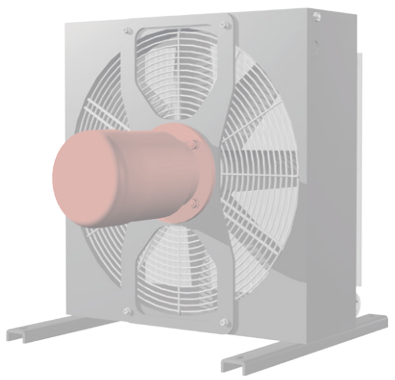


Air Coolers
Industrial / Mobile

General

Air cooling is a simple means of dissipating heat, a by-product of the efficiency losses, within industrial and mobile machines.

The fluid – usually oil or water-glycol – flows through a cooler. A fan draws air and drives it through the cooling element. Thus, there is a temperature difference and heat exchange takes place resulting in an increase in air temperature which is then released in the environment.

This process reduces the average temperature of the fluid up to a few Celsius degrees over the actual environmental temperature.

It is possible to install an air cooler in almost every situation, with a minimum impact on the existing lay out.
The operating costs are correspondingly low and can be reduced further by using a speed-controlled fan.
With new designs using special, low-noise fans and optimised air ducting we can also offer coolers with outstanding low noise emissions.

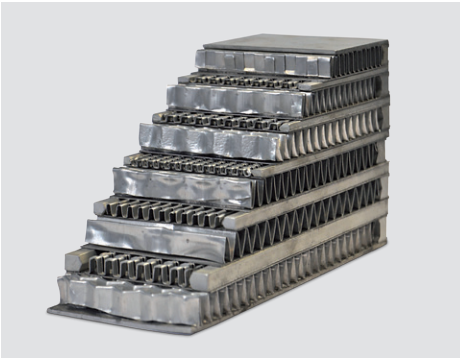
A wide range of coolers is available, with either axial and radial fan designs. AC, DC electric drives and hydraulic motors ensure versatility in catering to a variety of applications and ambient conditions.

Production, Test Rigs, Development

Cooling elements

The aluminium cooling elements are manufactured in our own HYDAC production plants. The cooling elements in 'plate and bar' construction demonstrate particularly impressive strength, design flexibility and optimal heat transfer.

We offer a large selection of air fin and fluid turbulator designs, ensuring radiators are tuned to provide maximum capacity in every situation – even in extremely contaminated environments.

