



Industrial cooling systems

Everything for today's liquid cooling solutions.

Consulting, engineering, chillers and services for
optimum solutions in industrial process cooling.

SHARING
COMPETENCE 

Pfannenberg 
ELECTRO-TECHNOLOGY FOR INDUSTRY

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We're the cooling experts.

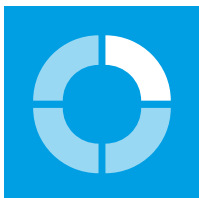
We have been developing solutions for dealing with the heat generated by industrial processes for decades. This brochure will provide you with an overview of our products and services and with a selection of sample applications.



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Introduction

What is liquid cooling?

An introduction to one of the most advanced methods for process optimisation and ensuring machine availability.



Cooling for the most demanding situations.

With increasing customer demands for higher precision, performance and efficiency, more and more manufacturers are turning to liquid cooling for their industrial processes and equipment.

Instead of air cooling, the heat is dissipated via water, oil, emulsions, as well as water-glycol mixtures. The media are delivered via individually designed hydraulic circuits – closed circuits are maintained at a specific pressure level, open circuits under atmospheric pressure. Wherever workpieces are processed with a liquid, these circuits can be used for cooling as well as lubrication.

Reliable and efficient.

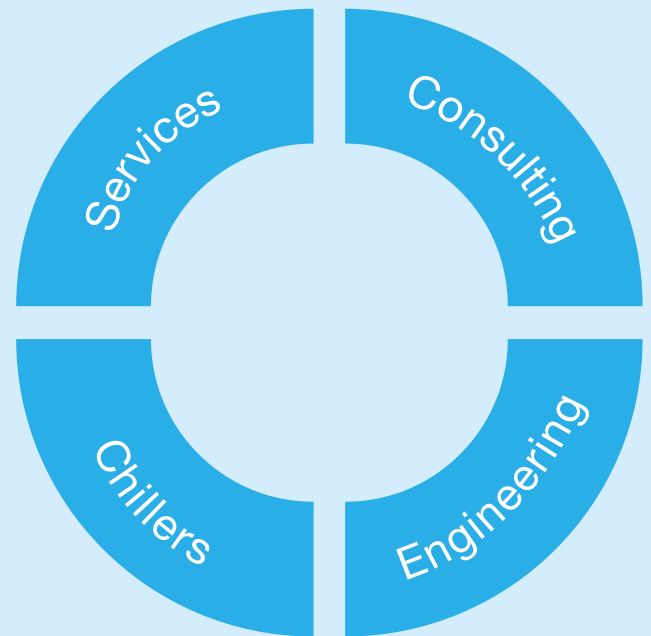
In many applications, reliable cooling is a crucial part of the process or the system. A rise in temperature will lead to increased wear and tear and malfunctions, to the destruction of work pieces and tools or even of the entire machine or system. Fast throughput, long life and maximum machine availability are almost impossible to achieve without precise liquid cooling.

The benefits of liquid cooling can also be used for air-cooled applications by combining chillers with air/water heat exchangers. Major advantages include the integrated design of the combined application and the dissipation of all the heat created by the process into the cooling liquid and not into the ambient air. In many industrial sectors, heat must not be dissipated into the production halls because the ambient temperature can affect the precision of the production process. Liquid cooling also offers significant advantages in terms of efficiency, for example through better thermal management and energy recovery.

Our approach

Looking at the whole picture.

There are many individual factors involved in the successful integration of chillers into a system. We are at your side with our manufacturer-independent and comprehensive advice from the planning phase onwards.



1. Consulting.



A full understanding of your requirements and the particular features of your system is the basis on which to build the optimum solution. Irrespective of whether the task is to repair a cooling system, improve energy efficiency, meet new legal requirements or carry out a comprehensive audit of your equipment – we can give you advice on every aspect of process cooling and provide you with answers in which you can trust.

3. Chillers.



Easily maintained devices for standard applications or customised solutions to special requirements – our high-performance chillers and air/water heat exchangers impress with the excellent quality of materials and technology and outstanding workmanship used in their construction. Thanks to a wide range of approvals, they are working in a wide range of industrial applications in many industries around the world.

