HYDAC INTERNATIONAL

Oil/Air Cooler Units
Motoinverter Series EL MI Type

COMPLETE OIL / AIR COOLER SYSTEM WITH AXIAL FAN FOR INDUSTRIAL APPLICATIONS.

General description

In hydraulic systems energy is transformed and transmitted. During this process, efficiency losses occur, i.e. mechanical and hydraulic energy is converted into heat. It is the purpose of the cooler to dissipate this heat and to maintain the thermal balance of the hydraulic fluid.

Application

These high performance coolers equipped with axial fans and motoinverter are suitable for hydraulic cooling applications, with both return line and off line versions available. Typical applications include: industrial power units, lubrication systems (i.e. gearboxes) and machine tools.

OK-EL MI Product Features

- Controlled Cooling Power
- Constant Output Oil Temperature
- 16 Bar Dynamic Pressure Rating

OK-EL MI coolers use high efficiency axial fans driven by motoinverter and sturdy aluminium bar-and-plate cooling elements. This guarantees immediate adjustment to required cooling performance under changing load conditions and superior cooler durability. Cooling power, as a function of fan speed, is controlled depending on the required oil outlet temperature.

The main advantage of this cooler/ motoinverter product line is the integration of oil temperature control via proportional fan speed into one very compact design. Further advantages are a lower noise level and lower power consumption over the term of a year.

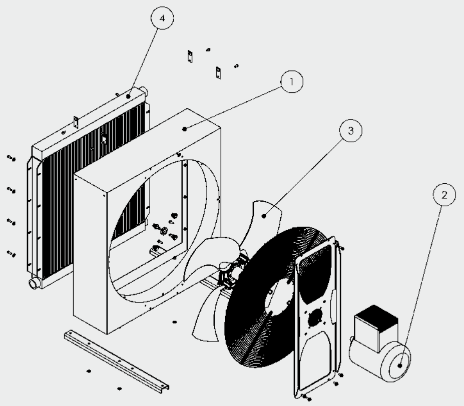
E 5.810.0/12.08

MAIN FEATURES AND CHARACTERISTICS

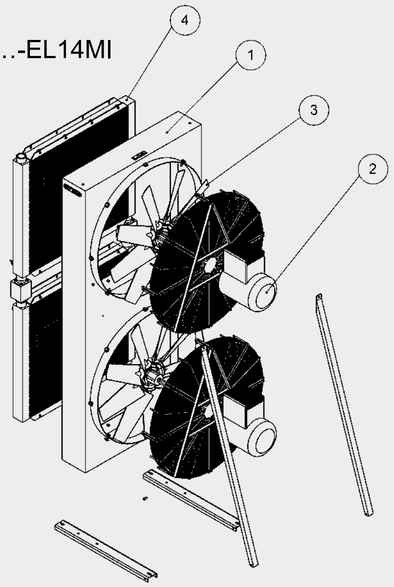
FEATURES AND ADVANTAGES	DESCRIPTION	CUSTOMER BENEFITS
Plug and Play	The motoinverter cooler needs only one power supply to run	Reduced engineering and installation costs
	Compact assembled configuration with integrated temperature thermistor in the cooling element and directly connected to the inverter	No additional cost for components and their installation like: temperature thermistor, signal converter, control devices, wiring and terminals
	Embedded motor speed control One motor type able to cover values up to 1800 RPM Flexibility whenever a higher RPM is needed	Reduced engineering for motor speed control No additional engineering if heat to dissipate increases (within max performances of the motoinverter cooler)
Low operational cost	Published performance data @ nominal RPM related to a cooler in the same size without motoinverter, allows an increase by 20%	No need for a second or a larger cooler
Lower average noise level	Noise level depending on the fan speed, corresponding to the required cooling power	Lower noise level for the most time of the year
Variable fan speed	The inverter controls the fan speed in order to have the oil temperature as constant as possible	Constant oil temperature at different ambient temperature allows an optimal cooling performance
	Energy absorption by the cooling system during the year is highly influenced from the season	Power consumption costs are related to real need cooling power
Motor power supply	The electrical motor is not directly connected to the main power supply which can be disturbed and not regulated	The inverter allows a controlled and stable power supply for the motor (PWM)
NTC temperature sensor	One component for temperature measuring	Fast to replace
Cartridge holder	To simplify service and maintenance work, NTC temperature sensor are fixed in cartridge holders; which allows a replacement without the need to empty the cooling circuit.	Easy maintenance
Inverter parameters	The inverter parameters are set according to the customer cooling system	Customised and adapted to the cooling system The inverter parameters can be changed on site
Oil/coling system	Less stress for oil and cooling system due to less temperature fluctuations	Oil temperature regulation due to the integrated system