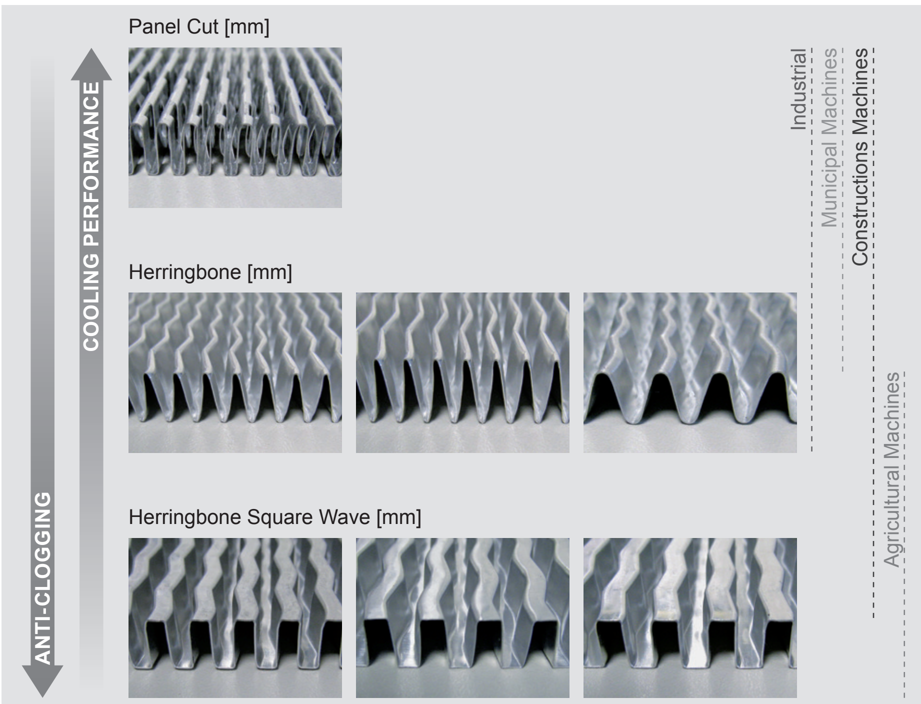


Example of different turbulators

Design of a cooling element

- High strength
- Versatile design
- Optimal heat transfer

Selection of air fins



Production of cooling elements


Manufacturing of fins and turbulators


CNC tank machining

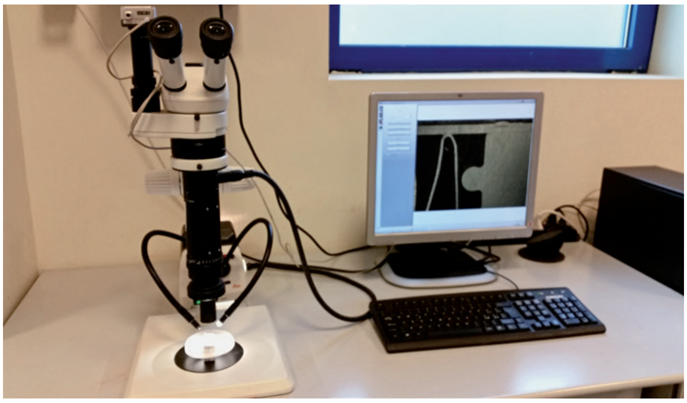

Radiator core assembly


Robot welding


CAB brazing furnace


Leakage test


Paint shop (powder coating)

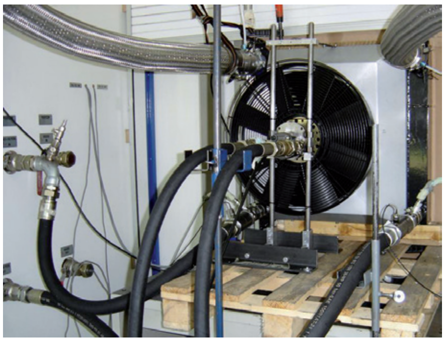

Quality inspection

Test rigs

Field measurements or tests carried out under real-life conditions are important methods to analyse the cooler performance and suitability for specific applications. Constancy and accuracy of the instruments used for measurments are essential requirements. Only in thus way changes in the cooling system, e.g. the position of the fan in the fan housing, can be accurately quantified.

HYDAC test rigs fulfill all requirements in terms of testing accuracy and have been certified by TÜV Süd.

The test criteria and the testing equipment to be used are specified in the test procedures. The cooling capacity values indicated by HYDAC were derived following the specification EN 1048.



Test rigs for measuring cooling capacity with

- Hydraulic oil
- Gear oil
- Water glycol
- Charge air

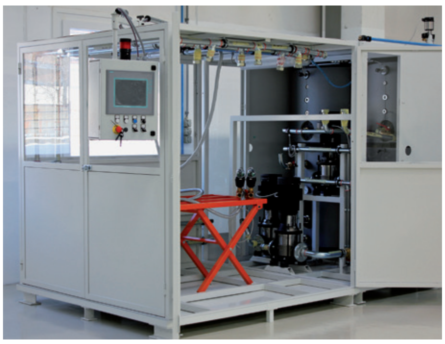
Pressure pulsation test rigs

Oil coolers in the primary flow are particularly affected by changing pressure loads. Regular tests according to ISO / DIN 10771-1 are performed in order to validate a cooler for its area of application.

Further tests:

Wind tunnel

Carried out in order to determine the performance data of cooling element combinations and to provide a database for cooler calculation using the simulation software KULI.



