HYDAC INTERNATIONAL

Pump–Transfer Cooler Filtration Unit
UKF–3

PUMP-TRANSFER COOLER FILTRATION UNIT UKF

1. GENERAL

1.1. DESCRIPTION

The UKF pump-transfer cooler filtration unit is a compact, easy-to-install unit for off-line filtration cooling circuits. Installation is simply a matter of hydraulic inline mounting to and from the tank and connecting the voltage supply.

1.2. FEATURES

Off-line unit consisting of:

- low-noise feed pump
- filter
- oil-water plate heat exchanger
- the circuit is fitted with check valves to isolate the filter when used with a positive head tank when changing the filter element

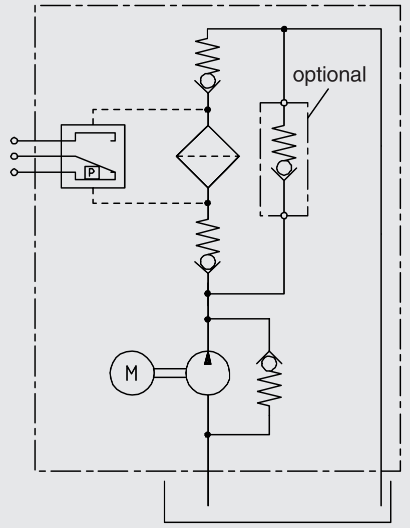
1.3. APPLICATIONS

- plastic injection moulding machines
- presses
- machining centres
- wind generators
- transmission systems

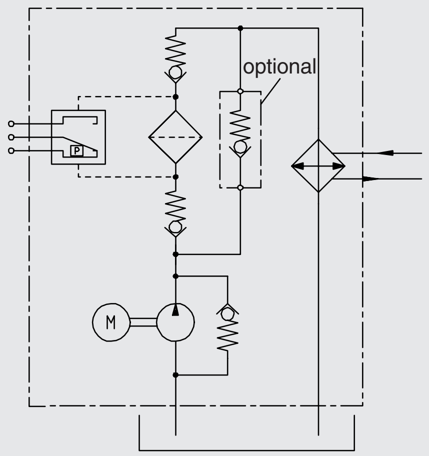
1.4. SYMBOLS

(shown with electrical differential pressure indicator)

UF (without heat exchanger)



UKF



2. TECHNICAL SPECIFICATIONS

2.1. OPERATING PRESSURE

Oil side: max. 10 bar
Water side: max. 27 bar (static)

2.2. SUCTION PRESSURE ACROSS THE SUCTION CONNECTION

-0.4 bar

2.3. MEDIUM

Oil side:
Mineral oil to DIN 51524 part 1 and 2.
Permissible contamination ≤ NAS 12

2.4. TEMPERATURE OF MEDIUM

Oil side: +10 °C to +80 °C
Water side: + 5 °C to +60 °C

2.5. MAX. VISCOSITY

See graph on page 6

2.6. AMBIENT TEMPERATURE

+ 10 °C to + 40 °C

2.7. MOUNTING POSITION

Vertical

2.8. PRESSURE DIFFERENTIALS AT ν = 46 mm²/s

- Housing 0.5 bar
- Check valves: 1 bar
- Filter: see page 8
- Heat exchanger: see page 9

2.9. REVOLUTIONS

min. 900 rpm to
max. 1800 rpm

2.10. DIRECTION OF ROTATION

Clockwise – see direction of arrow

2.11. WEIGHT (dry unit)

(UF + heat exchanger + filter)

UF:

1.5 KW	44 kg
2.2 KW	48 kg
4 KW	52 kg

Heat exchanger:

410 - 20	11 kg
410 - 40	14 kg
410 - 70	17 kg
410 - 100	22 kg
410 - 120	25 kg
415 - 20	14 kg
415 - 40	18 kg
415 - 60	24 kg
415 - 80	30 kg

Filter:

MF 180	2 kg
LF 330	4 kg
LF 500	6 kg

2.12. DRIVE

Three-phase electric motor
Insulation class: F
Safety type: IP55

2.13. VOLUMETRIC EFFICIENCY

> 90 % (n = 40 mm²/s)

2.14. NOISE LEVELS

(at 1500 rpm)

Pump [cm³/rev]	1 bar	6 bar
20	61	61
30	61	62
40	62	63
50	64	66
70	67	68
100	68	70
130	70	72

Test medium: ISO-VG 46 at 40 °C
The noise levels are only a guide as acoustic properties of a room, connections, viscosity and reflections have an effect on the noise level.

