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## Воздушные теплообменники BNK Buhler

# Oil/air coolers BNK



- Easy to maintain design
- Compact installation dimensions
- System-compatible cooling matrix / flow rate ratio
- Low noise emission
- Rugged cooling matrix
- Extensive accessories
- High suction pump

## Introduction and description

### Why coolers?

In many cases, installing an off-line cooler is not only an emergency solution, but also the best solution with respect to mechanics and economics. Oftentimes off-line filtration can also be incorporated quite effectively.

Since a bypass also always requires installation of a separate circulation pump, it's reasonable to combine it with the motor already installed for the fan.

The BNK series is a tiered line of oil/air coolers with circulation pump directly flange-mounted. The cooler size and pump flow rate are coordinated for performance grades compatible with the system. The gerotor pump ensures low noise emission for the entire aggregate.

### Why Bühler?

When we developed the BNK series, we incorporated our years of experience in designing and selling oil/air coolers. Especially the fatigue life of the cooling matrix was a focus during development.

The cooling matrix can easily be removed from the fan case for maintenance without uninstalling the fan or motor.

If our comprehensive standard range of products does not include the right solution for your application, we will gladly develop a custom solution for you.

Use the data in this leaflet to determine a suitable cooler for your application.

## Construction and application

The BNK consists of the following components:

- Cooling matrix
- Fan case with mounting rails
- Blower and pump unit consisting of AC motor, pump, fan, protective/mounting grate and motor bracket

The cooling matrix and fan/pump unit can be removed from the fan case individually without having to uninstall other components

The BNK series cooling matrix are made from aluminum. The coolers are designed for use in hydraulic circuits.

We also offer cooling matrix bypass versions (see type code).

## Planning information

### Set-up

The cooler must be set up so as not to interfere with air supply and exhaust. The distance to air obstacles behind the cooler should be at least half the cooler height (Dimension B).

Ensure adequate ventilation. During set-up, avoid exiting hot air or noise emission causing problems.

If the ambient air is dirty, excess deposit on the cooling matrix must be expected. This will reduce the cooling capacity. In this case, particularly in the case of air loaded with oil mist, the air ducts must be cleaned regularly.

When set up outdoors, adequately protect the motor from the weather.

Ensure easy access for inspection and maintenance.

### Mount

The coolers are secured to the mounting rails with four screws. Be sure the support structure is sized adequately. Install in any position.

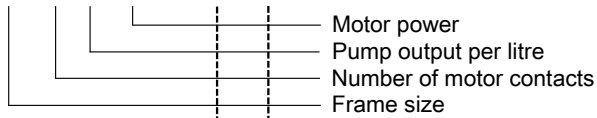
### Connecting the oil circuit

The connection between the system and the cooling matrix should be connected stress and vibration free, which can be achieved by using conduit.

Follow the pertinent safety regulations to prevent environmental damage due to possible oil leaks (e.g. collection pans).

## Model key

BNK 4.4-30-0.75kW- IBx - T50



BNK 4.4-30-0.75kW- IBx - T50

To also have a bypass and/or thermal contact, the specification will be added to the type designation:

Bypass version	<b>AB</b> (BNK 2-8)	<b>external bypass</b>
	<b>IB</b> (BNK 3-8)	<b>internal bypass</b>
	<b>ITB</b> (BNK 3-8)	<b>internal temperature-dependent bypass 2 bar / 45 °C</b>
	<b>ATB</b> (BNK 2-8)	<b>external temperature-dependent bypass 2 bar / 45 °C</b>
	<b>x</b>	<b>bypass value 2 bar, 5 bar, 8 bar</b>
Temperature switch	<b>T50, T60</b> <b>T70, T80</b>	<b>Temperature in °C, specification see separate data sheet</b>