Thermal shock test rig

To simulate extreme operating conditions in terms of temperature.

- Noise measurement
- Vibration tests
- Burst test
- Leakage test
- Corrosion tests in the salt spray chamber
- Cold chamber
- Thermal imaging camera

Development

Since product life cycles get shorter, it is necessary to develope multiple realiable versions of a new cooler design as soon as possible. Technical simulation plays an essential role here because it helps reduce development costs and times. Moreover, simulation as part of the development process results in more accurate design and optimization, long before the prototypes are produced. Last but not least,real-life tests can be kept to an absolute minimum.

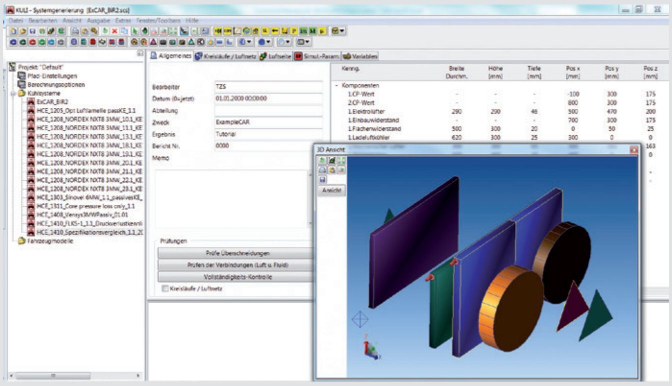
With KULI software is possible to assess the heat management of a machine as a whole. But it can also be used to design individual coolers or heat exchangers. By simulating various heat balances of individual components based on the measurement data of a model heat exchanger in the wind tunnel, reliable coolers and cooling systems are the results.

In addition to KULI, computational fluid dynamics (CFD) are an important method to optimise coolers, heat exchangers and cooling systems. Its purpose is to solve any given fluid dynamic or thermodynamic problem using numerical methods. For example, CFD can be used to analyse the effects of real, customer-specific installation situations on the cooler performance.

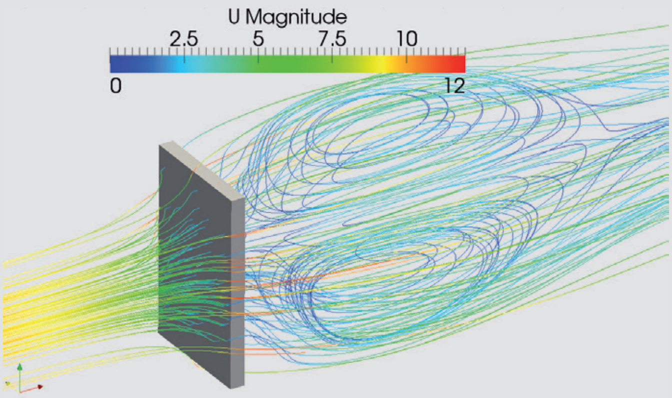
Finally the FEM method, i.e. the numerical analysis of problems in structural mechanics and thermal mechanics, is an important tool in development-stage simulation. Above all, it is used to assess structural stress and reduce hot spot stress in order to extend service life.

A team of development engineers by HYDAC works with the simulation methods depicted above in order to optimise existing components and systems and to identify new approaches to solutions, including custom solutions.

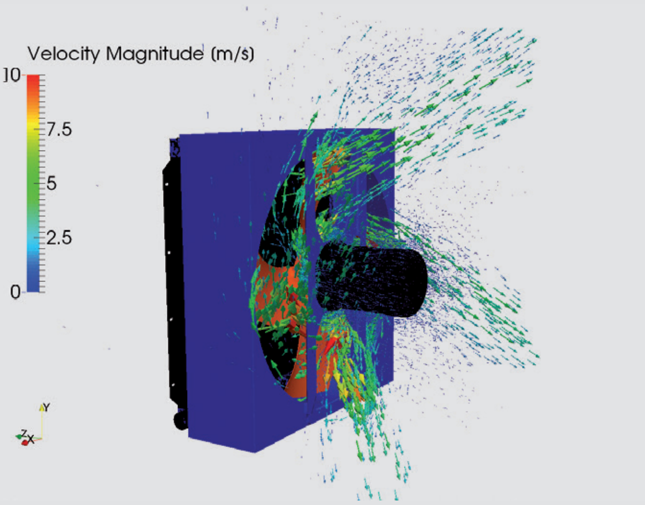
Kuli software
Rapid and accurate prediction of cooling capacities.