COOLER MAIN COMPONETS

OK-EL10MI

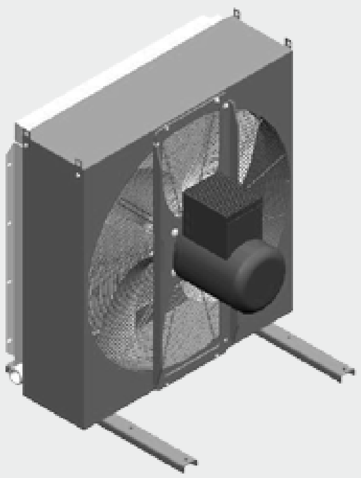


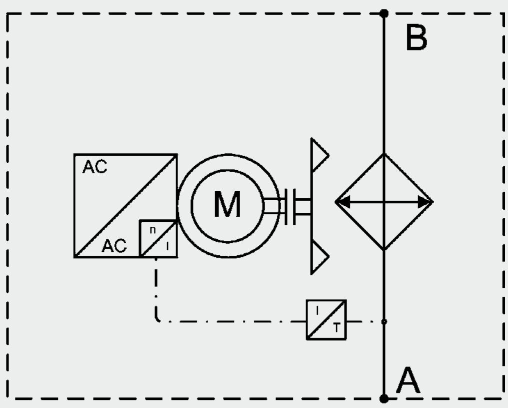
OK-EL12MI …-EL14MI



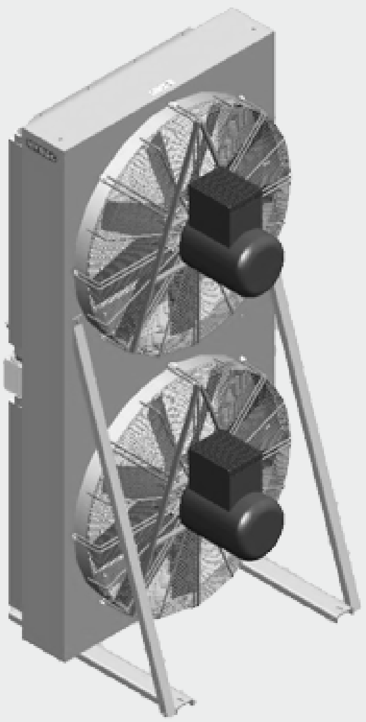
Complete Oil/Air cooler unit consist of (1) metal housing, (2) motoinverter, (3) axial fan and (4) heat exchanger. The oil connections are external.

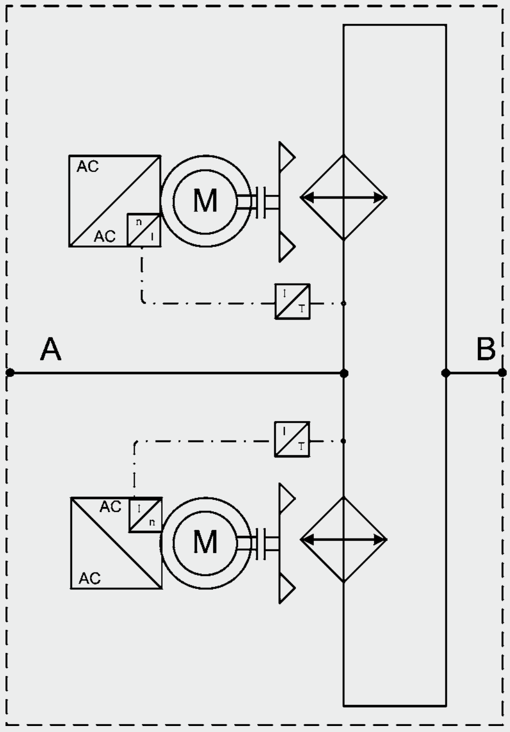
OK-EL8MI …-EL10MI





OK-EL12MI …-EL14MI





COOLING CAPACITY

Depending on oil flow and the temperature differential delta-T between oil inlet and air inlet temperature.

For cooling capacity with very low delta-T (i.e. < 10°C), please contact our technical support staff.

COOLER SELECTION

Designation:

P_V = Power loss [kW]
P_{01} = Specific cooling capacity [kW/°C]
V = Tank volume [l]
P_{oil} = Oil density [kg/l]
for mineral oil 0.915 kg/l
C_{oil} = Spec. heat capacity [kJ/kg°C]
for mineral oil 1.88 kJ/kg°C
ΔT = Temperature increase
in the system [°C]
t = Operating time [min]
T_1 = Desire oil temperature [°C]
T_3 = Ambient temperature [°C]

Example 1:
Measuring the power loss on existing units and machinery.

For this method the temperature increase of the oil is measured over certain period of time. The power loss can be calculated from the temperature increase

Parameters:
The oil temperature increases from 20°C to 60°C over 16 minutes.
The tank contains 400l.

Heat to dissipate:

$$P_V = \frac{\Delta T \times C_{oil} \times \rho_{oil} \times V}{t \times 60} \quad [kW]$$

$$P_V = \frac{40 \times 1.88 \times 0.915 \times 400}{16 \times 60} = 28.7 \quad [kW]$$

Cooler selection:

- Desired oil temperature: 60°C
- Ambient temperature (air): 30°C

$$P_{01} = \frac{P_V}{T_1 - T_3} \quad [kW/°C]$$

$$P_{01} = \frac{28.7}{60 - 30} = 0.96 \quad [kW/°C]$$

A 10% safety margin is recommended to allow for element contamination and therefore the specific power is:

$$P_{01} \times 1.1 = 1.06 \quad [kW/°C]$$

The power loss 1.06 kW/°C must be dissipated by an oil cooler.

