLK 2 -5 are 50/60 Hz versions, for BLK 6-10 the 50 Hz versions only, the 60 Hz versions are available upon request.

* DIN EN ISO 3744, Klasse 3 / Class 3

9.3 Abmessungen BNK

9.3 Dimensions BNK

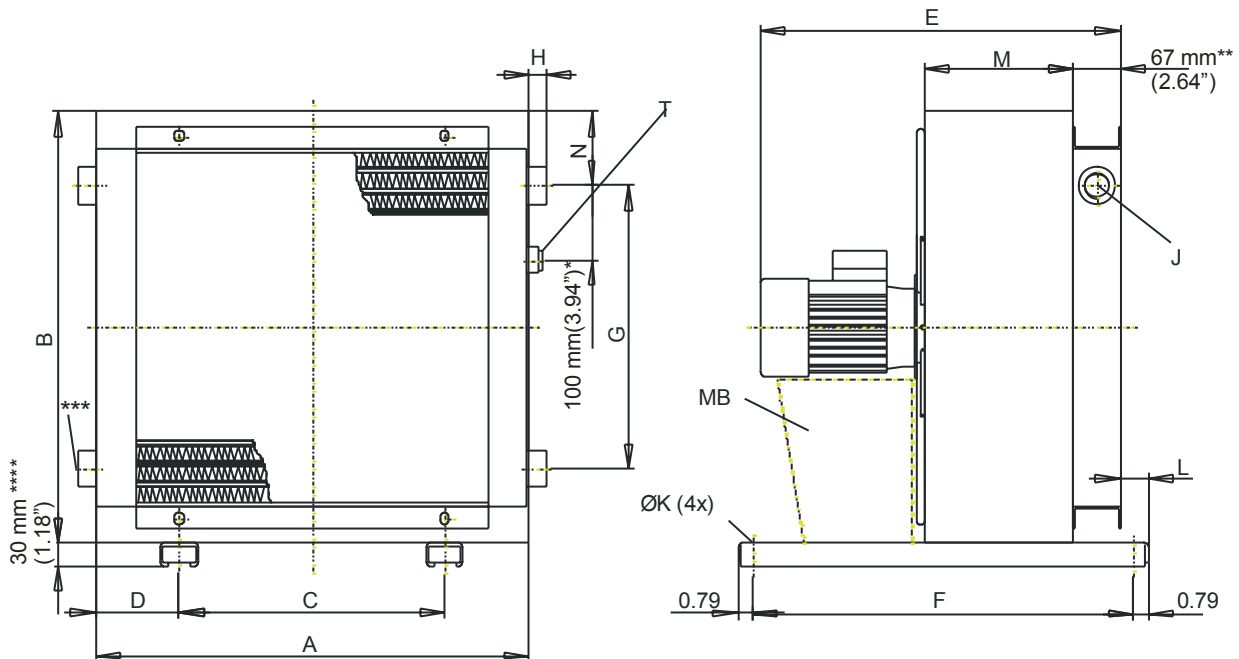


* = Anschluss für G ½ Temperaturschalter
 * = port for G ½ temperature switch

Typ / Type	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
BNK 1.4-7,5-0,75 kW	315	243	190	62.5	417	340	-	-	2x G ½	9	40	52	-	-	G1	G ¾	30	144	130
BNK 1.4-15-0,75 kW	315	243	190	62.5	417	340	-	-	2x G ½	9	40	52	-	-	G1	G1 ¼	30	130	130
BNK 2.4-15-0,75 kW	370	370	203	83.5	476	510	-	25	2x G1	9	33	125	106	119	G1	G1 ¼	30	130	212
BNK 2.4-30-0,75 kW	370	370	203	83.5	474	510	-	25	2x G1	9	33	125	106	119	G1	G1 ¼	30	130	212
BNK 2.4-40-1,1 kW	370	370	203	83.5	524	510	-	25	2x G1	9	33	125	106	119	G1	G1 ¼	30	130	212
BNK 3.4-15-0,75 kW	440	440	203	118.5	501	510	230	25	3x G1	9	33	150	105	119	G1	G1 ¼	30	130	247
BNK 3.4-30-0,75 kW	440	440	203	118.5	499	510	230	25	3x G1	9	33	150	105	119	G1	G1 ¼	30	130	247
BNK 3.4-40-1,1 kW	440	440	203	118.5	548	510	230	25	3x G1	9	33	150	105	119	G1	G1 ¼	30	130	247
BNK 4.4-30-0,75 kW	500	500	203	148.5	524	510	230	25	3x G1	9	33	175	104	119	G1	G1 ¼	30	130	277
BNK 4.4-40-1,1 kW	500	500	203	148.5	574	510	230	25	3x G1	9	33	175	104	119	G1	G1 ¼	30	130	277
BNK 4.4-60-1,5 kW	500	500	203	148.5	617	510	230	25	3x G1	9	33	175	104	135	G1 ¼	G1 ½	30	135	277
BNK 4.4-90-2,2 kW	500	500	203	148.5	688	510	230	25	3x G1	9	33	175	104	135	G1 ¼	G1 ½	53	135	277
BNK 4.6-40-1,1 kW	500	500	203	148.5	617	510	230	25	3x G1	9	33	175	104	135	G1 ¼	G1 ½	30	135	277
BNK 4.6-60-1,1 kW	500	500	203	148.5	652	510	230	25	3x G1	9	33	175	104	135	G1 ¼	G1 ½	53	135	277
BNK 5.4-60-2,2 kW	580	580	356	112	678	510	305	23.5	3x G1	9	33	200	100	134	G1 ¼	G1 ½	30	135	317
BNK 5.4-90-2,2 kW	580	580	356	112	713	510	305	23.5	3x G1	9	33	200	100	134	G1 ¼	G1 ½	53	135	319
BNK 5.6-40-1,5 kW	580	580	356	112	678	510	305	23.5	3x G1	9	33	200	100	134	G1 ¼	G1 ½	30	135	317
BNK 5.6-60-1,5 kW	580	580	356	112	713	510	305	23.5	3x G1	9	33	200	100	134	G1 ¼	G1 ½	53	135	317
BNK 6.4-60-3,0 kW	700	700	356	172	719	510	410	9.5	3x G1 ¼	9	33	225	110	132	G1 ¼	G1 ½	30	135	377
BNK 6.4-90-3,0 kW	700	700	356	172	754	510	410	9.5	3x G1 ¼	9	33	225	110	132	G1 ¼	G1 ½	53	135	377
BNK 6.6-60-2,2 kW	700	700	356	172	751	510	410	9.5	3x G1 ¼	9	33	225	110	132	G1 ¼	G1 ½	53	135	377
BNK 7.4-60-3,0 kW	700	840	356	172	744	510	590	9.5	3x G1 ¼	9	33	250	91	132	G1 ¼	G1 ½	30	135	447
BNK 7.4-90-3,0 kW	700	840	356	172	779	510	590	9.5	3x G1 ¼	9	33	250	91	132	G1 ¼	G1 ½	53	135	447
BNK 7.6-60-2,2 kW	700	840	356	172	776	510	590	9.5	3x G1 ¼	9	33	250	91	132	G1 ¼	G1 ½	53	135	447
BNK 8.6-60-3,0 kW	870	870	508	181	795	510	585	11	3x G1 ¼	9	33	275	101.5	134	G1 ¼	G1 ½	53	135	462

9.4 Abmessungen BLK

9.4 Dimensions BLK



- MB Die Motorbefestigung erfolgt bei einigen Typen mittels einer Konsole
 =
 T = Anschluss G ½ für Temperaturschalter
 Anschluss M14 x 1,5 für Temperaturschalter
 * bei BLK 9 und 10 = 150 mm
 ** bei Baugröße 10 = 94 mm
 *** Anschlussstutzen nur bei BLK 9 und 10
 **** BLK 1 = 20 mm

- MB = some types have consoles to support motor
 T = connection G ½ for temperature switch
 connection M14 x1,5 for temperature switch
 BLK 1
 * BLK 9 and 10 = 150 mm
 ** BLK 10 = 94 mm
 *** connection only at BLK 9 and 10
 **** BLK 1 = 20 mm

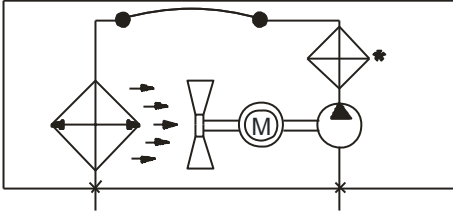
Kühlertyp / CoolerType	A	B	C	D	E	F	G	H	J	K	L	M	N	MB
BLK 1.2	315	244	190	62,5	144	165	-	25	2x G½	7	20	50	33	-
BLK 2.2	370	370	203	83,5	415	510	-	25	2x G1	9	33	125	106	-
BLK 2.4	370	370	203	83,5	415	510	-	25	2x G1	9	33	125	106	-
BLK 3.2	440	440	203	118,5	477	510	230	25	3x G1	9	33	150	105	-
BLK 3.4	440	440	203	118,5	440	510	230	25	3x G1	9	33	150	105	-
BLK 4.4	500	500	203	148,5	465	510	230	25	3x G1	9	33	175	104	-
BLK 4.6	500	500	203	148,5	465	510	230	25	3x G1	9	33	175	104	-
BLK 5.4	580	580	356	112	523	510	305	23,5	3x G1	9	33	200	100	-
BLK 5.6	580	580	356	112	490	510	305	23,5	3x G1	9	33	200	100	-
BLK 6.4	700	700	356	172	605	510	410	9,5	3x G1 ¼	9	33	225	110	x
BLK 6.6	700	700	356	172	545	510	410	9,5	3x G1 ¼	9	33	225	110	x
BLK 7.4	700	840	356	172	630	510	590	9,5	3x G1 ¼	9	33	250	91	x
BLK 7.6	700	840	356	172	570	510	590	9,5	3x G1 ¼	9	33	250	91	x
BLK 8.6	870	870	508	181	644	510	585	11	3x G1 ¼	12	33	275	101,5	x
BLK 8.8	870	870	508	181	620	510	585	11	3x G1 ¼	12	33	275	101,5	x
BLK 9.6	1010	1020	518	246	713	510	822	3	4x G1 ½	12	78	300	99	x
BLK 9.8	1010	1020	518	246	693	510	822	3	4x G1 ½	12	73	300	99	x
BLK 10.6	1185	1185	600	292,5	830	910	940	5	4x SAE 2 ½"	12	73	325	130	x
BLK 10.8	1185	1185	600	292,5	858	910	940	5	4x SAE 2 ½"	12	73	325	130	x

Anschluss BLK 10 = Flansch SAE 2 ½" – 3000 psi / Connection BLK 10 = SAE 2 ½" flange - 3000 psi

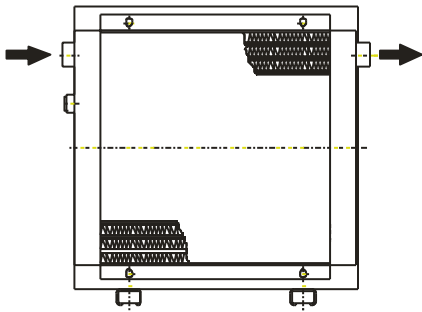
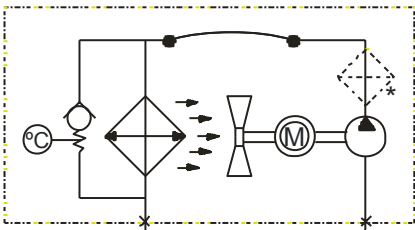
9.5 Funktionsschemata BNK

9.5 Function schemes BNK

Standard BNK



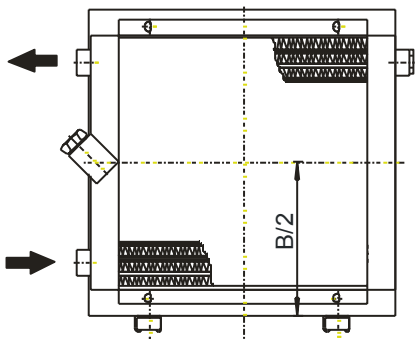
mit temperaturabhängigen Bypass /
 with temperature operated by-pass valve



BLK 2 Standard:
 Beim Kühlregister ist der Öleintritt auf der linken Seite. Der Ölaustritt ist immer auf der gegenüberliegenden Seite.