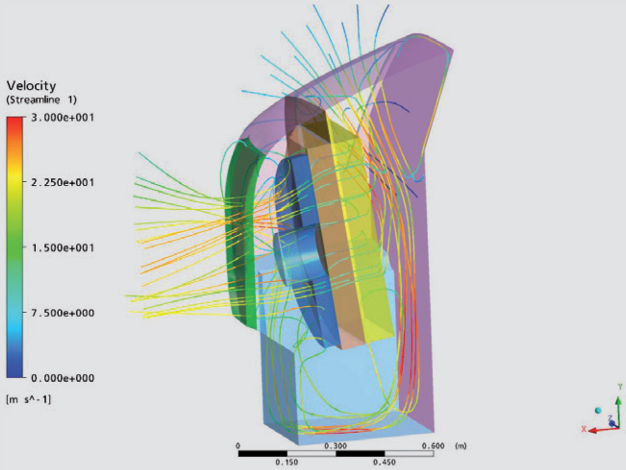
Simulations of passive cooling elements



Simulations of complete air coolers



Simulations of air coolers in particular installation spaces



Air Coolers for all Applications …

Industrial

		Cooling capacity	Medium: Mineral oil	Medium: Water glycol	Axial fan	Radial fan	With pump / pump + filter	Three-phase motor	DC motor	Hydraulic motor	Speed control	ATEX	Corrosion protection CPL
	**AC-LN**	up to 200 kW	•	•	•		•	•				•	•
	**OSCA / OSCAF**	up to 16 kW	•			•	•	•					
	**OK-ELC**	up to 34 kW	•	•	•			•*					
	**AC-LN MI**	up to 250 kW	•	•	•			•			•		•

* also available with single phase motor 230V-50Hz-1PH

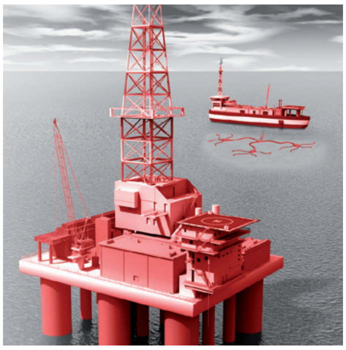
Mobile

		Cooling capacity	Medium: Mineral oil	Medium: Water glycol	Axial fan	Radial fan	With pump / pump + filter	Three-phase motor	DC motor	Hydraulic motor	Speed control	ATEX	Corrosion protection CPL
	**OK-ELD**	up to 34 kW	•	•	•				•		•		
	**OK-ELH / AC-LNH**	up to 140 kW	•	•	•					•	•	•	•
	**Combin-ation cooler CMS**	To customer specification	Oil, water-glycol, fuel, charge air		•		•		•	•	•	•	•

