KM SCHMÖLE

LOK Tube Coil Heat Exchangers

for Cooling of Oil and other Media

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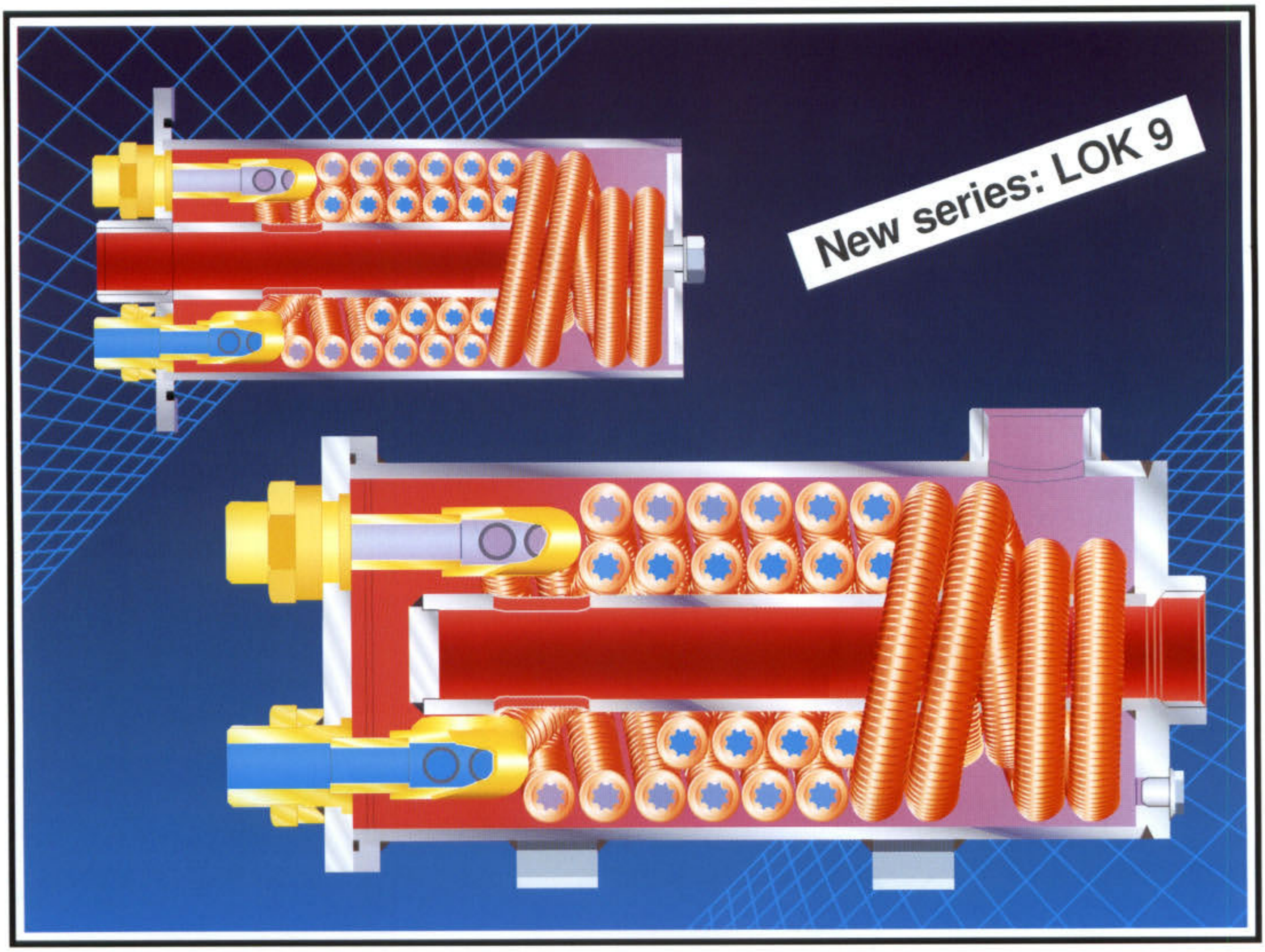


- High specific thermal capacity using Trufin W/HT Turbo-Chil High Performance Finned Tubes
- The new square blind flange of the design types S and M can be screwed off and reused when changing the finned tube coil
- Particularly compact design by single, double and triple start as well as single and double layer-wound finned tube coils
- Designed for easy installation and maintenance
- Low cooling water requirement
- Suitable for operating temperatures up to 150 °C using FPM (Viton) O-ring seals
- Many capacity sizes available on short delivery time ex stock

LOK Tube Coil Heat Exchangers Series 9

Application

LOK Tube Coil Heat Exchangers are suitable for cooling and heating of oil, emulsion, water and compressed air. They are used particularly in the following installations:

- Plastic injection moulding machines
- Plastic extruder installations
- Hydraulic systems, Presses
- Machine tools
- Couplings and gearboxes
- Compressors and pumps
- Temperature stabilizers
- Heat recovery units

Description

By the use of High Performance Finned Tubes, LOK Tube Coil Heat Exchangers are particularly compact and efficient. As large heat exchange surface areas can be installed in a small space LOK Tube Coil Heat Exchangers have a particularly favourable price-performance ratio.

LOK Tube Coil Heat Exchangers are equipped with Trufin W/HT Turbo-Chil High Performance Finned Tubes from copper or cupro-nickel produced by a thread rolling process from seamless tubes. Through a fin height of 4.5 mm and turbulence increasing helical inside ridges a thermal capacity being an optimum for tube coil heat exchangers is achieved.

The finned tube coil equipped with connection fittings is assembled with the blind flange and sealed by means of O-rings. This pre-assembled finned tube coil is mounted into the cylindrical steel shell and screwed into the shell flange. The sealing is made by an O-ring.

For design type T the finned tube coil is inserted from the rear into the steel shell, mounted into the blind flange soldered onto the shell, and sealed by O-rings.

The medium to be cooled, e. g. hydraulic or lubricating oil, is flowing on the shell side of the LOK Tube Coil Heat Exchangers and the cooling medium, e. g. cooling water, flows in the finned tube coil.

Design types

For a range of capacity up to approximately 111 kW LOK Tube Coil Heat Exchangers are supplied in three different series design types:

Design type S: Standard type with oil outlet connection on the shell side; with fixing brackets

Design type M: Heat exchanger with two shell side connections for oil inlet and outlet; with fixing straps on request

Design type T: Heat exchanger in open construction, suitable for mounting in tanks

Dimensions and Nominal capacities

Dimensions and nominal capacities of the LOK Tube Coil Heat Exchangers can be taken from diagrams 2 to 4.

The nominal capacities refer to the following working conditions:

- Mean oil temperature $\vartheta_{öm} = 45$ °C
- Kinematic viscosity of oil $\nu_{ö} = 40 \cdot 10^{-6}$ m²/s
- Oil velocity $v_{ö} = 1$ m/s
- Mean cooling water temperature $\vartheta_{wm} = 20$ °C
- Cooling water velocity $v_{w} = 2$ m/s

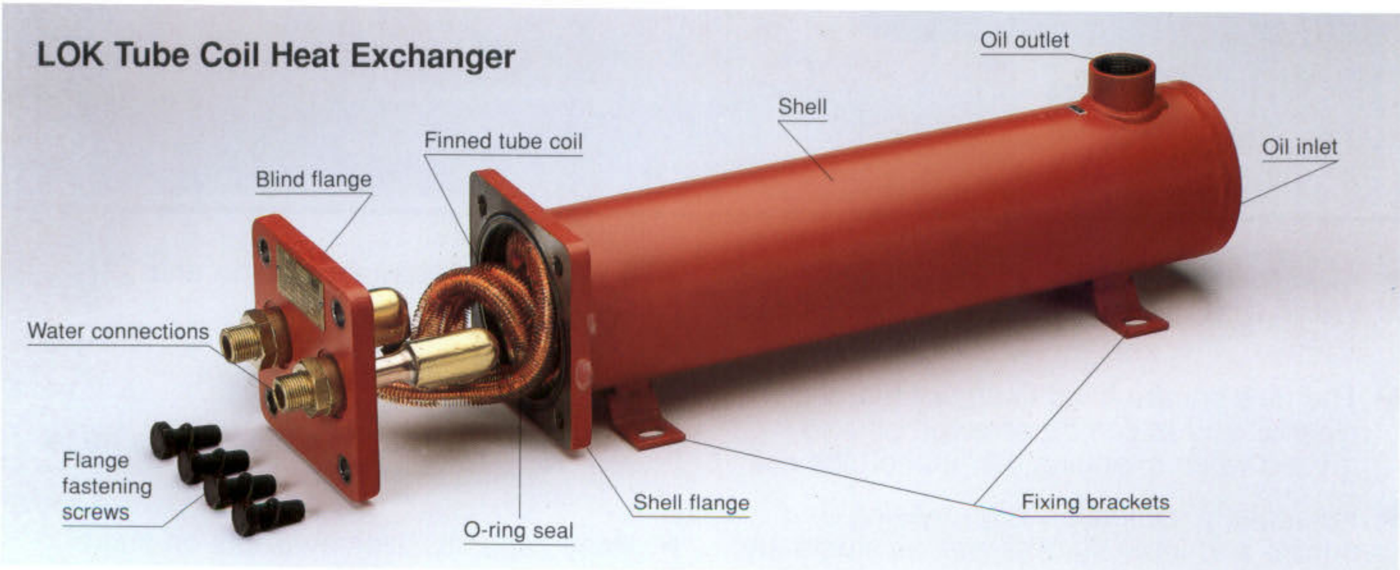
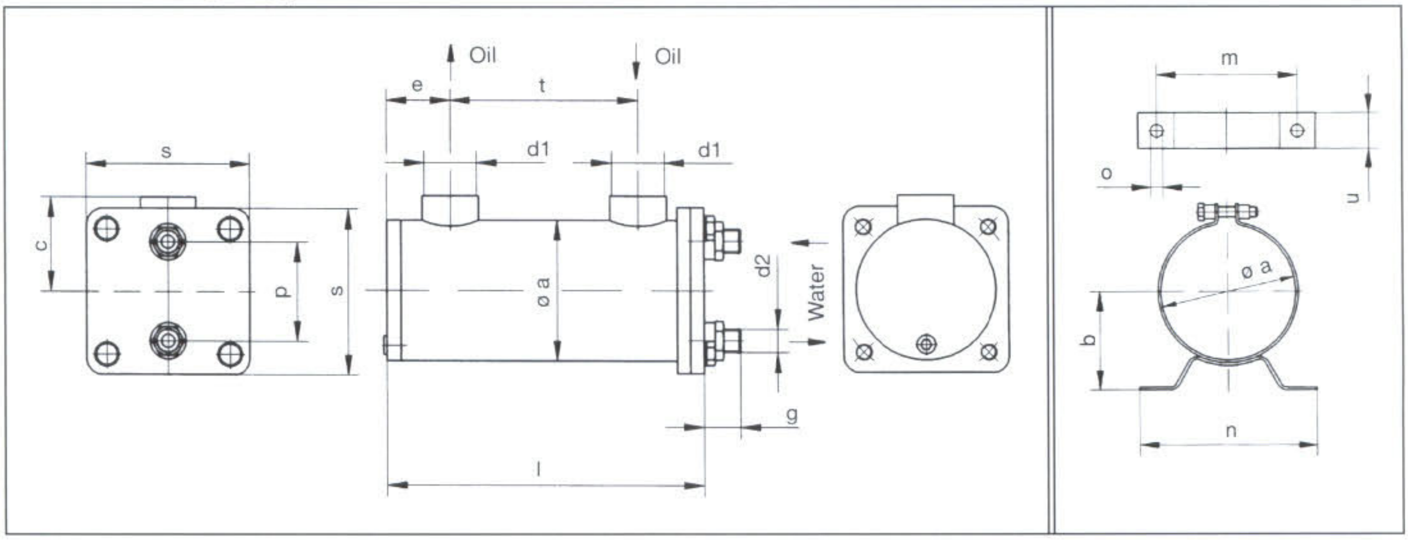