Suggestion:
At dT40°C => PV = 42.4kW

- Cooler OK-EL8MI
  P = 42.4kW at 120l/min and 1200RPM
- Cooler OK-EL10MI
  P = 42.4kW at 60l/min and 750RPM

Example 2:
The power loss can also be estimated. With unrestricted flow approx. 15 to 20% of the drive power.
With restricted flow up to 30% of the drive power.

TECHNICAL DETAILS

TABLE OF TECHNICAL SPECIFICATIONS, SIZE 8 TO 14

Type of cooler	Type of temperature sensor	Ambient temperature range [°C]	Oil flow [l/min] at max. operating pressure	N° of poles[-]/size[-] for the fan motor	Motoinverter capacity [kW] @ 50Hz	Noise level [dB(A)] (at 1m distance) @ 1000 RPM	Max. operating pressure [bar]	Max. oil temperature [°C]	Max. motor speed [RPM]	Max. viscosity [mm2/s] continuous working	Weight [kg]
OK-EL8MI	NTC	-20 … +40	*300	4/100	2.2	77	16	130	1720	2000	65
OK-EL10MI	NTC	-20 … +40	*330	4/100	2.2	78	16	130	1430	2000	145
OK-EL12MI	2x NTC	-20 … +40	*660 (2 cooling elements)	4/100 (2 motors)	2.2 (2 mot.)	83	16	130	1430	2000	300
OK-EL14MI	2x NTC	-20 … +40	*660 (2 cooling elements)	6/112 (2 motors)	2.2 (2 mot.)	88	16	130	1200	2000	360

* :max oil flow

1. For direction of fan rotation, please refer to arrow on cooler housing.
2. Electric fan drive: axial drive with forward flow through cooler element (sucking).
3. Cooling fluid: mineral oil to DIN 51524; for other fluids, please contact our sales/ technical department.
4. Three-phase motoinverter IP55, conforming to CE norm.
5. Published noise levels can only be used as guidance, as acoustic properties vary and depend on the characteristics of room, connections, viscosity and resonance.

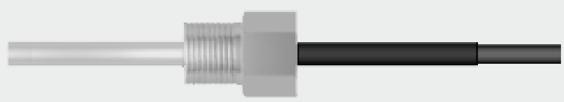
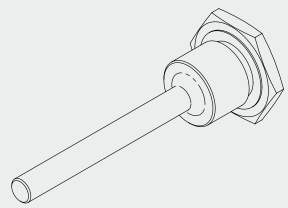
Warning!
When operating a cooler in conditions where the difference in temperature between ambient air and inlet oil exceeds 50° Celsius [C], care must be taken to avoid cycling of the fan at full speed/air flow. This can cause a rapid change in material temperature of the cooling element and may result in a significant reduction of the cooler lifetime or direct damage to the cooling element through thermal stress.

Please contact your HYDAC branch or distributor for speed control solutions.

NTC TEMPERATURE SENSOR

In our case the NTC temperature sensor (called also thermal resistor or thermistor) is an electronic component that exhibits a large change in resistance with a change in body temperature. Made of ceramic semiconductor and has a large negative temperature coefficient of resistance (NTC devices).

NTC MAIN TECHNICAL CHARACTERISTICS:

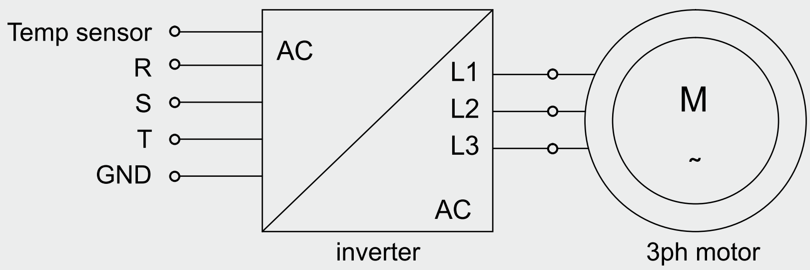
Technical characteristic	
Working range (NTC)	-20 …+120°C *)
Specific temperature at 25°C	10kΩ
Measure accuracy	1%
Protection degree	IP67
Temperature inertia	10K in liquid at 2m/s
Cartridge holder	

*) to achieve best accuracy

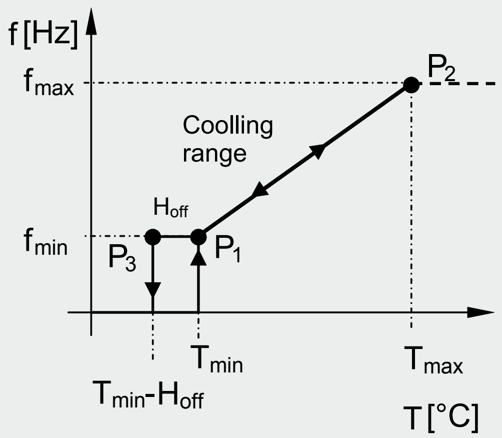
MOTOINVERTER MAIN DATA

Motor Type	3 phase single winding with 3 phase frequency inverter on board
Pole nr.	4 or 6
UIN nom	3x 400V ±15%
fIN range	40 … 70 Hz
P nom	2.2 kW @ 50Hz
Protection degree (IP)	55
Isolation class	F
Service type	S1
Mounting	IMB14 D160
Frame	Iec 100 (4pole) / 112 (6pole)