## Technical data

Technical data	
<b>Materials / surface protection</b>	
Cooling battery:	Aluminium, painted
Ventilation box, safety guard and motor brackets:	Plastic-coated steel
Pump:	hard anodised aluminium, sintered steel
<b>Colour:</b>	RAL 7001
<b>Operating fluids:</b>	Mineral oils per DIN 51524 Gear oil per DIN 51517-3
<b>Operating pressure, static:</b>	15/28/42 L/min – max. 6 bar 58/86 L/min – max. 8 bar
<b>Suction pressure:</b>	max. -0.4 bar
<b>Operating oil temperature:</b>	max. 80 °C (higher upon request)
<b>max. viscosity:</b>	100 cSt medium viscosity (higher upon request)
<b>Ambient temperature:</b>	-15 to 40 °C

Electric motors (others available upon request)	
<b>Voltage / frequency:</b>	230 / 400 V - 50 Hz ± 5 % 276 / 480 V - 60 Hz ± 5 %
<b>Thermal stability:</b>	Class of insulation F, utilisation per class B
<b>Protection class:</b>	IP55
The motors comply with standards IEC 60034, IEC 60072, IEC 60085	

## Basic data (at 50 Hz frequency)

Item no.	Cooler model	spec. cooling power kW/K	Cooling power at ETD = 40 K (kW)	max. circulation rate (l/min)	Motor power Number of poles Rated current at 400 V	Weight (kg)	Capacity (l)	Noise 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

## Calculation example and nomenclature

$t_{OE}$ [°C]	Inlet oil temperature
$t_{LE}$ [°C]	Inlet air temperature
<b>ETD</b> [K]	Temperature differential: <b>ETD = <math>t_{OE} - t_{LE}</math></b>
$P_{spez}$ [kW / K]	specific cooling performance (see performance curves): <b><math>P_{spez} = P / ETD</math></b>
<b>P</b> [kW]	Cooling performance in kW
<b>Q</b> [l/min]	Oil flow rate
$c_{oi}$ [kJ/kgK]	Specific heat capacity of the oil (approx. 2.0 kJ / kgK)
$\zeta$ [kg/dm <sup>3</sup> ]	Gravity of oil $\approx 0.9$ kg/dm <sup>3</sup>

## Calculation example

### Assumptions:

Tank capacity	<b>(V)</b> approx. 200 L
Start up temperature of oil	<b>(T<sub>1</sub>)</b> 15 °C ( $\approx 288$ K)
Oil heats up in approx. t = 25 min. (1500 s) to	<b>(T<sub>2</sub>)</b> 45 °C ( $\approx 318$ K)
Required oil temperature	<b>(t<sub>OE</sub>)</b> 60 °C
Inlet air temperature	<b>(t<sub>LE</sub>)</b> 30 °C

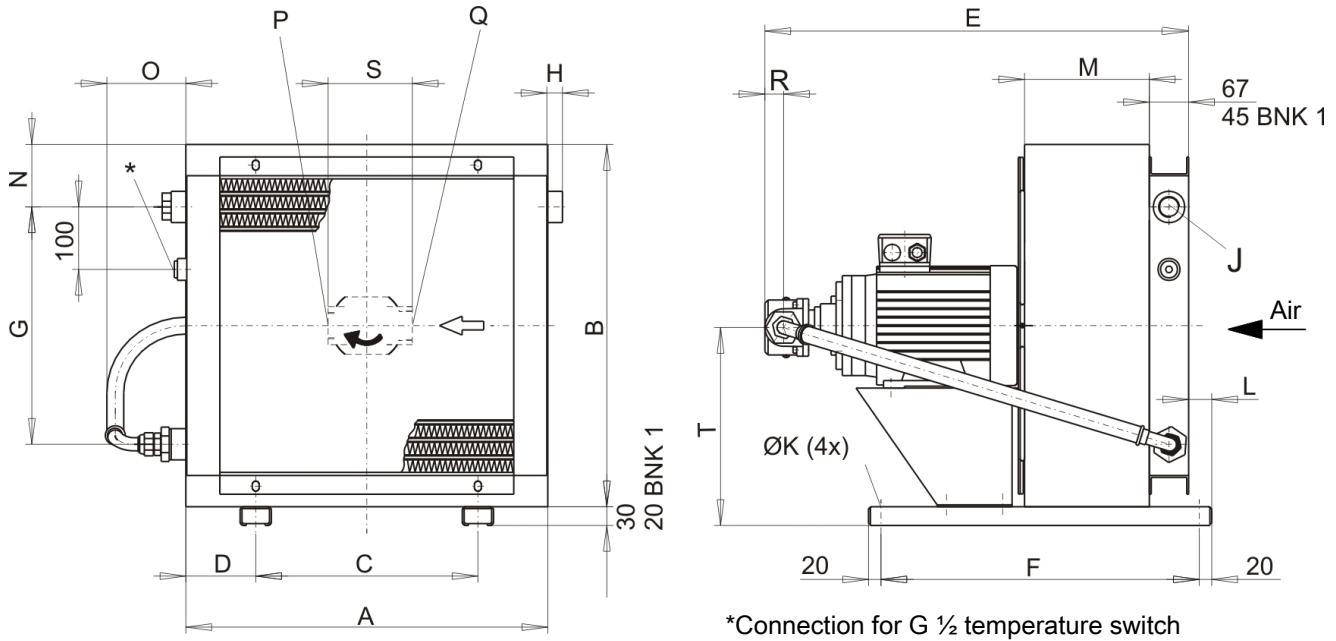
### Calculation:

