Off-Line Air / Oil Cooler
Series BNK

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

Buhler Technologies LLC
1030 West Hamlin Road, Rochester Hills, MI 48309
Phone: 248.652.1546 Fax: 248.652.1598
Internet: www.buhlertech.com
Email: sales@buhlertech.com

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 fluid in the system.

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?

Todays 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 software which makes sizing easier for you.

BNK

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
Color	RAL 7001

Fluids

Mineral oil	according to DIN 51524

Operating pressure

static	max. 145 psi
suction pressure	max. - 6 psi

Operating temperature

Media	max. 212 °F ((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

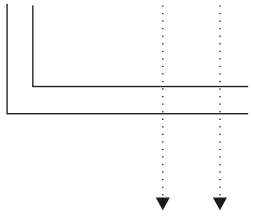
Basic Data (at 60 Hz Frequency)

Part No.	Type	Spec. cooling performance hp/°F	Cooling performance ETD = 40 K (hp)	Max. flow rate (gpm)	Power output Poles Full load at 480 V	Weight (lb)	Volume (gal)	Noise emission db(A) *
3601406	BNK 1.4-7,5-0,75kW	0.03	2.3	2.51	1.2 hp /4/ 2.5 A	55	0.18	65
3601401	BNK 1.4-15-0,75kW	0.05	4.1	5	1.2 hp /4/ 2.5 A	55	0.18	65
3602401	BNK 2.4-15-0,75kW	0.07	5.3	5	1.2 hp /4/ 2.5 A	66	0.34	68
3602402	BNK 2.4-30-0,75kW	0.10	7.3	8.8	1.2 hp /4/ 2.5 A	73	0.34	68
3602407	BNK 2.4-40-1,1kW	0.13	9.4	13	1.75 hp /4/ 3.4 A	77	0.34	68
3603401	BNK 3.4-15-0,75kW	0.12	8.8	5	1.2 hp /4/ 2.5 A	77	0.48	75
3603402	BNK 3.4-30-0,75kW	0.19	13.9	8.8	1.2 hp /4/ 2.5 A	84	0.48	75
3603407	BNK 3.4-40-1,1kW	0.23	16.5	13	1.75 hp /4/ 3.4 A	88	0.48	75
3604402	BNK 4.4-30-0,75kW	0.26	18.9	8.8	1.2 hp /4/ 2.5 A	95	0.61	76
3604407	BNK 4.4-40-1,1kW	0.31	23	13	1.75 hp /4/ 3.4 A	99	0.61	76
3604403	BNK 4.4-60-1,5kW	0.29	21.2	18	2.4 hp /4/ 4.3 A	112	0.61	76
3604404	BNK 4.4-90-2,2kW	0.31	22.4	22	3.5 hp /4/ 5.9 A	134	0.61	76
3604605	BNK 4.6-40-1,1kW	0.19	14.9	13	1.75 hp /6/ 3.8 A	112	0.61	67
3604603	BNK 4.6-60-1,1kW	0.21	15.3	18	1.75 hp /6/ 3.8 A	134	0.61	67
3605403	BNK 5.4-60-2,2kW	0.41	30	18	3.5 hp /4/ 5.9 A	157	0.82	83
3605404	BNK 5.4-90-2,2kW	0.45	33	22	3.5 hp /4/ 5.9 A	161	0.82	83
3605605	BNK 5.6-40-1,5kW	0.27	19.4	13	2.4 hp /6/ 4.8 A	154	0.82	72
3605603	BNK 5.6-60-1,5kW	0.28	20.4	18	2.4 hp /6/ 4.8 A	159	0.82	72
3606423	BNK 6.4-70-3,6kW	0.67	48.3	18	4.8 hp /4/ 7.8 A	192	1.08	90
3606424	BNK 6.4-105-3,6kW	0.75	54.1	22	4.8 hp /4/ 7.8 A	194	1.08	90
3606623	BNK 6.6-70-2,6kW	0.48	34.5	18	3.5 hp /6/ 6.3 A	190	1.08	77
3607423	BNK 7.4-70-3,6kW	0.69	49.8	18	4.8 hp /4/ 7.8 A	218	1.43	93
3607424	BNK 7.4-105-3,6kW	0.78	56	22	4.8 hp /4/ 7.8 A	220	1.43	93
3607623	BNK 7.6-70-2,6kW	0.53	38	18	3.5 hp /6/ 6.2 A	216	1.43	79
3608623	BNK 8.6-70-3,6kW	0.84	60.6	18	4.8 hp /6/ 8.4 A	260	1.66	83