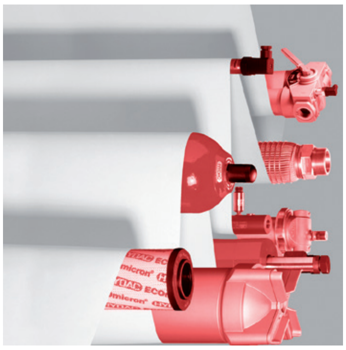
… and all Industries

Industry

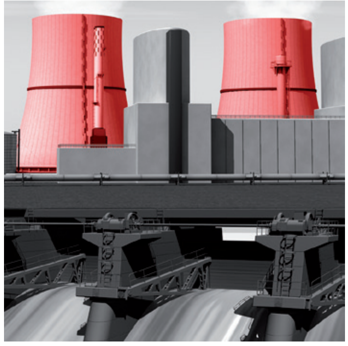
Steel



Oil & Gas

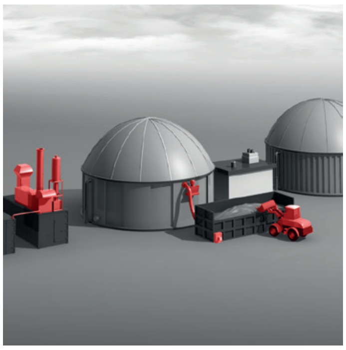


Paper industry

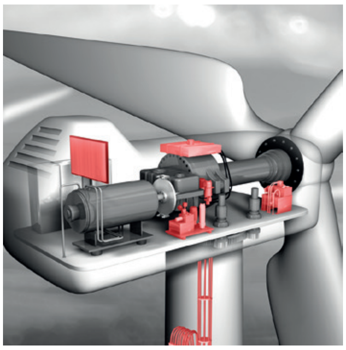


Thermal power plants

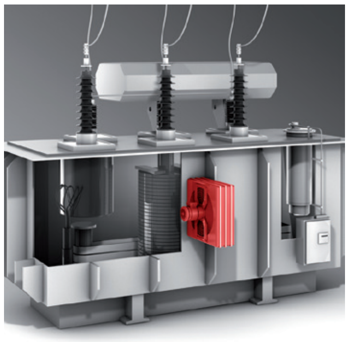
Hydro-electric power stations



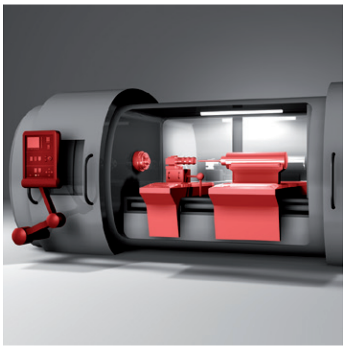
Biogas plants



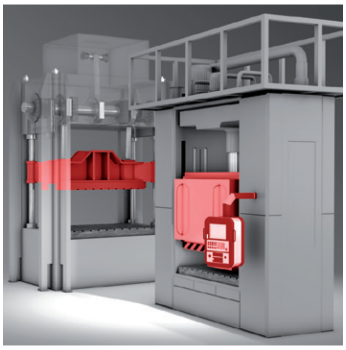
Wind turbines



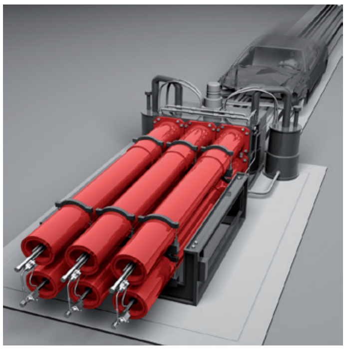
Transformers



Machine tools



Presses



Test rigs

Marine

Mobile

Construction machines

Agricultural machines

Forestry machines

Municipal machines

Energy-efficient with the Energy Related Products (ErP) Directive

The purpose of the Energy Related Products (ErP) Directive 2009/125/EC is to reduce the energy consumption of these products and improve the environmental performance through Ecodesign. EU-wide standards are defined for each product group for this purpose.

All HYDAC coolers comply with the criteria of EU Directives.

Cooler Selection

The size of the cooler depends on various factors:

- the temperature difference between the medium and the ambient air
- the flow rate of the medium through the cooling element
- the flow rate of the air through the cooling element (fan speed)
- the design of the fins and turbulators

The following data is required for selecting the correct cooler:

- the cooling capacity required (power dissipation of the system)
- the medium to be cooled
- flow rate of the medium being cooled
- maximum medium inlet temperature into cooler
- maximum ambient air temperature (air temperature onto cooler)
- altitude and ambient conditions

If the required cooling capacity is not known, then it can either be calculated from the tank heat load or estimated from the installed electrical power.