2.15. OPERATING DATA FOR HEAT EXCHANGER

- Medium (water side):
  - Water glycol (coolant)
  - HFC operating fluids
  - Water
  - Oil
- Contamination:
  The amount of particles in suspension should be less than 10 mg/l. Particle size < 0.6 mm (spherical).
  Thread-like particles cause a rapid increase in pressure drops.
- Corrosion:
  The following critical values refer to a pH value of 7
  - Free chlorine:
    CL_2 < 0.5 ppm
  - Chloride ions:
    CL < 700 ppm at 20 °C
    < 200 ppm at 50 °C
  - Other critical values:
    - pH 7 - 10
    - Sulphate SO_4^{2-} < 100 ppm
    - [H CO_3 -] / [SO_4^{2-}] > 1
    - Ammonia, NH_3 < 10 ppm
    - Free CO < 10 ppm

  The following ions are not corrosive under normal conditions:

  Phosphate, nitrate, nitrite, iron, manganese, sodium and potassium.
- Heat exchanger connections
  Female thread (max. torque rating: 385 Nm).
  The pipes must be connected so that the connections are stress-free. Linear expansion and vibrations from the pipes to the heat exchanger must be avoided.

3. MODEL CODE

(also order code)

UKF -3 / 1.0 / P / 70 / 2.2 / 410–70 / MF180/10 / D
UF -3 / 1.0 / P / 70 / 2.2 / – / MF180/10 / D

Type

UKF	pump + heat exchanger + filter
UF	pump + filter

Model

1.0	UF	
	UKF heat exchanger at the back	(410)
2.0	heat exchanger at the side (see also Dimensions on page 7)	(415)

Seals

P Perbunan

Pump flow rate: cm³/rev

cm³/rev	1000 rpm	1500 rpm
20	20 l/min	30 l/min
30	30 l/min	45 l/min
40	40 l/min	60 l/min
50	–	75 l/min
70	–	105 l/min
100	–	150 l/min
130	–	185 l/min

Motor

1.5 KW - 1000 rpm - 4 A
2.2 KW - 1500 rpm - 5.2 A
4 KW - 1500 rpm - 9 A

Wide voltage range motor:

All voltages and frequencies between 380/420V - 50Hz and 440/480V - 60Hz possible

For calculation, see page 5

Heat exchanger UKF

Model	1.0		2.0	
	410 -	20	415 -	20
		40		40
		70		60
		100		80
		120		

UF without heat exchanger: –

For calculation, see page 5

Filter

MF180
LF330
LF500

Filtration rating		Contamination retention at Δp: 5 bar		
		MF180	LF330	LF500
3	3 µm absolute	89 g	36.9	60.7
5	5 µm absolute	90 g	39.4	64.8
10	10 µm absolute	94 g	44.3	72.9
20	20 µm absolute	111 g	49.2	81
10P	10 µm nominal	120 g	–	–

For further details on filter elements, see Mobile Spin-On Filters brochure no.: E 7.301../.., and Filter Elements brochure no.: E 7.200../.., for Betamicron® 3 plus pressure filter elements

To determine the pressure differential, see page 8

Differential pressure clogging indicator 5 bar

BM	VD 5 BM.1	(visual; manual reset)
C	VD 5 C.0	(electrical)
D	VD 5 D.0/-L24	(electrical/visual)

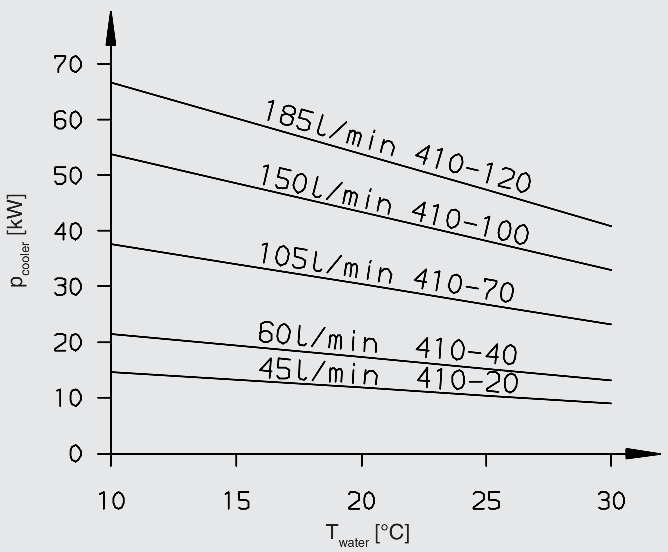
For further details, see Clogging Indicator brochure no.: E 7.050../..

