Rittal – The System.

Faster – better – everywhere.

TopTherm LCP Hybrid

3311.600	3311.800
3311.610	3311.810
3311.700	3311.900
3311.710	3311.910

Montage-, Installations- und Bedienungsanleitung
Assembly and operating instructions

EN

Foreword

Dear Customer!

Thank you for choosing a Rittal Liquid Cooling Package (also referred to hereafter as "LCP").

This documentation applies to the LCP Hybrid unit.

Take time to read this documentation carefully.

Pay particular attention to the safety instructions in the text and to section 2 "Safety instructions".

This is essential for:
– secure assembly of the Liquid Cooling Package
– safe handling and
– trouble-free operation.

Please keep the complete documentation readily available so that it is always on hand when needed.

We wish you every success!

Yours
Rittal GmbH & Co. KG

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We are always happy to answer any technical questions regarding our entire range of products.

Table of contents

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1 Notes on documentation

1.1 Storing the documents

The assembly, installation and operating instructions as well as all applicable documents are an integral part of the product. They must be passed to those persons who are engaged with the unit and must always be available and on hand for the operating and maintenance personnel.

1.2 Symbols used in these operating instructions

The following symbols are used in this documentation:

Danger!
Hazardous situation which may lead to death or serious injury if the instructions are not followed.

Warning!
Hazardous situation which may lead to death or severe injury if the instructions are not followed.

Caution!
Hazardous situation which may lead to (minor) injuries if the instructions are not followed.

Note:
Information concerning individual procedures, explanations, or tips for simplified approaches. It also indicates situations which may result in material damage.

■ This symbol indicates an "Action Point" and shows that you should perform an operation/procedure.

1.3 Associated documents

In conjunction with these assembly, installation and operating instructions, the superordinate system documentation (if available) also applies.

Rittal GmbH & Co. KG is not responsible for any damage which may result from failure to comply with these assembly, installation and operating instructions. The same applies to failure to comply with the valid documentation for the accessories used.

1.4 Normative instructions

1.4.1 Legal information concerning the operating instructions

We reserve the right to make changes in content. Rittal GmbH & Co. KG will not be held liable for any mistakes in this documentation. Liability for indirect damages associated with the supply or use of this documentation is excluded to the extent allowable by law.

1.4.2 Copyright

1.4.3 Revision

Rev. 1A of 08/10/2014

2 Safety instructions

The Liquid Cooling Packages produced by Rittal GmbH & Co. KG are developed and produced with due regard to all safety precautions. Nevertheless, the unit still poses a number of unavoidable dangers and risks. The safety instructions provide you with an overview of these dangers and the necessary safety precautions.

In the interests of your own safety and the safety of others, please read these safety instructions carefully before assembly and commissioning of the Liquid Cooling Package.

Follow the user information found in these instructions and on the unit carefully.

2.1 Important safety instructions

Danger! Injury due to falling loads!
Do not stand under suspended loads when transporting the unit with a hoist trolley, a forklift, or a crane.

Warning! Danger of cut wounds, especially from the sharp edges of the heat exchanger module!
Put on protective gloves before beginning assembly or cleaning work!

Warning! Injury due to falling loads!
If the server rack is not fully populated, there is a risk of it tipping over when the Liquid Cooling Package is swung away. Heavy equipment should be installed in the bottom part of the server enclosure. Where necessary, secure the server enclosure to the floor to prevent it tipping over.

Caution! Risk of malfunction or damage!
Do not modify the unit! Use only original spare parts!

Caution! Risk of malfunction or damage!
Proper operation can only be ensured if the unit is operated under the intended ambient conditions. As far as possible, be sure that the ambient conditions for which the unit is designed are complied with, e.g. temperature, humidity, air purity.

Caution! Risk of malfunction or damage!
The medium necessary for the control system, i.e. cooling water, must be available throughout the entire operating time.

Caution! Risk of malfunction or damage!
It is vital that the manufacturer's consent is obtained before adding antifreeze!

