

# Liquid Cooling Solutions

Application-specific packaged solutions  
for process cooling in an industrial  
environment

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**Pfannenberg**   
ELECTRO-TECHNOLOGY FOR INDUSTRY

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# 1 Editorial

Dear Readers,

There is a clear trend emerging in industry: more and more users are now looking to system solutions rather than just chillers for their process cooling requirements. These solutions can consist of air/water heat exchangers and application-specific chillers, for example. They cool the complete assembly with a closed water circuit and offer significant benefits compared to traditional approaches such as cooling with ambient air.

Today, users in the industry have the task of removing dissipated heat in the form of exhaust air from factory shop floors using cooling devices such as air/water heat exchangers and chillers. Modern chillers produce cold water at the site of the application and must be air-cooled to achieve a refrigerating effect in order to compensate the related heat load. Water-cooled condensers are an alternative; however, the process water in this case has to come from a system in which the water temperature fluctuates with the seasons. Also a minimum temperature delta of five degrees is required to keep such a system working. For all these solutions, the application-specific configuration is key.

The heat on a factory shop floor means that many end customers have to install additional thermal management measures to cool the whole space, which is very costly. This is where "Liquid cooling solutions" come in.

I trust you enjoy reading this article as we share our Competence.

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## 2 An integrated view

Up to now, cooling for each part of an assembly has usually been considered separately. However, this has left valuable optimisation potential untapped. Maximum efficiency cooling for a whole system can be achieved with a system solution consisting of air/water heat exchangers and water-based chillers. A closed pipe or also a semi open system is used to provide cooling to all the components in an assembly. These might be electrical enclosures, processes or individual machine parts such as spindles, motors or hydraulic equipment.

And this is how it works: in a closed chiller system, electrical enclosures or assemblies are cooled with cold water at a specified inlet temperature which is pumped through a pipe system. Having flowed through the electrical enclosures or assemblies, the water is warmer as it returns to the chiller. This creates a temperature delta which the chiller equalises by cooling the water from the outlet temperature down to the inlet temperature. The chiller system feeds cold water into the application inside the factory hall or outdoors and the constant flow temperature significantly improves machine availability and machining accuracy. On top there is no other cooling media being as efficient as water.

The combination of application-specific chiller systems with air/water heat exchangers is particularly suitable for applications in which power must not be dissipated in the immediate environment, where the ambient air is too aggressive to allow the use of traditional cooling devices, where high-level protection is required (up to IP 65) or where the cooling devices must be maintenance-free.