4. DETERMINING THE COOLING CAPACITY OF UKF

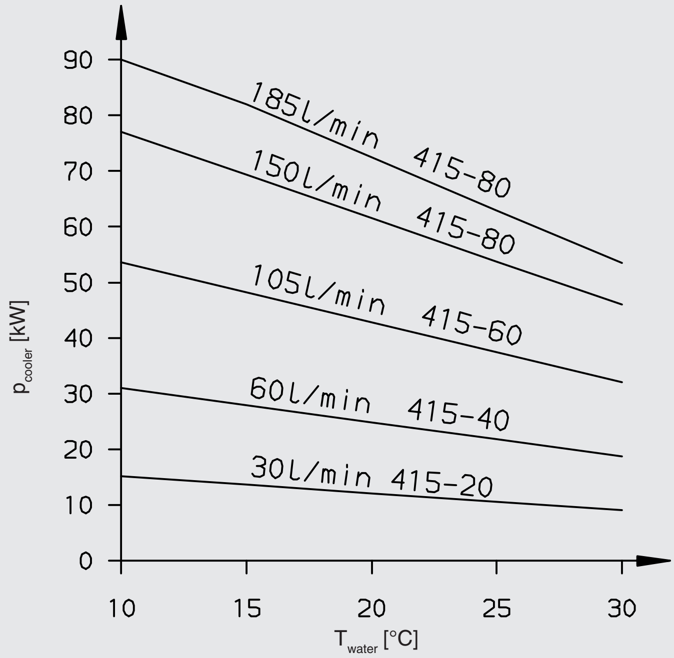
PRE-SELECTION GRAPHS
(see also point 12 and 13)

Parameters:
T_{oil} = 55 °C
Oil ISO VG 46
$\frac{Q_{oil}}{Q_{H_2O}}$ = 4 (see graph at point 6)

UKF-3/1.0



UKF-3/2.0



TABLES FOR ACCURATE DETERMINATION OF COOLING CAPACITY
*P: cooling capacity example at T_{oil} = 55 °C and T_{H_2O} = 20 °C

	410-20				410-40				410-70				410-100				410-120			
L/min	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*
20	0.200	0.137	-2.50	5.8	0.200	0.154	-1.80	6.1	0.200	0.198	0.20	7.2	0.220	0.225	0.50	8.1	0.240	0.350	0.10	8.6
30	0.300	0.205	-3.90	8.5	0.320	0.212	-4.40	9.0	0.280	0.250	-0.90	9.5	0.300	0.292	0.10	10.8	0.320	0.310	0.00	11.4
40	0.360	0.273	-3.50	10.8	0.420	0.280	-5.70	11.8	0.400	0.300	-4.00	12.0	0.360	0.345	0.00	12.9	0.380	0.374	0.30	13.7
45	**0.360**	**0.298**	**-2.20**	**11.6**	0.480	0.309	-7.00	13.2	0.480	0.320	-6.50	13.5	0.400	0.367	-0.70	14.0	0.400	0.400	0.80	14.8
60	0.400	0.360	-1.00	13.8	**0.620**	**0.420**	**-8.40**	**17.3**	0.660	0.415	-10.10	17.9	0.620	0.436	-7.30	18.1	0.560	0.470	-3.00	18.4
75	0.460	0.410	-1.30	15.8	0.740	0.515	-9.30	21.1	0.800	0.520	-11.60	22.0	0.820	0.525	-12.20	22.4	0.780	0.540	-9.60	22.5
105	0.660	0.500	-6.20	20.1	0.780	0.680	-3.10	26.2	**1.120**	**0.725**	**-16.70**	**30.4**	1.100	0.737	-15.00	30.8	1.140	0.737	-16.70	31.3
150	0.880	0.645	-9.40	26.1	0.960	0.840	-3.40	32.6	1.340	1.030	-12.30	40.8	**1.560**	**1.040**	**-21.60**	**43.4**	1.580	1.040	-22.30	43.8
185	1.020	0.750	-10.80	30.3	1.140	0.943	-6.60	37.2	1.340	1.210	-3.30	46.2	1.880	1.275	-25.20	52.7	**1.980**	**1.290**	**-29.30**	**53.8**

	415-20				415-40				415-60				415-80			
L/min	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*	F_{oil}	F_{H_2O}	K	P*
20	0.280	0.205	-3.00	8.3	0.250	0.235	-0.45	8.6	0.260	0.265	0.40	9.4	0.280	0.283	0.30	10.0
30	**0.400**	**0.310**	**-3.70**	**12.1**	0.430	0.320	-4.55	12.7	0.380	0.355	-0.80	13.0	0.400	0.386	-0.40	13.9
40	0.520	0.400	-4.70	15.9	0.580	0.418	-6.80	16.7	0.560	0.437	-5.10	17.0	0.500	0.475	-0.70	17.3
45	0.560	0.450	-4.70	17.4	0.640	0.465	-7.10	18.8	0.640	0.480	-6.60	19.0	0.600	0.514	-3.40	19.3
60	0.620	0.575	-1.30	21.3	**0.860**	**0.618**	**-10.10**	**24.8**	0.880	0.630	-10.60	25.2	0.840	0.640	-8.10	25.3
75	0.720	0.670	-1.40	24.8	1.040	0.770	-11.30	30.5	1.060	0.780	-11.70	31.0	1.120	0.780	-14.20	31.8
105	0.900	0.830	-1.70	31.2	1.220	1.050	-6.30	39.8	**1.440**	**1.080**	**-14.80**	**42.8**	1.560	1.090	-20.00	44.0
150					1.480	1.370	-3.00	51.0	1.820	1.530	-11.60	57.9	**2.100**	**1.550**	**-23.00**	**61.5**
185					1.680	1.570	-2.30	58.7	1.920	1.810	-2.40	67.0	2.300	1.900	-16.00	72.5