Diagram 1:
LOK Tube Coil Heat Exchangers design type S

LOK Tube Coil Heat Exchangers Series 9

LOK 9 – Design Type M

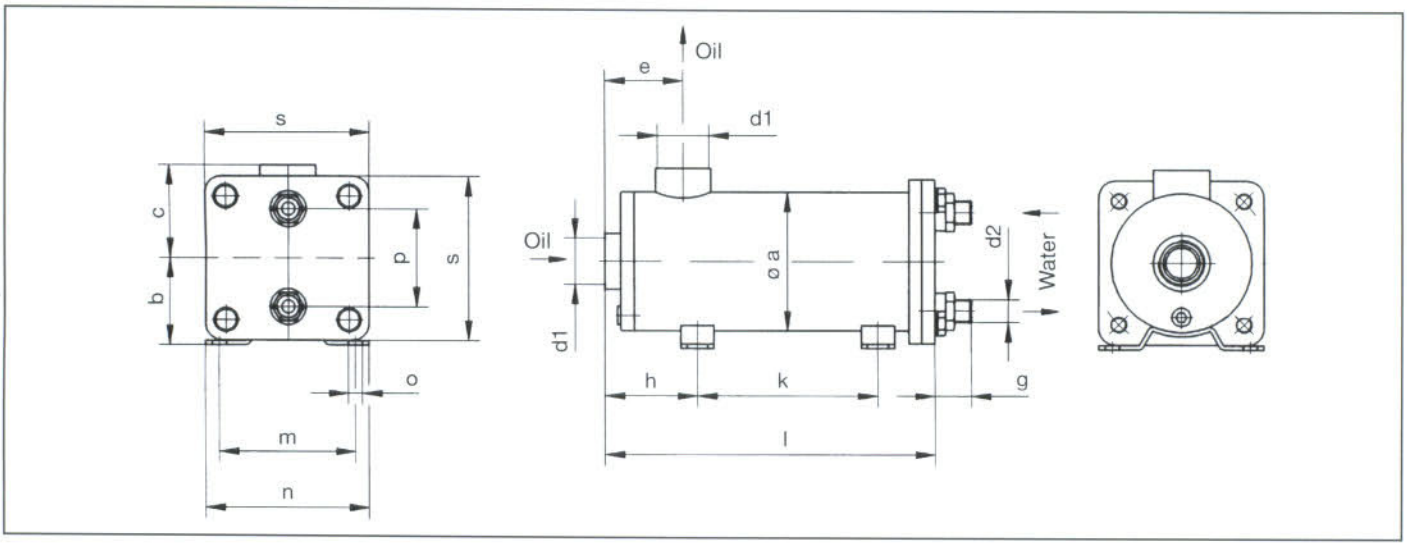


Heat exchanger type LOK	Nom. capacity $\dot{Q}$ kW	Flow rate: Oil $\dot{V}_ö$ l/min	Flow rate: Water $\dot{V}_w$ l/h	Dimensions: b mm	c mm	d_1 mm	d_2 mm	e mm	g mm	l mm	m mm	n mm	o mm	p mm	s mm	t mm	u mm	Approx. weight G_{total} kg
Shell outside diameter a = 70 mm																		
M 9-00.12-1	5.9	70	350	46	55	G 3/4	G 3/8	39	30	415	68	90	8.5	40	85	312	20	5.5
M 9-00.14-1	10.9	70	350	46	55	G 3/4	G 3/8	39	30	675	68	90	8.5	40	85	562	20	8.0
Shell outside diameter a = 108 mm																		
M 9-01.13-2	8.0	180	700	67	77	G 1	G 1/2	65	31	455	110	128	8.5	70	130	312	25	9.0
M 9-01.14-1	11.8	180	350	67	77	G 1	G 1/2	65	31	455	110	128	8.5	70	130	312	25	10.0
M 9-01.14-2	11.8	180	700	67	77	G 1	G 1/2	65	31	455	110	128	8.5	70	130	312	25	10.0
M 9-01.21-2	16.0	180	700	67	77	G 1	G 1/2	65	31	455	110	128	8.5	70	130	312	25	12.0
M 9-01.22-2	22.2	180	700	67	77	G 1	G 1/2	39	31	680	110	128	8.5	70	130	562	25	15.5
M 9-01.23-2	28.4	180	700	67	77	G 1	G 1/2	39	31	680	110	128	8.5	70	130	562	25	16.5
Shell outside diameter a = 127 mm																		
M 9-02.22-2	19.4	220	1250	78	85	G 1 1/4	G 1/2	55	31	685	118	140	11	90	150	536	30	18.0
M 9-02.31-2	32.9	220	1250	78	85	G 1 1/4	G 1/2	55	31	685	118	140	11	90	150	536	30	21.6
Shell outside diameter a = 152.4 mm																		
M 9-03.31-2	29.4	290	1770	95	97	G 1 1/4	G 3/4	53	39	976	140	170	13	110	180	847	30	33.8
M 9-03.41-2	46.3	290	1770	95	97	G 1 1/4	G 3/4	53	39	976	140	170	13	110	180	847	30	38.7
M 9-03.42-2	60.3	290	1770	95	97	G 1 1/4	G 3/4	53	39	976	140	170	13	110	180	847	30	42.8
Shell outside diameter a = 193.7 mm																		
M 9-04.51-3	72.3	370	4590	130	131	G 2	G 1	60	45	1292	180	220	13	130	230	1110	30	70.0
M 9-04.52-3	83.7	370	4590	130	131	G 2	G 1	60	45	1292	180	220	13	130	230	1110	30	74.0
M 9-04.53-3	111.3	370	4590	130	131	G 2	G 1	60	45	1292	180	220	13	130	230	1110	30	83.0

Diagram 3:
Dimensions and nominal capacities of LOK Tube Coil Heat Exchangers of design type M

Attention:
If required, please, order fixing straps as shown above as accessories (2 pieces for each heat exchanger)