Determining the Cooling Capacity from the Tank Heat Load

Designations:

P_V	Required dissipation, cooling capacity	[kW]
P_{01}	Specific cooling capacity	[kW/K]
V	Tank volume	[l]
δ_{Oil}	Density for mineral oil: 0.915	[kg/l]
CP_{Oil}	Specific heat capacity for mineral oil: 1.88	[kJ/kgK]
ΔT	Increase in temperature in the system	[°C]
t	Operating time	[min]
T_1	Oil temperature required	[°C]
T_2	Ambient temperature of the air	[°C]

In this case, the required dissipation is determined for systems and machines that are already in operation by first measuring the temperature increase in the medium over a defined time period (but before the temperature stabilises). The heat load of the system can be determined from the available data.

Example:
The oil temperature in a system increases from 20 °C to 60 °C over a period of 30 minutes, the tank capacity is 400 l.

Calculation of the cooling capacity:

V	400	[l]
ΔT	(60-20) = 40	[°C]
t	30	[min]

$$Pv = \frac{\Delta T_{Oil} \text{ x } cp_{Oil} \text{ x } \delta_{Oil} \text{ x } V_{Oil}}{t \text{ x } 60} = \frac{40 \text{ x } 1.88 \text{ x } 0.915 \text{ x } 400}{30 \text{ x } 60} = 15.30 \text{ [kW]}$$

Calculation of the specific cooling capacity:

T_1	60	[°C]
T_2	30	[°C]

$$P_{01} = \frac{P_V}{T_1 - T_2} = \frac{15.3}{60 - 30} = 0.51 \text{ [kW/K]}$$

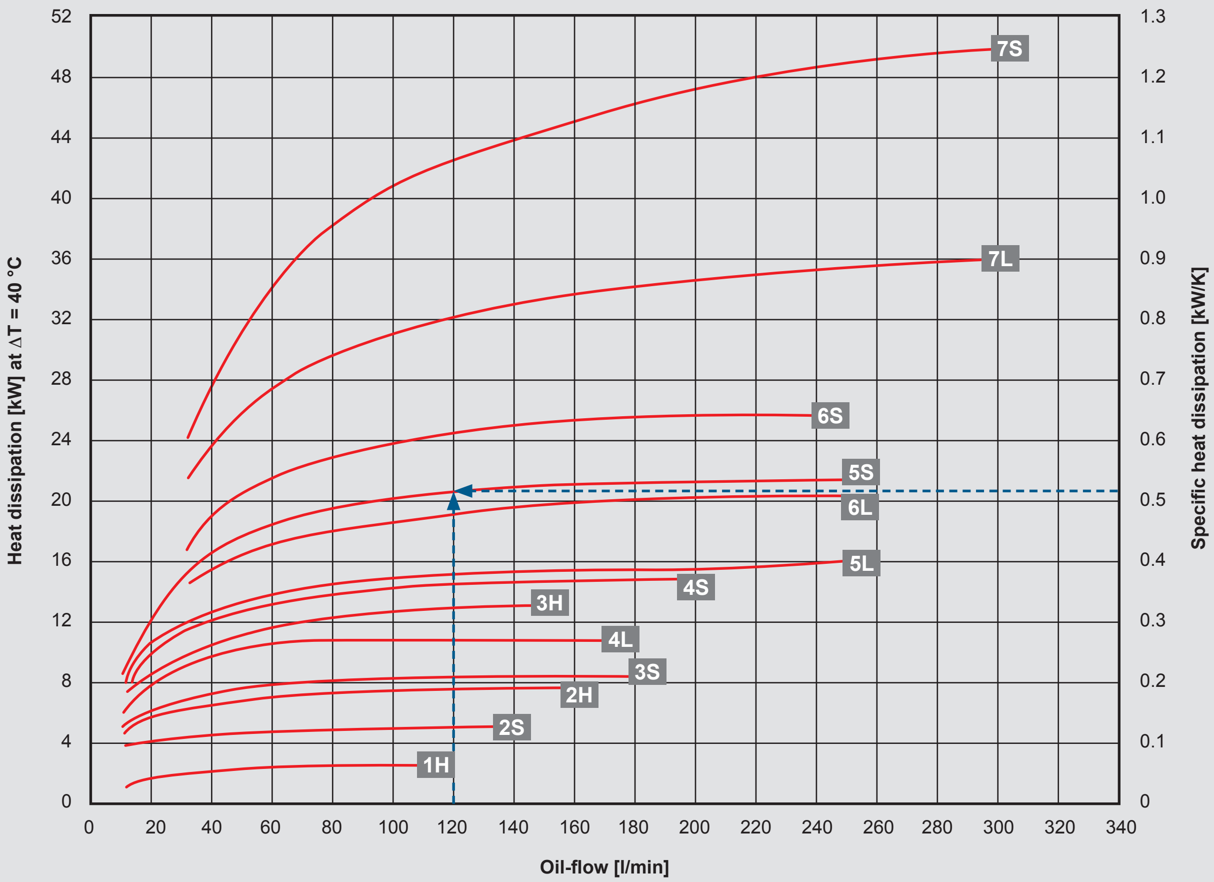
With 5 % safety margin (to allow for contamination), the specific cooling capacity

