



Off-line cooler BNK

Drives and hydraulic aggregates are used in machine construction, raw material production, maritime and many other areas.

In hydraulic systems oil transfers power and motion, in drives it's a vital lubricant. Both as a power transfer medium and lubricant oil is heated by friction losses during operation.

Since the viscosity of the oil changes along with the temperature, precise temperature stabilisation using oil/air coolers is a vital requirement for systems and drives for consistent power. The temperature further affects the ageing behaviour and the life of oils.

To minimise the negative fluctuating oil flow has on the cooler design with varying ambient air temperatures, it's wise to combine the cooler with a built-in circulation pump.

The BNK series is characterised by efficient cooling matrixes, a compact, easy to maintain design and energy-efficient drive motors along with gerotor pumps.

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 it does not interfere with the 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 from 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.

For outdoor setup, 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 adequately sized. Install in any position.

Connecting the oil circuit

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

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

Technical data

Technical Data

Materials/surface protection

Cooling matrix:	Aluminium, painted
ventilation box, safety guard and motor brackets:	Steel, powder-coated
Pump:	anodised aluminium, sintered steel

Colour: RAL 7001

Operating fluids: Mineral oils per DIN 51524
Gear oil per DIN 51517-3

Operating pressure, static: 2.5/5.1/9.2/13.3 gpm - max. 87 psi
18.4/27.9 gpm - max. 116 psi

Suction pressure: max. - 6 psi

Operating oil temperature: max. 176 °F (higher upon request)

max. viscosity: 100 cSt medium viscosity (higher upon request)

Ambient temperature: 5 to 104 °F

Electric motors (others available upon request)

Voltage / frequency: 220/380V – 230/400V – 240/415V 50Hz
460 60 Hz

Thermal stability: Insulation class F,
utilisation per Class B

Protection class: IP55

The motors comply with standards
IEC 60034, IEC 60072, IEC 60085

Calculation example and nomenclature

t_{OE} [°F]	Inlet oil temperature
t_{LE} [°F]	Inlet air temperature
ETD [°F]	Temperature differential: $ETD = t_{OE} - t_{LE}$
P_{spec} [hp / °F]	specific cooling performance (see performance curves): $P_{spec} = P / ETD$
P [hp]	Cooling performance in hp
Q [gpm]	Oil flow rate
C_{Oil} [BTU/lb·°F]	Specific heat capacity of the oil (approx. 0,48 BTU/lb·°F)
ζ [lb/gal]	Gravity of oil $\approx 7,51$ lb/gal

Calculation example

Assumptions:

Tank capacity (V) approx. 52.8 gal

Start up temperature of oil (T_1) 59 °F (≈ 288 K)

Oil heats up in approx.

$t = 25$ min. (1500 s) to (T_2) 113 °F (≈ 318 K)

Required oil temperature (t_{OE}) 140 °F

Inlet air temperature (t_{LE}) 86 °F

Calculation:

1. Calculating P from the tank warming

$$P = \frac{V \cdot \zeta \cdot c_{Oil} (T_2 - T_1)}{t} = \frac{52.8 \text{ gal} \cdot 0.9 \frac{\text{kg}}{\text{l}} \cdot 2 \frac{\text{kJ}}{\text{kg} \cdot \text{K}} \cdot (318 \text{ K} - 288 \text{ K})}{1500 \text{ s}} = 7.2 \text{ kW}$$

2. $ETD = t_{OE} - t_{LE} = 140 \text{ °F} - 86 \text{ °F} = 54 \text{ °F}$

3. Determining the cooler size: $P_{spec} = P / ETD = 9,7 \text{ hp} / 54 \text{ °F} \approx 0.18 \text{ hp/°F}$

4. Select a cooler from the basic data with $P_{spec} \approx 0.18 \text{ hp/°F}$. There is one option:
BNK 3.4 with 30 L (9,2 gpm) pump

Basic data (at 60 Hz frequency)