2. Engineering.



Challenge us and benefit from our experience in numerous industrial sectors. We are one of the few companies in the world that develop and manufacture the entire range of industrial thermal management solutions. We have extensive expertise and all the necessary resources to offer you all you need, from individual components to complete, newly developed systems.

4. Services.



The bottom line: product availability is crucial. Therefore, our services are a key component of the product. We offer worldwide support to ensure that your machines remain up and running, ranging from commissioning and training to preventative maintenance and a stock of spare parts. Our service is not limited to Pfannenberg products, but also explicitly covers devices from all other manufacturers.



Comprehensive advice

Consulting.

There is a high requirement for advice on liquid cooling. Our approach guarantees that all aspects of a situation have been considered.



Everything taken into account – right from the start.

Safer operation, energy-saving, cost optimisation – in order to meet these and other objectives, we offer you a comprehensive advice which considers economic and legal issues as well as the technical situation on your site.

We find the right answers.

Something wrong with the cooling circuit in your application? Is cooling below your current requirements? Do you need a more accurate or more easily regulated cooling temperature? Is energy consumption too high or machine uptime too low? Are components missing or need replacing? Does the refrigerant need change due to legal requirements? Is a new control unit or a completely new system required?

No matter what your situation is: With their ability to grasp details and make conclusions, our experts find the solution that gives you the best value for money.

An example: General overhaul of a warehouse.

The chillers in the refrigerated warehouse of a Hamburg logistics company had been in operation for a very long time, some of them for more than 30 years. High energy costs, insufficient cooling and problems with regulating the system due to oil deposits in the evaporators all pointed to the need for a general overhaul.

Our experts developed a fully norm-compliant concept for the company which restored machine availability and substantially improved energy efficiency.

The results:

- No more serious oil problems in the system.
- Switch to a new cooling liquid.
- Development and installation of new control unit.
- Cables and pipes totaling 5 km in length were laid, documentation was prepared.
- Electronic injection valves were installed.
- Energy costs were cut by 40 %.

After the system had been put into operation successfully, also took over the maintenance and further optimisation of the plant.



Finding the right solution

Engineering.

Ready for a custom-tailored solution: Everything for the development and production of ready-to-connect cooling solutions.



Development and planning.

Do you need a specific solution for a new application or are you looking for experts to help you with the planning? If standard products do not meet your requirements, we are happy to assist you with the development of your solution. Complex flow calculations, computer-aided chiller design, our own development laboratories and climate chambers – we offer you the full range of technical support to create tested and certified solutions meeting your product ideas. Our products and services include:

- Configuration of complete systems.
- Component dimensioning.
- Calculation and construction of hydraulic circuits.
- Control circuit design.
- Pipework and wiring schemes.

Custom-designed solutions.

Our standard devices reflect many years of experience in numerous areas of industry. We can also offer you application-specific devices and solutions which we develop together with you:

- Robust devices for challenging environmental conditions.
- High-precision chillers for laboratory applications.
- Special design of housing and cooling circuits.

Advantage by „Sharing Competence“.

If you are developing solutions for use in challenging situations, you will benefit from our experience in cooling many different kinds of machines and systems including

those in machining centers, print works, timber processing, welding operations, packaging facilities and in the food and beverage industry. However, this is not all. Innovative solutions require the transfer of knowledge. True to our motto „Sharing Competence“, we maintain an intensive dialogue between our application technicians and developing engineers who share their expertise with you to create products which meet your specific requirements and take into account recent market developments.



Equipment selection

Chillers.

Reliability produced in series: efficient, ready-to-connect chillers for use anywhere in the world.



You can count on us: Pfannenberg.

Pfannenberg cooling systems meet the requirements of industry for accurate temperature control and absolute reliability – 24/7, all year round. Compact and designed for easy maintenance, the devices can be used in many ways and are ideal for applications requiring cooling capacity between 1.1 and 150 kW.

Because the chillers are delivered from the factory as turnkey units, they only need to be connected to the electricity supply and the pipework in order to provide practically any process with a cold, recirculating cooling medium.

System expertise.