Flow direction from left to right. Other ports must be plugged.

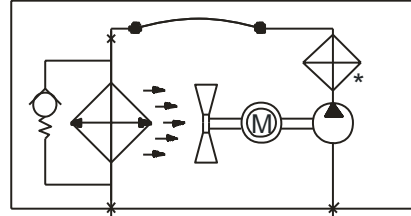
Innenliegender Bypass IB/ITB (BNK 3 – 8)
 Internal by-pass IB/ITB (BNK 3 – 8)



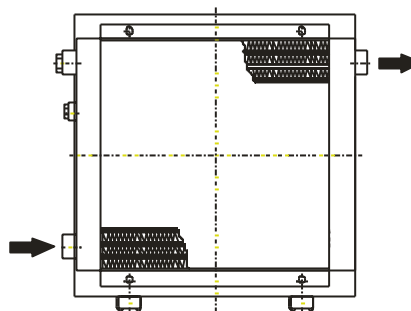
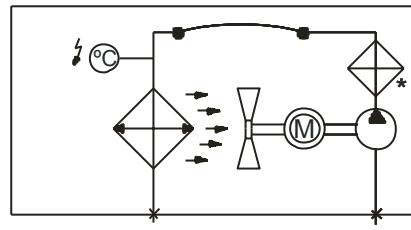
Öleintritt und Ölaustritt immer auf der gleichen Seite. Anschlüsse auf der gegenüberliegenden Seite müssen verschlossen werden.

Oil inlet and outlet are at the same side. Ports on opposite side must be plugged.

Mit Bypass-Ventil / with by-pass valve



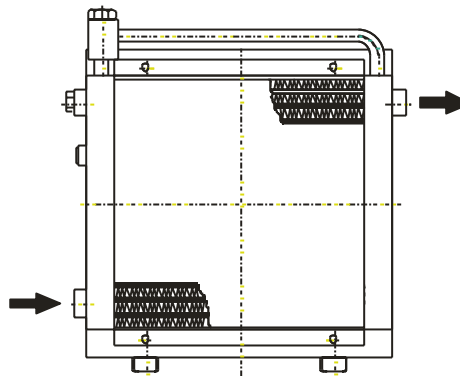
mit eingebautem Temperaturschalter /
 with temperature switch



BKL 3-8 Standard:
 Beim Kühlregister ist der Öleintritt immer auf der linken Seite unten. Der zweite Anschluss oben muss verschlossen werden. Ölaustritt ist auf der gegenüberliegenden Seite.

Flow direction from lower left to upper right. Other ports must be plugged.

Außenliegender Bypass AB/ATB (BNK 2–8)
 External by-pass AB/ATB (BNK 2 – 8)



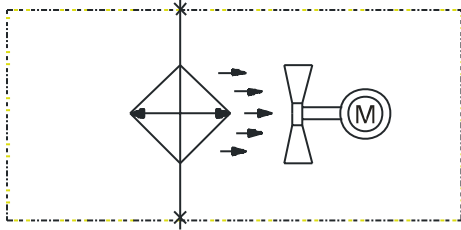
Beim Kühlregister ist der Öleintritt immer unten links. Der zweite Anschluss muss verschlossen werden. Der Ölaustritt ist immer auf der gegenüberliegenden Seite.

Oil inlet always from lower left port, outlet on opposite side. Other ports must be plugged.

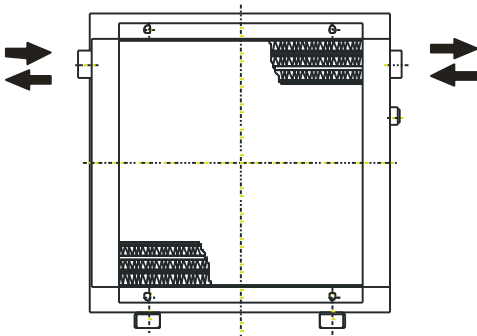
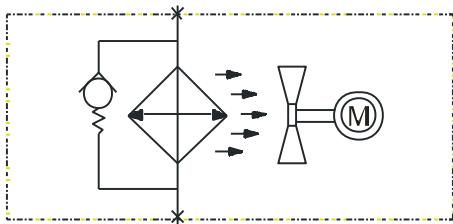
9.6 Funktionsschemata BLK

9.6 Function schemes BLK

Standardausführung / Standard



Mit Bypass-Ventil / with by-pass valve

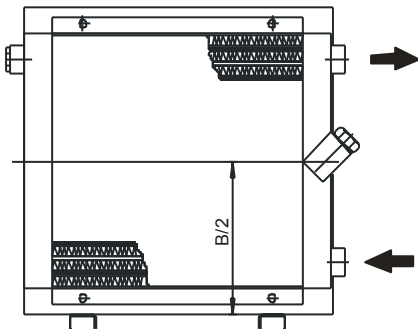


Standard BLK 2:

Durchflussrichtung wahlweise von links nach rechts oder genau umgekehrt.

Flow direction optional from left to right or vice versa.

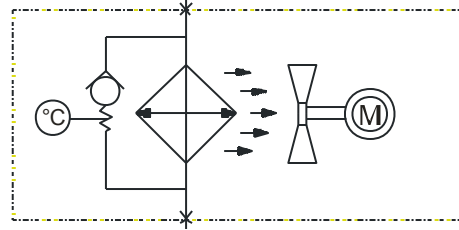
Innenliegender Bypass IB/ITB (BLK 3-9)
Internal by-pass IB/ITB (BLK 3-9)



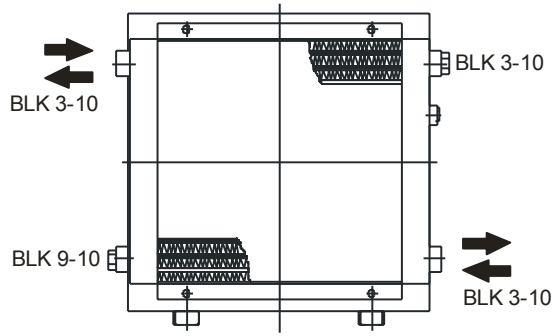
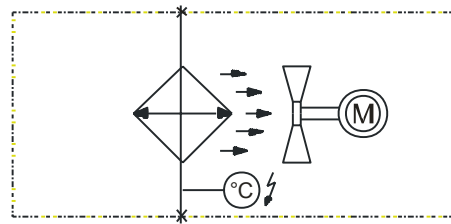
Öleintritt und Ölaustritt immer auf der gleichen Seite. Anschlüsse auf der gegenüberliegenden Seite müssen verschlossen werden.

Oil inlet and outlet are always at the same side. Ports on opposite side must be plugged.

mit temperaturabhängigem Bypass-Ventil /
 with temperature operated by-pass valve



mit eingebautem Temperaturschalter /
 with temperature switch

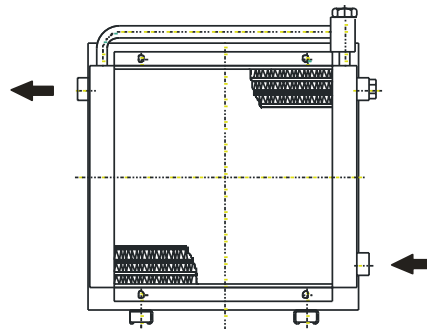


Standard BLK 3-10:

Durchflussrichtung wahlweise von links oben nach rechts unten oder genau umgekehrt. Der zweite Anschluss muss verschlossen werden.

Flow direction optional from high left to low right or vice versa. Other ports must be plugged.

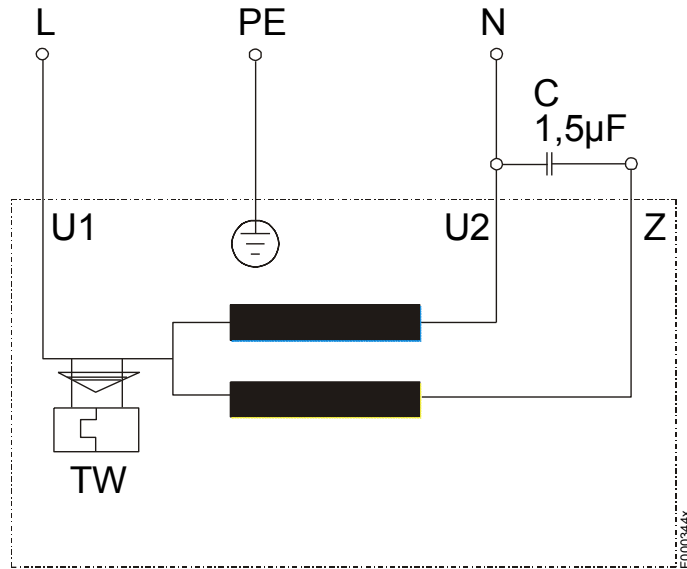
Außenliegender Bypass AB (BLK 2-10)/ATB (BLK 2-9)
External by-pass AB (BLK 2-10)/ATB (BLK 2-9)



Öleintritt immer unten. Weitere Anschlüsse müssen verschlossen werden. Ölaustritt ist immer auf der gegenüberliegenden Seite.

Oil inlet is always from low port, outlet on opposite side. Other ports must be plugged.