P_{01} x 1.05 = 0.53 [kW/K]

Estimating the cooling capacity from the installed electrical power
If the plant is not yet in operation, then the expected heat load can also be estimated: without throttling, it is approx. 15 – 20 % of the drive power, with throttling, it is up to 30 % of the drive power.

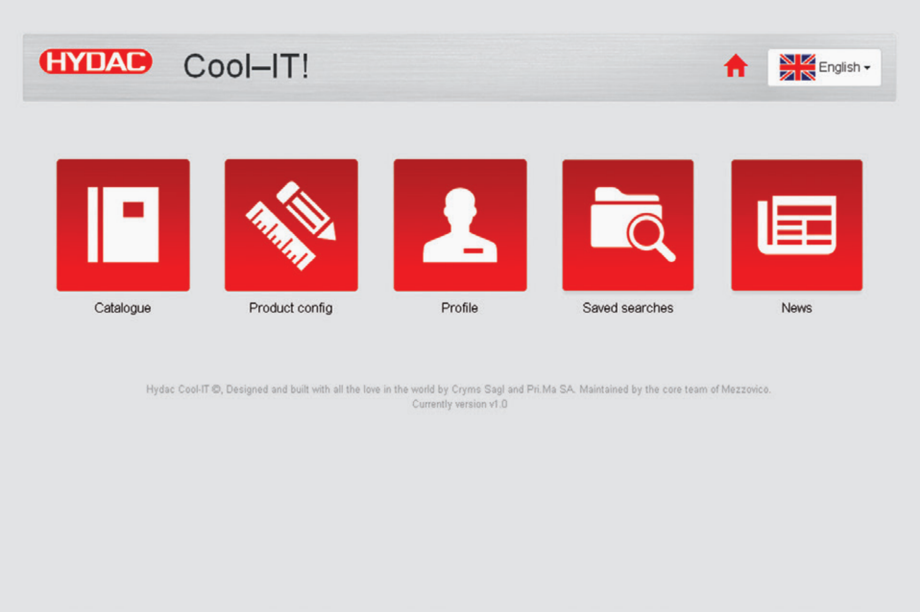
Selecting the Correct Size

This heat load must be dissipated by an air cooler. The suitable size can now be selected in the diagram.



Tolerance: ±5 %

Sizing Software



Our design software, HYDAC Cool IT, was developed in order to speed up and simplify selection from the HYDAC air cooler range.

You can also use our Specification sheet for air coolers in order to ensure you have all of the necessary data to hand.

Contact our Technical Sales Office for further details.

Specification Sheet for Air Coolers

Please contact the Technical Sales Office for your customised combination cooler (CMS) design.