Whether they are cooling oil or water, in our chillers we combine the three main systems that are needed (refrigeration circuit, hydraulic circuit and control loop) so that they work together optimally

as a unit. This is crucial to high efficiency, long life and reliability of our solutions.

Refrigeration circuit.

The function of this circuit is to dissipate heat from the hydraulic circuit to the colder ambient air or the process water. We select the components of this system carefully so that maximum performance, efficiency and maintainability are guaranteed. Compressors and fans for industrial applications and evaporators and condensers with a large surface area are combined with the optimum cooling medium in order to achieve the best-possible result for the application.

Hydraulic circuit.

The hydraulic circuit is used to circulate and store the cooling medium. We choose from a wide range of high-quality hydraulic components which allow maximum

flexibility concerning flow amount and pressure.

Control circuit.

Using effective digital control systems, we ensure optimum interaction between the mechanical components. Digital controllers connected to temperature sensors, pressure and flow switches and fill level monitors continuously make logical decisions to ensure that fluid cooling and circulation work reliably. There are also options for remote monitoring and control.



Equipment selection

Chiller configurations.

Simplified selection process: Perfectly pre-configured and readily available chillers for a wide range of applications.



Product feature Hydraulic Protection (H).

Chillers with this product feature are especially equipped to protect the hydraulic system. Details:

- Adjustable flow monitor to raise attention in case of a drop in the flow rate.
- Water-level monitor to protect the pump from damage as the result of running dry.
- Hydraulic bypass to protect the pump by ensuring a minimum flow quantity and to protect the system by limiting the pressure.

Product feature Smart Cooling (S).

Chillers with this product feature have a professional temperature monitoring feature and error detection. Details:

- Optional differential temperature control system to take account of the ambient temperature, if the application includes particular requirements in terms of condensation and elongation.
- A Tmin/Tmax temperature monitor to issue an alert if the temperature of the coolant rises or falls unexpectedly.
- An error display to facilitate servicing and troubleshooting combined with a common alarm signal. (For dedicated separate alarm messages and to communicate with external control systems, an additional RS-485 interface is needed.)

Particular benefits: The chiller indicates when it needs to be serviced. Error codes and data recording facilitate fault elimination and preventive maintenance. However, even if the chiller itself is working perfectly, malfunctions of the system can occur and be displayed:

- Flow alarm – the refrigerant flow is outside the set limits.
- Temperature alarm – the chiller is finding irregularities in the temperature profile.



Product feature Precision Cooling (P).

Chillers with this feature have a limit on temperature deviation at ± 1 K (must be combined with the S feature). Details:

- Hot gas bypass to improve the accuracy of the temperature control system without burdening the compressor with excessive switching between on and off (operation at >50 % of the nominal output).
- Fan on/off to improve the accuracy of temperature control by managing the output of the evaporator-heat exchanger.

Note: Variable control of the fan speed is available in chillers with EC fans.

Standard configurations for easier product selection:

PRODUCT FEATURE	CONFIGURATION					
	BASIC	H	S	HS	SP	HSP
Hydraulic Protection H	—	+	—	+	—	+
Smart Cooling S	—	—	+	+	+	+
Precision Cooling P	—	—	—	—	+	+

Due to a wide range of uses, some chillers in the HS configuration are available directly from stock.



Equipment selection

Customised chillers.

Ready for special requirements: We are your partner for custom-tailored solutions.



Development expertise.

Reliable, versatile and ready-to-connect, the standard versions of our chillers never fail to impress. With a range of optional equipment items, they can be adapted to individual requirements. For customised solutions which go beyond this, our engineers, with access to decades of development experience at Pfannenberg and to comprehensive technical resources, are available for you. The benefit: you will find everything under one roof, from engineering to production.

Flexible in design.

The development of customised solutions requires a lot of flexibility and know-how. For example, the expansion of business to new markets has a big impact on the portfolio of chillers and the service concept. We are used to deal with these situations; we offer products with the standard CE mark as well

as variants with UL-certification. We also have a lot of experience producing equipment for countries with particular demands concerning the power supply.

Along with the special requirements for electrical systems, cables, plugs and switches, the hydraulic system is particularly important. Choosing adequate pumps and calculating temperature profiles are key prerequisites for successful system integration.