10 Anhang: Anschlussdiagramm 10 Appendix: wiring diagram



U1 = blau / blue

U2 = schwarz / black

Z = braun / brown

PE = grün-gelb / green-yellow

alle Kanten gratfrei Oberflächenbear- beitungszeichen ✓ = ✓ ^{Roh} X ✓ = ✓ ^{Rz 63} Y ✓ = ✓ ^{Rz 16} Z ✓ = ✓ ^{Rz 4}	ALLE RECHTE VORBEHALTEN			Maße ohne Toleranzangabe nach ISO 2768-mK		Maßstab	(Gewicht)
						Werkstoff:	
Zust.		Änd.	Datum	Name	Ers für	Zeichng.-Nr. 35/001-Z02-01-4	Art.-Nr. 35ET154
						ARBEITSANWEISUNG:	

EG-Konformitätserklärung **EC-declaration of conformity**



Hiermit erklären wir, dass die nachfolgenden Produkte den wesentlichen Anforderungen der folgenden EG-Richtlinie in ihrer aktuellen Fassung entsprechen:

Herewith we declare that the following products correspond to the essential requirements of the following EC directive in its actual version:

2006/42/EG (Maschinenrichtlinie / *machinery*)

Folgende weitere Richtlinien wurden berücksichtigt / *the following directives were regarded*

2006/95/EG (Niederspannungsrichtlinie / *low voltage directive*)

2004/108/EG (EMV / *EMC*)

Produkte / *products*:

Öl-Luft Kühler, Öl-Nebenstromkühler

Oil/Air cooler, Offline Oil/Air cooler

Typ(en) / *type(s)*:

BLK, BNK

Zur Beurteilung der Konformität wurden folgende harmonisierte Normen in aktueller Fassung herangezogen:

The following harmonized standards in actual revision have been used:

- **EN 12100-1** **Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 1: Grundsätzliche Terminologie, Methodologie**
- **EN 12100-2** **Sicherheit von Maschinen - Grundbegriffe, allgemeine Gestaltungsleitsätze - Teil 2: Technische Leitsätze**
- **EN 60204-1** **Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen**
- **EN 55011** **Industrielle, wissenschaftliche und medizinische Geräte - Funkstörungen - Grenzwerte und Messverfahren**
- **EN 61000-6-2** **Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche**

Dokumentationsverantwortlicher für diese Konformitätserklärung ist der Unterzeichnende mit Anschrift am Firmensitz.

The person authorised to compile the technical file is the one that has signed and is located at the company's address

Ratingen, den 14.07.2010

Stefan Eschweiler
Geschäftsführer – *general manager*



Dekontaminierungserklärung

Declaration of Contamination status



Gültig ab / valid since: 2011/05/01 Revision 0 ersetzt Rev. / replaces Rev ---

Die gesetzlichen Vorschriften schreiben vor, dass Sie uns die Dekontaminierungserklärung ausgefüllt und unterschrieben zurück zu senden haben. Die Angaben dienen zum Schutz unserer Mitarbeiter. **Bringen Sie die Bescheinigung an der Verpackung an. Ansonsten ist eine Bearbeitung Ihres Reparaturauftrages nicht möglich!**

Legal regulations prescribe that you have to fill in and sign the Declaration of Contamination status and send it back. This information is used to protect our employees. Please attach the declaration to the packing. Otherwise, your repair order cannot be processed.

Gerät / **Device:** _____ Serien-Nr. / **Serial no. :** _____

Rücksendegrund / **Reason for return:** _____

[] Ich bestätige hiermit, dass das oben spezifizierte Gerät ordnungsgemäß gereinigt und dekontaminiert wurde und keinerlei Gefahren im Umgang mit dem Produkt bestehen.
I herewith declare that the device as specified above has been properly cleaned and decontaminated and that there are no risks present when dealing with the device.

Ansonsten ist die mögliche Gefährdung genauer zu beschreiben / In other cases, please describe the hazards in detail:

Aggregatzustand (bitte ankreuzen) / Condition of aggregation (please check):

Flüssig / Liquid Fest / Solid Pulvrig / Powdery Gasförmig / Gaseous

Folgende Warnhinweise sind zu beachten (bitte ankreuzen) / The following safety advices must be obeyed (please check):

Explosiv <i>Explosives</i>	Giftig / Tödlich <i>Acute toxicity</i>	Entzündliche Stoffe <i>Flammable</i>	Brandfördernd <i>Oxidizing</i>
Komprimierte Gase <i>Gas under pressure</i>	Gesundheitsgefährdend <i>Irritant toxicity</i>	Gesundheitsschädlich <i>Health hazard</i>	Umweltgefährdend <i>Environmental hazard</i>

Bitte legen Sie ein aktuelles Datenblatt des Gefahrenstoffes bei / Please include the current material safety data sheet of the hazardous material!

Angaben zum Absender / Information about the dispatcher:

Firma / Company: _____ Anschrift / Address: _____
 Ansprechpartner / Contact person: _____
 Abteilung / Division: _____ E-Mail: _____
 Tel. / Phone: _____ Fax: _____

Ort, Datum / Location, date: _____

Unterschrift / Stempel
 Signature / Stamp: _____

Low Pressure Filter

Pi 200

Nominal pressure 32/63 bar (460/910 psi), nominal size up to 600

1. Features

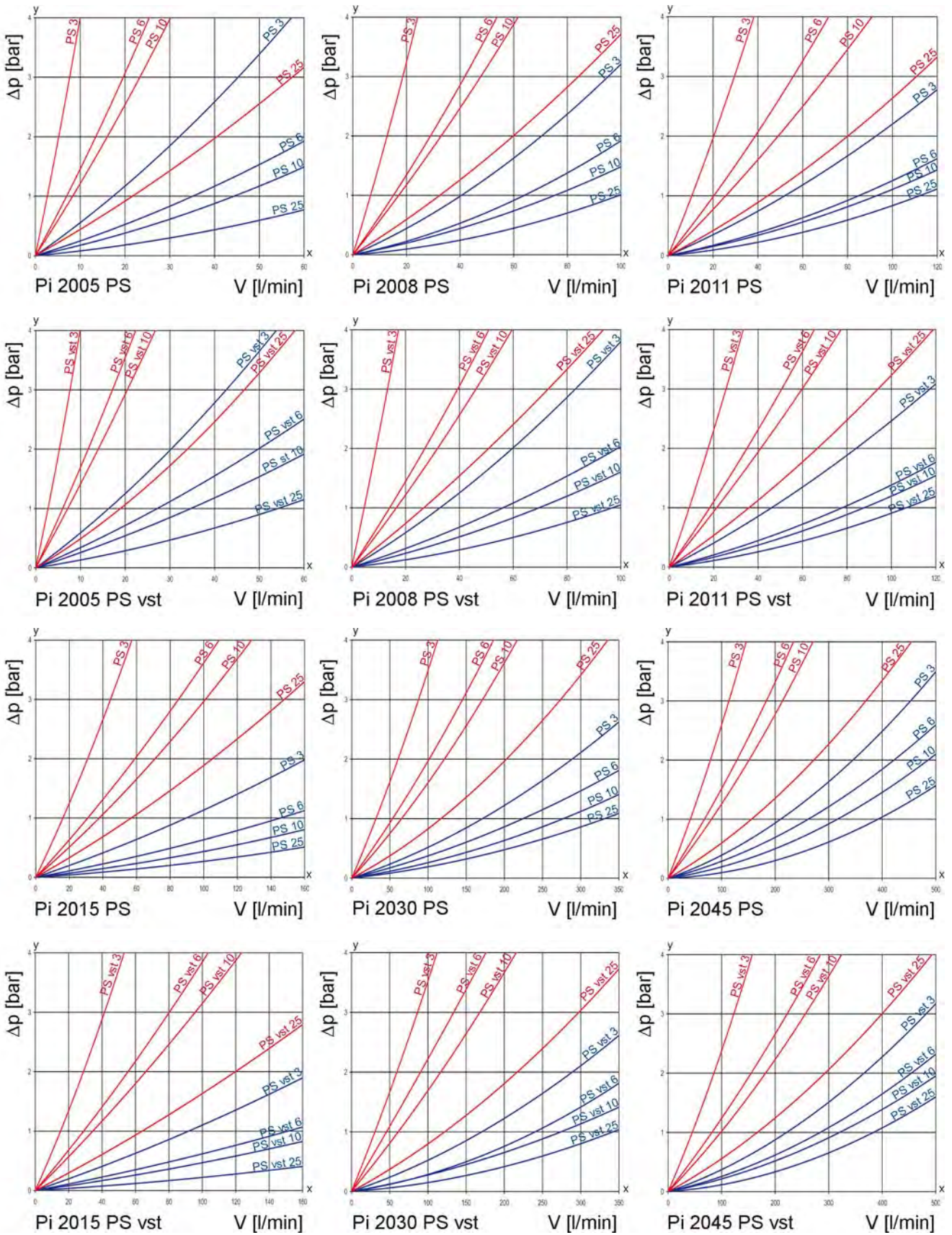
High performance filters for modern hydraulic systems

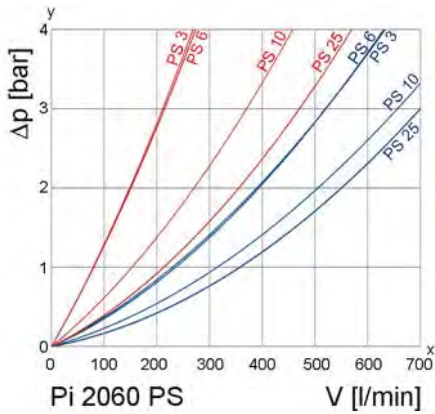
- Provided for pipe installation
- Modular system
- Compact design
- Minimal pressure drop through optimal flow design
- Visual/electrical/electronic maintenance indicator
- Threaded connections
- Quality filters, easy to service
- Equipped with highly efficient glass fibre PS filter elements
- Beta rated elements according to ISO 16889 multipass test
- Elements with high differential pressure stability and dirt holding capacity
- Other connections on request
- Worldwide distribution



2. Flow rate/pressure drop curve (filter housing incl. element)

■ 190 mm²/s
■ 33 mm²/s

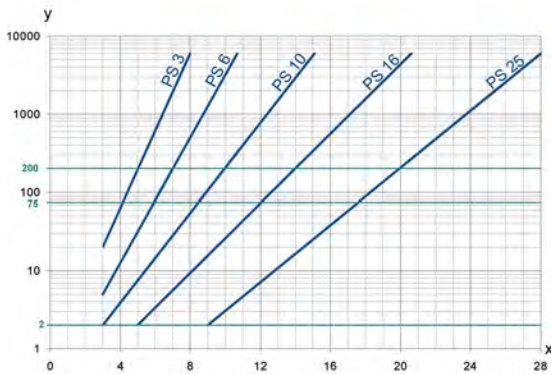




y = differential pressure Δp [bar]
 x = flow rate V [l/min]

Calculation of individual filter under www.industrialfiltration-catalogue.mahle.com

3. Separation grade characteristics



y = beta-value
 x = particle size [μm]

determined by multipass tests (ISO 16889)
 calibration according to (NIST)

4. Filter performance data

tested according to ISO 16889 (multipass test)