LOK 9 – Design Type S



Heat exchanger type LOK	Nom. capacity $\dot{Q}$ kW	Flow rate: Oil $\dot{V}_ö$ l/min	Flow rate: Water $\dot{V}_w$ l/h	Dimensions: b mm	c mm	d_1 mm	d_2 mm	e mm	g mm	h mm	k mm	l mm	m mm	n mm	o mm	p mm	s mm	Approx. weight G_{total} kg
Shell outside diameter a = 70 mm																		
S 9-00.11-1	3.1	70	350	45	55	G 3/4	G 3/8	64	30	102	140	290	75	100	11	40	85	4.0
S 9-00.12-1	5.9	70	350	45	55	G 3/4	G 3/8	64	30	102	240	420	75	100	11	40	85	5.5
S 9-00.13-1	7.4	70	350	45	55	G 3/4	G 3/8	64	30	102	450	680	75	100	11	40	85	6.5
S 9-00.14-1	10.9	70	350	45	55	G 3/4	G 3/8	64	30	102	450	680	75	100	11	40	85	8.0
Shell outside diameter a = 108 mm																		
S 9-01.13-2	8.0	180	700	70	77	G 1	G 1/2	66	31	84	325	479	110	140	13	70	130	9.0
S 9-01.14-1	11.8	180	350	70	77	G 1	G 1/2	66	31	84	325	479	110	140	13	70	130	10.0
S 9-01.14-2	11.8	180	700	70	77	G 1	G 1/2	66	31	84	325	479	110	140	13	70	130	10.0
S 9-01.21-2	16.0	180	700	70	77	G 1	G 1/2	66	31	84	325	479	110	140	13	70	130	12.0
S 9-01.23-2	28.4	180	700	70	77	G 1	G 1/2	66	31	84	550	699	110	140	13	70	130	16.5
Shell outside diameter a = 127 mm																		
S 9-02.22-1	19.3	220	630	80	85	G 1 1/4	G 1/2	72	31	85	400	539	125	150	13	90	150	15.5
S 9-02.22-2	19.4	220	1250	80	85	G 1 1/4	G 1/2	72	31	85	400	539	125	150	13	90	150	15.5
S 9-02.23-2	24.6	220	1250	80	85	G 1 1/4	G 1/2	72	31	85	400	539	125	150	13	90	150	17.5
S 9-02.32-2	41.2	220	1250	80	85	G 1 1/4	G 1/2	72	31	85	600	789	125	150	13	90	150	25.0
Shell outside diameter a = 152.4 mm																		
S 9-03.31-1	29.9	290	890	95	97	G 1 1/4	G 3/4	80	39	131	450	661	140	170	13	110	180	27.0
S 9-03.31-2	29.4	290	1770	95	97	G 1 1/4	G 3/4	80	39	131	450	661	140	170	13	110	180	27.0
S 9-03.32-2	35.8	290	1770	95	97	G 1 1/4	G 3/4	80	39	131	450	661	140	170	13	110	180	30.0
S 9-03.42-2	60.3	290	1770	95	97	G 1 1/4	G 3/4	80	39	160	650	961	140	170	13	110	180	42.0
Shell outside diameter a = 193.7 mm																		
S 9-04.41-1	41.9	370	1530	130	125	G 1 1/2	G 1	92	45	155	450	775	180	210	13	130	230	48.0
S 9-04.41-2	42.6	370	3060	130	125	G 1 1/2	G 1	92	45	155	450	775	180	210	13	130	230	48.0
S 9-04.42-3	56.6	370	4590	130	125	G 1 1/2	G 1	92	45	155	450	775	180	210	13	130	230	54.0
S 9-04.51-3	72.3	370	4590	130	131	G 2	G 1	100	45	194	650	1045	180	210	13	130	230	64.0
S 9-04.52-3	83.7	370	4590	130	131	G 2	G 1	100	45	194	650	1045	180	210	13	130	230	68.0
S 9-04.53-3	111.3	370	4590	130	131	G 2	G 1	100	45	300	750	1305	180	210	13	130	230	83.0

Diagram 2:
Dimensions and nominal capacities of LOK Tube Coil Heat Exchangers of design type S

LOK Tube Coil Heat Exchangers Series 9

Materials

For LOK Tube Coil Heat Exchangers the following materials are used:

Component	Copper construction		Cupro-nickel construction	
	Material	Standard	Material	Standard
Shell	St 37.0	AD-W 4	St 37.0	AD-W 4
Blind flange	R St 37-2	AD-W 1	R St 37-2	AD-W 1
Finned tube coil	SF-Cu	DIN 1787	CuNi10Fe1Mn	DIN 17664
Connections				
shell side	St 37.0	DIN 1629	St 37.0	DIN 1629
tube side	CuZn38Pb1.5	DIN 17660	CuZn35Ni	DIN 17660
O-ring-seal	FPM 85 (Viton)	DIN 3771	FPM 85 (Viton)	DIN 3771

For the different design types and sizes the following materials are used for the finned tube coil:

Design type	Sizes	Materials	
S	all	SF-Cu	CuNi10Fe1Mn
M	all	SF-Cu	CuNi10Fe1Mn
T	up to T 9-03.23-1	SF-Cu	CuNi10Fe1Mn
T	from T 9-03.31-1	–	CuNi10Fe1Mn

The shells are supplied with the following primer:
Colour red – RAL* 3000.

For special applications LOK Tube Coil Heat Exchangers of the design type T can be supplied with a gasket.

On request the finned tube coils in SF-Cu can be supplied outside electro-tinned.

* RAL = Ausschuß für Lieferbedingungen und Gütesicherung im Deutschen Normenausschuß (= Committee for Delivery Conditions and Quality Assurance in the Standards Committee of Germany)

Range of application

LOK Tube Coil Heat Exchangers with finned tube coils from copper are suitable for cooling of oil, emulsion, water from closed circuits and compressed air by cooling media such as domestic water, water from closed circuits and underground water.

They are also suitable for heating of oil, water from closed circuits or air by heating media such as water from closed circuits or steam.

In case of higher exposure to corrosion – e. g. when using water from rivers and lakes or sea water – the cupro-nickel construction can be used. The suitability of the media used for the material chosen (copper or cupro-nickel) must be verified by the user for the individual case.

LOK Tube Coil Heat Exchangers can be used within the following range of application:

Working condition	Permissible range of application	
	Shell side	Tube side
Pressure	≤ 25 bar *	≤ 25 bar
Temperature	≤ 150 °C	≤ 90 °C

* When using LOK Tube Coil Heat Exchangers as compressed air coolers, the corresponding specifications of the Pressure Vessel Code must be respected, which may specify a permissible working pressure being considerably lower than above mentioned.

Testing

LOK Tube Coil Heat Exchangers are submitted to the following leak tests by nitrogen under water:

- Tube side: design types S, M, T: pressure 27.5 bar/30 s
- Shell side: design types S, M: pressure 27.5 bar/30 s
  design type T: pressure 11.0 bar/30 s

Construction requirements

When installing LOK Tube Coil Heat Exchangers the relevant requirements and the actual operating conditions have to be respected.

LOK Tube Coil Heat Exchangers have to be protected, if necessary, against the stresses of strongly pulsating flows. It is recommended to use for example a bypass circuit with temperature regulation, whereby the flow rate of the medium to be cooled can be controlled to a reasonable limit. Furthermore, when starting the cooling installation, this circuit will avoid cold and therefore too viscous media passing the heat exchanger which would excessively stress the heat exchanger.

Ordering Code

The ordering code for LOK Tube Coil Heat Exchangers is composed as follows:

Example: LOK S 9 – 01. 14 – 2 Cu

- Type — LOK
- Design type — S
- Series — 9
- Shell size — 01
- Finned tube coil size — 14
- No. of parallel tubes — 2
- Material of finned tube coil — Cu

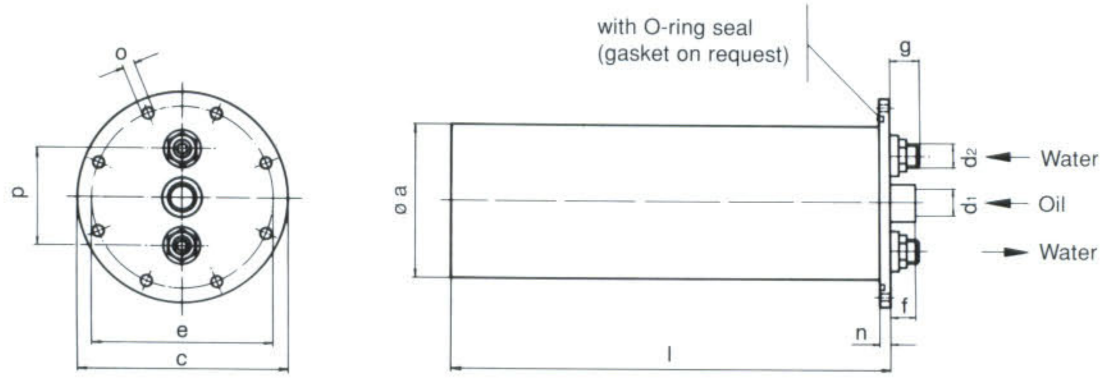
Please, indicate the complete ordering code in enquiries and orders, i. e. including the symbol for the material of the finned tube coil:

- Copper = Cu
- Cupro-nickel = CuNi

Approvals

LOK Tube Coil Heat Exchangers are considered to be pressure vessels in the sense of the German Pressure Vessel Code. The HP 0 Approval required for their manufacture has been obtained for all design types and capacity sizes.