All these aspects lead to solutions which fulfill customised requirements to the greatest extent – from design to prototype validation.

For example: Integration in X-ray systems.

A global manufacturer of non-destructive test systems required application-specific chillers for integration in industrial X-ray

machines. Following a complex catalogue of requirements, Pfannenberg was selected to develop, construct and test chillers that had been customised to meet perfectly the client's requirements. Some crucial activities:

- Tests and calculations for the configuration of the hydraulic circuit.
- Design and CAD modeling of the chillers integrated in the machines.
- Acoustic tests, noise reduction, performance analysis.



Custom-tailored chillers from Pfannenberg are used in numerous industries:



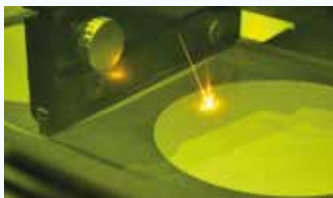
Imaging



Laser cutting and welding



Energy generation and supply



Additive manufacturing



Automobile industry



Packaging industry

Our chillers.

Rack

- 2 performance classes from 1.1 to 1.7 kW.
- Ideal for installations with limited space.
- Easy integration in existing machine types.

PC 2500

- Performance class up to 2.5 kW.
- Very quiet, thanks to low noise high performance pump.
- Exceptionally compatible with solutions on the market.

PWW

- Passive cooling system.
- 4 performance classes from 9 to 24 kW.
- Specially designed for applications where process water is available.

CCE

- 6 performance classes from 1.1 to 6.5 kW.
- Compact frame allows installation on top of electrical enclosures and machines.



EB 2.0

- 7 performance classes from 3.2 to 16 kW.
- An All-rounder: ideal for customer specific requirements.
- Suitable for a stand-alone setup.

EB Oil

- 12 performance classes from 3 to 40 kW.
- Specially designed for cooling of oils and high-viscosity emulsions.

EB Large

- 5 performance classes from 19 to 40 kW.
- Specially developed to meet the demanding requirements of industrial applications.

EB eXTreme

- High cooling capacity.
- 9 performance classes from 37 to 150 kW.
- Sophisticated design and innovative technologies, e.g. precise cooling, electrical expansion valves and fully digitalised sensors.





Equipment selection

Air/water heat exchangers.

The combination of chillers and air/water heat exchangers ensures safe thermal management in electrical enclosures even under difficult conditions.



Optimum system solution for thermal management.

Particularly in areas where the air is strongly polluted or the climate is challenging, where water at the correct temperature is hard to come by and where no additional heat should be directed into production halls, chillers with air/water heat exchangers are an ideal solution for thermal management in electrical enclosures.

The combination of both technologies ensures that the heat dissipation provided by the chiller is separated from the cooling of the application taking place under difficult conditions as mentioned above.

Pfannenberg provides the complete solution as a single source supplier. The customer benefits from a well-balanced system and clear responsibilities.

Our air/water heat exchangers do not require maintenance and are not affected by high temperatures or by aggressive or oily ambient air. Three design concepts allow different installation options depending on the application in question:

- Partially recessed door or side mounting (PWI series).
- Side or door mounting (PWS series).
- Space-saving top mounting (PWD series).



ECOOL air/water heat exchanger
PWI / PWS 6502.