PS elements with			PS vst elements with		
max. Δp 20 bar			max. Δp 210 bar		
PS 3	$\beta_{5(C)} \geq 200$		PS vst 3	$\beta_{5(C)} \geq 200$	
PS 6	$\beta_{7(C)} \geq 200$		PS vst 6	$\beta_{7(C)} \geq 200$	
PS 10	$\beta_{10(C)} \geq 200$		PS vst 10	$\beta_{10(C)} \geq 200$	
PS 25	$\beta_{20(C)} \geq 200$		PS vst 25	$\beta_{20(C)} \geq 200$	

values guaranteed up to
 10 bar differential pressure

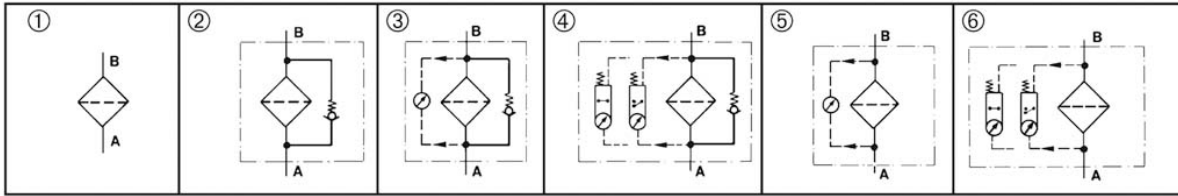
values guaranteed up to
 20 bar differential pressure

5. Quality assurance

MAHLE filters and filter elements are produced according to the following international standards:

Norm	Designation
DIN ISO 2941	Hydraulic fluid power filter elements; verification of collapse/burst resistance
DIN ISO 2942	Hydraulic fluid power filter elements; verification of fabrication integrity
DIN ISO 2943	Hydraulic fluid power filter elements; verification of material compatibility with fluids
DIN ISO 3723	Hydraulic fluid power filter elements; method for end load test
DIN ISO 3724	Hydraulic fluid power filter elements; verification of flow fatigue characteristics
ISO 3968	Hydraulic fluid power-filters-evaluation of pressure drop versus flow characteristics
ISO 10771.1	Fatigue pressure testing of metal containing envelopes in hydraulic fluid applications
ISO 16889	Hydraulic fluid power filters-multipass method for evaluation filtration performance of a filter element

6. Symbols



7. Order numbers

Example for ordering filters:

1. Filter housing	2. Filter element
V = 80 l/min and visual/electrical maintenance indicator	PS vst 3
Type: Pi 2008-069	Type: Pi 2208 PS vst 3
Order number: 77665284	Order number: 77680200

7.1 Housing design

Nominal size NG [l/min]	Order number	Type	①	②	③	④	⑤	⑥
			no options	with bypass valve	with bypass valve and visual indicator	with bypass valve and electrical indicator	with visual indicator	with electrical indicator
50	77665144	Pi 2005-060						
	77665110	Pi 2005-056						
	77665128	Pi 2005-057						
	77665136	Pi 2005-058						
	77665169	Pi 2005-068						
	77665177	Pi 2005-069						
80	77665235	Pi 2008-060						
	77665201	Pi 2008-056						
	77665219	Pi 2008-057						
	77665227	Pi 2008-058						
	77665276	Pi 2008-068						
	77665284	Pi 2008-069						
110	78205114	Pi 2011-060						
	78205122	Pi 2011-056						
	78205130	Pi 2011-057						
	78205148	Pi 2011-058						
	78205155	Pi 2011-068						
	78205163	Pi 2011-069						
150	77840580	Pi 2015-060						
	76165203	Pi 2015-056						
	76165211	Pi 2015-057						
	79320748	Pi 2015-058						
	76165229	Pi 2015-068						
	78396616	Pi 2015-069						
300	77665474	Pi 2030-060						
	77665441	Pi 2030-056						
	77665458	Pi 2030-057						
	77665466	Pi 2030-058						
	77665516	Pi 2030-068						
	77665532	Pi 2030-069						

7.1 Housing design

Nominal size NG [l/min]	Order number	Type	①	②	③	④	⑤	⑥
			no options	with bypass valve	with bypass valve and visual indicator	with bypass valve and electrical indicator	with visual indicator	with electrical indicator
450	77664881	Pi 2045-060						
	77664873	Pi 2045-056						
	77664865	Pi 2045-057						
	77664857	Pi 2045-058						
	77664923	Pi 2045-068						
	77664931	Pi 2045-069						
600	70576046	Pi 2060-060						
	70576045	Pi 2060-056						
	70534876	Pi 2060-057						
	79714171	Pi 2060-058						
	78205254	Pi 2060-068						
	70576047	Pi 2060-069						

When filter with non bypass configuration is selected, the collapse pressure of the element must not be exceeded.

7.2 Filter elements (a wider range of element types is available on request)

Nominal size NG [l/min]	Order number	Type	Filter material	max. Δp [bar]	Filter surface [cm ²]
50	77680135	Pi 2105 PS 3	PS 3	20	590
	77943509	Pi 5105 PS 6	PS 6		590
	77680325	Pi 3105 PS 10	PS 10		590
	77680440	Pi 4105 PS 25	PS 25		590
	77680192	Pi 2205 PS vst 3	PS vst 3	210	425
	77943533	Pi 5205 PS vst 6	PS vst 6		425
	77680382	Pi 3205 PS vst 10	PS vst 10		425
	77680507	Pi 4205 PS vst 25	PS vst 25		425
80	77680143	Pi 2108 PS 3	PS 3	20	1150
	77943517	Pi 5108 PS 6	PS 6		1150
	77680341	Pi 3108 PS 10	PS 10		1150
	77680457	Pi 4108 PS 25	PS 25		1150
	77680200	Pi 2208 PS vst 3	PS vst 3	210	850
	77943541	Pi 5208 PS vst 6	PS vst 6		850
	77681190	Pi 3208 PS vst 10	PS vst 10		850
	77680515	Pi 4208 PS vst 25	PS vst 25		850
110	77680150	Pi 2111 PS 3	PS 3	20	1700
	77943525	Pi 5111 PS 6	PS 6		1700
	77680333	Pi 3111 PS 10	PS 10		1700
	77680465	Pi 4111 PS 25	PS 25		1700
	77680218	Pi 2211 PS vst 3	PS vst 3	210	1275
	77943558	Pi 5211 PS vst 6	PS vst 6		1275
	77680390	Pi 3211 PS vst 10	PS vst 10		1275
	77680523	Pi 4211 PS vst 25	PS vst 25		1275
150	77680168	Pi 2115 PS 3	PS 3	20	2425
	77955099	Pi 5115 PS 6	PS 6		2425
	77680358	Pi 3115 PS 10	PS 10		2425
	77680473	Pi 4115 PS 25	PS 25		2425

7.2 Filter elements (a wider range of element types is available on request)

Nominal size NG [l/min]	Order number	Type	Filter material	max. Δp [bar]	Filter surface [cm ²]
150	77680226	Pi 2215 PS vst 3	PS vst 3	210	2010
	77955123	Pi 5215 PS vst 6	PS vst 6		2010
	77680408	Pi 3215 PS vst 10	PS vst 10		2010
	77680531	Pi 4215 PS vst 25	PS vst 25		2010
300	77680176	Pi 2130 PS 3	PS 3	20	4620
	77955107	Pi 5130 PS 6	PS 6		4620
	77680366	Pi 3130 PS 10	PS 10		4620
	77680481	Pi 4130 PS 25	PS 25		4620
	77680234	Pi 2230 PS vst 3	PS vst 3	210	3800
	77955131	Pi 5230 PS vst 6	PS vst 6		3800
	77680416	Pi 3230 PS vst 10	PS vst 10		3800
	77680549	Pi 4230 PS vst 25	PS vst 25		3800
450	77680184	Pi 2145 PS 3	PS 3	20	6865
	77955115	Pi 5145 PS 6	PS 6		6865
	77680374	Pi 3145 PS 10	PS 10		6865
	77680499	Pi 4145 PS 25	PS 25		6865
	77680242	Pi 2245 PS vst 3	PS vst 3	210	5600
	77955149	Pi 5245 PS vst 6	PS vst 6		5600
	77680424	Pi 3245 PS vst 10	PS vst 10		5600
	77680556	Pi 4245 PS vst 25	PS vst 25		5600
600	70346506	Pi 2160 PS 3	PS 3	20	9398
	76114318	Pi 5160 PS 6	PS 6		9398
	79393380	Pi 3160 PS 10	PS 10		9398
	79748047	Pi 4160 PS 25	PS 25		9398

8. Technical specifications

Design:	in-line filter
Nominal pressure:	
Pi 2005 - 2011	10 ⁷ load changes 63 bar (900 psi)
Pi 2015 - 2060	10 ⁷ load changes 25 bar (360 psi)
	2x 10 ⁶ load changes 32 bar (460 psi)
Test pressure:	
Pi 2005 - 2011	95 bar (1370 psi)
Pi 2015 - 2060	48 bar (690 psi)
Temperature range:	-30 °C to +120 °C
	survival temperature -40 °C (other temperature ranges on request)
Bypass setting:	Δp 3.5 bar \pm 10 %
Filter head material:	GDAL
Filter housing material:	AL/St
Sealing material:	NBR/AL
Maintenance indicator setting:	Δp 2.2 bar \pm 10 %
Electrical data of maintenance indicator:	
Max. voltage:	250 V AC/200 V DC
Max. current:	1 A
Max. power:	70 W
Type of protection:	IP 65 in inserted and secured status
Contact:	normally open/closed
Cable sleeve:	M20x1.5

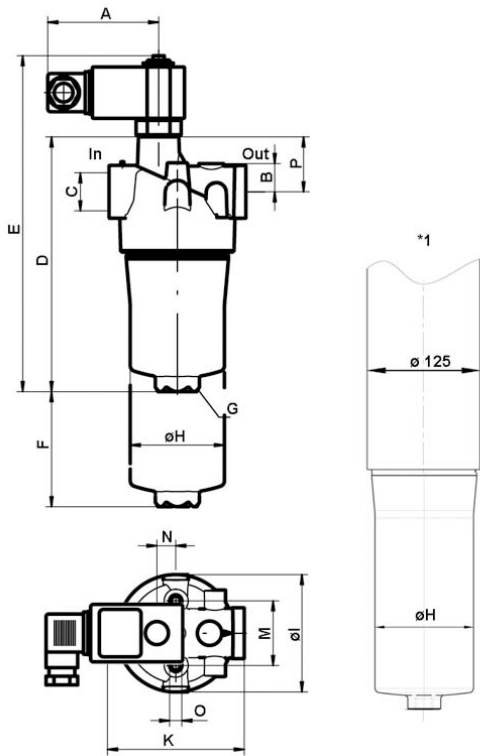
The switching function can be changed by turning the electric upper part by 180° (normally closed contact or normally open contact). The state on delivery is a normally closed contact. By inductivity in the direct current circuit the use of suitable protection circuit should be considered. Further maintenance indicator details and designs are available in the maintenance indicator data sheet.

We draw attention to the fact that all values indicated are average values and do not always occur in specific cases of application. Our products are continually being further developed. Values, dimensions and weights can change as a result of this. Our specialized department will be pleased to offer you advice.

We recommend you to contact us concerning applications of our filters in areas governed by the EU Directive 94/9 EC (ATEX 95). The standard version can be used for liquids based on mineral oil (corresponding to the fluids in Group 2 of Directive 97/23 EC Article 9). If you consider to use other fluids please contact us for additional support.

Subject to technical alteration without prior notice.

9. Dimensions



In Inlet

Out Outlet

*1 Housing design for NG 600

All dimensions except "C" in mm.