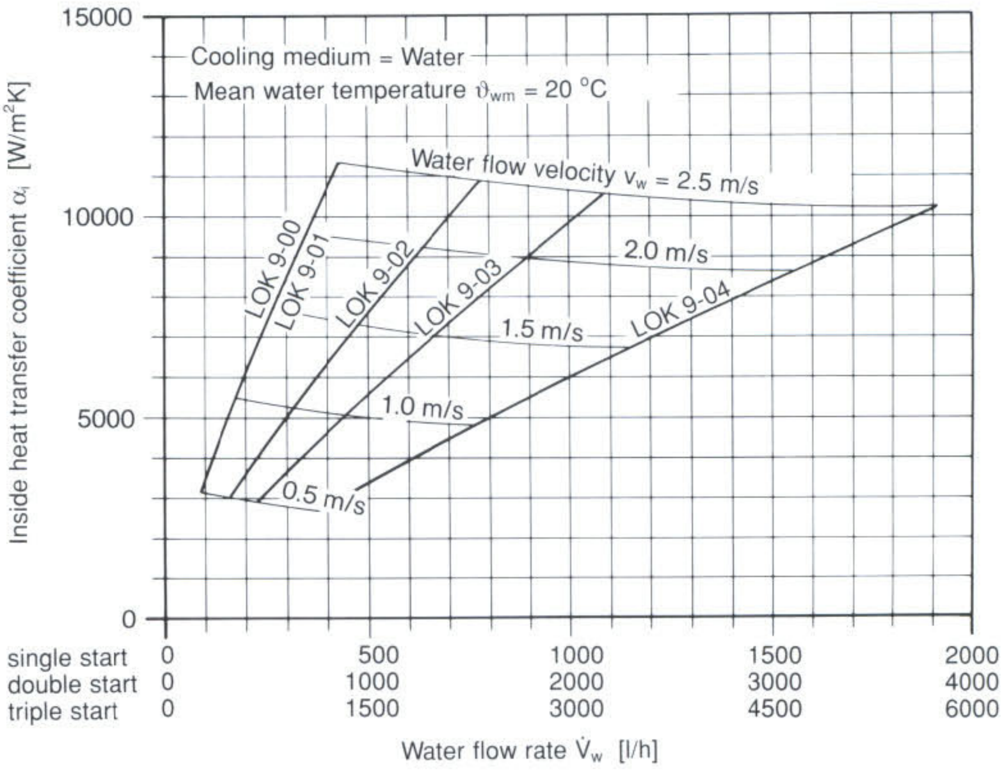
LOK 9 – Design Type T



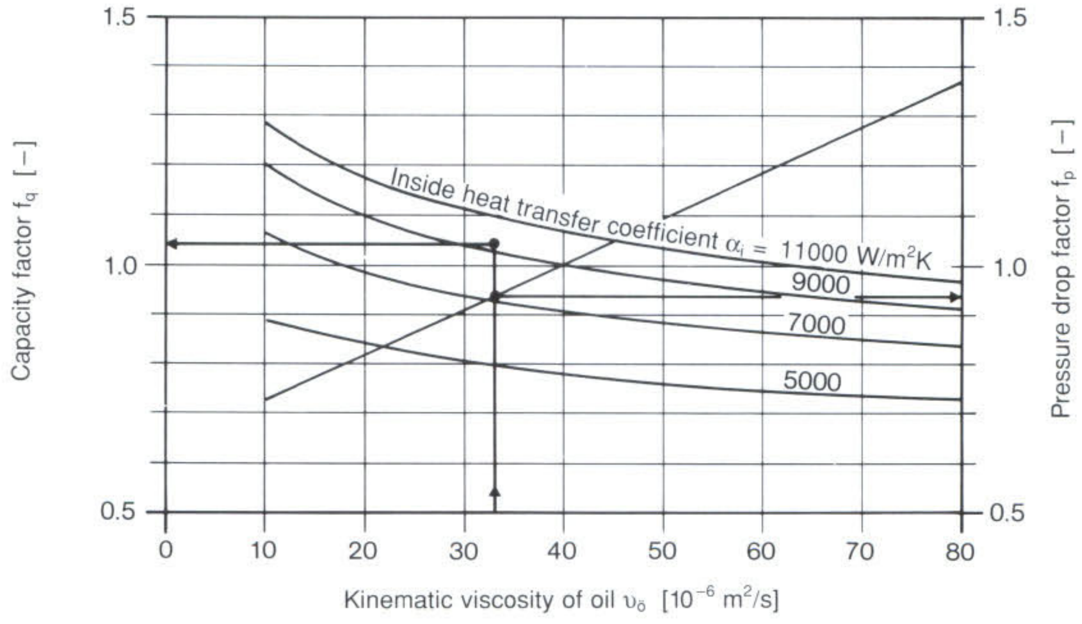
Heat exchanger type LOK	Nominal capacity	Flow rate		Dimensions										Approx. weight
	$\dot{Q}$	Oil $\dot{V}_ö$	Water $\dot{V}_w$	c	d_1	d_2	e	f	g	l	n	o	p	G_{total}
	kW	l/min	l/h	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg
Shell outside diameter a = 108 mm														
T 9-01.12-1	5.4	180	350	160	G 3/4	G 1/2	140	30	33	150	10	9	70	5.5
T 9-01.13-1	8.7	180	350	160	G 3/4	G 1/2	140	30	33	210	10	9	70	6.0
T 9-01.14-1	11.8	180	350	160	G 3/4	G 1/2	140	30	33	260	10	9	70	7.0
T 9-01.14-2	11.8	180	700	160	G 3/4	G 1/2	140	30	33	350	10	9	70	7.5
T 9-01.21-2	16.0	180	700	160	G 3/4	G 1/2	140	30	33	430	10	9	70	10.0
T 9-01.22-2	22.2	180	700	160	G 3/4	G 1/2	140	30	33	540	10	9	70	12.0
T 9-01.23-2	28.4	180	700	160	G 3/4	G 1/2	140	30	33	650	10	9	70	13.0
Shell outside diameter a = 127 mm														
T 9-02.21-1	13.8	220	630	190	G 1	G 1/2	170	26	33	290	10	9	90	10.0
T 9-02.22-1	19.3	220	630	190	G 1	G 1/2	170	26	33	390	10	9	90	13.5
T 9-02.22-2	19.4	220	1250	190	G 1	G 1/2	170	26	33	390	10	9	90	13.5
T 9-02.23-2	24.6	220	1250	190	G 1	G 1/2	170	26	33	480	10	9	90	16.0
T 9-02.31-2	32.9	220	1250	190	G 1	G 1/2	170	26	33	610	10	9	90	20.0
Shell outside diameter a = 152.4 mm														
T 9-03.23-1	22.9	290	890	235	G 1 1/2	G 3/4	210	24	40	380	12	9	110	18.5
T 9-03.31-1*	29.9	290	890	235	G 1 1/2	G 3/4	210	24	40	480	12	9	110	22.0
T 9-03.31-2*	29.4	290	1770	235	G 1 1/2	G 3/4	210	24	40	520	12	9	110	22.5
T 9-03.32-2*	35.8	290	1770	235	G 1 1/2	G 3/4	210	24	40	610	12	9	110	25.5
T 9-03.41-2*	46.3	290	1770	235	G 1 1/2	G 3/4	210	24	40	750	12	9	110	32.5
T 9-03.42-2*	60.3	290	1770	235	G 1 1/2	G 3/4	210	24	40	920	12	9	110	39.0
Shell outside diameter a = 193.7 mm														
T 9-04.42-3*	56.6	370	4590	265	G 2	G 1	240	40	45	735	16	14	130	44.5
T 9-04.51-3*	72.3	370	4590	265	G 2	G 1	240	40	45	835	16	14	130	50.0
T 9-04.52-3*	83.7	370	4590	265	G 2	G 1	240	40	45	1005	16	14	130	66.0

Diagram 4:
Dimensions and nominal capacities of LOK Tube Coil Heat Exchangers of design type T

* These heat exchangers are only supplied with cupro-nickel finned tube coils.



Graph 2:
Inside heat transfer coefficient α_i of LOK Tube Coil Heat Exchangers with single, double and triple start finned tube coils (number of tubes with parallel flow)



Graph 3:
Conversion factors: Capacity factor f_q and pressure drop factor f_p for LOK Tube Coil Heat Exchangers

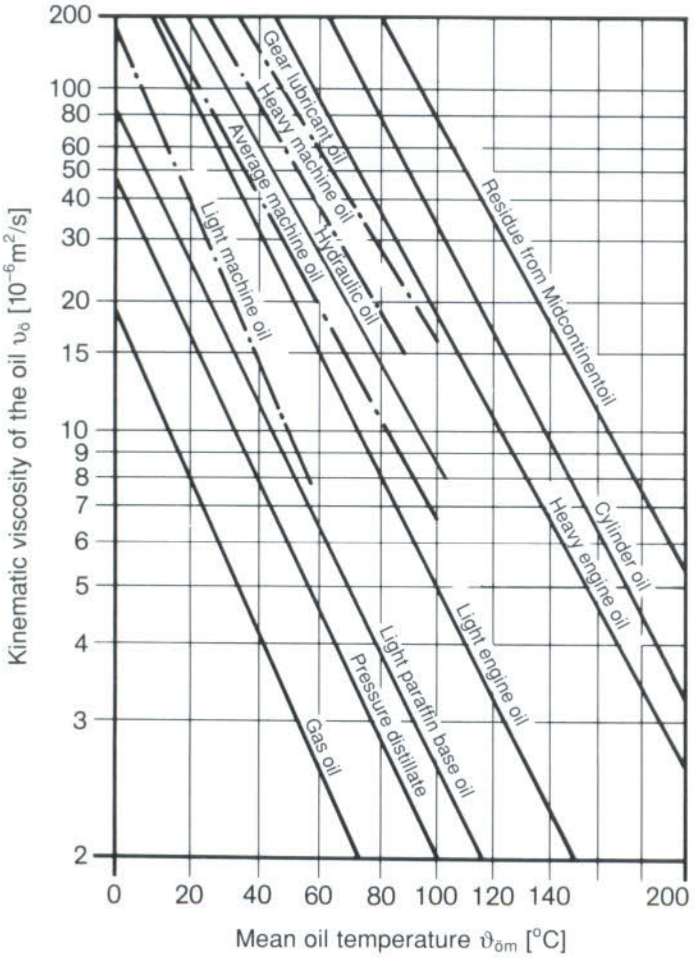
Thermal design

As LOK Tube Coil Heat Exchangers are mainly used for cooling of oil by water, the following explanations only refer to this application.

The transferable thermal capacity as well as the oil and water side pressure drop of the LOK Tube Coil Heat Exchangers can be determined by means of the graphs on the following pages. These graphs have been established by own measurements using the following operating data:

- Mean oil temperature $\vartheta_{öm} = 45$ °C
- Kinematic viscosity of the oil $\upsilon_ö = 40 \cdot 10^{-6}$ m^2/s
- Mean cooling water temperature $\vartheta_{wm} = 20$ °C
- Cooling water velocity $v_w = 2$ m/s

The kinematic viscosity of the oil $\upsilon_ö$ is shown in graph 1 for various mineral oils as a function of the mean oil temperature $\vartheta_{öm}$.



Graph 1:
Kinematic viscosity of mineral oils

For the thermal design of LOK Tube Coil Heat Exchangers it must be observed that too high cooling water velocities may result in erosion-corrosion of copper finned tube coils. In case of cooling water velocities higher than 2 m/s the use of finned tube coils of cupro-nickel is recommended.

Varying operation conditions will result in different capacities. This refers particularly to the kinematic viscosity of the oil $\upsilon_ö$, the cooling water flow rate $\dot{V}_w$ and the mean logarithmic temperature difference $\Delta\vartheta_m$.