Item no.	Cooler model	spec. cooling power hp/°F	Cooling power at ETD = 72 °F (hp)	max. circulation rate (gpm)	Power output Poles Rated current at 460 V	Motor service factor	Weight (lb)	Capacity (gal)	Sound pressure level db(A)*
3601406IE3**	BNK 1.4-7.5-0.75kW	0,03	2,1	2.5	1.0 hp/4/1.4 A	1.25	66	0.18	67
3601401IE3**	BNK 1.4-15-0.75kW	0,04	2,9	5,1	1.0 hp/4/1.4 A	1.25	66	0.18	67
3602406IE3**	BNK 2.4-7,5-0,75kW	0,07	5	2,5	1.0 hp/4/1.4 A	1.25	82	0.34	66
3602401IE3**	BNK 2.4-15-0.75kW	0,08	5,8	5,1	1.0 hp/4/1.4 A	1.25	86	0.34	69
3602402IE3**	BNK 2.4-30-0.75kW	0,1	7,2	9.2	1.0 hp/4/1.4 A	1.25	88	0.34	69
3602407IE3**	BNK 2.4-40-1.1kW	0,11	7,9	13.3	1.5 hp/4/2.0 A	1.25	95	0.34	69
3603406IE3**	BNK 3.4-8-0,75kW	0,13	9,4	2,5	1.0 hp/4/1.4 A	1.25	101	0.48	71
3603401IE3**	BNK 3.4-15-0.75kW	0,15	10,8	5,1	1.0 hp/4/1.4 A	1.25	99	0.48	74
3603402IE3**	BNK 3.4-30-0.75kW	0,17	12,2	9.2	1.0 hp/4/1.4 A	1.25	99	0.48	74
3603407IE3**	BNK 3.4-40-1.1kW	0,19	13,7	13.3	1.5 hp/4/2.0 A	1.25	106	0.48	74
3604401IE3**	BNK 4.4-15-0,75kW	0,18	13	5,1	1.0 hp/4/1.4 A	1.25	117	0.61	73
3604402IE3**	BNK 4.4-30-0.75kW	0,23	16,6	9.2	1.0 hp/4/1.4 A	1.25	110	0.61	76
3604407IE3**	BNK 4.4-40-1.1kW	0,25	18	13.3	1.5 hp/4/2.0 A	1.25	119	0.61	76
3604403IE3**	BNK 4.4-60-1.5kW	0,26	18,7	18.4	2.0 hp/4/2.8 A	1.25	130	0.61	76
3604404IE3**	BNK 4.4-90-2.2kW	0,28	20,2	27.9	3.0 hp/4/4.0 A	1.25	163	0.61	76
3605403IE3**	BNK 5.4-60-2.2kW	0,42	30,2	18.4	4.0 hp/4/4.0 A	1.25	176	0.82	82
3605404IE3**	BNK 5.4-90-2.2kW	0,45	32,4	27.9	3.0 hp/4/4.0 A	1.25	179	0.82	82
3606423IE3**	BNK 6.4-60-3.0kW	0,68	49	18.4	4.0 hp/4/5.3 A	1.25	220	1.08	89
3606424IE3**	BNK 6.4-90-3.0kW	0,76	54,7	27.9	4.0 hp/4/5.3 A	1.25	223	1.08	89
3606623IE3***	BNK 6.6-60-2.2kW	0,49	35,3	18.4	3.0 hp/6/4.8 A	1.15	194	1.08	77
3607423IE3**	BNK 7.4-60-3.0kW	0,7	50,4	18.4	4.0 hp/4/5.3 A	1.25	242	1.43	92
3607424IE3**	BNK 7.4-90-3.0kW	0,79	56,9	27.9	4.0 hp/4/5.3 A	1.25	245	1.43	92
3607623IE3***	BNK 7.6-60-2.2kW	0,54	38,9	18.4	3.0 hp/6/4.8 A	1.15	216	1.43	78
3608623IE3**	BNK 8.6-60-3.0kW	0,83	59,8	18.4	4.0 hp/6/5.9 A	1.25	357	1.66	82