Type	A	B	C*	D	E	F	G SW	H	I	K	M	N	O	P	Weight [kg]
Pi 2005	78	19	G½	186	240	80	27	66	80	95	45	13.0	M8x10	37.5	0.9
Pi 2008	78	19	G¾	243	300	80	27	66	80	95	45	13.0	M8x10	37.5	1.0
Pi 2011	78	19	G¾	333	393	80	27	66	80	95	45	13.0	M8x10	37.5	1.1
Pi 2015	78	30	G1¼	268	326	110	32	109	128	150	60	24.5	M12x15	43.5	2.3
Pi 2030	78	30	G1¼	363	421	110	32	109	128	150	60	24.5	M12x15	43.5	2.5
Pi 2045	78	30	G1¼	509	566	110	32	109	128	150	60	24.5	M12x15	43.5	7.4
Pi 2060	78	30	G1¼	615	672	110	32	109	128	150	60	24.5	M12x15	43.5	5.5

* NPT and SAE connections on request

10. Installation, operating and maintenance instructions

10.1 Filter installation

When installing the filter make sure that sufficient space is available to remove filter element and filter housing.

Preferably the filter should be installed with the filter housing pointing downwards.

The maintenance indicator must be visible.

10.2 Connecting the electrical maintenance indicator

The electrical indicator is connected via a 2-pole appliance plug according to DIN EN 175301-803 with poles marked 1 and 2. The electrical section can be inverted to change from normally open position to normally closed position or vice versa.

The state on delivery is a normally closed contact

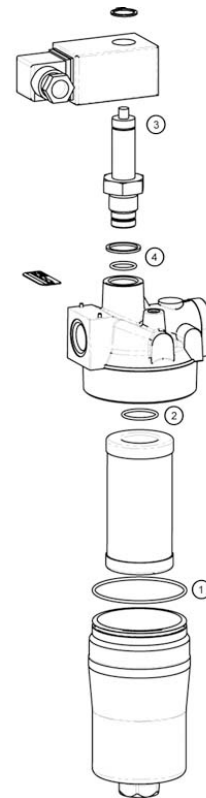
10.3 When should the filter element be replaced?

- Filters equipped with visual and electrical maintenance indicator:
During cold starts, the indicator may give a warning signal. Press the red button of the visual indicator once again only after operating temperature has been reached. If the red button immediately pops up again and/or the electrical signal has not switched off after reaching operating temperature, the filter element must be replaced after the end of the shift.
- Filters without maintenance indicator:
The filter element should be replaced after the trial run or flushing of the system. Afterwards follow instructions of the manufacturer.
- Please always ensure that you have original MAHLE spare elements in stock: Disposable elements cannot be cleaned.

10.4 Element replacement

- Stop system and relieve filter from pressure.
- Unscrew the filter housing by turning counter-clockwise. Clean the housing using a suitable cleaning solvent.
- Remove element by pulling down carefully.
- Check O-ring on the filter housing for damage. Replace, if necessary.
- Make sure that the order number on the spare element corresponds to the order number of the filter name-plate.
To ensure no contamination occurs during the exchange of the element first open the plastic bag and push the element over the spigot in the filter head. Now remove plastic bag.
- Lightly lubricate the threads of the filter housing a little bit and screw into the filter head. Maximum tightening torque for NG 50 to 110 = 60 Nm, for NG 150 to 600 = 100 Nm.

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78356446.07/2013



11. Spare parts list

Order numbers of spare parts		
Position	Type	Order number
① - ③	Seal kit for filter	
	Pi 2005 - Pi 2011	
	NBR	77550213
	FPM	77845795
	EPDM	77845803
	Pi 2015 - Pi 2060	
	NBR	77550221
	FPM	77845811
	EPDM	77845829
③	Maintenance indicator	
	Visual PiS 3098/2,2	77669971
	Electrical PiS 3097/2,2	77669948
	Electrical upper section only	77536550
④	Seal kit for maintenance indicator	
	NBR	77760309
	FPM	77760317
	EPDM	77760325

Maintenance Indicators

1. Features

Filter elements are economically used only if their dirt holding capacity is fully exploited. This is achieved by using filter housings with a maintenance indicator.

MAHLE manufactures maintenance indicators of the following designs:

- Differential pressure indicators
- Pressure indicators/switches/gauges
- Vacuum switches/gauges

With any filter element the collection of dirt particles continuously reduces the number of open pores or, in other words: The open cross section for allowing the liquid to flow is continuously reduced. Thus the pressure on the upstream side of the element (dirt side) increases continuously.

With pressure filters, the pressure is measured upstream and downstream of the filter element (differential pressure). With return line filters the pressure is measured only on the upstream side because, depending on the tank design, atmospheric pressure exits on the downstream side of the filter element is measured analog. With suction filters the vacuum is measured downstream.

A piston with attached magnet is moved against the force of a spring, with which the indicating point is determined by the piston surface. A homopolar poled magnet is fitted in the outer part in the indicating button.

The closer the pole-springs move towards each other, the stronger is the force with the magnets mutually repel, until finally the red button on the indicator pops out.

This red button remains visible until it is pushed in during the daily check which is to be performed while the plant is at operating temperature. If the button pops out immediately after being pushed in, the filter element must be replaced latest at the end of the shift.

This optical function may also be used for generating contactless electrical signals. For this purpose an electrical upper part is pushed over the hydraulic/optical part. This upper part incorporates all electrical switching elements.

- Optical and electrical indicator with standard check function
- Normally open/normally closed combination - standard feature
- Electrical function, easy to install at a later time
- Two-step indication, at 75 % and 100 % optional
- Signal lock out up to approx. 30 °C optional
- Rugged, non-bypass design
- Optimal element exploitation
- Worldwide distribution



2. Differential pressure indicators

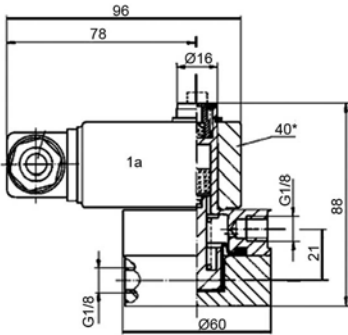


Fig. 1

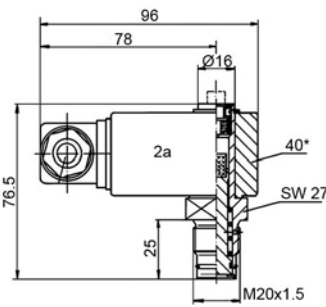


Fig. 2

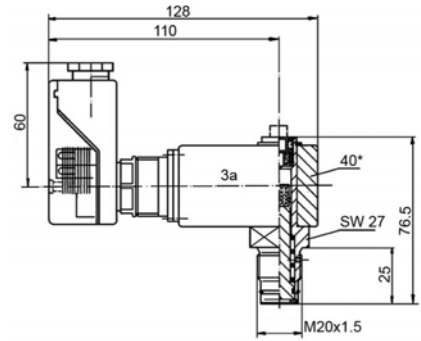


Fig. 3

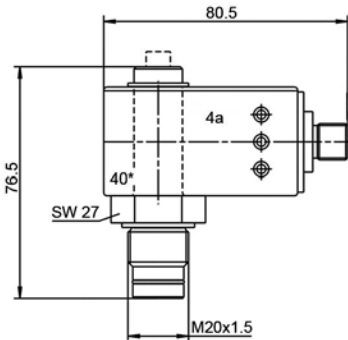


Fig. 4

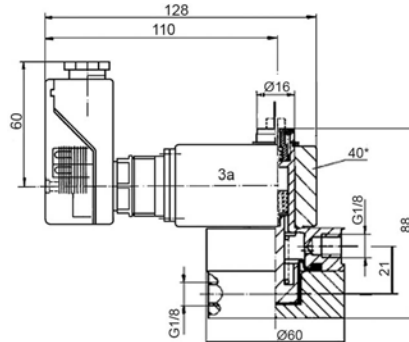


Fig. 15

40* = 40 mm wide

Differential pressure indicators

Nominal pressure [bar]	Temperature [°C]	Type	Order number	Indicator setting [bar]	Indication	Contact type*	Fig.	Material lower section	Material upper section
10	-10 - +120	PiS 3087	77738990	1.2	visual	-	1	Al	PA 6
		PiS 3086	77737513		visual/electr.	1	1 + 1a		
		PiS 3104	78236994		visual/electr.	4	1 + 3a (15)		
160	-10 - +120	PiS 3098	77669971	2.2	visual	-	2	Al	PA 6
		PiS 3097	77669948		visual/electr.	1	2 + 2a		
		PiS 3116	78308074		visual/electr.	3	2 + 2a		
		" " M12	79764028		visual/electr.	10	4 + 4a		
160	-10 - +120	PiS 3119	78309122	1.7/2.2	visual/electr.	2	2 + 2a	Al	PA 6
		PiS 3012	78308454		visual/electr.	4	3 + 3a		
		PiS 3131	79760869		visual/electr.	5	3 + 3a		
		PiS 3141	79761859		visual/electr.	6	3 + 3a		
		PiS 3151	79761909		visual/electr.	8	4 + 4a		
		PiS 3154	76300339		visual/electr.	9	4 + 4a		
		PiS 3157	76326706		visual/electr.	11	4 + 4a		
160	-10 - +120	PiS 3098	77938582	3.5	visual	-	2	Al	PA 6
		PiS 3097	78236648		visual/electr.	1	2 + 2a		
160	-10 - +120	PiS 3098	77669989	5.0	visual	-	2	Al	PA 6
		PiS 3097	77669955		visual/electr.	1	2 + 2a		
		PiS 3116	78308082		visual/electr.	3	2 + 2a		
160	-10 - +120	PiS 3119	78309130	3.7/5.0	visual/electr.	2	2 + 2a	Al	PA 6
		PiS 3012	78308447		visual/electr.	4	3 + 3a		
		PiS 3157	76326714		visual/electr.	11	4 + 4a		
		PiS 3131	79760877		visual/electr.	5	3 + 3a		
		PiS 3141	79761867		visual/electr.	6	3 + 3a		
		PiS 3151	79761917		visual/electr.	8	4 + 4a		
		PiS 3154	76300321		visual/electr.	9	4 + 4a		