*DIN EN ISO 3744, Class 3

Type code

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



Poles (see table above)
Size (see table above)

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

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

By-pass version	**AB**	external by-pass
	IB	integrated by-pass
	ITB	integrated temperature operated by-pass 29 psi / 113 °F
	ATB	external temperature operated by-pass 29 psi / 113 °F
	x	by-pass pressure 29 psi (**2 bar)**
Temperature switch	**T50,T60**	figures stand for °C, details see data sheet
	T70,T80	

Definitions and Example

$t_{ÖE}$ [°C]	inlet oil temperature
t_{LE} [°C]	inlet air temperature
ETD [K]	temperature differential: **ETD = $t_{ÖE}$ - 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
$C_{Öl}$ [kJ/kgK]	specific heat capacity of oil (approx. 1.8 kJ/kg·K (≈ 0.77 BTU/lb·K))
ς [kg/dm³]	oil density = 0.89 kg/dm³ (≈ 0.032 lb/in³)

Calculation sample:

Assumptions:

tank capacity	(**V**)	ca. 200 l (≈ 52.8 gal)
start up temperature of oil	(T_1)	15 °C (≈ 288 K, 59 °F))
the oil is heated up approx. t = 25 min. (1500 s) to	(T_2)	45°C (≈ 318 K, 133 °F)
required oil temperature	($t_{ÖE}$)	60 °C (≈ 333 K, 140 °F)
inlet air temperature	(t_{LE})	30 °C (≈ 303 K, 86 °F)

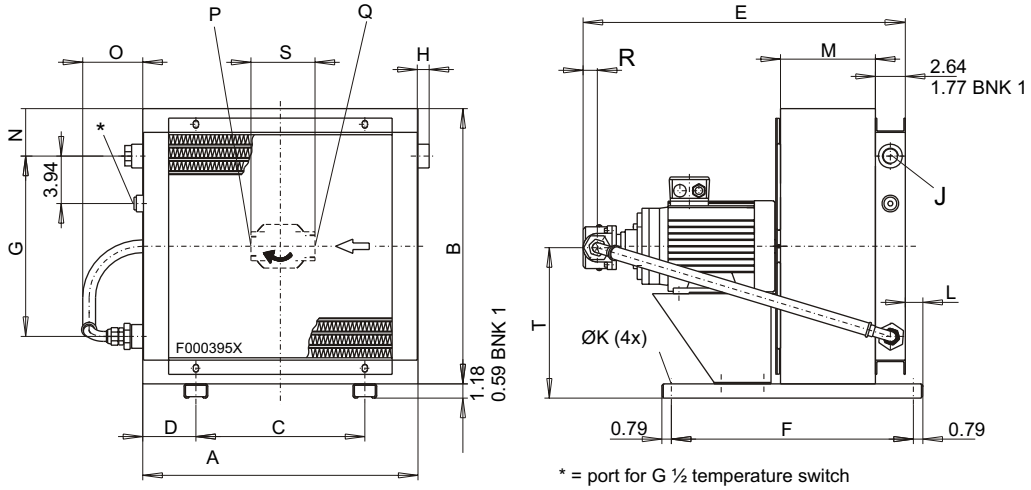
1. Calculation of P

$$P = \frac{V \cdot \varsigma \cdot c_{Öl} \cdot (T_2 - T_1)}{t} = \frac{200\,l \cdot 0{,}9\,\frac{kg}{l} \cdot 2\,\frac{kJ}{kg \cdot K} \cdot (318\,K - 288\,K)}{1500\,s}$$