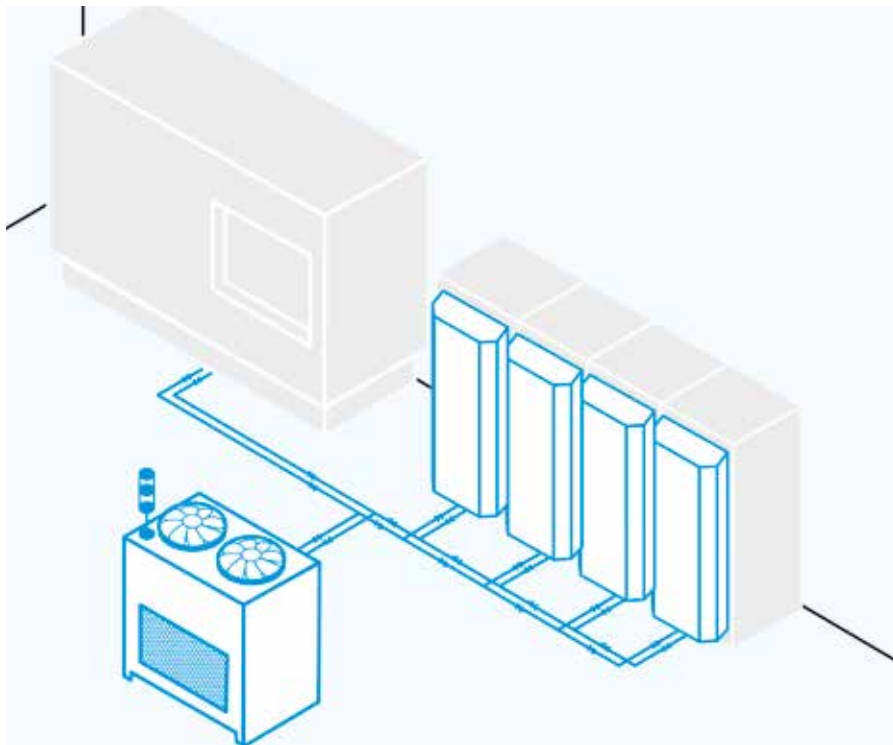


Diagram showing the combination of an EB Large chiller with 4 PWS series air/water heat exchangers.

The benefits of this solution:

- Central provision of the coolant water.
- Separated heat dissipation.
- Closed pipe system for cooling of electrical enclosures even in challenging ambient conditions.
- Highly reliable solution with completely maintenance-free air/water heat exchangers.



Ensuring availability

Services.

A key factor in the selection of a suitable solution, apart from the cost, is a service arrangement to cover commissioning, maintenance, repairs and training.



It is the service which makes the solution a perfect one.

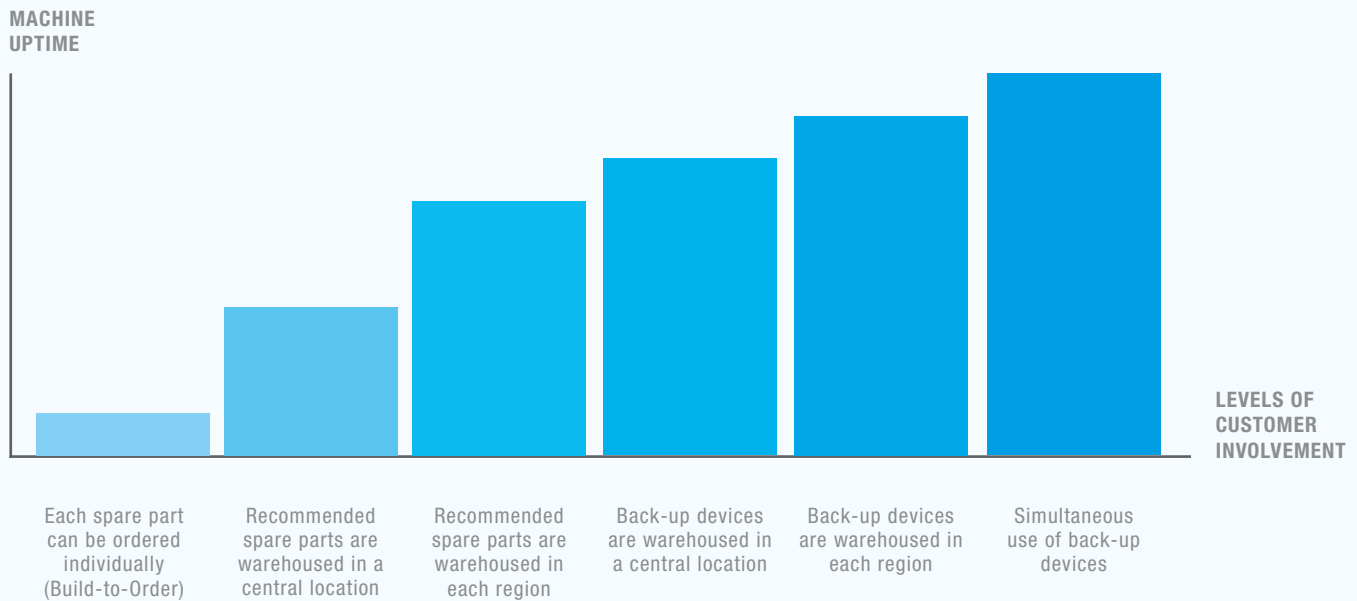
The importance of perfect service and what must be taken into account is illustrated by the example of a customised service arrangement on three continents in collaboration with a leading supplier of packaging machines. As with many other modern production systems, the operation here is subject to many challenging requirements. If a cooling system fails, machines can come to a standstill within minutes. With target machine uptime at 98 %, malfunctions must be dealt within 24 hours at every site.