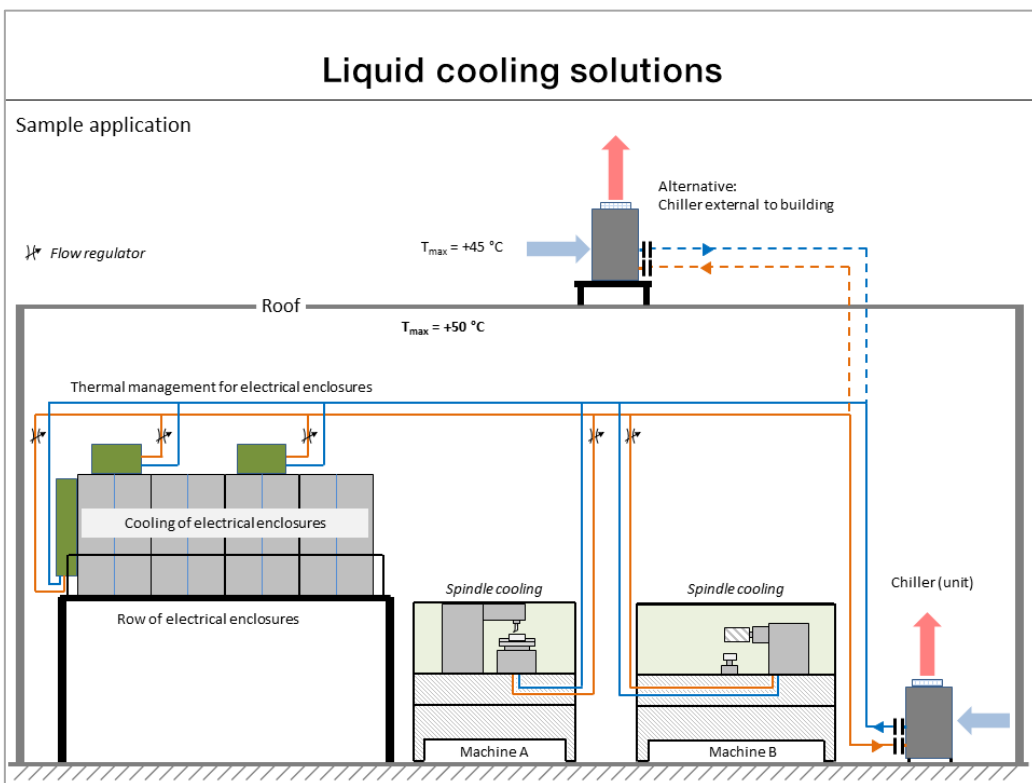


Fig. 1: A sample application of liquid cooling solution

### 3 Modular and energy-efficient

Pfannenberg offers installation-ready chiller systems with performance specifications ranging from 1 to 160 kW. The modular concept of the EB series allows users to select from up to 30 standard options. These include hydraulic bypass/relief valves, flow monitors, tank level monitors, air filters, air filter monitors, check valves, solenoid valves, single alarm display and UL certification. Special solutions are also available.

The latest chiller series, EB 2.0, is offered in five standard configurations for cooling capacity from 3.2 to 16 kW and thanks to its reworked design and high-quality components delivers maximum efficiency without loss of performance in accordance with ErP guideline 2009/125/EU. All refrigerants used are in line with the new F-Gas regulation in terms of GWP. Using microchannel heat exchangers as condensers makes the chillers particularly efficient, compact and resistant to corrosion. An additional filter fan lengthens maintenance intervals. The intelligent housing design, with two removable side panels, facilitates access to the components on the interior, thus enabling efficient maintenance.



Fig. 2: The chillers in the latest EB 2.0 series are particularly efficient, compact and corrosion-resistant.

The viscosity of the cooling media (water, water/glycol mixes, emulsion and low-viscosity oils are all options) – is low: maximum 10 cSt (10 mm<sup>2</sup>/s) at an ambient temperature of + 40 °C. All in all, the EB 2.0 devices are suitable for ambient temperatures from -20 °C to +45 °C. As they can be regulated with very high accuracy, – ±0.1 K by applying inverter technology for different cooling requirements – the EB series chillers can be used for the most demanding applications, such as the automotive industry, machine tool construction, the packaging industry and laser cutting machines.

## 4 Application-specific configuration

The experts at Pfannenber work with their customers to develop application-specific chiller systems. To achieve exactly the right configuration, it is essential to first determine the heat load for the whole assembly.

The second step is to specify the type of cooling medium (ideally water), the target temperature and the flow quantity which the system must deliver in the actual application. This process should take into account how the heat is transmitted to the cooling medium and the type of refrigerant necessary to operate the refrigerant circuit. The type of cooling medium and which chiller model is used depends on whether usable process water is available at the factory and if so, whether it is warm or cold (see overview of device variants).

An analysis of the environmental conditions prevailing where the chiller system is to be installed is also carried out. For example, there might be high temperatures and contaminated air indoors, while outdoors the temperature might fluctuate widely. Both of these factors can have an impact on the configuration of the chiller system, making accessories such as filter fans or crankcase heating necessary.

Taking the temperature of the cooling medium at the inlet and the highest likely ambient temperature as a basis, Pfannenber determines the best chiller model with the correct characteristic curves for the job. The safety of the application in terms of the available sizes is taken into account in the selection of the model. The characteristic curves of the chiller pump are also checked to ensure that it provides sufficient pressure for the application at the configured flow rate. This is because some fluid-cooled systems can experience higher pressure losses than normal if the refrigerant pipes are narrow or long.

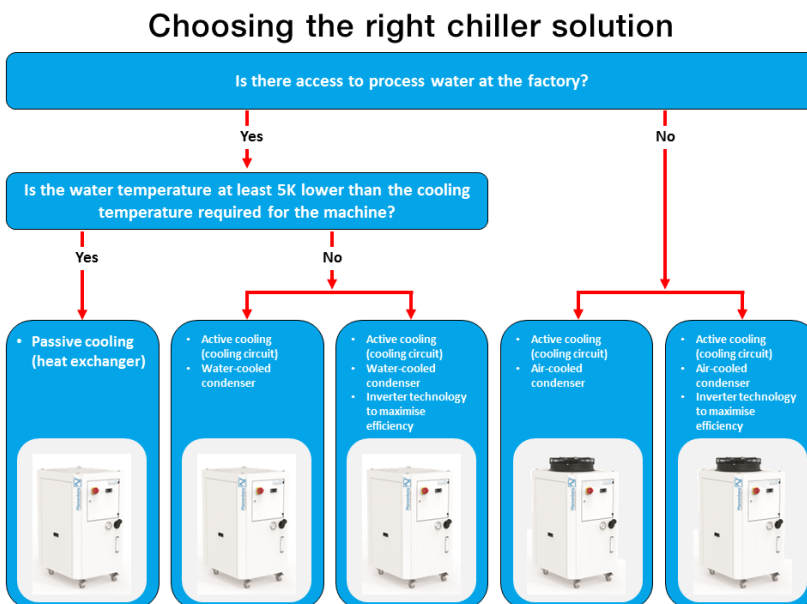


Fig. 3: Overview of five device variants - the right solution for every scenario.