P = 7.2 kW ≈ 9,7 hp

2. ETD = $t_{ÖE}$ - t_{LE} = 333 K - 303 K = 30 K ≈ 54 °F
3. required specific performance:
   P_{spez} = P / ETD = 7,2 kW / 30 K = 0,24 kW/K ≈ 0.18 hp/°F
4. From the table, select a cooler with: P_{spez} ≈ 0.18 hp/°F:
   There is only one possibility:
   BLK 3.4 with 30 l (7.4 gpm) pump

Dimensions (inch)



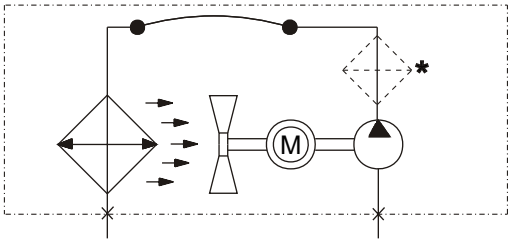
* = port for G ½ temperature switch

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	16.26	13,39	-	-	2x G½	0.35	1.57	2.05	-	-	G1	G ¾	1.18	5.67	5.12
BNK 1.4-15-0,75kW	12.4	9.57	7.48	2.46	16.26	13.39	-	-	2x G½	0.35	1.57	2.05	-	-	G1	G1¼	1.18	5.12	5.12
BNK 2.4-15-0,75kW	14.57	14.57	7.99	3.29	18.62	20.08	-	0.98	2x G1	0.35	1.30	4.92	4.17	4.69	G1	G1¼	1.18	5.12	8.35
BNK 2.4-30-0,75kW	14.57	14.57	7.99	3.29	18.54	20.08	-	0.98	2x G1	0.35	1.30	4.92	4.17	4.69	G1	G1¼	1.18	5.12	8.35
BNK 2.4-40-1,1kW	14.57	14.57	7.99	3.29	18.94	20.08	-	0.98	2x G1	0.35	1.30	4.92	4.17	4.69	G1	G1¼	1.18	5.12	8.35
BNK 3.4-15-0,75kW	17.32	17.32	7.99	4.67	19.61	20.08	9.06	0.98	3x G1	0.35	1.30	5.91	4.13	4.69	G1	G1¼	1.18	5.12	9.72
BNK 3.4-30-0,75kW	17.32	17.32	7.99	4.67	19.53	20.08	9.06	0.98	3x G1	0.35	1.30	5.91	4.13	4.69	G1	G1¼	1.18	5.12	9.72
BNK 3.4-40-1,1kW	17.32	17.32	7.99	4.67	19.92	20.08	9.06	0.98	3x G1	0.35	1.30	5.91	4.13	4.69	G1	G1¼	1.18	5.12	9.72
BNK 4.4-30-0,75kW	19.69	19.69	7.99	5.85	20.51	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	4.69	G1	G1¼	1.18	5.12	10.91
BNK 4.4-40-1,1kW	19.69	19.69	7.99	5.85	20.91	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	4.69	G1	G1¼	1.18	5.12	10.91
BNK 4.4-60-1,5kW	19.69	19.69	7.99	5.85	24.37	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	5.31	G1¼	G1½	1.18	5.31	10.91
BNK 4.4-90-2,2kW	19.69	19.69	7.99	5.85	27.20	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	5.31	G1¼	G1½	2.09	5.31	10.91