Differential pressure indicators									
Nominal pressure [bar]	Temperature [°C]	Type	Order number	Indicator setting [bar]	Indication	Contact-type*	Fig.	Material lower section	Material upper section
400	-10 - +120	PiS 3093	77669898	2.2	visual	-	2	CuZn	PA 6
		PiS 3092	77669856		visual/electr.	1	2 + 2a		
		PiS 3115	78308041		visual/electr.	3	2 + 2a		
400	-10 - +120	PiS 3105	77970387	1.7/2.2	visual/electr.	2	2 + 2a	CuZn	PA 6
		PiS 3102	77942139		visual/electr.	4	3 + 3a		
		PiS 3132	79760919		visual/electr.	5	3 + 3a		
		PiS 3142	79761875		visual/electr.	6	3 + 3a		
		PiS 3152	79761925		visual/electr.	8	4 + 4a		
		PiS 3155	76300354		visual/electr.	9	4 + 4a		
		PiS 3158	76326722		visual/electr.	11	4 + 4a		
400	-10 - +120	PiS 3093	77669914	5.0	visual	-	2	CuZn	PA 6
		PiS 3092	77669864		visual/electr.	1	2 + 2a		
		PiS 3115	78308058		visual/electr.	3	2 + 2a		
		PiS 3115 M12	79764010		visual/electr.	10	4 + 4a		
400	-10 - +120	PiS 3105	77970395	3.7/5.0	visual/electr.	2	2 + 2a	CuZn	PA 6
		PiS 3102	77942147		visual/electr.	4	3 + 3a		
		PiS 3155	76300362		visual/electr.	9	4 + 4a		
		PiS 3132	79760919		visual/electr.	5	3 + 3a		
		PiS 3142	79761883		visual/electr.	6	3 + 3a		
		PiS 3152	79761933		visual/electr.	8	4 + 4a		
		PiS 3158	76326730		visual/electr.	11	4 + 4a		
400	-10 - +120	PiS 3093	77669880	8	visual	-	2	CuZn	PA 6
		PiS 3092	77669872		visual/electr.	1	2 + 2a		
		PiS 3115	78308066		visual/electr.	3	2 + 2a		
450	-10 - +120	PiS 3193	77844061	2.2	visual	-	2	1.4301	PA 6
		PiS 3192	78308488		visual/electr.	1	2 + 2a		
		PiS 3110	79353574		visual/electr.	7	3 + 3a		
450	-10 - +120	PiS 3193	78308538	5.0	visual	-	2	1.4301	PA 6
		PiS 3192	78308546		visual/electr.	1	2 + 2a		
		PiS 3110	79353582		electrical	7	3 + 3a		

*Contact type

- 1 Normally open/normally closed; 1 setting point; wiring box DIN EN 175301-803; max. 250 V AC/200 V DC; max. 1 A
- 2 Normally closed; 2 setting points; wiring box DIN EN 175301-803; max. 150 V; max. 1 A
- 3 Change-over contact; 1 setting point; wiring box DIN EN 175301-803; max. 150 V; max. 1 A
- 4 Change-over contact; 2 setting points; LED; Mercedes Benz Norm DBL 9666 EA; wiring box DIN EN 175201-804; max. 10-30 V; max. 1 A
- 5 Change-over contact; 2 setting points; LED; signal surpression; time delay; wiring box DIN EN 175201-804; 10-30 V; max. 1 A
- 6 Change-over contact; 2 setting points; LED; signal surpression; wiring box DIN EN 175201-804, 10-30 V; max. 1 A
- 7 Analog signal 4-20 mA; 2 setting points; LED; signal cold start; wiring box DIN EN 175201-804; 24 V; max. 1 A
- 8 Normally open/normally closed; 2 setting points; LED; signal surpression; plug connection M12x1; 10-30 V; max. 1 A
- 9 Normally open/normally closed; 2 setting points; LED; plug connection M12x1; 10-30 V; max. 1 A
- 10 Change-over contact; 1 setting point; plug connection M12x1; 150 V; max. 1 A
- 11 Normally closed/normally closed; 2 setting points; LED; plug connection M12x1; 150 V; max. 1 A

3. Pressure indicators/pressure switches

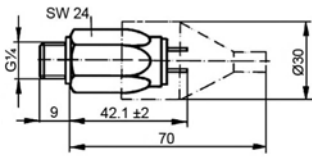


Fig. 5

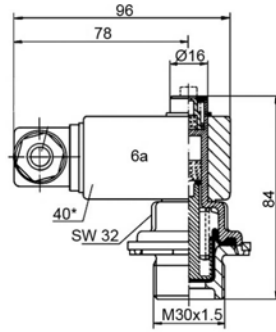


Fig. 6

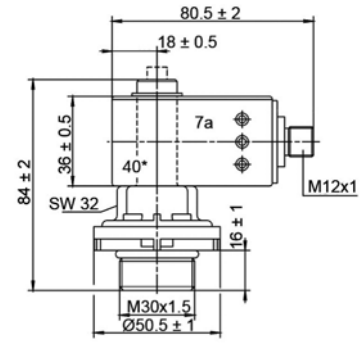


Fig. 7

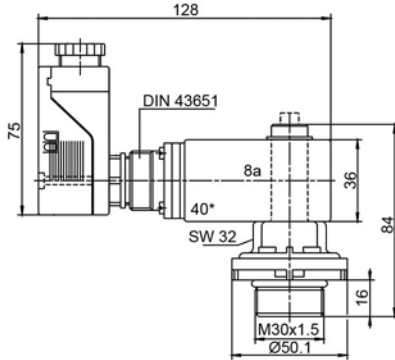


Fig. 8

40* = 40 mm wide

Pressure indicators/pressure switches

Nominal pressure [bar]	Temperature [°C]	Type	Order number	Indicator setting [bar]	Indication	Contact type*	Fig.	Material lower section	Material upper section
10	-10 - +80	PiS 3084	77669781	1.2	visual	-	6	PA 66	PA 6
		PiS 3085	77669807		visual/electr.	1	6 + 6a		
		PiS 3125	78308033		visual/electr.	3	6 + 6a		
10	-10 - +80	PiS 3106	78309155	0.9/1.2	visual/electr.	2	6 + 6a	PA 66	PA 6
		PiS 3103	77942170		visual/electr.	4	8 + 8a		
10	-10 - +80	PiS 3084	77737802	2.2	visual	-	6	PA 66	PA 6
		PiS 3085	77738032		visual/electr.	1	6 + 6a		
		PiS 3125	78308108		visual/electr.	3	6 + 6a		
		PiS 3125 M12	79764747		visual/electr.	10	7 + 7a		
10	-10 - +80	PiS 3156	76300370	1.7/2.2	opt./elektr.	9	7 + 7a	PA 66	PA 6
		PiS 3159	76326748		visual/electr.	11	7 + 7a		
		PiS 3143	79761891		visual/electr.	6	8 + 8a		
		PiS 3153	79761941		visual/electr.	8	7 + 7a		
		PiS 3133	79760927		visual/electr.	5	6 + 3a		
		PiS 3106	78308850		visual/electr.	2	6 + 6a		
		PiS 3103	77970429		visual/electr.	4	8 + 8a		
10	-25 - +85	DSS/1.2	77863814	1.2	electrical	norm. open	5	galvanized steel	delivered with protection cap
		DSO/1.2	77870587		electrical	n. closed	5		
10	-25 - +85	DSS/2.2	77845845	2.2	electrical	norm. open	5		
		DSO/2.2	77870595		electrical	n. closed	5		
10	-25 - +85	DSS/5	77863822	5.0	electrical	norm. open	5		
		DSO/5	77870603		electrical	n. closed	5		

*Contact type

see remarks below 2. Differential pressure indicators

4. Vacuum/pressure gauges

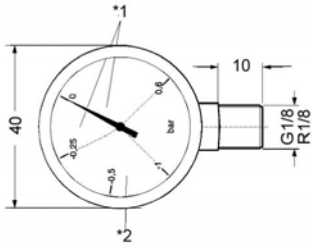


Fig. 9
*1 = Green area/*2 = Red area

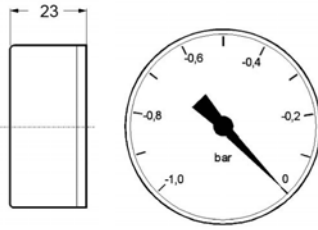


Fig. 10

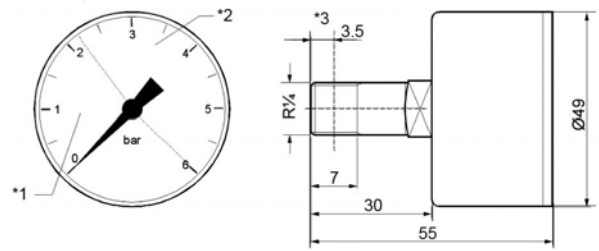


Fig. 11
*3 = Metering level

Vacuum/pressure gauges

Nominal size [NG]	Type	Order number	Indicating range [bar]	Connection size	Fig.	Class	Dial face
40	Vacuum gauge	76345763	-1 - +0.6	R1/8 conical	9	min. 2.5	Red/Green area sep. line -0.25 bar
		77545908		G1/8	9		white
50		77617558	-1 - 0	R¼ conical	10		
50	Pressure gauge	78381998	0 - 6	R¼ conical	11		Red/Green area sep. line 2.2 bar

5. Vacuum switches

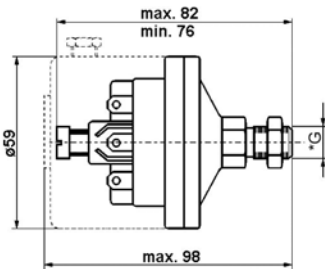


Fig. 12
*G = Connection

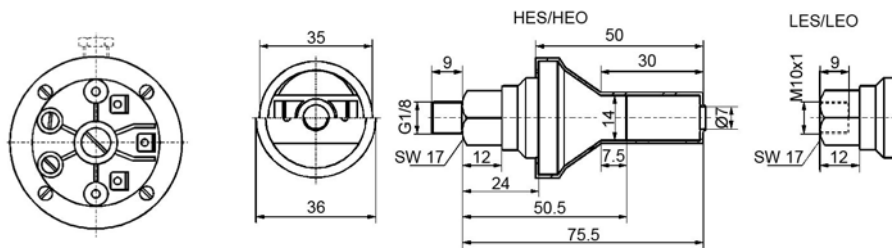


Fig. 13
HES/HEO only for fluids, LES/LEO only for air

Vacuum switches

Permissible over-pressure [bar]	Temperature [°C]	Type	Order number	Switch setting[mbar]	Contact type	Fig.	Connection *G	Material lower section	Material upper section
0.5	-10 - +70	PiS 3070	77669690	-15 - -80	single pole change-over switch, snap-in joint	12	G¼	GD-Al	PA 6
1			77669724	-50 - -600			G1/8		
0.1	-20 - +80 short-term +120	HES 2200 BP	78308892	-200 ±10	normally open	13	G1/8 outside	GD-ZnAl	PC
		HEO 2200 BP	78308900		normally closed				
		LES 250 I	78308918	-50 ±4	normally open	M10x1 inside			
		LEO 250 I	78308926		normally closed				