For T_{oil} from 45 to 55 °C, T_{H_2O} from 10 to 35 °C, Oil ISO VG 46: $\frac{Q_{oil}}{Q_{H_2O}}$ = 4 (see graph at point 6)

$$P_{cool} = F_{oil} \times T_{oil\ in} - F_{H_2O} \times T_{H_2O\ in} + K$$

A calculation program is available for making an accurate calculation.
The following details are required:

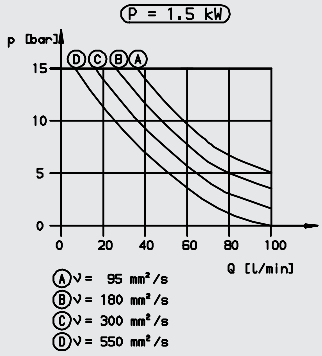
- Oil type
- Required tank temperature with UKF
- Required cooling capacity
- Water inlet temperature and max. water quantity.

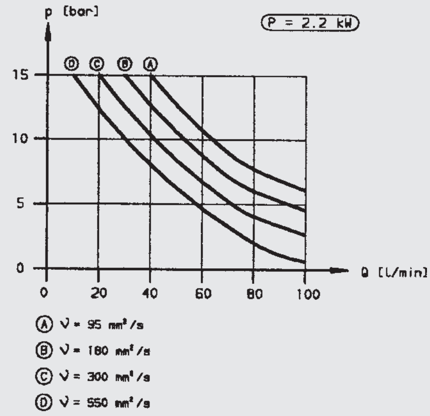
Areas shaded grey: not recommended (Δp too high or efficiency of heat exchanger too low)

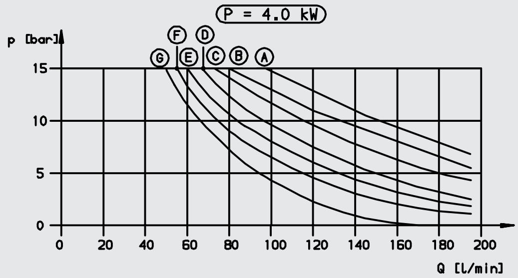
Figures in bold: preferred values

The cooling capacity is also dependent on the viscosity. At a lower viscosity the cooling capacity increases, at a higher viscosity it decreases.