MOTOINVERTER BLOC DIAGRAM



MOTOINVERTER FREQUENCY REGULATION



	Description
P_1	Cooler switch ON point (Tmin, fmin)
P_2	Cooler max speed (Tmax, fmax)
P_3	Cooler switch OFF point (Tmin-Hoff, fmin)

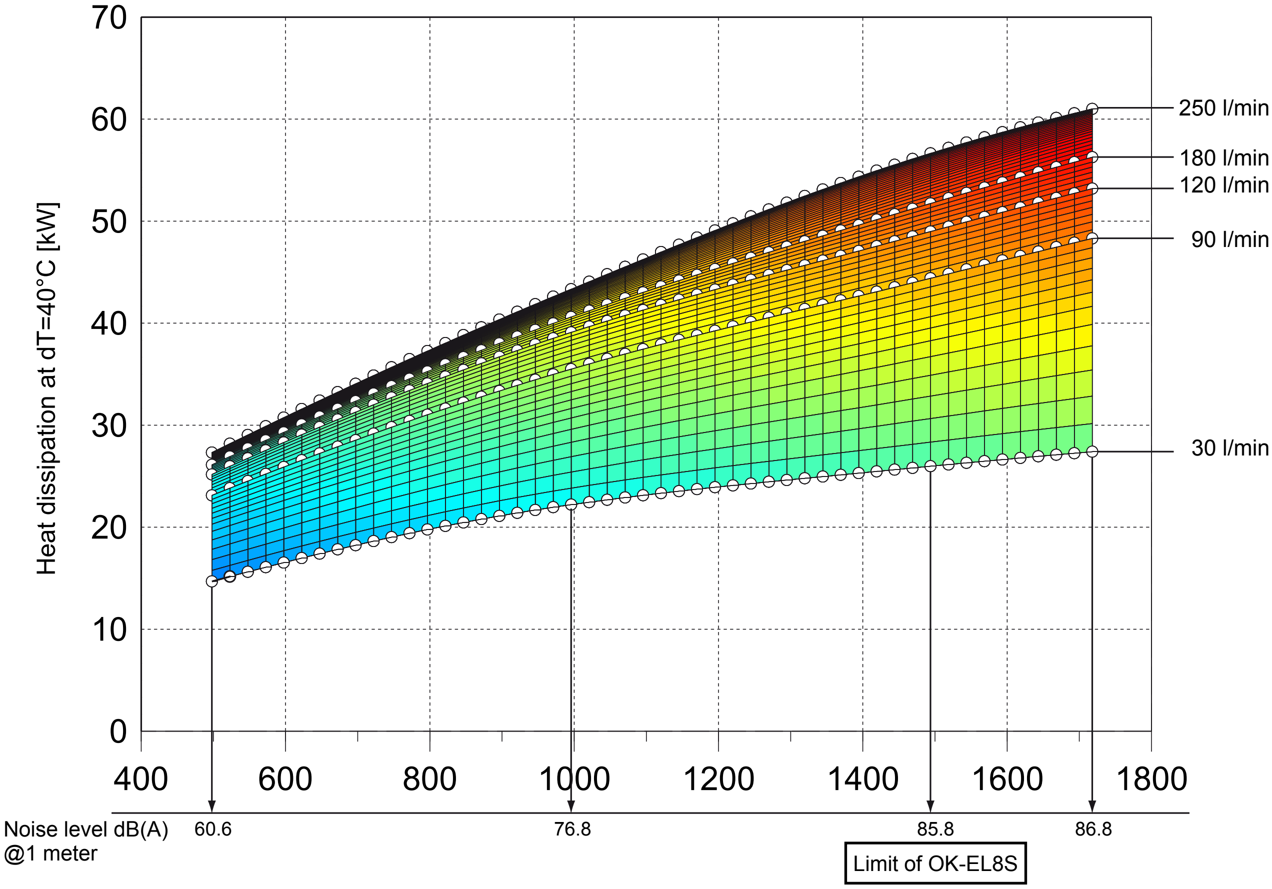
Param. to set	Description
T_{min}	Oil temperature => cooler ON
T_{max}	Oil temperature @ motor max. speed
f_{min}	Min motor frequency => cooler ON
f_{max}	Max motor frequency
H_{off}	Temperature offset between cooler switch ON - OFF

NOTE
The inverter parameters are set according to the customer requirements before cooler dispatch.
For on site parameters modification **HYDAC SA, Switzerland** is at your disposal.