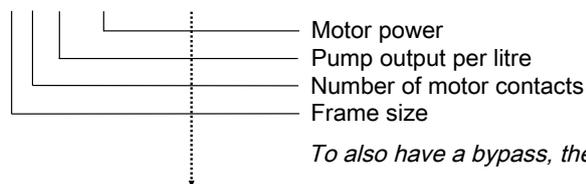
*DIN EN ISO 3744, Class 3

**Electr. motor per NEMA, UL, CSA, EAC approval

***Electr. motor per NEMA, UL, CUL approval

Model key

BNK 4.4-30-0.75kW- IBx



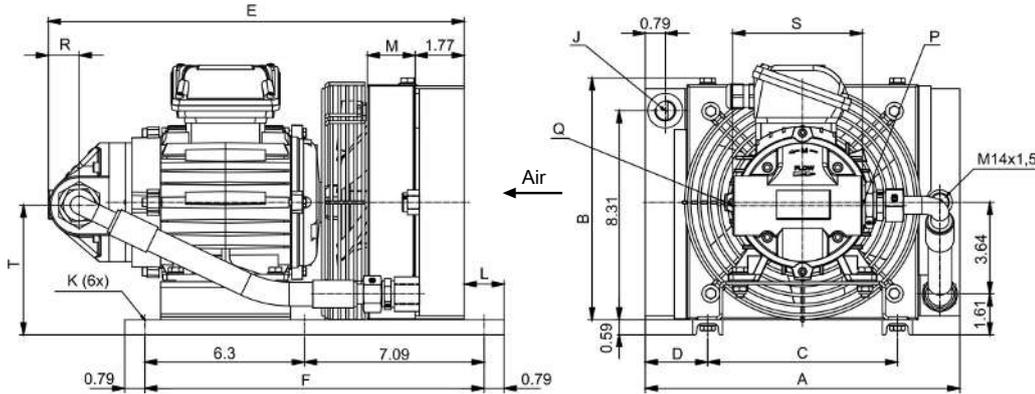
To also have a bypass, the specification will be added to the type designation:

BNK 4.4-30-0.75kW- IBx

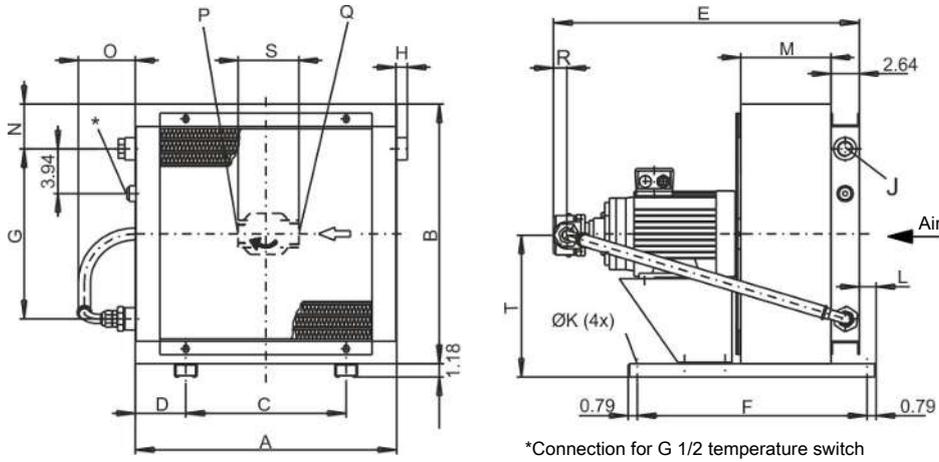
Bypass version	AB	(BNK 2-8)	external bypass
	IB	(BNK 3-8)	internal bypass
	ITB	(BNK 3-8)	internal temperature-dependent bypass 29 psi / 113 °F
	ATB	(BNK 2-8)	external temperature-dependent bypass 29 psi / 113 °F
	x		bypass value 29 psi, 73 psi, 116 psi