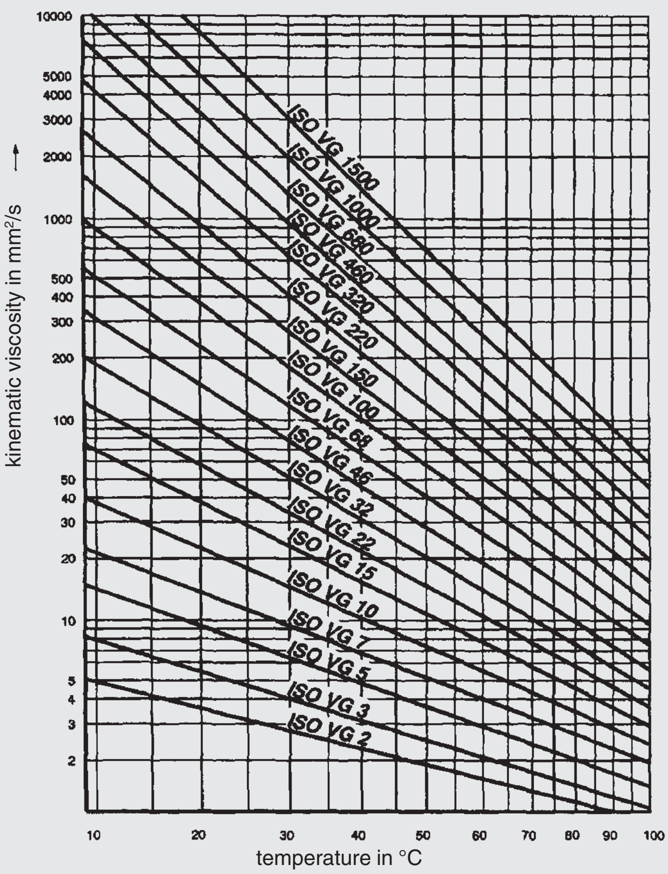
5. GRAPHS FOR MOTOR-PUMP SELECTION



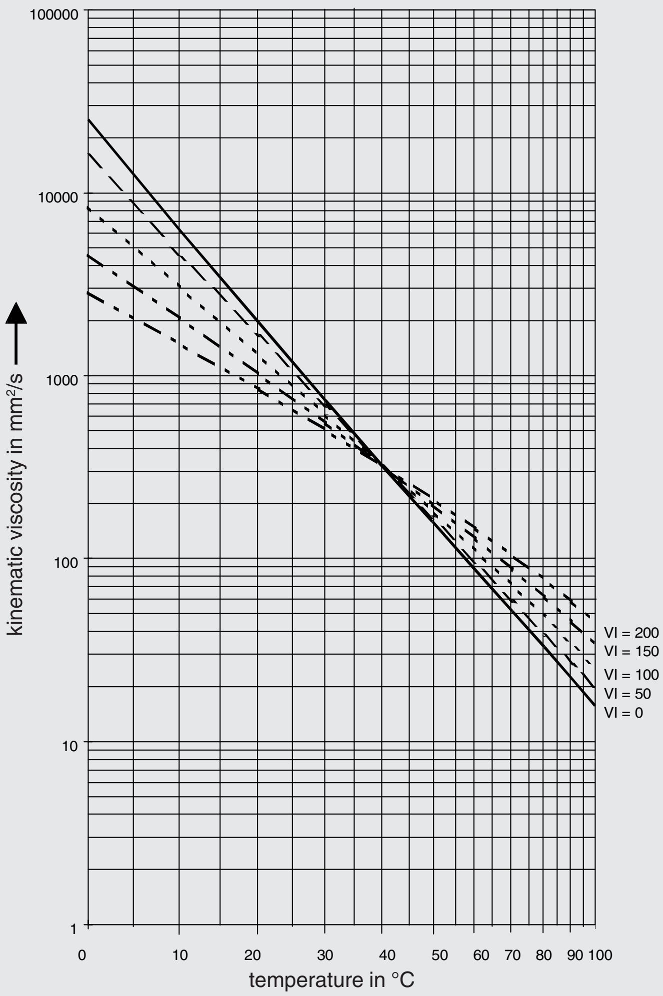




VISCOSITY / TEMPERATURE GRAPH
To DIN 51519 Viscosity index 50



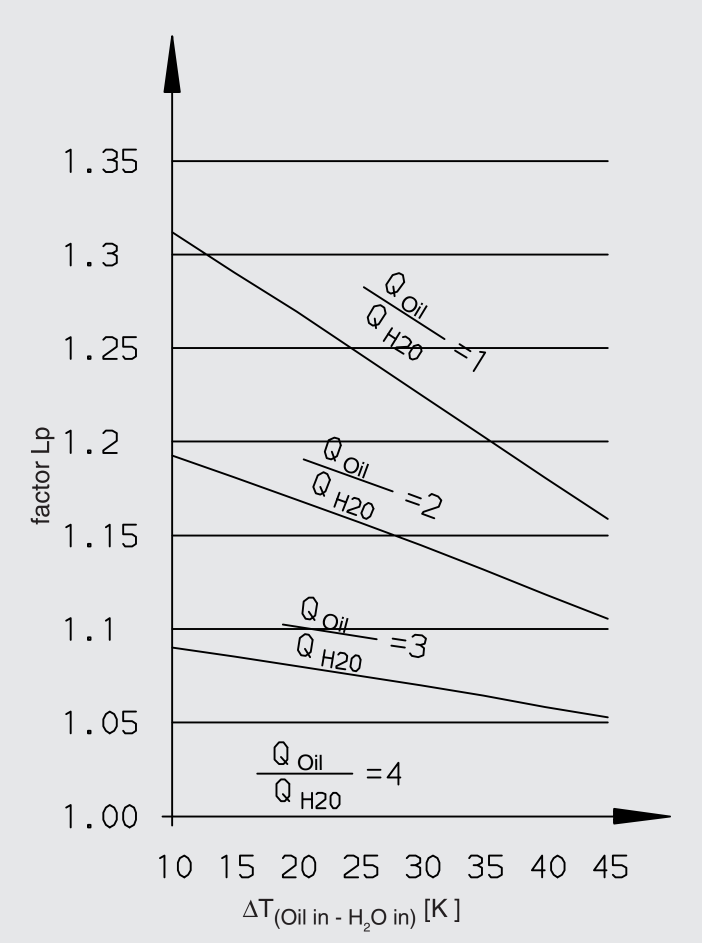
VISCOSITY / TEMPERATURE GRAPH
Viscosity index 0 to 200, oil ISO VG 320



The viscosity index (VI) indicates how much the viscosity of the oil changes with temperature.
The higher the viscosity index, the smaller the change in viscosity in relation to the temperature.
⇒ Oils with a high viscosity index have a lower viscosity at low temperatures than oils with a low viscosity index.

6. OUTPUT CORRECTION

with higher water through-put



Calculation of the oil and water outlet temperature

Temperature loss: oil

$$\Delta T \approx 36 \times \frac{P}{Q_{Oil}}$$

P = cooling capacity [kW]

Q_{Oil} = flow rate [l/min]