PERFORMANCE DIAGRAMS

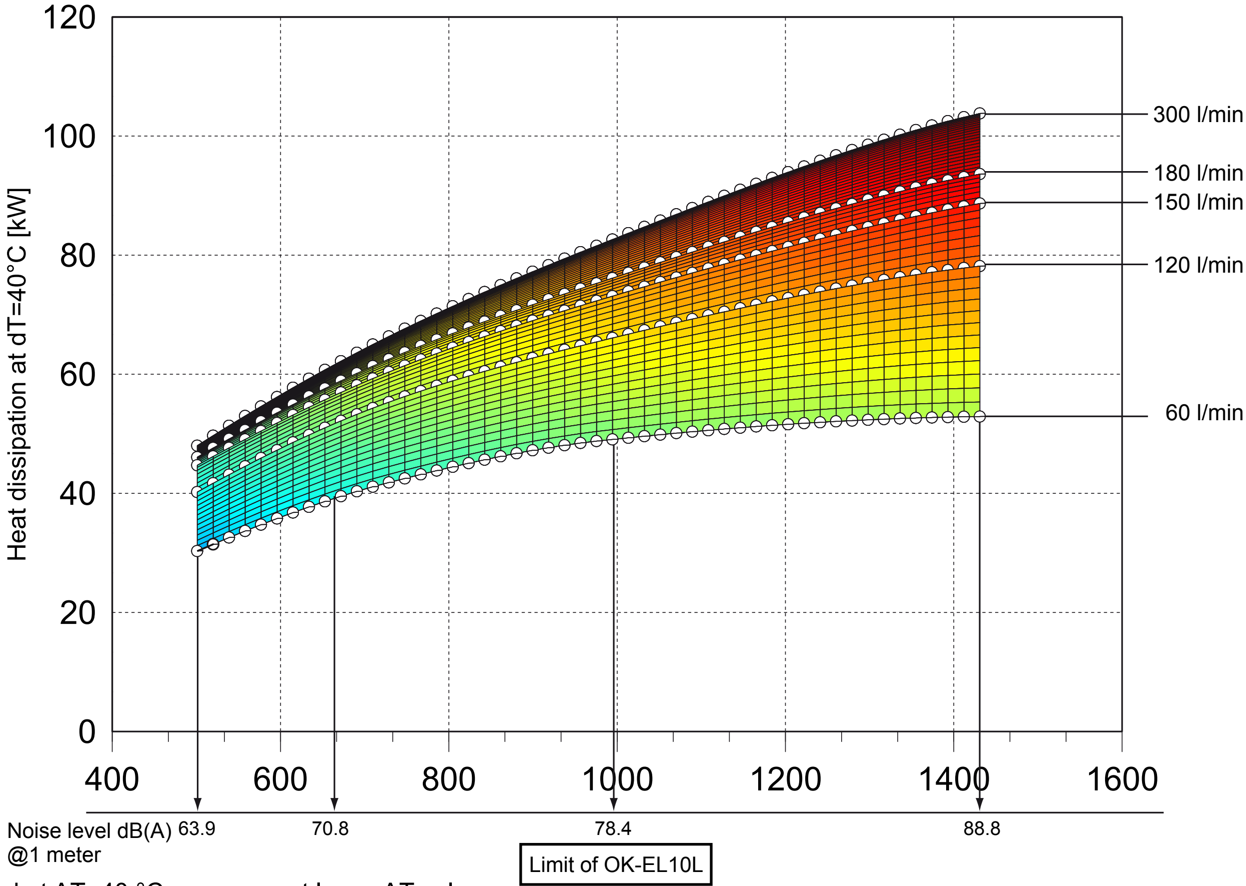
Cooling capacity depends on oil flow and the temperature differential ΔT between the oil inlet and air inlet.
For calculation of cooling capacity with very low ΔT values (i.e. < 10°C), please contact our technical support staff for help.
Tolerance: +/- 8%