6. Vacuum indicators/air filters

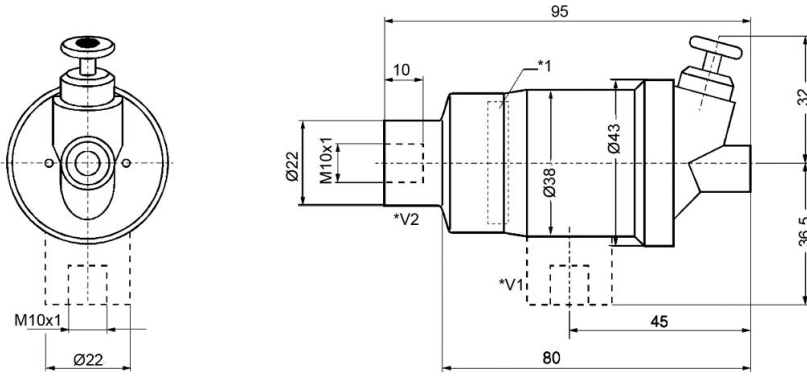


Fig. 14

*1 = Indication: position of display in mbar

*V1 = Version 1

*V2 = Version 2

Vacuum indicators/air filters

Temperature [°C]	Type	Order number	Indicator setting $\pm 10\%$ [mbar]	Indication type	Fig.	Version
-40 - +110	TB 745	78309056	-50	optical self locking	14	1
	TB 745/1	78309064	-50			2
	TB 746/1	78309049	-65			2

7. Accessories

7.1 Seal kits

Type	NBR	FPM	EPDM
	Order number		
PiS 3092, 3093, 3102, 3105, 3115, 3132, 3142, 3152, 3155, 3192, 3193, 3158	77760275	77760283	77760291
PiS 3012, 3097, 3098, 3116, 3119, 3131, 3141, 3151, 3154, 3157	77760309	77760317	77760325
PiS 3084, 3085, 3103, 3106, 3125, 3133, 3143, 3153, 3156, 3159	78383382	78383390	78383408
PiS 3086, 3087, 3104	77760242	77760259	-

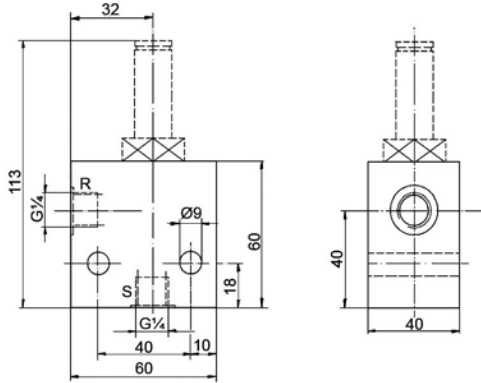
7.2 Electrical expansion kit/spare parts

Designation	Order number
Electrical upper section normally open/closed for PiS 3084, 3087, 3093, 3098, 3193 (contact type 1)	77536550
Wiring box with lamp insert 12 - 230 V for electrical upper section normally open (acc. to DIN EN 175301-803)	78307548
Electrical upper section change-over contact for PiS 3084, 3087, 3093, 3098, 3193 (contact type 3)	78308017
Wiring box with 2 LEDs 10 - 30 V for electrical upper section change over contact (acc. to DIN EN 175301-803)	78308025

Designation	Order number
Electrical upper section change-over contact M12x1 für PiS 3084, 3087, 3093, 3098, 3193 (contact type 10)	79764036
Electrical upper section 2SP-LED-M12x1-SU (contact type 8) spare part for 2 setting points indicator!	76116651
Electrical upper section 2SP-LED-M12x1 (contact type 9) spare part for 2 setting points indicator!	76300412
Electrical upper section W-2SP-LED-SU-VERZ (contact type 5) spare part for 2 setting points indicator!	79760943
Electrical upper section W-2SP-LED-SU (contact type 6) spare part for 2 setting points indicator!	76118590
Electrical upper section W-2SP/Ö-LED-M12x1 (contact type 11) spare part for 2 setting points indicator!	76326755
Electrical upper section normally closed with signal suppression PiS 3003	77765357
Electrical upper section normally open with signal suppression PiS 3002	77765365

7.3 Mounting block for differential pressure indicators (M20x1.5)

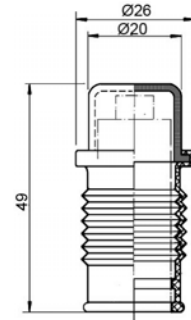
Designation	Order number
Mounting block (St)	77809098
Mounting block (1.4301), 450 bar	77698517



R = clean side
S = dirt side

7.4 Protection cap

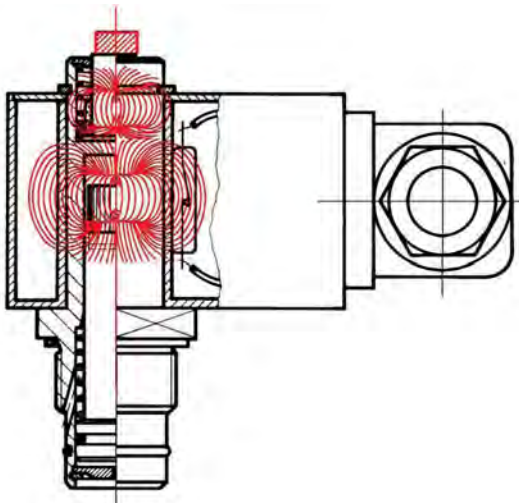
Designation	Order number
Protection cap for all visual pressure and differential pressure indicators, -20 °C to +80 °C Resistant to: gasoil, purifying agent, insolation, dust, salt, water, concret	78285330



8. Function

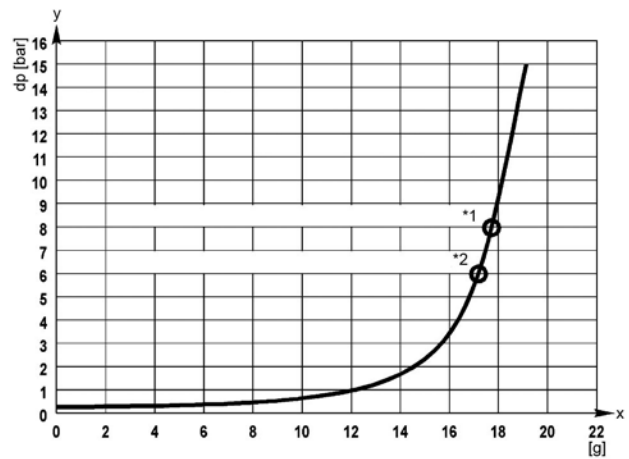
The magnetic field as previously described, contactless operates reed contacts in the electrical upper part. The desired contact type is selected by inverting upper part. Another option keeping the electrical signal electronically suppressed up to 30 °C operating temperature is also available. This eliminates false electrical signal during the cold start phase.

For efficient servicing it is desirable to have a pre-warning device (so that the filter element can be replaced, e.g. with the next tool change). For this purpose electrical upper parts with two indicating points, i.e. at 75 % and at 100 % of the indicator setting are available.



Pressure/vacuum gauges give an analog reading of the existing state of contamination of the filter elements. They require continuous control to ensure that the service time and reserve capacity are not unduly exceeded. If the contamination signal is disregarded, the filter element may collapse or, if a bypass valve is installed, part of the contamination fluid may reach the hydraulic components via the bypass valve and cause failure of the hydraulics.

Pressure/vacuum switches are provided with snap action switches, which ascertains that signal are issued only when the limit values have been fully reached.



Dirt holding capacity - Δp curve

x = dirt holding capacity [g]

y = differential pressure Δp [bar]

*1 = signal step maintenance indicator 100 %

*2 = signal step maintenance indicator 75 %

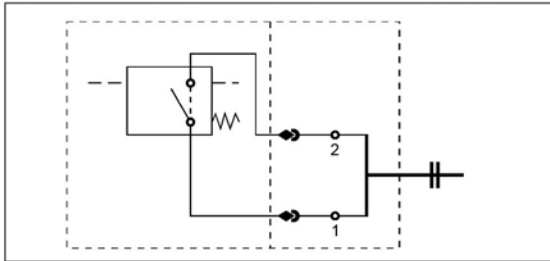
9. Technical specifications

9.1 Contact type normally open/normally closed

Contact type 1	
Types PiS 3085, 3086, 3092, 3097, 3192	
Max. voltage:	250 V AC/ 200 V DC
Max. current:	1 A
Contact load:	70 W
Type of protection:	IP 65 in inserted and secured status
Contact type :	normally open/normally closed
Cable sleeve:	M20x1.5
Wiring box:	DIN EN 175 301-803

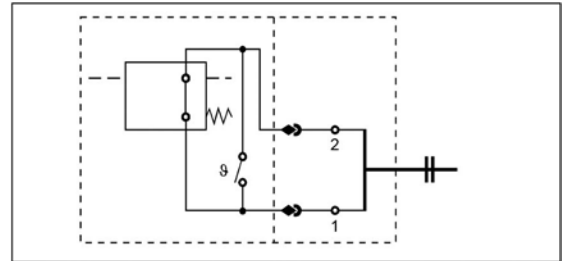
The switching function can be changed by turning the electric upper part by 180° (normally closed contact or normally open contact). The state on delivery is a normally closed contact.

By inductivity in the direct current circuit the use of suitable protection circuit should be considered. Electrical parts are insulated (plastic material housing).



9.2 Contact type normally closed or open with signal suppression

Contact type normally closed	
Type PiS 3003 (expansion kit)	
Contact type normally open	
Type PiS 3002 (expansion kit)	
Signal suppression by thermorelay	
Signal is released at +30 °C	
for further technical details see 9.1	



Maintenance indicators PiS 3084, 3087, 3093, 3098, 3193 can be mounted in 45°.

We draw attention to the fact that all values indicated are average values which do not always occur in specific cases of application: Our products are continually being further developed. Values, dimensions and weights can change as a result of this. Our specialized department will be pleased to offer you advice.

When using our filters in areas which are to be classified according to EU directive 94/9 EG (ATEX), we recommend prior discussion with us. The standard version can be used for liquids based on mineral oil /corresponding to the fluids in Group 2 of Directive 97/23 EG Article 9). Please consult with us if using other media.

Subject to technical alterations without prior notice.

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HERION & RAU
Fluidtechnik GmbH

Compact-Pressure Switch SW 27 Series PDC

Electromechanical Pressure Switch

Switching Point adjustable: 0,2 to 16bar

Pneumatics



90076.1009

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D-71083 Herrenberg

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fax +49 (0) 7032/2017-199

kontakt@bar-control.de
www.bar-control.de

Features

Compact-Pressure Switches SW 27 series PDC are electro-mechanical signal converter, distinguished by high precision that are changing the pressure of fluids into electrical signals.

Switching point and hysteresis are being offered factory-set. Optional the setting of pressure and hysteresis are adjustable by the user.

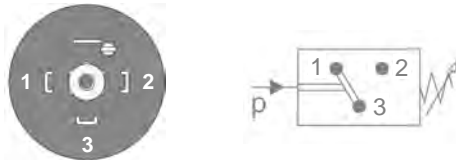
Compact-Pressure Switches series PDC are designed for use in fluid-technical-systems under normal environmental conditions. The PDC operates as a diaphragm pressure switch and is intended for use with different gradings up to max.16bar setting pressure range. The specific design of the PDC, laid-out as a changer, enables overhanging electrical performance characteristics. Based on this the PDC is applicable reliably for a voltage up to max. 250V with a switching current up to 4A but also for small currents and voltages of 5V with minimum 5mA.

The units are available with sockets DIN EN 175301-803.