These capacity differences can be calculated according to equation (1):

$$\dot{Q}_{eff} = \dot{Q} \cdot f_q \cdot f_t \qquad [kW] \qquad (1)$$

The capacity factor f_q considers the influence of the kinematic viscosity of the oil and at the same time that of the cooling water flow rate. The capacity factor is obtained by means of the graphs 2 and 3.

In graph 2 the inside heat transfer coefficient α_i is shown as function of the cooling water flow rate $\dot{V}_w$ and the cooling water velocity v_w respectively, with the various heat exchanger types as parameters.

From graph 3 you may take the capacity factor f_q as a function of the kinematic viscosity of the oil $\upsilon_ö$ and the inside heat transfer coefficient α_i.

The temperature factor f_t considers the influence of the mean logarithmic temperature difference $\Delta\vartheta_m$ of the media in heat exchange and can be calculated according to equation (2):

$$f_t = \frac{\Delta\vartheta_m}{25} = \frac{(\vartheta_{öe} - \vartheta_{wa}) - (\vartheta_{öa} - \vartheta_{we})}{25 \cdot \ln \dfrac{\vartheta_{öe} - \vartheta_{wa}}{\vartheta_{öa} - \vartheta_{we}}} \qquad [-] \qquad (2)$$

Generally, the inlet and outlet temperatures are known. Missing values can be easily calculated by means of the following equations:

$$\dot{Q}_{eff} = \frac{\dot{V}_w}{3\,600\,000} \cdot \varrho_w \cdot c_{pw} (\vartheta_{wa} - \vartheta_{we}) \qquad [kW] \qquad (3a)$$

$$\dot{Q}_{eff} = \frac{\dot{V}_ö}{60\,000} \cdot \varrho_ö \cdot c_{pö} (\vartheta_{öe} - \vartheta_{öa}) \qquad [kW] \qquad (3b)$$

Pressure drop

The oil and water side pressure drop of the LOK Tube Coil Heat Exchangers can be determined by means of the graphs on the following pages.

The influence of the kinematic viscosity of the oil $\upsilon_ö$ to the oil side pressure drop $\Delta p_ö$ can be taken into account by means of equation (4):

$$\Delta p_{öeff} = \Delta p_ö \cdot f_p \qquad [bar] \qquad (4)$$

The pressure drop factor f_p can be taken from graph 3.

Example of a thermal design

The following working data are given:

- Thermal capacity $\dot{Q}_{eff}$ = 24 kW
- Heating medium = Hydraulic oil
- Kinematic viscosity of the oil $\upsilon_ö$ = $40 \cdot 10^{-6}$ m²/s
- Oil inlet temperature $\vartheta_{öe}$ = 53 °C
- Oil flow rate $\dot{V}_ö$ = 150 l/min
- Cooling medium = Water
- Water inlet temperature ϑ_{we} = 10 °C
- Water flow rate $\dot{V}_w$ = 1250 l/h

The cooling water outlet temperature results from equation (3a):

$$\vartheta_{wa} = \frac{\dot{Q}_{eff} \cdot 3\,600\,000}{\dot{V}_w \cdot \varrho_w \cdot c_{pw}} + \vartheta_{we}$$

$$= \frac{24 \cdot 3\,600\,000}{1250 \cdot 1000 \cdot 4.186} + 10 = 26.5\ °C$$

The oil outlet temperature results from equation (3b):

$$\vartheta_{öa} = \vartheta_{öe} - \frac{\dot{Q}_{eff} \cdot 60\,000}{\dot{V}_ö \cdot \varrho_ö \cdot c_{pö}}$$

$$= 53 - \frac{24 \cdot 60\,000}{150 \cdot 860 \cdot 1.93} = 47.2\ °C$$

Consequently, the mean oil temperature amounts to

$$\vartheta_{öm} = \frac{53 + 47.2}{2} = 50.1\ °C$$

According to graph 1 the kinematic viscosity at this oil temperature amounts to

$$\upsilon_{öm} = 33 \cdot 10^{-6}\ m^2/s$$

According to the working data the heat exchanger type LOK 9-02.23-2 is chosen.

It follows from graph 2:

- Inside heat transfer coefficient α_i = 9200 W/m²K
- Cooling water velocity v_w = 2.0 m/s

It follows from graph 3:

- Capacity factor f_q = 1.04
- Pressure drop factor f_p = 0.94

The temperature factor is calculated according to equation (2):

$$f_t = \frac{(53 - 26.5) - (47.2 - 10)}{25 \cdot \ln \frac{(53 - 26.5)}{(47.2 - 10)}}$$

$$f_t = \frac{26.5 - 37.2}{25 \cdot \ln \frac{26.5}{37.2}} = \frac{37.2 - 26.5}{25 \cdot \ln \frac{37.2}{26.5}} = \frac{10.7}{25 \cdot \ln 1.404} = 1.26$$

From the graphs of the chosen heat exchanger type it follows:

- Thermal capacity $\dot{Q}$ = 21.5 kW
- Oil side pressure drop $\Delta p_ö$ = 1.08 bar
- Water side pressure drop Δp_w = 0.85 bar

The real transferable thermal capacity is obtained from equation (1):

$$\dot{Q}_{eff} = 21.5 \cdot 1.04 \cdot 1.26 = 28.2\ kW$$

The real oil side pressure drop is obtained from equation (4):

$$\Delta p_{öeff} = 1.08 \cdot 0.94 = 1.02\ bar$$

Nomenclature

c_p	kJ/kgK	Specific heat capacity
f	–	Conversion factor
$\dot{Q}$	kW	Thermal capacity
$\dot{V}_w$	l/h	Water flow rate
$\dot{V}_ö$	l/min	Oil flow rate
v	m/s	Flow velocity
α	W/m²K	Heat transfer coefficient
Δp	bar	Pressure drop
ϱ	kg/m³	Density
ϑ	°C	Temperature
$\Delta\vartheta$	K	Temperature difference
υ	m²/s	Kinematic viscosity

Indexes

a	Outlet
e	Inlet
eff	Real
i	Inside
m	Mean
ö	Oil
p	Pressure drop
q	Capacity
t	Temperature
w	Water