BNK 4.6-40-1,1kW	19.69	19.69	7.99	5.85	24.37	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	5.31	G1¼	G1½	1.18	5.31	10.91
BNK 4.6-60-1,1kW	19.69	19.69	7.99	5.85	25.75	20.08	9.06	0.98	3x G1	0.35	1.30	6.89	4.09	5.31	G1¼	G1½	2.09	5.31	10.91
BNK 5.4-60-2,2kW	22.83	22.83	14.02	4.41	26.89	20.08	12.01	0.93	3x G1	0.35	1.30	7.87	3.94	5.28	G1¼	G1½	1.18	5.31	12.48
BNK 5.4-90-2,2kW	22.83	22.83	14.02	4.41	28.27	20.08	12.01	0.93	3x G1	0.35	1.30	7.87	3.94	5.28	G1¼	G1½	2.09	5.31	12.56
BNK 5.6-40-1,5kW	22.83	22.83	14.02	4.41	26.89	20.08	12.01	0.93	3x G1	0.35	1.30	7.87	3.94	5.28	G1¼	G1½	1.18	5.31	12.48
BNK 5.6-60-1,5kW	22.83	22.83	14.02	4.41	28.27	20.08	12.01	0.93	3x G1	0.35	1.30	7.87	3.94	5.28	G1¼	G1½	2.09	5.31	12.48
BNK 6.4-70-3,6kW	27.56	27.56	14.02	6.77	27.83	20.08	16.14	0.37	3x G1¼	0.35	1.30	8.86	4.33	5.20	G1¼	G1½	1.18	5.31	14.84
BNK 6.4-105-3,6kW	27.56	27.56	14.02	6.77	29.21	20.08	16.14	0.37	3x G1¼	0.35	1.30	8.86	4.33	5.20	G1¼	G1½	2.09	5.31	14.84
BNK 6.6-70-2,6kW	27.56	27.56	14.02	6.77	29.92	20.08	16.14	0.37	3x G1¼	0.35	1.30	8.86	4.33	5.20	G1¼	G1½	2.09	5.31	14.84
BNK 7.4-70-3,6kW	27.56	33.07	14.02	6.77	28.82	20.08	23.23	0.37	3x G1¼	0.35	1.30	9.84	3.58	5.20	G1¼	G1½	1.18	5.31	17.46
BNK 7.4-105-3,6kW	27.56	33.07	14.02	6.77	30.20	20.08	23.23	0.37	3x G1¼	0.35	1.30	9.84	3.58	5.20	G1¼	G1½	2.09	5.31	17.46
BNK 7.6-70-2,6kW	27.56	33.07	14.02	6.77	30.91	20.08	23.23	0.37	3x G1¼	0.35	1.30	9.84	3.58	5.20	G1¼	G1½	2.09	5.31	17.46
BNK 8.6-70-3,6kW	34.25	34.25	20.00	7.13	28.60	20.08	23.03	0.43	3x G1¼	0.35	1.30	10.83	4.00	5.28	G1¼	G1½	2.09	5.31	18.19

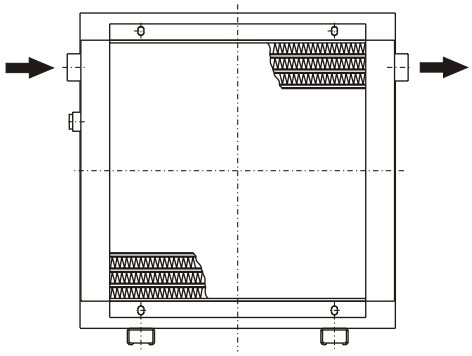
* Threads according to ISO 228

Function schemes

Standard BNK 2

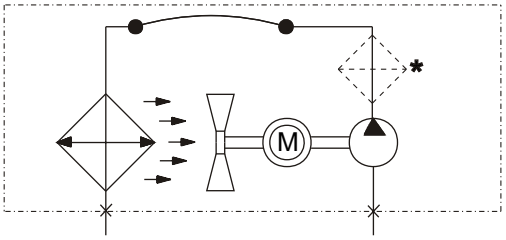


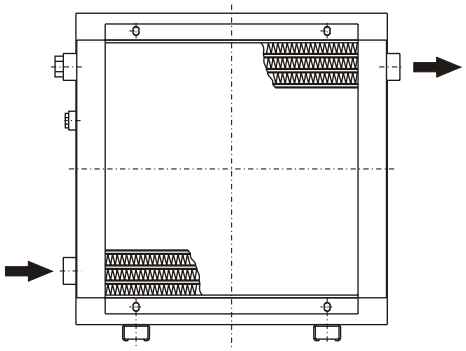
* recommended position of an additional oil filter