1. Calculating P from the tank warming

$$P = \frac{V \cdot \zeta \cdot c_{oil} (T_2 - T_1)}{t} = \frac{200 \text{ l} \cdot 0.9 \frac{\text{kg}}{\text{l}} \cdot 2 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} \cdot (318 \text{ K} - 288 \text{ K})}{1500 \text{ s}} = 7.2 \text{ kW}$$

2.  $ETD = t_{OE} - t_{LE} = 60 \text{ °C} - 30 \text{ °C} = 30 \text{ K}$
3. Determining the cooler size:  $P_{spez} = P / ETD = 7.2 \text{ kW} / 30 \text{ K} = 0.24 \text{ kW/K}$
4. Select a cooler from the basic data with  $P_{spez} 0.24 \text{ kW/K}$ . There is one option: BNK 3.4 with 30 L pump

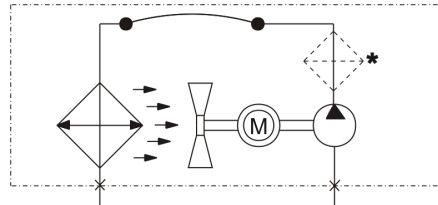
Dimensions



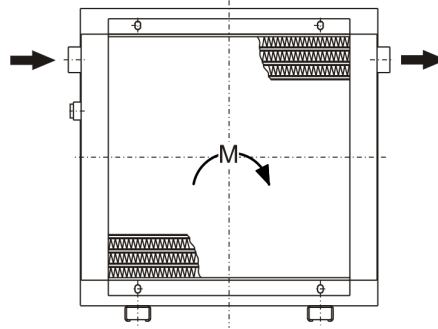
Model	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
BNK 1.4-7.5-0.75kW	315	243	190	62.5	417	340	-	-	2x G ½	9	40	52	-	-	G1	G ¾	30	144	130
BNK 1.4-15-0.75kW	315	243	190	62.5	417	340	-	-	2x G ½	9	40	52	-	-	G1	G1 ¼	30	130	130
BNK 2.4-15-0.75kW	370	370	203	83.5	476	510	-	25	2x G1	9	33	125	106	119	G1	G1 ¼	30	130	212
BNK 2.4-30-0.75kW	370	370	203	83.5	474	510	-	25	2x G1	9	33	125	106	119	G1	G1 ¼	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 ¼	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 ¼	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 ¼	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 ¼	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 ¼	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 ¼	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	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 ¼	G1 ½	53	135	314
BNK 6.4-60-3.0kW	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 6.4-90-3.0kW	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 6.6-60-2.2kW	700	700	356	172	729	510	410	9.5	3x G1 ¼	9	33	225	110	132	G1 ¼	G1 ½	53	135	377
BNK 7.4-60-3.0kW	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 7.4-90-3.0kW	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 7.6-60-2.2kW	700	840	356	172	754	510	590	9.5	3x G1 ¼	9	33	250	91	132	G1 ¼	G1 ½	53	135	447
BNK 8.6-60-3.0kW	870	870	508	181	795	510	585	11	3x G1 ¼	9	33	275	101.5	134	G1 ¼	G1 ½	53	135	462