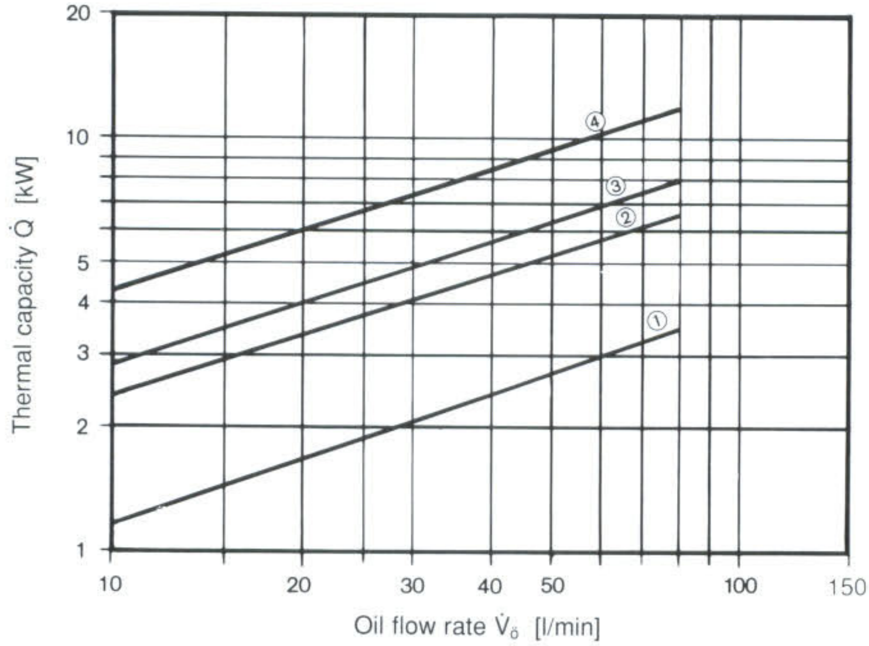
LOK Tube Coil Heat Exchangers Series 9

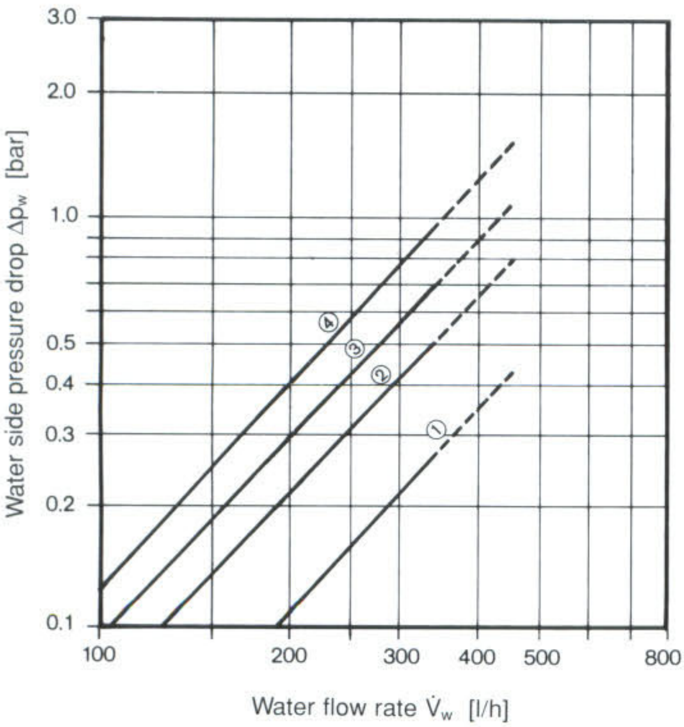
Shell outside diameter a = 70 mm

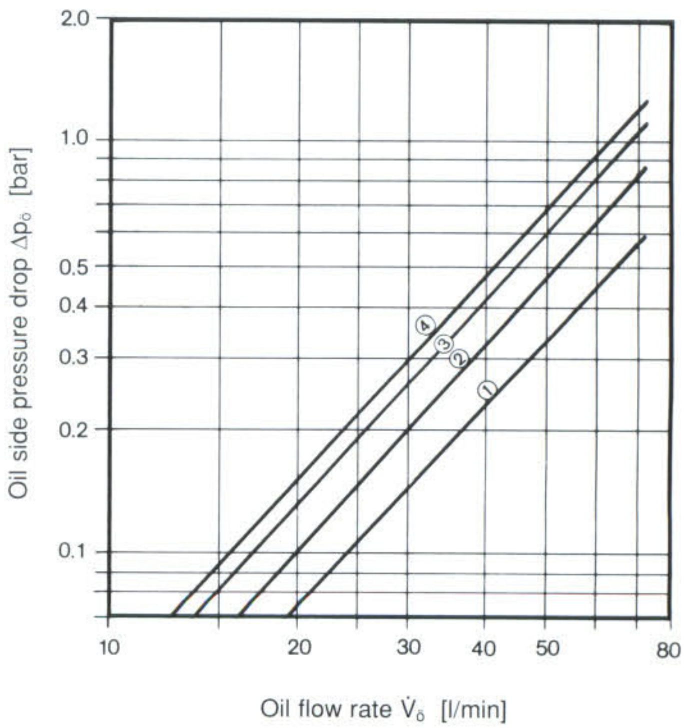
LOK Tube Coil Heat Exchanger Type	Des. Type S	Des. Type M	Des. Type T	No. in Graph
9–00.11–1	●	–	–	①
9–00.12–1	●	●	–	②
9–00.13–1	●	–	–	③
9–00.14–1	●	●	–	④

Operating conditions:

- ▶ Heating medium = Hydraulic oil
- ▶ Kinematic viscosity of the oil $\upsilon_{ö}$ = $40 \cdot 10^{-6}$ m²/s
- ▶ Mean oil temperature $\vartheta_{öm}$ = 45 °C
- ▶ Mean water temperature ϑ_{wm} = 20 °C
- ▶ Water flow velocity v_w = 2 m/s
- ▶ Mean temperature difference $\Delta\vartheta_m$ = 25 K





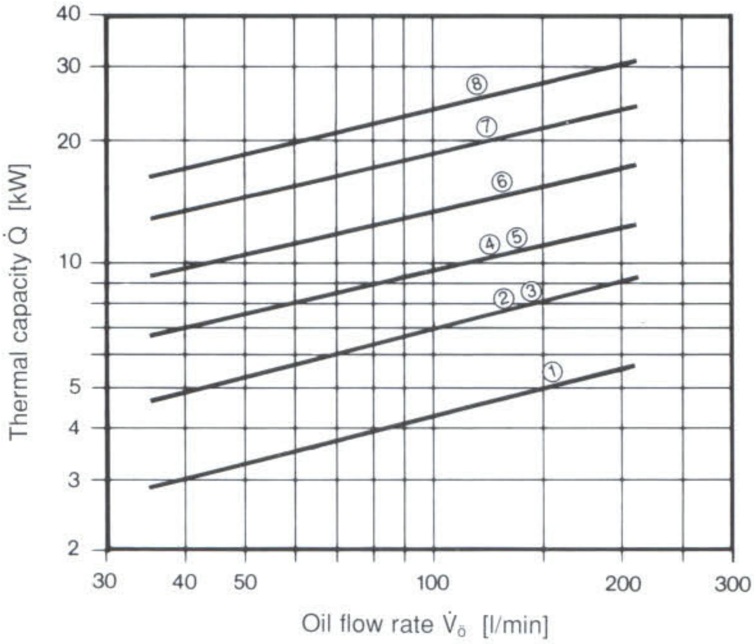


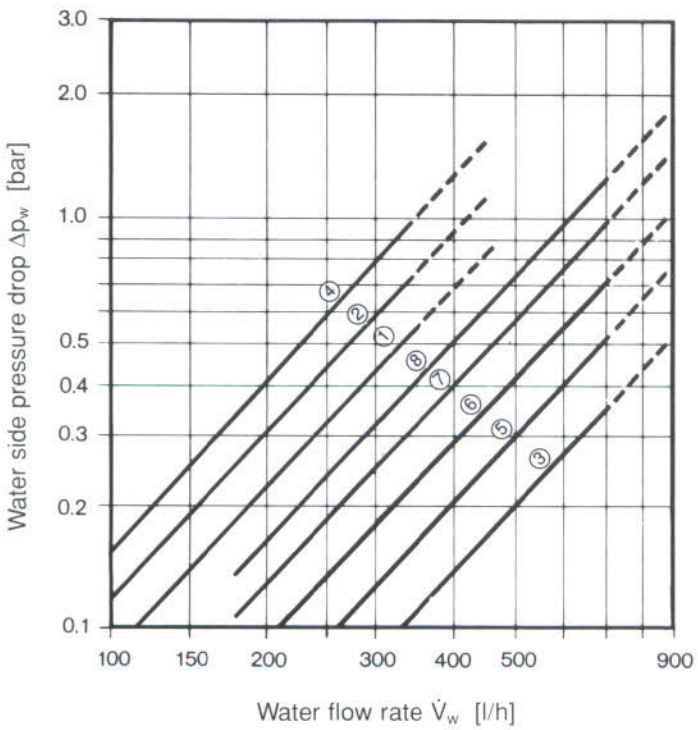
Shell outside diameter a = 108 mm

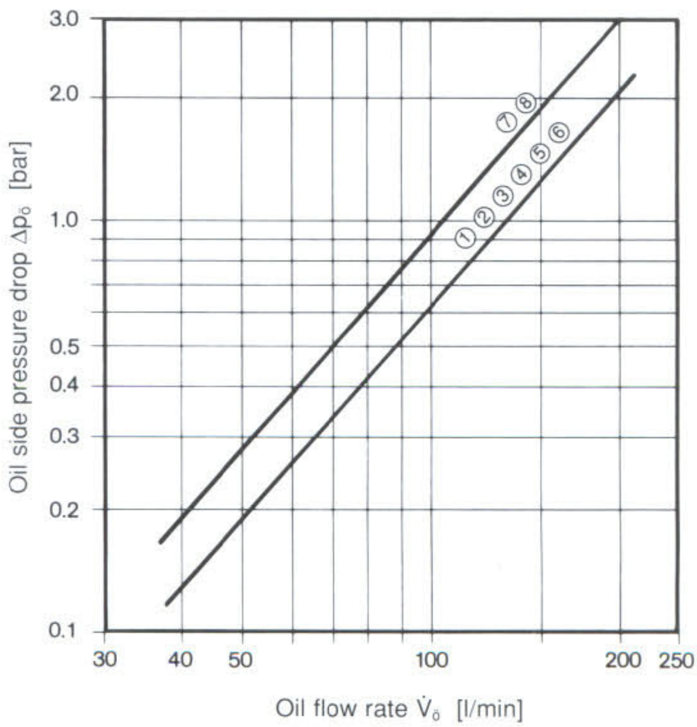
LOK Tube Coil Heat Exchanger Type	Des. Type S	Des. Type M	Des. Type T	No. in Graph
9–01.12–1	–	–	●	①
9–01.13–1	–	–	●	②
9–01.13–2	●	●	–	③
9–01.14–1	●	●	●	④
9–01.14–2	●	●	●	⑤
9–01.21–2	●	●	●	⑥
9–01.22–2	–	●	●	⑦
9–01.23–2	●	●	●	⑧

Operating conditions:

- ▶ Heating medium = Hydraulic oil
- ▶ Kinematic viscosity of the oil $\upsilon_{ö}$ = $40 \cdot 10^{-6}$ m^2/s
- ▶ Mean oil temperature $\vartheta_{öm}$ = 45 °C
- ▶ Mean water temperature ϑ_{wm} = 20 °C
- ▶ Water flow velocity v_w = 2 m/s
- ▶ Mean temperature difference $\Delta\vartheta_m$ = 25 K