Be prepared.

Not to be fully prepared when a machine alarm occurs invites risk. Even if it is possible to get a trained service technician on site within 24 hours, how can you be sure that he will be able to solve the problem? Can you rely on the expertise and documentation on dealing with alarm messages and trained personnel being on site? Will the right spare parts be available? Would it make sense to take preventive measures and replace critical parts in order to avoid too long storage time.

Reliable collaboration is based on controlling the risk of the plant installer and plant operator to an appropriate extent. It is not a matter of whether breakdowns will occur, but when, how often and with which consequences for the specific application, your customer and production process. That is why we consider service not as an additional deliverable, but as an integral component of our product: a solution tailored to your requirements.

Risk management to ensure machine uptime:



Options to guarantee machine availability.

Failure safety from the start.

High machine availability begins with professional commissioning. This applies particularly to the complex configuration of cold water replacements. We offer end-to-end services in order to avoid malfunctions and damage to machines and to guarantee production on your systems in the long term – all around the world:

- Manufacturer-independent commissioning and maintenance.
- Manufacturer-independent repair and seal checking.
- Spare parts and spare part packages held in readiness.
- Training and courses.

Commissioning and maintenance.

Our service technicians provide professional installation and

operation including all necessary measurements, tests, adjustments and documentation. With regular preventative maintenance and by inspecting the chiller systems for leaks and possible damage from vibration, corrosion and ageing, we improve failure safety and ensure furthermore that legal requirements are always met.

Repair.

A benefit of our global service is its ability to respond quickly. Together with you, we expand our local service network specifically, where your machines are installed and professional service is needed. If a cooling system starts to lose capacity or threatens to break down, we can be on your premises straightaway and start with error diagnosis and repair. This saves transporting the devices backwards and forwards and reduces downtime to a minimum.

Furthermore, we have bundled the most frequently needed spare and wear parts into Pfannenberg original spare parts packages. To guarantee the machine availability, we recommend to keep these packages on stock.

Trainings.

The reliability of your systems is not guaranteed by technical components alone. Also, crucial to the smooth functioning of your machines is the ability of your staff to monitor procedures and respond correctly at any moment.

Our trainings and seminars help them to do this. We offer them both on your site and on our premises.



Pfannenberg at work

Bypass solution for chillers in the food and drink industry.

An Italian manufacturer of machines for making pasta experiences frequent problems in the production process. Defect pumps in the cooling system prevent the delivery of fresh water for pasta preparation. This leads to downtime with additional repair and substantial costs.



The requirements of the application.

Reliable supply of cold fresh water for the pasta extruder. A guarantee of permanent and faultless functioning. Necessity of hydraulic bypasses and a guarantee of reliability.

The Pfannenberg solution.

An analysis undertaken jointly with the client allows the ideal solution to be identified: Hydraulic bypasses. A standard option of the CC 6301 model chiller exactly fulfils the special requirements and is available for immediate delivery. These features set our chillers apart from the rest:

- Many different standard options, such as an integrated hydraulic bypass, integrated flow monitor, aluminum air filters etc.
- Separate cooling and hydraulic circuits.
- Optimum stability in the long-term thanks to high-quality components.
- Liquid cooling with water, water/glycol mixes.
- Programmable control module that allows small hysteresis of the temperature of the cooling medium.
- Steel housing with a thick powder coating.