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

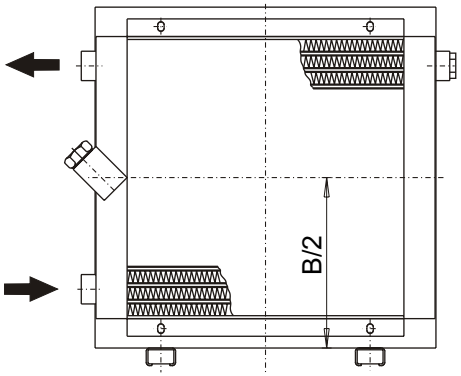
Standard BNK 1/3 to BNK 7





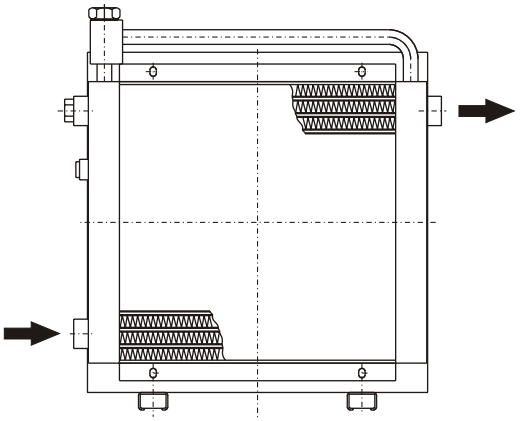
Flow direction from lower left to upper right. Other ports must be plugged.

Internal by-pass IB/ITB (BNK 3-7)



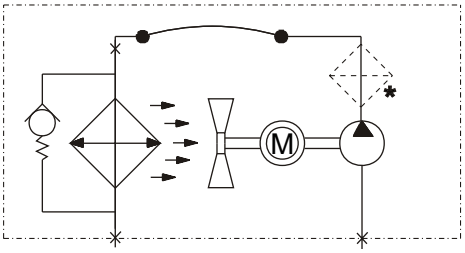
Oil inlet and outlet are at the same side. Ports on opposite side must be plugged.

External by-pass AB/ATB (BNK 2-7)

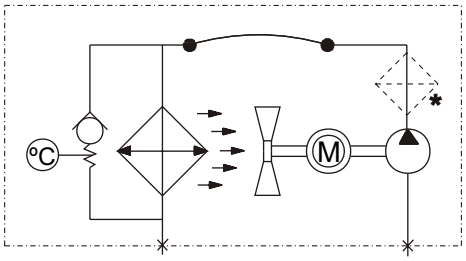


Oil inlet always from lower left port, outlet on opposite side. Other ports must be plugged.

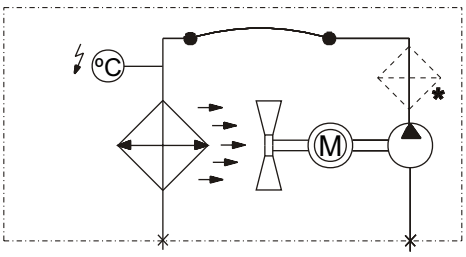
With by-pass valve



With temperature operated by-pass valve



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 accessability 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 .

The series BNK is a product designed by BUHLER company

The company

BUHLER TECHNOLOGIES GMBH, Ratingen was founded in 1969.

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

BUHLER also specializes 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.

Buhler quality

Buhler 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.