Dimensions

BNK 1



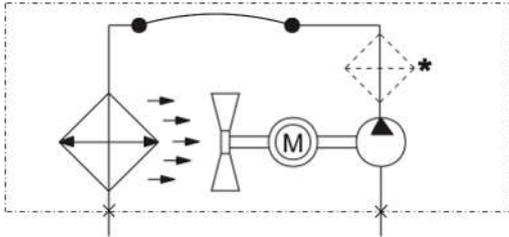
BNK 2-8



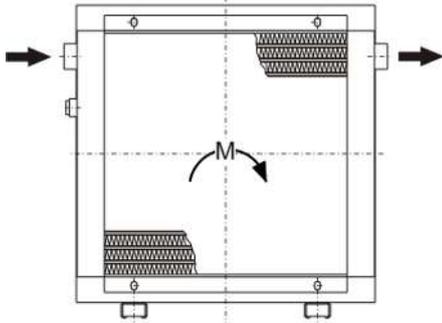
Model	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T
BNK 1.4-7,5-0,75kW	12.4	9.57	7.48	2.46	16.42	13.39	-	-	2x G 1/2	0.35	1.57	2.05	-	-	G1	G3/4	1.18	5.67	5.12
BNK 1.4-15-0,75kW	12.4	9.57	7.48	2.46	16.42	13.39	-	-	2x G 1/2	0.35	1.57	2.05	-	-	G1	G1 1/4	1.18	5.12	5.12
BNK 2.4-7,5-0,75kW	14.57	14.57	7.99	3.92	18.74	20.08	-	0.98	2x G1	0.35	1.3	4.92	4.17	4.69	G1	G3/4	1.18	5.12	8.35
BNK 2.4-15-0,75kW	14.57	14.57	7.99	3.29	18.74	20.08	-	0.98	2x G1	0.35	1.3	4.92	4.17	4.69	G1	G1 1/4	1.18	5.12	8.35
BNK 2.4-30-0,75kW	14.57	14.57	7.99	3.29	18.66	20.08	-	0.98	2x G1	0.35	1.3	4.92	4.17	4.69	G1	G1 1/4	1.18	5.12	8.35
BNK 2.4-40-1,1kW	14.57	14.57	7.99	3.29	19.45	20.08	-	0.98	2x G1	0.35	1.3	4.92	4.17	4.69	G1	G1 1/4	1.18	5.12	8.35
BNK 3.4-8-0,75kW	17.32	17.32	7.99	4.67	19.72	20.08	9.06	0.98	3x G1	0.35	1.3	5.91	4.13	4.69	G1	G3/4	1.18	5.12	9.72
BNK 3.4-15-0,75kW	17.32	17.32	7.99	4.67	19.72	20.08	9.06	0.98	3x G1	0.35	1.3	5.91	4.13	4.69	G1	G1 1/4	1.18	5.12	9.72
BNK 3.4-30-0,75kW	17.32	17.32	7.99	4.67	19.65	20.08	9.06	0.98	3x G1	0.35	1.3	5.91	4.13	4.69	G1	G1 1/4	1.18	5.12	9.72
BNK 3.4-40-1,1kW	17.32	17.32	7.99	4.67	20.47	20.08	9.06	0.98	3x G1	0.35	1.3	5.91	4.13	4.69	G1	G1 1/4	1.18	5.12	9.72
BNK 4.4-15-0,75kW	19.69	19.69	7.99	5.85	20.71	20.08	9.06	0.98	3x G1	0.35	1.3	6.89	4.09	4.69	G1	G1 1/4	1.18	5.12	10.91
BNK 4.4-30-0,75kW	19.69	19.69	7.99	5.85	20.63	20.08	9.06	0.98	3x G1	0.35	1.3	6.89	4.09	4.69	G1	G1 1/4	1.18	1.18	10.91
BNK 4.4-40-1,1kW	19.69	19.69	7.99	5.85	21.5	20.08	9.06	0.98	3x G1	0.35	1.3	6.89	4.09	4.69	G1	G1 1/4	1.18	5.12	10.91
BNK 4.4-60-1,5kW	19.69	19.69	7.99	5.85	24.02	20.08	9.06	0.98	3x G1	0.35	1.3	6.89	4.09	5.16	G1 1/4	G1 1/2	1.18	5.31	10.91
BNK 4.4-90-2,2kW	19.69	19.69	7.99	5.85	27.09	20.08	9.06	0.98	3x G1	0.35	1.3	6.89	4.09	5.16	G1 1/4	G1 1/2	2.09	5.31	10.91
BNK 5.4-60-2,2kW	22.83	22.83	14.02	4.41	26.69	20.08	12.01	0.93	3x G1	0.35	1.3	7.87	3.94	5.16	G1 1/4	G1 1/2	1.18	5.31	12.48
BNK 5.4-90-2,2kW	22.83	22.83	14.02	4.41	28.07	20.08	12.01	0.93	3x G1	0.35	1.3	7.87	3.94	5.16	G1 1/4	G1 1/2	2.09	5.31	12.56
BNK 6.4-60-3,0kW	27.56	27.56	14.02	6.77	29.02	20.08	16.14	0.37	3x G1 1/4	0.35	1.3	8.86	4.33	5.2	G1 1/4	G1 1/2	1.18	5.31	14.84
BNK 6.4-90-3,0kW	27.56	27.56	14.02	6.77	30.39	20.08	16.14	0.37	3x G1 1/4	0.35	1.3	8.86	4.33	5.2	G1 1/4	G1 1/2	2.09	5.31	14.84
BNK 6.6-60-2,2kW	27.56	27.56	14.02	6.77	29.57	20.08	16.14	0.37	3x G1 1/4	0.35	1.3	8.86	4.33	5.2	G1 1/4	G1 1/2	2.09	5.31	14.84
BNK 7.4-60-3,0kW	27.56	33.07	14.02	6.77	1.18	20.08	23.23	0.37	3x G1 1/4	0.35	1.3	9.84	3.58	5.2	G1 1/4	G1 1/2	1.18	5.31	17.6
BNK 7.4-90-3,0kW	27.56	33.07	14.02	6.77	31.38	20.08	23.23	0.37	3x G1 1/4	0.35	1.3	9.84	3.58	5.2	G1 1/4	G1 1/2	2.09	5.31	17.6
BNK 7.6-60-2,2kW	27.56	33.07	14.02	6.77	30.55	20.08	23.23	0.37	3x G1 1/4	0.35	1.3	9.84	3.58	5.2	G1 1/4	G1 1/2	2.09	5.31	17.6
BNK 8.6-60-3,0kW	34.25	34.25	20	7.13	33.62	26.18	23.03	0.43	3x G1 1/4	0.35	1.3	10.83	4	5.24	G1 1/4	G1 1/2	2.09	5.31	18.19