MTTF*. Standardised components and a well-thought-out plug and play concept minimize repair costs and machine downtime.

*MTTF: Mean Time To Failures.

The Implementation.

In total, 14 CC 6301 chillers were installed with an integrated hydraulic bypass. These stand-alone devices are robust, UL-certified and guarantee maximum machine availability and maximum



Chiller CC 6301 + BPH



Pfannenberg at work

Cooling lubricant supply: Maximum efficiency on a small budget.

A world-leading manufacturer of hydraulic components and systems seeks a smart and cost-effective solution for a special production application. An existing system consisting of an oil tank and chiller system is to be expanded by 2 oil tanks. For budgetary reasons, acquiring 2 new chillers is ruled out.



The requirements of the application.

Provision of four work benches with cooling lubricants, reliable cooling from 3 oil tanks (capacities of 200, 300 and 800 liters) where 1 oil tank is already in place and connected to a chiller. Solution with maximum possible cost-efficiency.

The Pfannenberg solution.

Taking budgetary restrictions into account and making maximum use of the on-site circumstances, a customised, economic system solution was developed. The central component is a chiller system dimensioned to meet the requirements and located outside the building to enable better accessibility to mains water. 3 water/oil heat exchangers, one on

each of the oil tanks, complete the solution.

Special features of the system solution are:

- A robust EB 190 WT chiller which can also be located outside if necessary.
- 3 maintenance-free water/oil heat exchangers.
- Maximum safety, energy and cost-efficiency.
- Optimum long-term stability and reliability (maximum MTTF*).
- Unsurpassed easy servicing (minimum MTTR**).

The Implementation.

The company benefits from an individual solution which proves to be very economical both in terms of its acquisition and in its daily use. For even better cost-efficiency, the chiller already in use was integrated

into another application within the factory.

*MTTF: Mean Time To Failures.
**MTTR: Mean Time To Repair.



Chiller EB 190 WT



Pfannenberg at work

Restoring machine availability for a track-laying company.

In the factory of a manufacturer specialised in tracks and rail components, improving the performance of a track-drilling unit causes the two chillers connected to it to overload, frequently resulting in downtime for the machine.



The requirements of the application.

Reliable oil cooling of a high-performance track drilling unit. Safeguarding machine uptime, particularly at lunchtime and in the afternoon when the production hall is heated by the sun.

The Pfannenberg solution.

An analysis undertaken on site with the client revealed that the cooling capacity of the two chillers was no longer sufficient for the requirement.

In order to match the improved performance of the track-drilling unit with appropriate cooling, the cooling system had to be redesigned. Taking the temporarily high ambient temperatures in the production hall into account, the

high-performance EB 90 chiller was chosen. This unit has an integrated control module which allows precision regulation of the temperature of the cooling medium. An excellent solution with:

- Separate cooling and hydraulic circuits.
- Control module to program small hysteresis of the oil temperature.
- Operation at ambient temperatures of up to +40 °C.
- Robust steel housing with a powder coating.

The Implementation.

Thanks to our experts' on-site analysis, the company saved itself an expensive and ultimately inadequate repair of its old chillers. The new solution tailored to its current requirements provided the machine availability values it was looking for, even in the midday

heat. A maintenance contract agreed subsequently ensured that optimum functioning would continue on a permanent basis.