Temperature increase: water

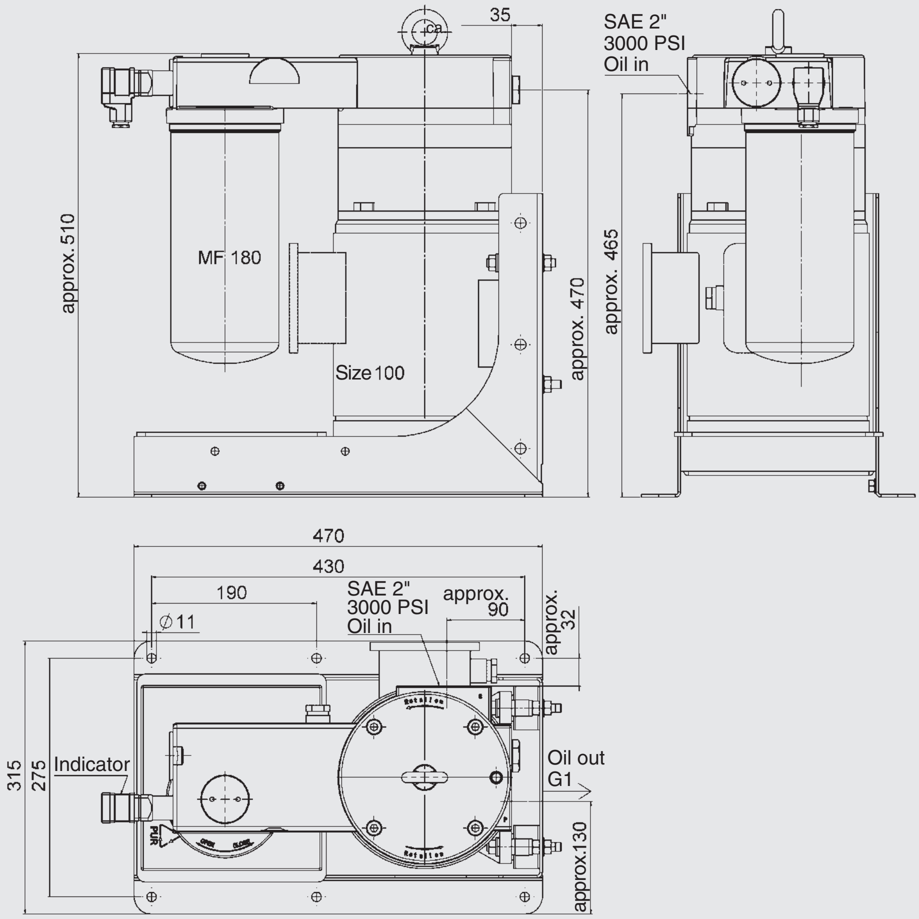
$$\Delta T \approx 14.4 \times \frac{P}{Q_{water}}$$

P = cooling capacity [kW]

Q_{water} = flow rate [l/min]