OK-EL8MI



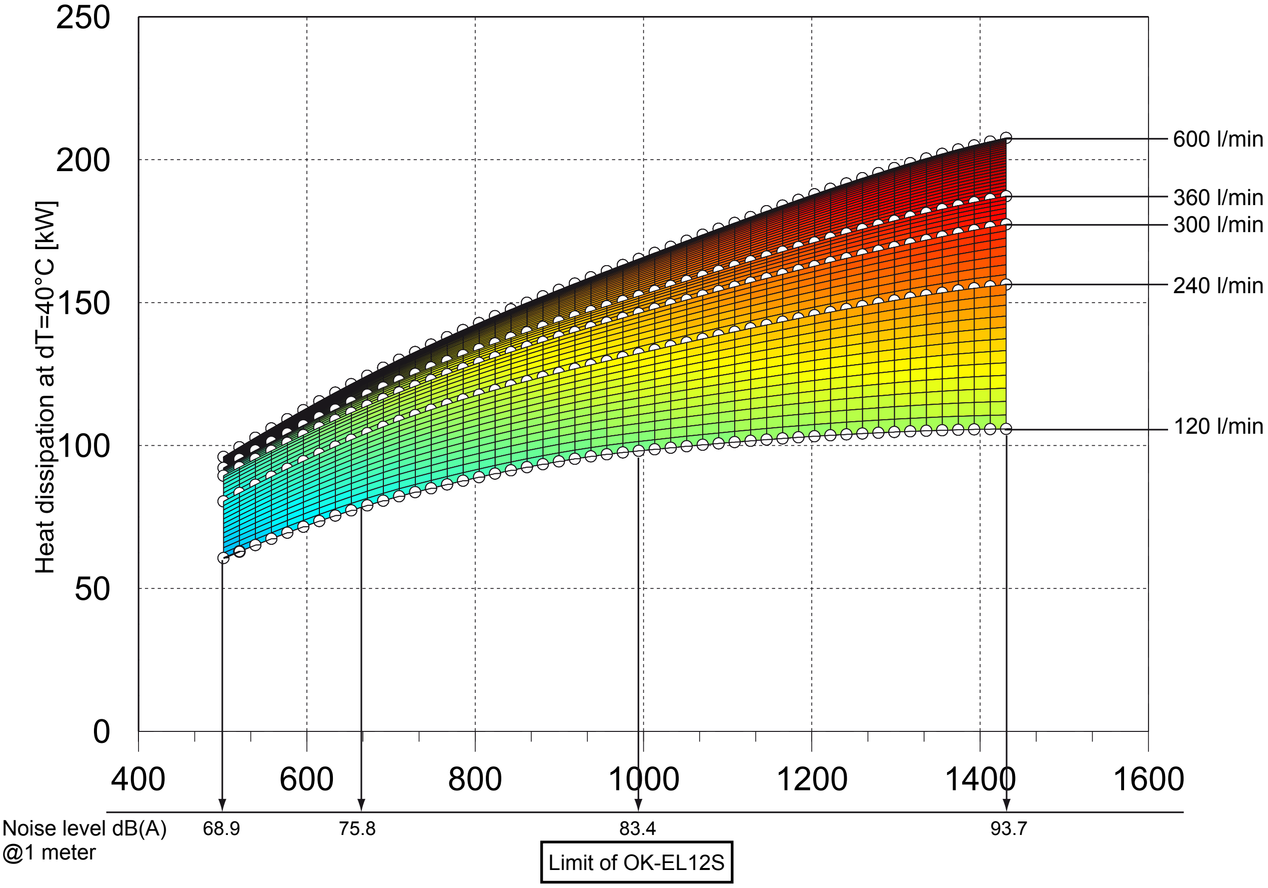
Values measured at ΔT=40 °C, may vary at lower ΔT values.

OK-EL10MI



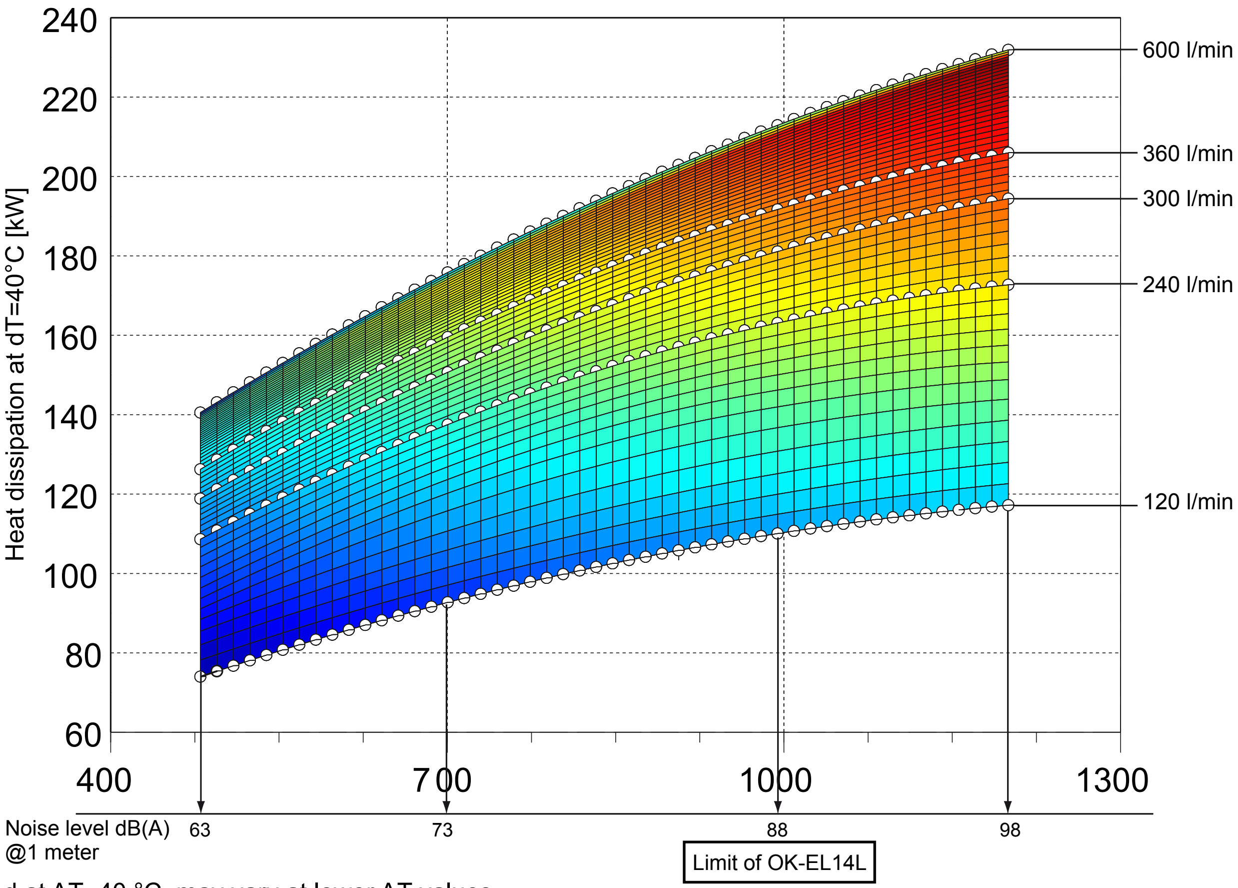
Values measured at ΔT=40 °C, may vary at lower ΔT values.
Published noise levels can only be used as guidance, as acoustic properties vary and depend on the characteristics of room, connections, viscosity and resonance.