Functional diagram

Standard version BNK 2

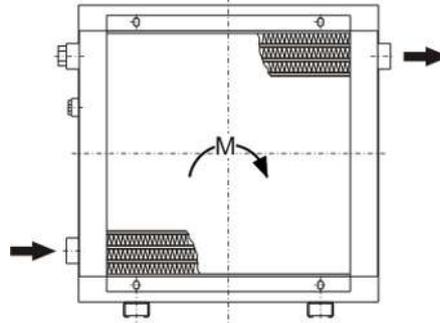
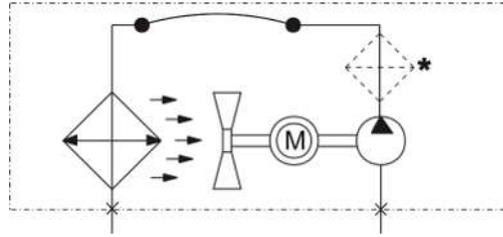


* recommended position of additional oil filter



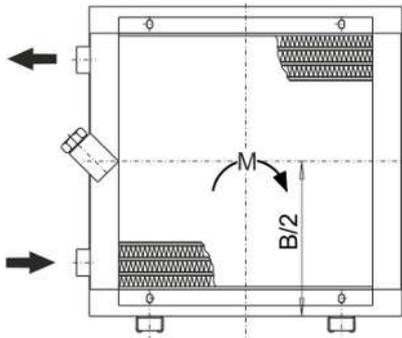
The oil inlet is on the left of the cooling battery. The oil outlet is always on the opposite side.

Standard version BNK 1, 3 to BNK 8



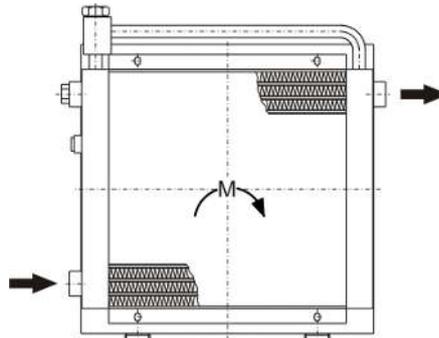
The oil inlet is on the bottom left of the cooling battery. The second connection at the top must be closed. The oil outlet is always on the opposite side.

Internal bypass IB/ ITB (BNK 3-8)



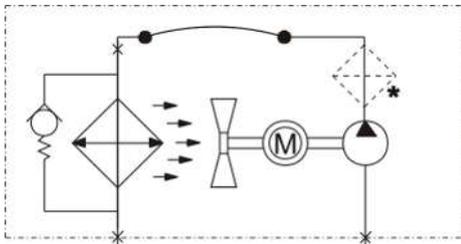
The oil inlet and outlet is always on the same side of the cooling battery. The connection on the opposite side must be closed.

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