Project: ____________________

Contact: ____________________

Telephone: ____________________

E-mail: ____________________

Application: ____________________

The cooler is installed		○ in return line	○ offline	
Version:		○ without pump	○ with pump	○ with pump + filter
Motor type:	AC	○ 400V-50Hz-3Ph	○ 230V-50Hz-1Phe	○ 100V-50Hz-1Ph
	DC	○ 12 V	○ 24 V	
	HY	○ 6.3 cc	○ 14.0 cc	○ 22.0 cc
	Other	____________________		
If known: Cooler type		____________________		

Design data

Medium:	____________________		
Flow rate through the cooler:	__________	l/min	
Max. temperature in the oil circuit:	__________	°C	Cooler inlet temperature
Max. ambient temperature (air):	__________	°C	
Required cooling capacity:	__________	kW	
Target temperature after cooler:	__________	°C	
Tank volume of the storage tank:	__________	ltr	
Operating pressure:	__________	bar	
Max. permitted pressure loss	__________	bar	

Version

Max. possible unit dimensions:	__________	mm	H x W x D
Max. noise level:	__________	dB(A)	

Accessories:	○ Thermostat, adjustable (AITR)	○ Thermostat, fixed (AITF)
	○ Integrated thermal pressure bypass (IBT)	○ Integrated pressure bypass (IBP)
	○ Air filter grille	○ Air filter meshpack
	○ Vibration mounts	○ __________

Notes/Miscellaneous:

____

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____

____

Specification Sheet AC-LN 8-14 MI with Speed Control

Project: ______________________________

Contact: ______________________________

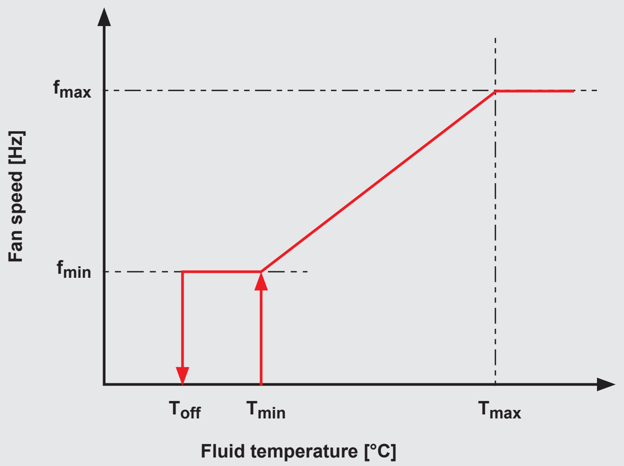
Phone: ______________________________

E-mail: ______________________________

Application: ______________________________

Cooler type: ______________________________

Data required



T_{min}	Temperature at which the frequency converter starts the fan
T_{max}	Temperature at which the frequency converter switches to the highest speed
T_{off}*	Temperature at which the frequency converter switches off the fan
f_{min}	Min. rpm of the motor
f_{max}	Max. rpm of the motor

Motor 1

T_{min} ______________________ °C f_{min} ______________________ rpm

T_{max} ______________________ °C f_{max} ______________________ rpm

T_{off} ______________________ °C

Motor 2 (AC-LN 12 MI / AC-LN 14 MI)

T_{min} ______________________ °C f_{min} ______________________ rpm

T_{max} ______________________ °C f_{max} ______________________ rpm

T_{off} ______________________ °C

Note

The temperature must between +20 °C and +85 °C.

Min. speed:	200 min^{-1}	
Max. permitted speed	AC-LN 8, 9, 10 and 12 MI:	1,720 min^{-1}
	AC-LN 11 and 14 MI:	1,500 min^{-1}

*** T_{off}:**
Ensure a slight hysteresis between T_{min} and T_{off} in order to prevent the fan switching on and off continuously at low temperatures.
The hysteresis will vary depending on the environment and the system, usually a few degrees Celsius is sufficient.

Note

The information in this brochure relates to the operating conditions.

For applications and operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.

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