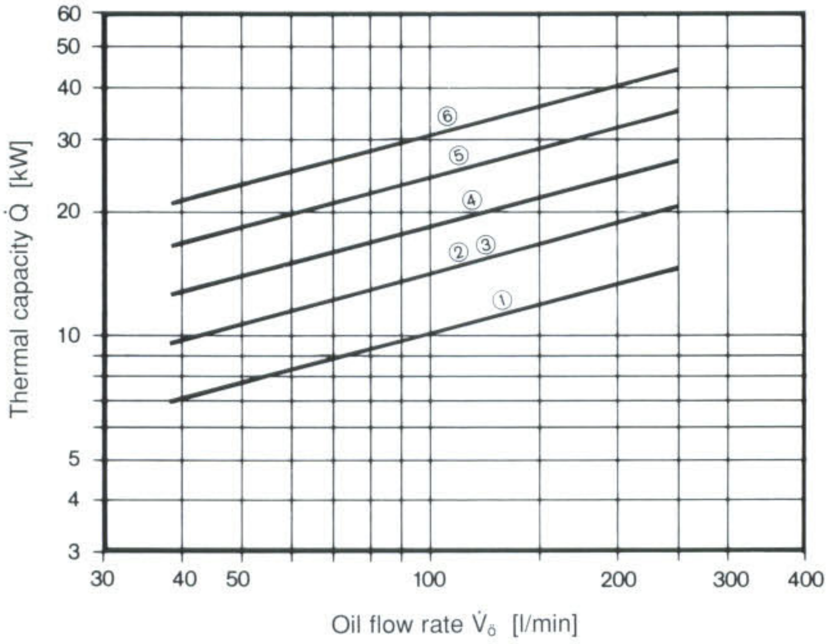
LOK Tube Coil Heat Exchangers Series 9

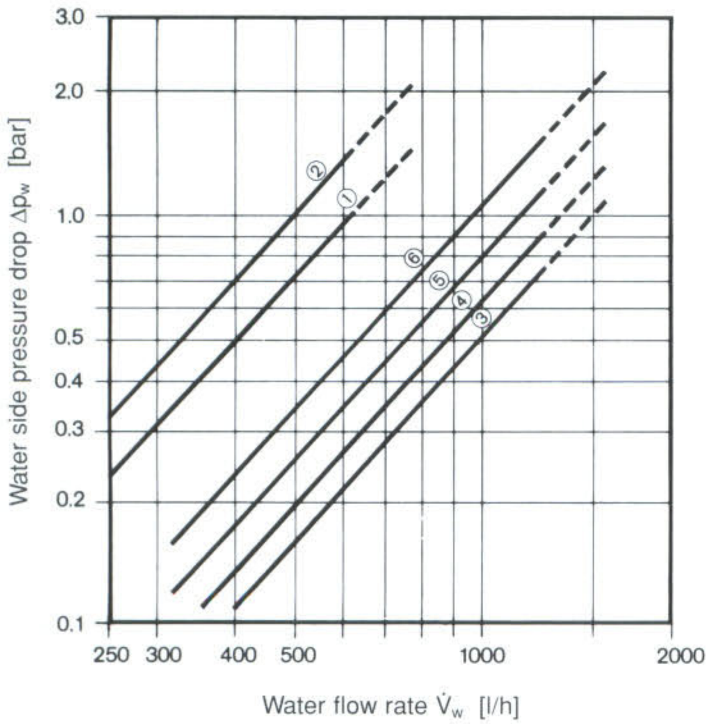
Shell outside diameter a = 127 mm

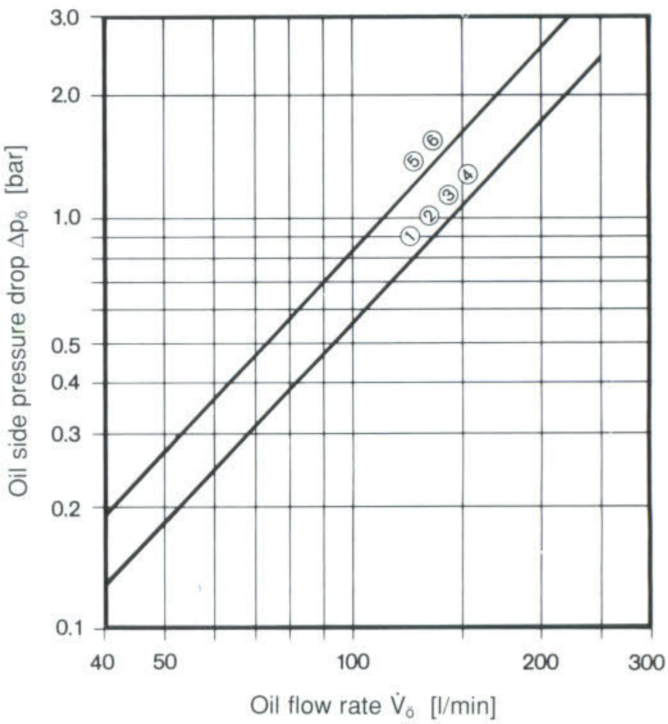
LOK Tube Coil Heat Exchanger Type	Des. Type S	Des. Type M	Des. Type T	No. in Graph
9–02.21–1	–	–	●	①
9–02.22–1	●	–	●	②
9–02.22–2	●	●	●	③
9–02.23–2	●	–	●	④
9–02.31–2	–	●	●	⑤
9–02.32–2	●	–	–	⑥

Operating conditions:

- ▶ Heating medium = Hydraulic oil
- ▶ Kinematic viscosity of the oil $\upsilon_ö = 40 \cdot 10^{-6}$ m²/s
- ▶ Mean oil temperature $\vartheta_{öm} = 45$ °C
- ▶ Mean water temperature $\vartheta_{wm} = 20$ °C
- ▶ Water flow velocity $v_w = 2$ m/s
- ▶ Mean temperature difference $\Delta\vartheta_m = 25$ K





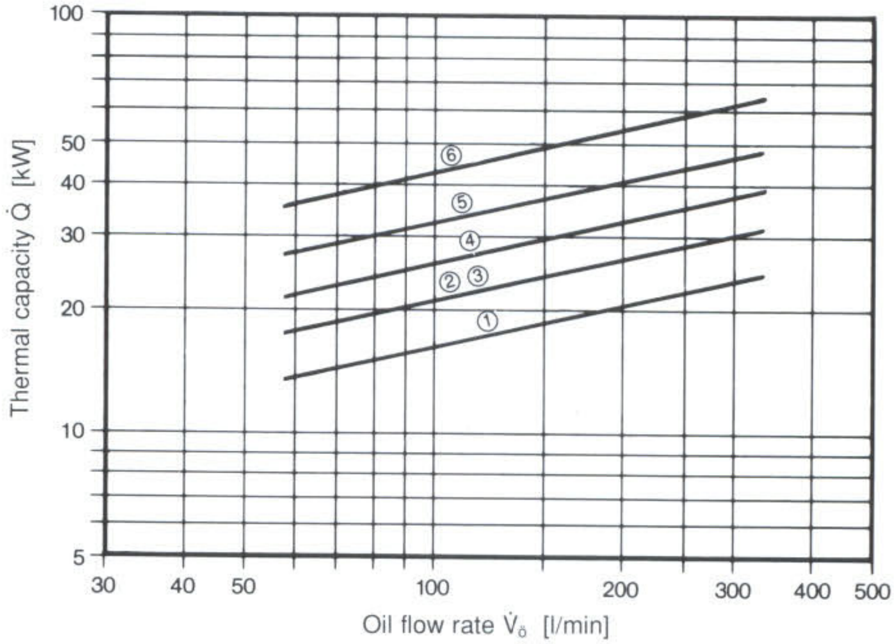


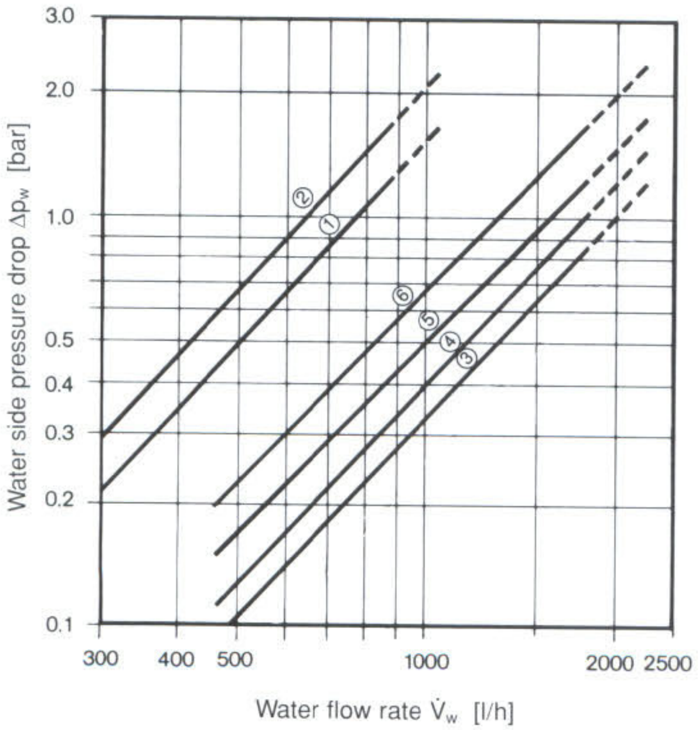
Shell outside diameter a = 152.4 mm

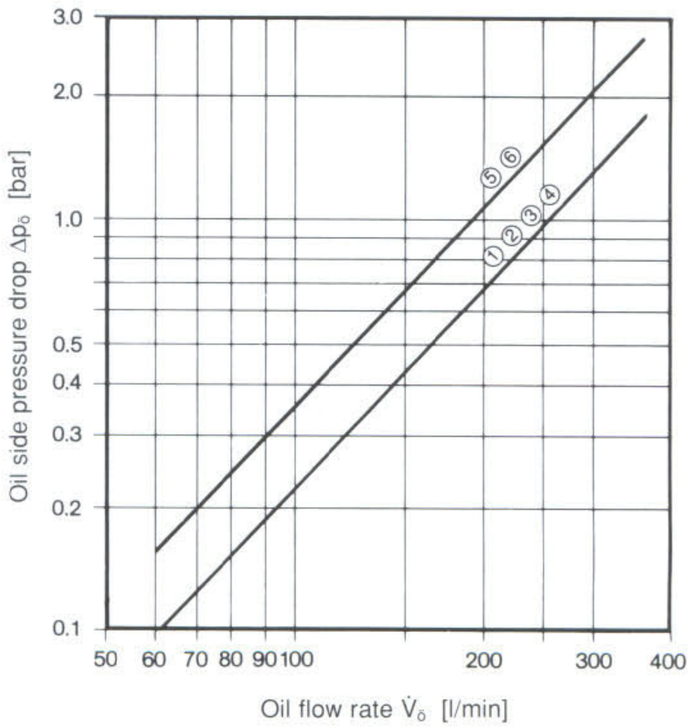
LOK Tube Coil Heat Exchanger Type	Des. Type S	Des. Type M	Des. Type T	No. in Graph
9-03.23-1	–	–	●	①
9-03.31-1	●	–	●	②
9-03.31-2	●	●	●	③
9-03.32-2	●	–	●	④
9-03.41-2	–	●	●	⑤
9-03.42-2	●	●	●	⑥

Operating conditions:

- Heating medium = Hydraulic oil
- Kinematic viscosity of the oil $\upsilon_{ö} = 40 \cdot 10^{-6}$ m²/s
- Mean oil temperature $\vartheta_{öm} = 45$ °C
- Mean water temperature $\vartheta_{wm} = 20$ °C
- Water flow velocity $v_w = 2$ m/s
- Mean temperature difference $\Delta\vartheta_m = 25$ K