7. DIMENSIONS

UF-3/1.0



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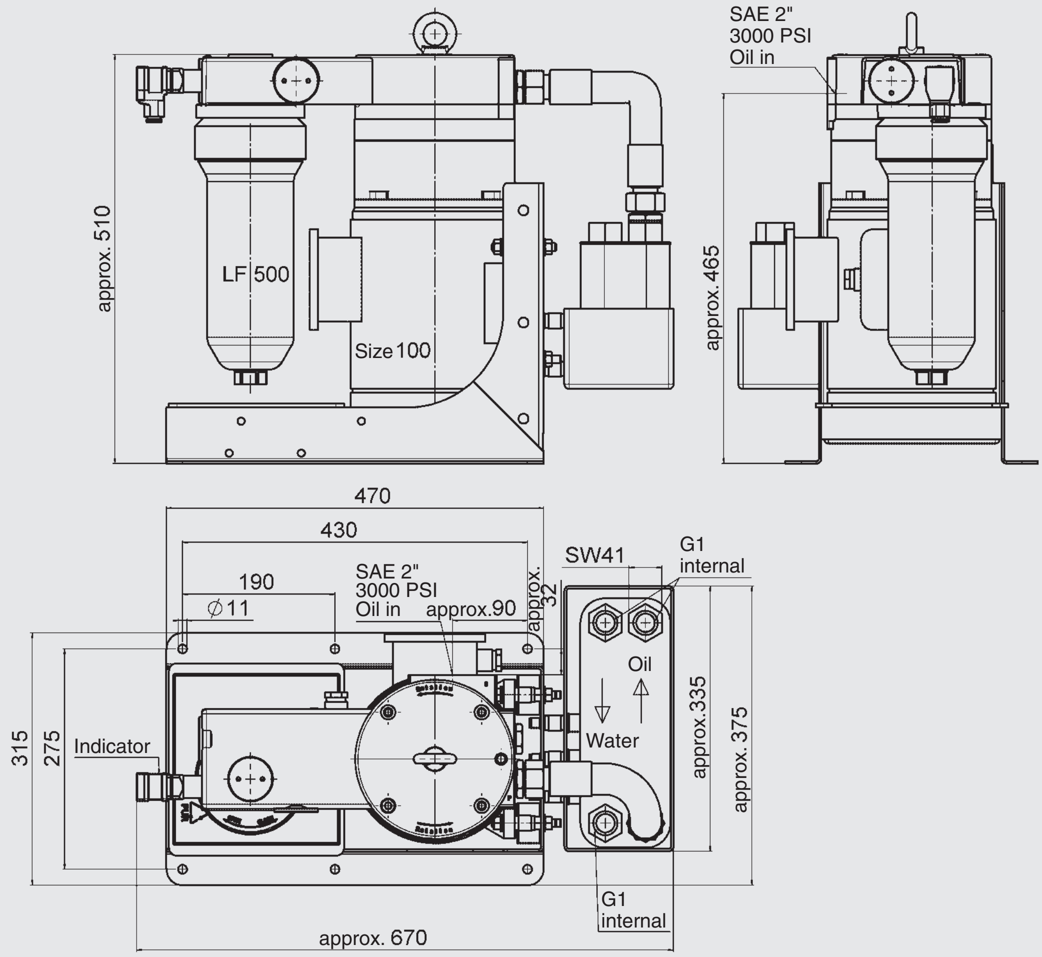
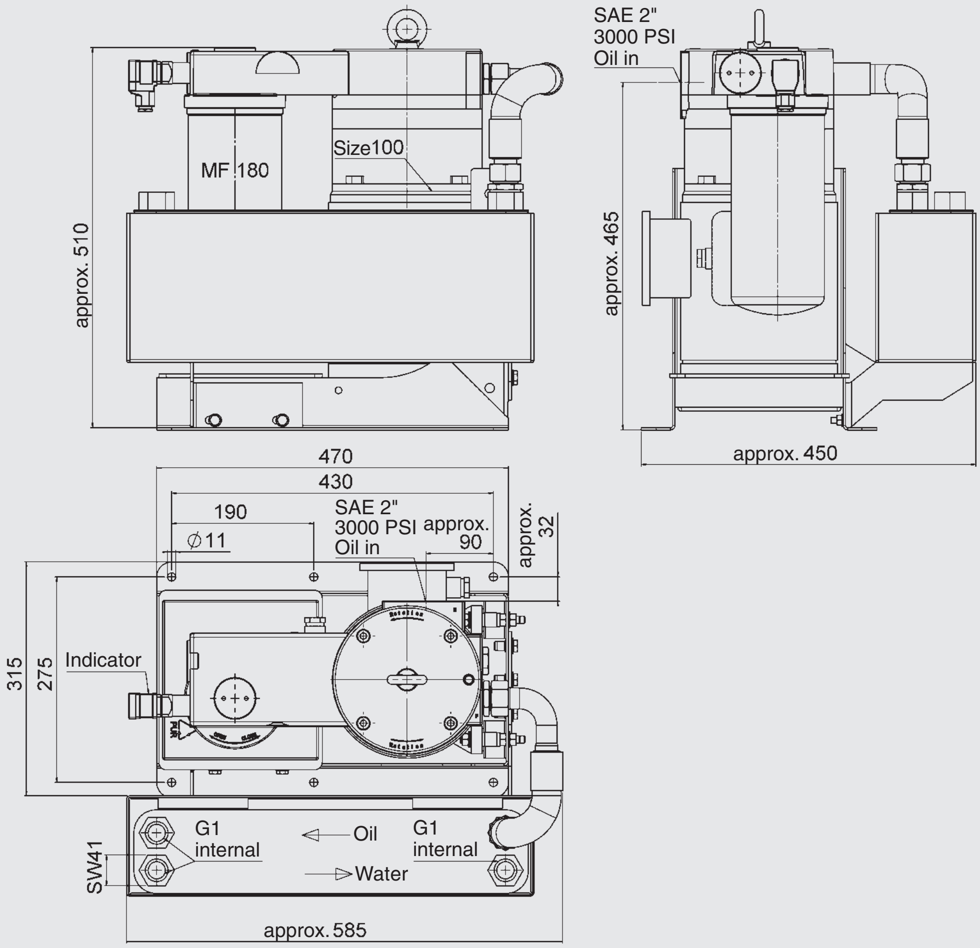


UKF-3/2.0



SAE 2"
3000 PSI
Oil in
MF 180
Size100
approx. 510
approx. 465
approx. 450
470
430
190
∅11
SAE 2"
3000 PSI
Oil in
approx.
90
approx.
32
315
275
Indicator
G1
internal
Oil
G1
internal
Water
SW41
approx. 585

8. FILTER SIZE – FILTER MATERIAL – FILTRATION RATING

8.1. SELECTING THE FILTRATION RATING ACCORDING TO MANUFACTURERS' AND OPERATORS' EXPERIENCE

Permissible contamination class to NAS 1638	ISO 4406	Suggested filtration rating x in µm (β_x = 100)	Type of hydraulic system
3 4 5	14/12/9 15/13/10 16/14/11	3 µm	To prevent fine contamination in highly sensitive systems with a high reliability requirement, primarily aerospace and laboratory conditions.
5 6	16/14/11 17/15/12	3 - 5 µm	Sensitive high performance systems & control systems in high pressure applications, frequently in aerospace technology, industrial robots and machine tools where proportional and servo valves are used.
7 8	18/16/13 19/17/14	5 - 10 µm	High performance industrial hydraulic systems with high level of operating safety, using precision hydraulic components such as, for example, control pumps.
8 9 10	19/17/14 20/18/15 21/19/16	10 - 20 µm	General hydraulic and mobile hydraulic systems with conventional directional valve controls
9 10 11	20/18/15 21/19/16 22/20/17	15 - 25 µm	Systems in heavy machinery hydraulics, primarily in the low pressure sector
11 12	22/20/17 23/21/18	20 - 40 µm	Low pressure systems with large tolerances and low demands for contamination protection