Functional diagram

Standard version BNK 2

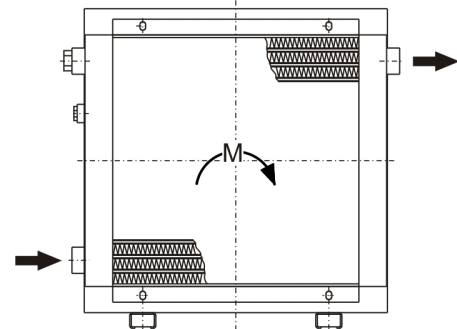
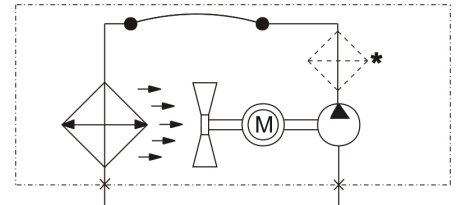


\* recommended position of additional oil filter



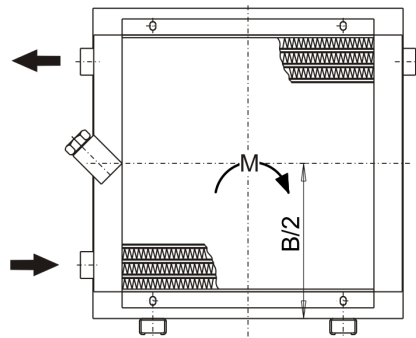
The oil inlet is on the left of the cooling battery. The oil outlet is always on the opposite side.

Standard version BNK 1, 3 to BNK 8



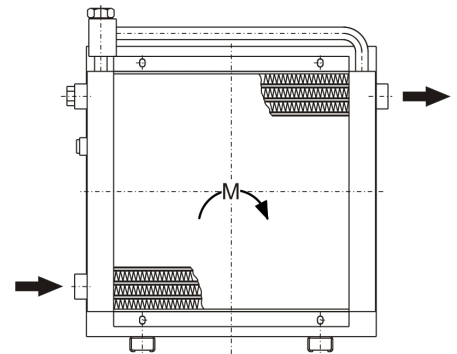
The oil inlet is on the bottom left of the cooling battery. The second connection at the top must be closed. The oil outlet is always on the opposite side.

Internal bypass IB/ ITB (BNK 3-8)



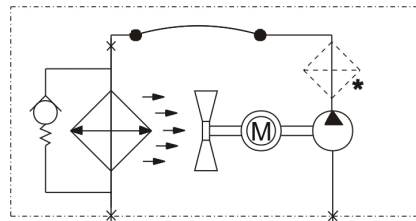
The oil inlet and outlet is always on the same side of the cooling battery. The connection on the opposite side must be closed.

External bypass AB/ATB (BNK 2-8)

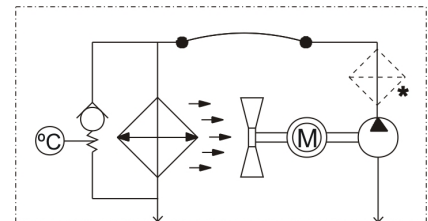


The oil inlet is always at the bottom left of the cooling battery. The second connection must be closed. The oil outlet is always on the opposite side.

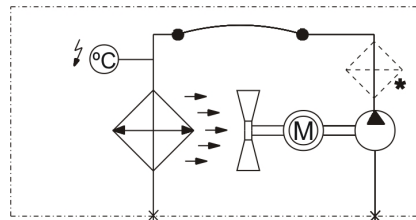
With bypass valve



With temperature-dependent bypass valve



With temperature switch attached





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