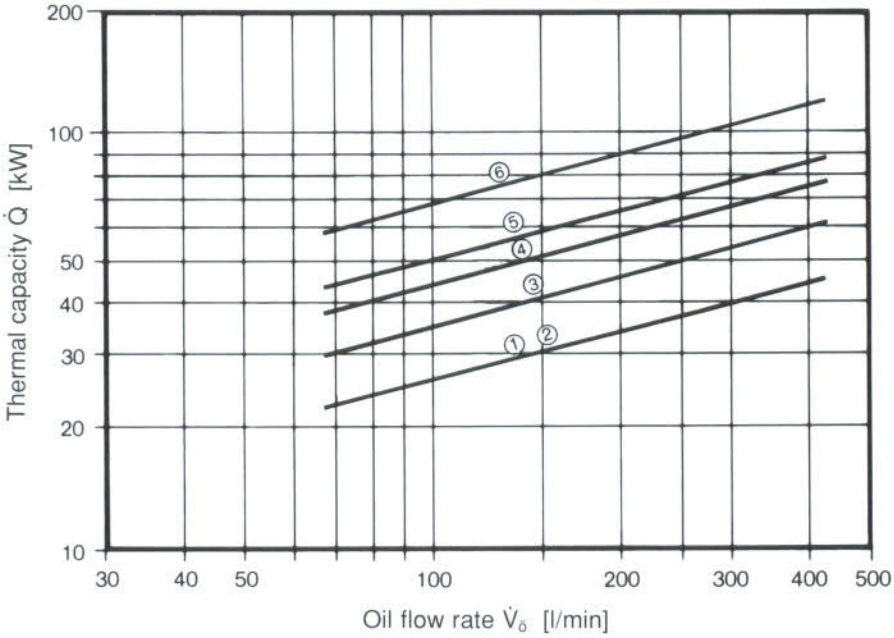
LOK Tube Coil Heat Exchangers Series 9

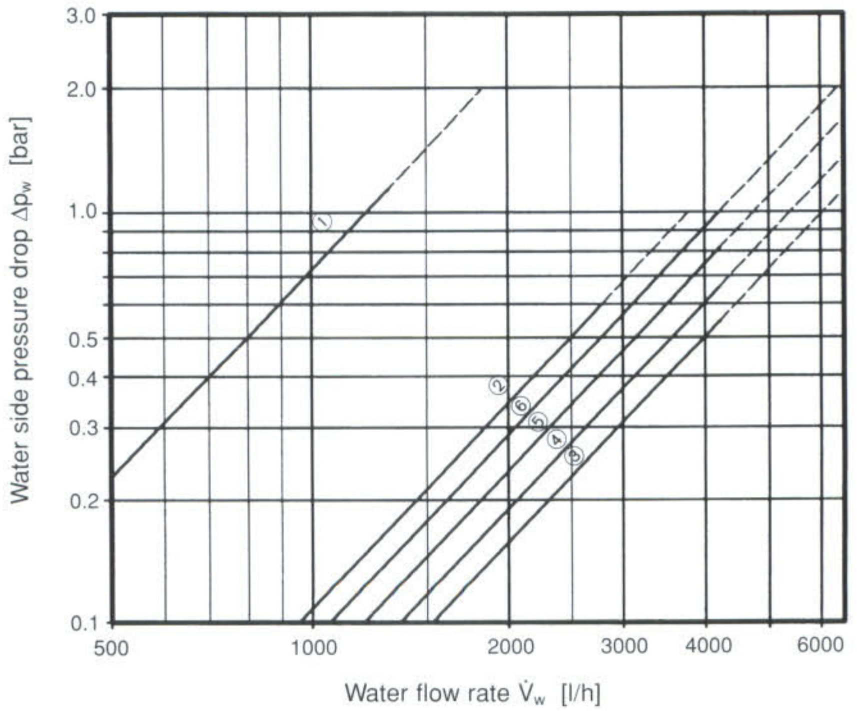
Shell outside diameter a = 193.7 mm

LOK Tube Coil Heat Exchanger Type	Des. Type S	Des. Type M	Des. Type T	No. in Graph
9–04.41–1	●	–	–	①
9–04.41–2	●	–	–	②
9–04.42–3	●	–	●	③
9–04.51–3	●	●	●	④
9–04.52–3	●	●	●	⑤
9–04.53–3	●	●	–	⑥

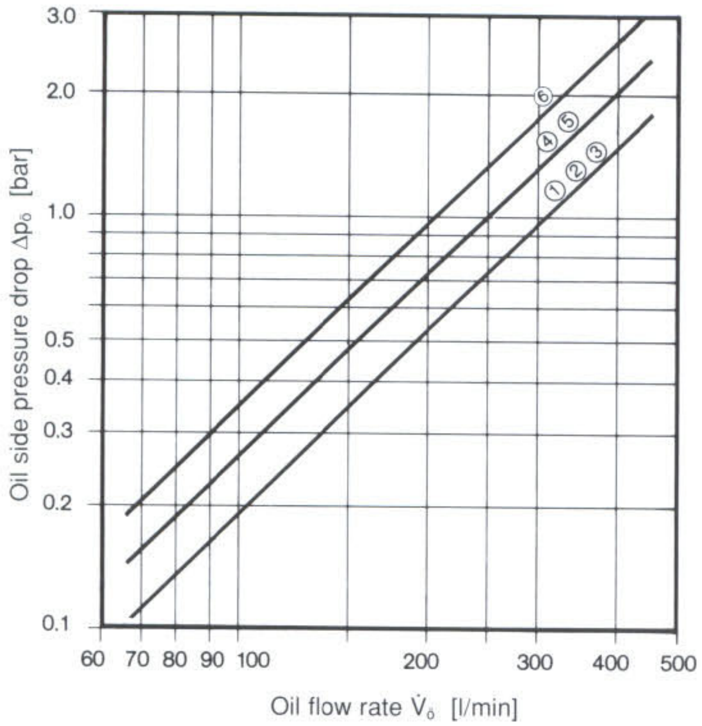
Operating conditions:

- ▶ Heating medium = Hydraulic oil
- ▶ Kinematic viscosity of the oil $\upsilon_{ö} = 40 \cdot 10^{-6}$ m²/s
- ▶ Mean oil temperature $\vartheta_{öm} = 45$ °C
- ▶ Mean water temperature $\vartheta_{wm} = 20$ °C
- ▶ Water flow velocity $v_w = 2$ m/s
- ▶ Mean temperature difference $\Delta\vartheta_m = 25$ K





Shell outside diameter a = 193.7 mm



Graph:
Oil side pressure drop of LOK Tube Coil Heat Exchangers of the type 9 - 04 (see page 14 !)

This product description is based on our own research and the relevant literature. This general information shall neither replace technical consultation for the individual case nor tests and trials under actual conditions by the customer. This refers particularly to the suitability of the material chosen for the intended application.

Although this document was compiled with utmost care, we cannot assume a liability for its correctness, in particular regarding errors and modifications.

The relevant standards and regulations for the operation of heat exchangers have to be respected.

Our sales and technical departments are available for any further advice you may need.

KM-Schmöle GmbH

Quality Assurance System Certification

Lloyd's Register
Quality Assurance

CERTIFICATE OF APPROVAL

This is to Certify that the Quality Management System

KM-Schmöle GmbH
Menden and Fröndenberg, Federal Republic of Germany

has been approved by Lloyd's Register Quality Assurance Limited to the following quality management system standards:

ISO 9001-1987 EN 29001-1987
DIN ISO 9001:1990 BS 5750:Part 1:1987

The Quality Management System is applicable to:

Design and manufacture of finned tubes and heat exchangers.

Approval Certificate No. 926985

Original Approval: 1st April 1993
Current Certificate: 1st April 1993
Certificate Expiry: 31st March 1996

on behalf of LRQA

The approval is subject to the company maintaining its system to the required standards, which will be monitored by LRQA.

The use of the Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001.

Further Product Information

- Finned Tubes (programme survey) — No. 820 e
- Heat Exchangers (programme survey) — No. 850 e
- RRB Tube Bundle Heat Exchangers from corrosion resistant materials — No. 883 e
- Skyvefin – Air-cooled Aluminium Heat Exchangers — No. 885 e
- List of leaflets about Finned Tubes and Heat Exchangers — No. 811 e

The Company

KM-Schmöle GmbH are considered to be one of the leading manufacturers in the fields of heat exchange and control engineering.

Our clients expect both our involvement in solving their application technology problems as well as a continued determination to develop new production programmes and procedures.

With many years of experience behind us and a continued commitment to intensive research and development and modern manufacturing procedures, supported by a certified quality system, we shall continue to meet these challenges.

KM-Schmöle GmbH are a 100 % subsidiary of KM-kabelmetal AG, Osnabrück. The KM group with a turnover of appr. 2.3 billion DM is one of the largest manufacturers of semi-manufactured and special products from copper and copper alloys.

KM-Schmöle GmbH have three product divisions:

- Product Division 1: Finned Tubes and Heat Exchangers
- Product Division 2: Valves and Associated Instruments
- Product Division 3: Evaporators and Condensers for Refrigerators and Deep Freezers

Finned Tubes and Heat Exchangers

The products:

- Low, medium-high and high-finned tubes from copper, copper alloys, aluminium, aluminium alloys, steel, stainless steel, nickel base alloys and titanium.
- Tube coil and tube bundle heat exchangers for cooling, heating, evaporation and condensation of liquid and gaseous media of all kind.

The client branches of industry:

- Mechanical engineering
- Automobile engineering
- Heating industry
- Refrigeration and air-conditioning industry
- Power plant engineering
- Chemical and petro-chemical industry

KM SCHMÖLE

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