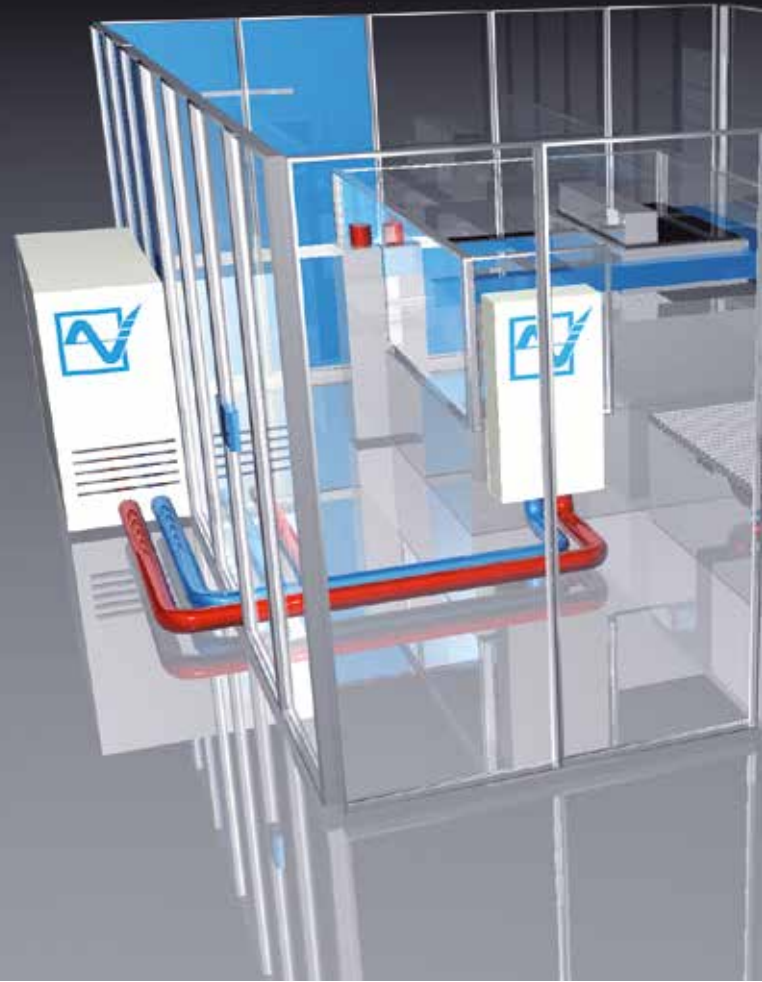
Chiller EB 90



Pfannenberg at work

Water cooling under extreme conditions in a desert state.

It is expected that temperatures in the large laundry planned for an airport will rise to 60 °C and above and will be accompanied by high humidity. Using cooling units for thermal management of the electrical enclosures would be counter-productive as the heat they dissipate would make the space even hotter, cause the electronics to fail and put the functioning of the system at risk.



The requirements of the application.

Thermal management without heating up the air in the immediate surroundings even more. High machine availability with temperature and humidity at challenging levels.

The Pfannenberg solution.

The concept custom-tailored to meet the requirements uses water cooling. Air/water heat exchangers operate independently of the quality of the ambient air and do not generate any heat. A design perfectly adapted to the application combines three air/water heat exchangers and a chiller into an

ideal solution.

Special features of the system solution are:

- Maintenance-free **ECOOL** air/water heat exchangers, types PWS 6502 and PWS 6102 (>+1 °C...+70 °C, IP 55).
- EB 60 WT type chiller can be positioned outside as an option (-20 °C... +40 °C, IP 54).
- Maximum safety, energy-saving and cost-efficiency.
- Optimum long-term stability and reliability (maximum MTBF*).
- Unsurpassed easy servicing (minimum MTTR**).

The Implementation.

A feature specifically for the requirements was a chiller suited

to operation outside of the laundry. It supplies the air/water heat exchangers located inside and the constant flow temperature increases machine uptime substantially.

*MTTF: Mean Time To Failures.
**MTTR: Mean Time To Repair.



EB 60 WT CE chiller, **ECOOL** PWS 6102 and PWS 6502 air/water heat exchangers

Benefits at a glance

Comprehensive expertise for the safety of your production systems.

From planning and the selection or development of equipment to comprehensive service arrangements: We offer everything you need to find the optimum solution for your requirements.

Consulting

- We have experts around the world ready to answer all your questions about liquid cooling.
- We support you in upgrading your current systems, as well as planning of new ones.

Engineering

- Benefit from our decades of experience in developing efficient and reliable components.
- Our engineers and laboratories are on hand at all times to undertake measurements, tests and calculations.

Chillers

- We hold state-of-the-art, individually configurable standard products in stock for you.
- We develop custom-tailored solutions to meet special requirements.

Services

- We support you to ensure your machine availability. You determine to which extent according to your individual risk profile.
- Our maintenance and repair service is available around the world, even if you are using systems and machines from other manufacturers.

Service

Chiller

ces

Consulting

ers

Engineering



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