Contact Arrangement / Circuit Symbols

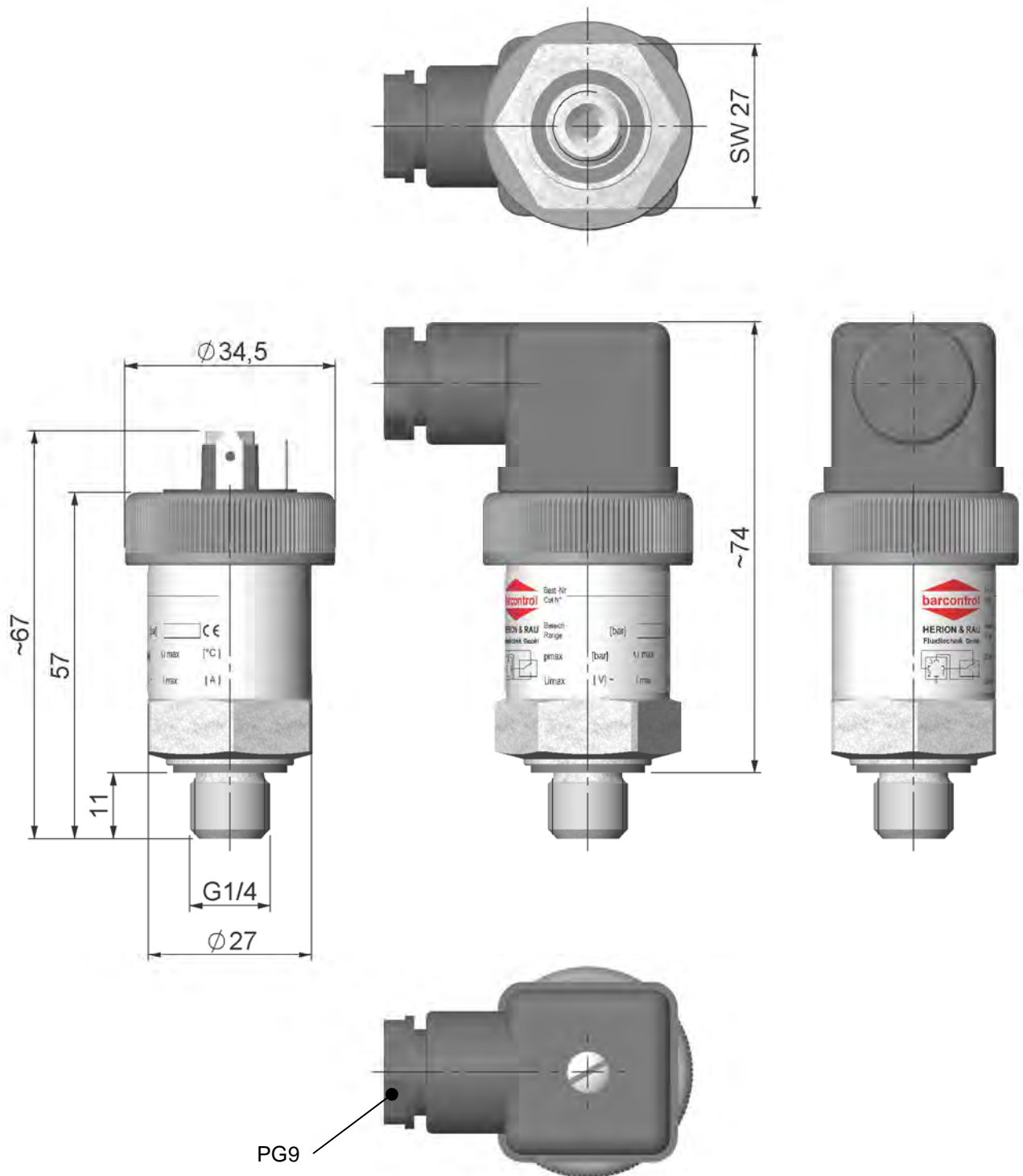
DIN EN 175301-803



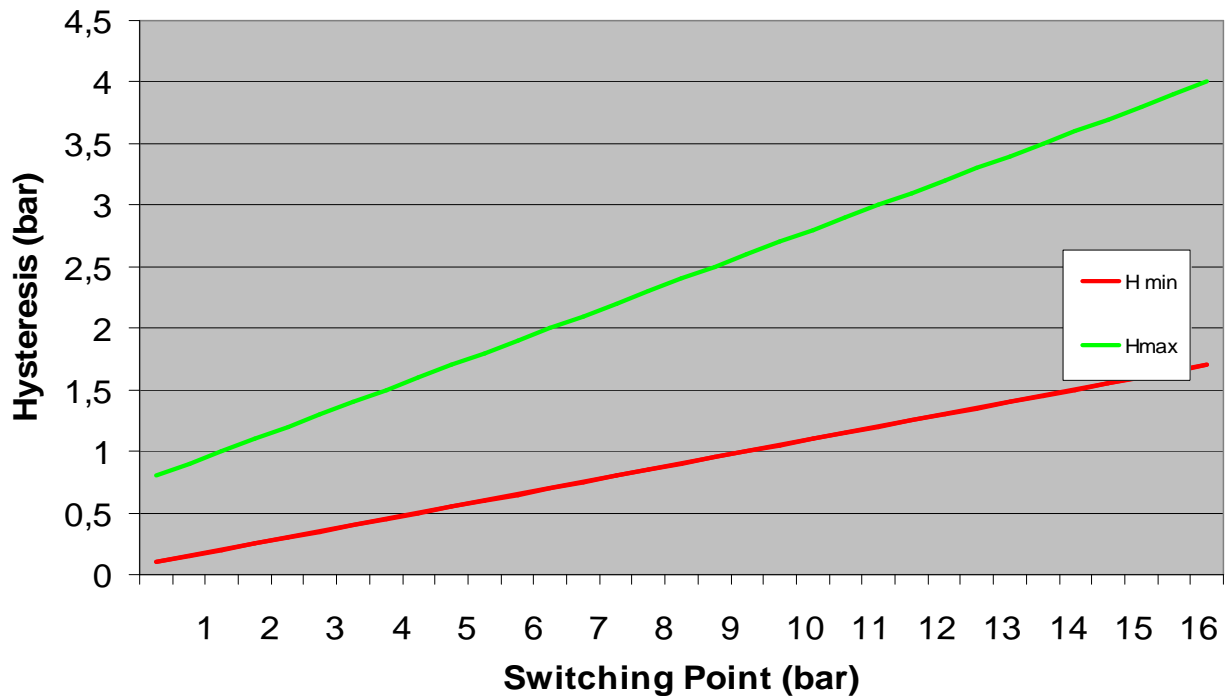
Technical Data

Operating fluid:	compressed air; neutral fluids
Type of mounting:	with fluid connection
Fluid connection:	external thread G ¹ / ₈ " , G ¹ / ₄ " , M10x1 , 1/8NPT , 1/4NPT , other on request
Mounting position:	optional
Operating pressure range:	0,2...2bar; 0,5...8bar; 1...16bar (max. system pressure 60bar)
Repeatability:	±2% relating to operating range maximum value
Switching pressure difference:	adjustable, see diagram switching pressure difference page 4
Max. switching frequency:	100/min
Temperature range:	-20°C to +80°C
Vibration resistance:	10g (10 ... 2000Hz)
Shock resistance:	30g
Electrical connection:	socket DIN EN 175301-803 (DIN 43650 type A)
Switching element:	change-over switch with catch spring as switching element and self-cleaning contacts
Operating current and voltage at operating category:	AC12 acc. to VDE0660 (EN60947): 4A at 250VAC AC14 acc. to VDE0660 (EN60947): 1A at 250VAC DC12 acc. to VDE0660 (EN60947): 2A at 28VDC DC14 acc. to VDE0660 (EN60947): 0,5A at 28VDC
CE-Certification:	acc. to EU-Standard 73/23/EWG
Protection category EN 60529:	IP65 with fitted socket
Material:	housing: steel-zinc coated, other on request seal/diaphragm: NBR
Weight:	0,100 kg

Dimensions



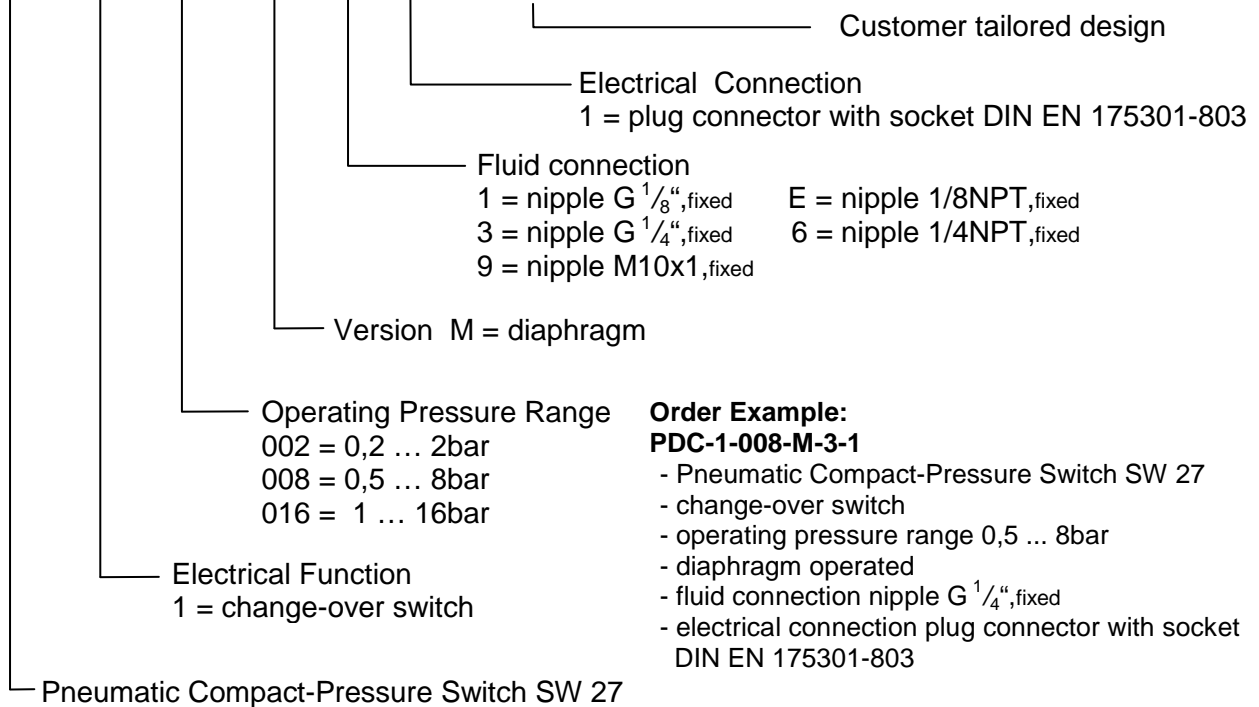
Switching Pressure Difference



Example: At a switching point of 4bar the switching pressure difference (hysteresis) is adjustable from 0,5bar up to 1,5bar (guiding value).

Order Code

PDC - 1 - XXX - M - X - 1 - GE XXX



Specifications are subject to change without notice.



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