The final stage in the application-specific configuration is to think about whether the selected standard version meets the other requirements of the application, such as performance data, control and regulation options, available space, certifications and colour. It is then decided whether standard options are necessary or helpful and if so, which. With numerous available options available, the EB chillers meet the requirements of practically any application in industrial environments.

## 5 Economic Solution

Pfannenberg is the only manufacturer to offer a "Total Worry-free Package" for process cooling which along with supplying a range of different cooling devices includes advice, application-specific configuration, installation and maintenance. This creates system solutions for problem-free cooling of electrical enclosures and processes as well as standalone machines.

This concept is facilitated by Pfannenberg's unique integrated cooling concept: The active cooling devices, the air/air heat exchangers and the air/water heat exchanges are all cut-out-compatible and fit in the housing of all widely available electrical enclosures. This means that machine and plant manufacturers, end users and distributors benefit from higher flexibility, and save costs on warehousing and servicing.

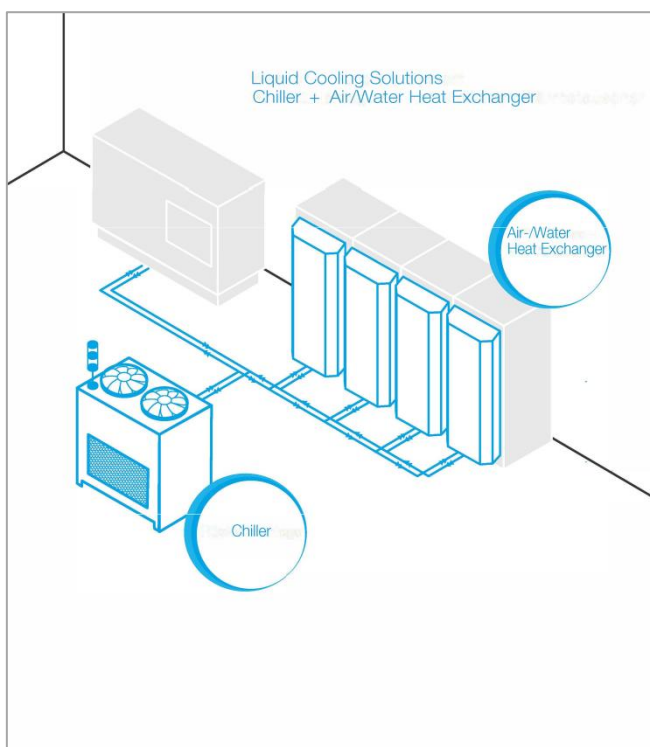


Fig. 4: A system solution can cool electrical enclosures, processes and standalone machines.

## 6 Conclusion

The advantage of an intelligent system solution with application-specific chillers and air/water heat exchangers is that the dissipated heat can be moved directly from the factory shop floor via air channels or an outside chiller system. It also offers very high reliability and problem-free operation as all the components of the system are chosen to work together perfectly. Low maintenance, cut-out-compatibility and energy efficiency optimise energy consumption and keep operating costs to a minimum. The integrated concept and the numerous options allow the system to be adapted to almost any application, even when conditions change.



Fig. 5: 'Liquid cooling solutions' are suitable for the most demanding applications, such as milling machines with precision spindles, where an imprecise cooling temperature would have a negative effect on the machining tolerances of the workpiece.



## 7 Company Profile

Pfannenberg is a medium-sized company that operates globally and develops and sells high quality electro-technology for industrial applications. The company manufactures components and system solutions for the business sectors thermal management and signaling technology. The product range for the business sector thermal management comprises air/water heat exchangers, air/air heat exchangers, cooling units, liquid chillers in various cooling capacities as well as fan heaters and thermostats. Thermal management solutions from Pfannenberg are used above all in industrial environments, e.g. for the cooling of electrical enclosures and machines in automobile production, the food industry, wind and solar power plants.

In the field of signaling technology Pfannenberg provides visual and audible signaling devices which conform to internationally recognized standards. These are used in building management or by machine and plant constructors to comply with fire regulations and other health and safety regulations. In both business sectors the companies provide the customers with single components and complete system solutions with individual consultations.

Pfannenberg sells its products in over 50 countries and has worldwide four production plants: in Germany, Italy, China and the USA. A comprehensive distribution network is guaranteed by its 9 subsidiaries. The company was founded in 1954 and still has its headquarters in Hamburg. It has a worldwide staff of about 400. The turnover in 2013 amounted to roughly 63 million euros.

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**Disclaimer:**

All details were carefully researched in April 2016.

We can, however, not offer any guarantees with regard to the completeness and correctness of the stated information.

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