OK-EL12MI



Values measured at ΔT=40 °C, may vary at lower ΔT values.

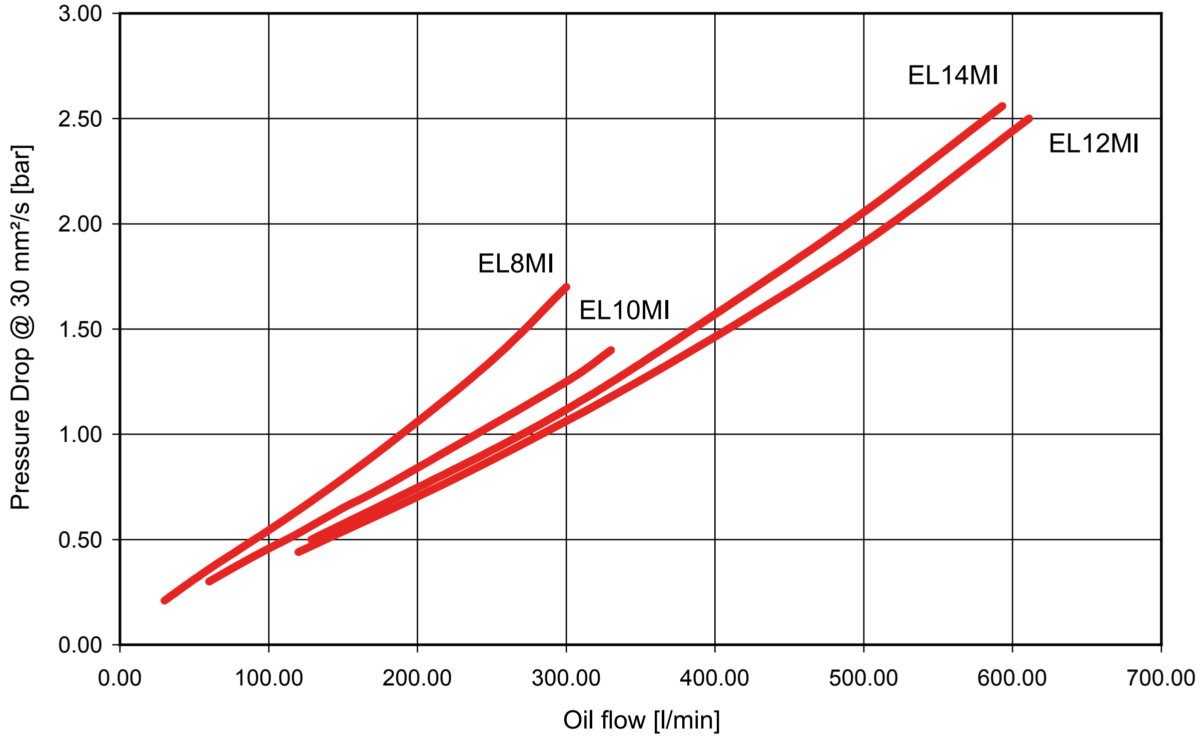
OK-EL14MI



Values measured at ΔT=40 °C, may vary at lower ΔT values.
Published noise levels can only be used as guidance, as acoustic properties vary and depend on the characteristics of room, connections, viscosity and resonance.