8.2. PRESSURE DIFFERENTIAL – FILTER ELEMENT

Filter curves

Gradient coefficient [$K\Delta_{element}$] at 30 mm²/s

	Filtration rating 3µm	5µm	10µm	20µm	10P
MF180	0.0025	0.0020	0.0018	0.0009	0.0016
LF330	0.00606	0.00485	0.00333	0.00194	–
LF500	0.00420	0.00300	0.00180	0.00140	–

$$\Delta p_{element} = [K\Delta_{element}] \times Q\ [l/min] \times \frac{\text{operating viscosity } [mm^2/s]}{30\ mm^2/s}$$

9. NOTES ON INLINE MOUNTING

The pressure differential in a hydraulic line is dependent on:

1) Flow rate
2) Kinematic viscosity
3) Pipe dimensions

and can be estimated for hydraulic oils as follows:

$$\Delta p \approx 5.84 \times \frac{l}{d^4} \times Q \times \upsilon \left[bar\right]$$

l = pipe length [m]
d = pipe internal diameter [mm]
Q = flow rate [l/min]
ν = kinematic viscosity [mm²/s]

This applies to straight pipe runs and hydraulic oils

- Additional threaded connections and pipe bends increase the pressure differential

Note:
- As few threaded connections as possible
- Few pipe bends; if required, use large radius
- Difference in height between pump and oil level as small as possible
- Hoses must be suitable for a vacuum of min. 5000 mmW (e.g. hoses to be steel-reinforced (wire-braided))
- Do not reduce pipe cross-section predetermined by the unit

10. TABLE OF PRESSURE DROPS VIA HEAT EXCHANGER

(for T_{oil} = 45 °C ISO VG 46)

L/min	410-20 Δp[bar]	410-40 Δp[bar]	410-70 Δp[bar]	410-100 Δp[bar]	410-120 Δp[bar]	415-20 Δp[bar]	415-40 Δp[bar]	415-60 Δp[bar]	415-80 Δp[bar]
20	0.36	0.18	0.11	0.08	0.06	0.65	0.30	0.20	0.15
30	0.59	0.27	0.16	0.11	0.10	1.07	0.45	0.30	0.23
40	0.83	0.35	0.21	0.15	0.13	1.52	0.62	0.39	0.30
45	0.95	0.40	0.23	0.17	0.14	1.76	0.72	0.45	0.33
60	1.37	0.56	0.31	0.22	0.19	2.50	1.02	0.62	0.45
75	1.96	0.74	0.39	0.28	0.24	3.47	1.34	0.81	0.58
105	3.47	1.11	0.58	0.40	0.34	6.12	2.02	1.23	0.87
150	6.35	1.87	0.92	0.63	0.53		3.28	1.92	1.37
185	9.26	2.68	1.20	0.83	0.70		4.62	2.51	1.80

11. CALCULATION OF PRESSURE DIFFERENTIAL AT OPERATING PRESSURE

- Pressure drops at operating temperature

11.1. FILTER ELEMENT:

Calculation of the clean element according to point 8.2. to approx. 1 bar

11.2. HEAT EXCHANGER AND PIPE ON PRESSURE SIDE

Max. 2 bar combined (see point 9. and 10.)

11.3. PIPE ON THE SUCTION SIDE

Max. 0.4 bar (see point 9.)

12. NOTES ON CALCULATING THE UKF

12.1. ESTIMATE OF THE COOLING CAPACITY REQUIREMENT FOR MINERAL OIL

12.1.1 **Via increase in tank temperature:**

$$P = \frac{\Delta T \times V}{t} \times \frac{1}{35}$$

P = heat dissipation [kW]
ΔT = temperature increase in tank [°C]
V = tank contents [l]
t = operating time [min]

Example:
In a system the tank temperature increases from 20 °C to 70 °C (= 50 K) in 30 minutes
The tank volume is 400 l

$$P = \frac{50 \times 400}{30} \times \frac{1}{35}$$

$$P = 19\ [kW]$$

12.1.2 **Via the installed electric power**
Cooling capacity ≈ 25% of the installed electrical power

13. SIZING A UKF USING THE 25% RULE

Cooling capacity ≈ 25% of the installed electrical power
Circulating volume ≈ 25% of the tank volume
Water quantity ≈ 25% of the oil quantity

Note:
All calculations for the heat exchanger are based on oil data provided by the company Aral.

14. NOTE

The information in this brochure relates to the operating conditions and applications described.

For applications or operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.