PRESSURE DROP CURVES

Differential pressure Δp measured at 30 mm²/s using mineral oil



Correction factor K for other viscosities:

Viscosity (mm²/s)	10	15	22	30	46	68	100	150
Factor K	0.35	0.5	0.75	1	1.4	1.9	2.5	3.5

MODEL TYPE

(also order example)

OK-EL 8MI / 3.1 / M / 1

Type of cooler
OK-EL = Oil/Air cooler

Size / motor max speed
8MI = 1800 min-1
10MI = 1500 min-1
12MI = 1500 min-1
14MI = 1200 min-1

Type code and modification number:
for current levels of each type of cooler, see table on the internet site

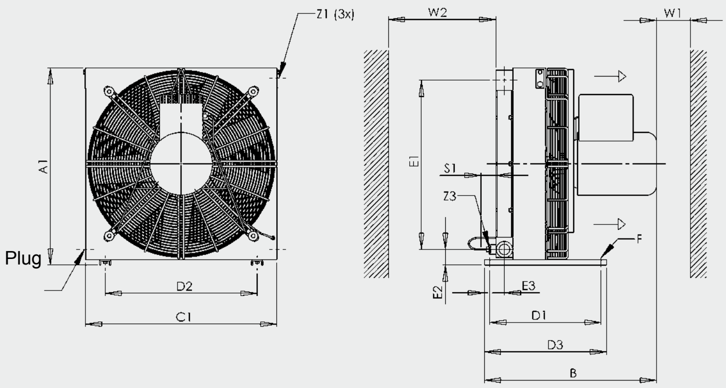
Fluids
M = Mineral oil to DIN 51524
Other fluids upon request

Paint
1 = RAL 5009 (Standard)
Other paint available upon request

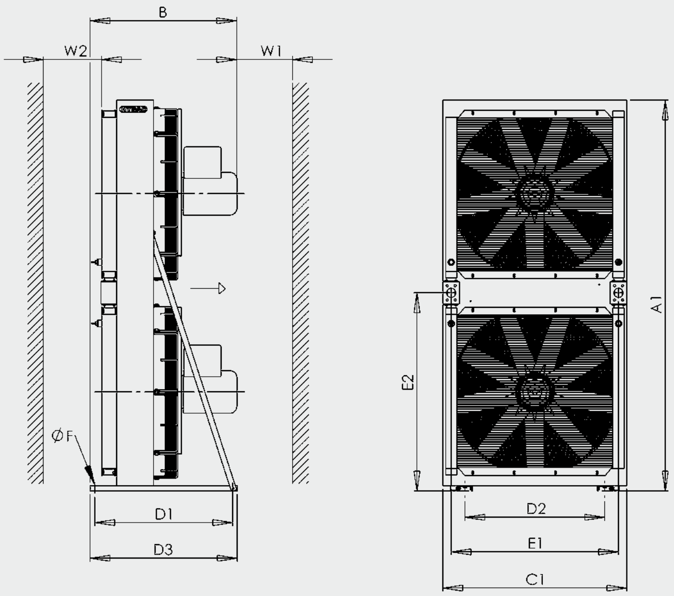
Motor power supply
Standard voltages and frequencies for 3–phase motor
Input voltage range 400VAC ± 15%
Input frequency range 50Hz -20% / +40%

DIMENSIONS

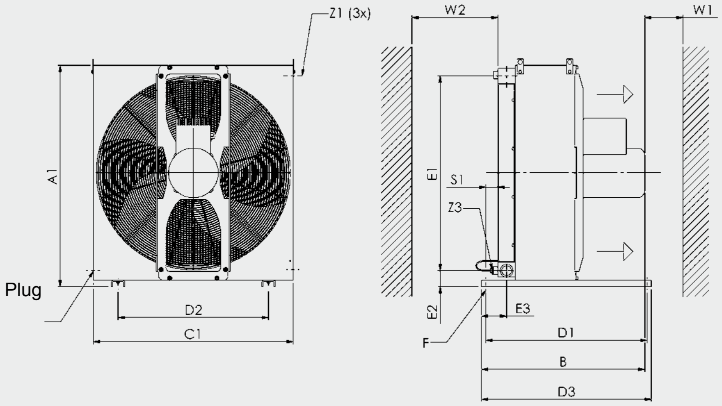
OK-EL8MI



OK-EL12MI and 14MI



OK-EL10MI



	A1 ±10	B ±25	C1 ±10	D1 ±2	D2 ±2	D3 ±2	E1 ±5	E2 ±5	E3 ±5	F Ø/Slot	S1	W1 * Min.	W2 * Min.	Z1	Z3
OK-EL8MI	726	634	706	410	560	450	630	58	74	9x20	> 100	1200	600	G1 ¼”	M22x1.5
OK-EL10MI	1030	767	930	750	700	790	910	75	116	12	> 100	2800	900	G1 ½”	M22x1.5
OK-EL12MI	2130	735	1000	750	760	800	910	1080	–	30x13	> 100	3000	1000	G1 ½”	M22x1.5
OK-EL14MI	2300	735	1150	750	900	800	910	1164	–	30x13	> 100	3000	1000	G1 ½”	M22x1.5

* : for smaller distances, please contact our technical office

CERTIFICATION FOLLOWING EN 1048

HYDAC SA design and manufacture high quality coolers that are tested on certified test stands to give reliable and repeatable high performance. To ensure the performance is accurate, testing in compliance with a recognized international test standard is the best solution. For air/liquid coolers this is EN1048.

HYDAC SA test procedure complies with the requirements of EN 1048 and both the procedure and test equipment are independently inspected and certified by TÜV SÜD.

The cooler performance details in this brochure have been tested following EN 1048.

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.

NOTIZEN

NOTIZEN