Caution! Risk of malfunction or damage!
During storage and transportation below freezing point, the water circuit should be drained completely using compressed air!

2.2 Service and technical staff

The installation, commissioning, maintenance and repair of this unit may only be carried out by qualified, trained mechanics.

Only properly instructed personnel may work on a unit while in operation.

2.3 RoHS compliance

The Liquid Cooling Package fulfils the requirements of EU Directive 2011/65/EC on the Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) of 1 July 2011.

Note:
The corresponding information about the RoHS Directive can be found on our website at www.rittal.com.

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3 Device description

3.1 General functional description

The LCP Hybrid is essentially an air/water heat exchanger. It cools the room by cooling the hot air from devices in a server enclosure to the ambient temperature. This prevents the temperature at the installation site from rising as a result of heat loss from the IT components. To this end, the device is fitted to the rear of a server enclosure.

Air routing follows the "front to back" cooling principle, and is effected by the device fans built into the server enclosure. The expelled warm air is routed through the air/water heat exchanger of the Liquid Cooling Package. To this end, the fans of the built-in 482.6 mm (19") equipment must be capable of overcoming the airside pressure loss from the LCP Hybrid.

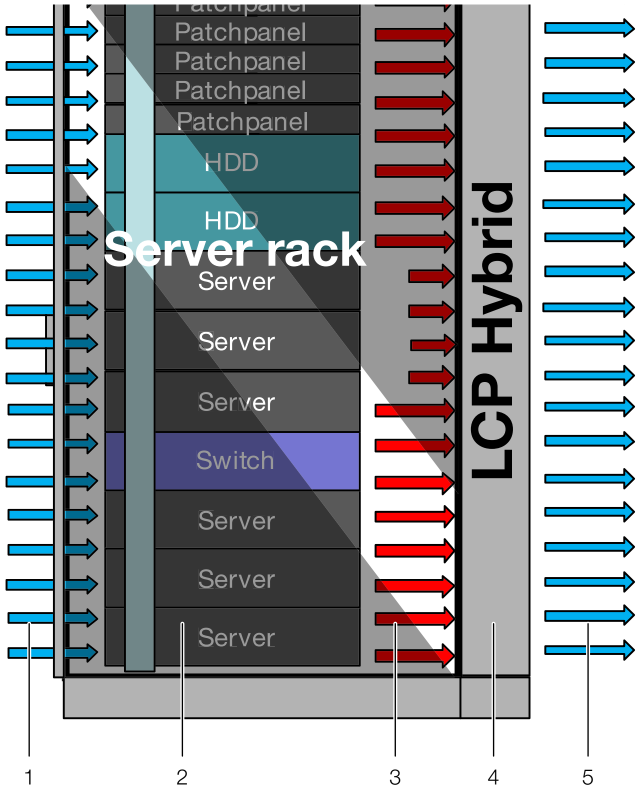

Fig. 1: Air routing on the LCP Hybrid – Side view

Key

1 Cold ambient air
2 Server rack with installed equipment
3 Hot airflow from 482.6 mm (19") equipment
4 LCP Hybrid with air/water heat exchanger
5 Cooled air

Immediately in front of the heat exchanger is a row of heat pipes. These heat pipes support even distribution of the thermal load over the entire height of the heat exchanger.

In the heat exchanger, the thermal energy (heat loss from the devices) is transferred to a cold water system. There, the air is cooled and then flows out into the ambient air at the rear.

Note:
The water inlet temperature must always be selected (controlled) to be above the dew point for the existing ambient temperature and humidity in the data centre. The dew point can be found in the Mollier h-x diagram (fig. 2).
Furthermore, we advise compliance with the ASHRAE standard "ASHRAE TC 9.9, 2011 Thermal Guidelines for Data Processing Environments".

Note:
As an alternative to use of the h-x diagram, in section 13.2.2 "Determination of the dew point", you will find tables showing the dew point for selected temperatures and air humidity levels.

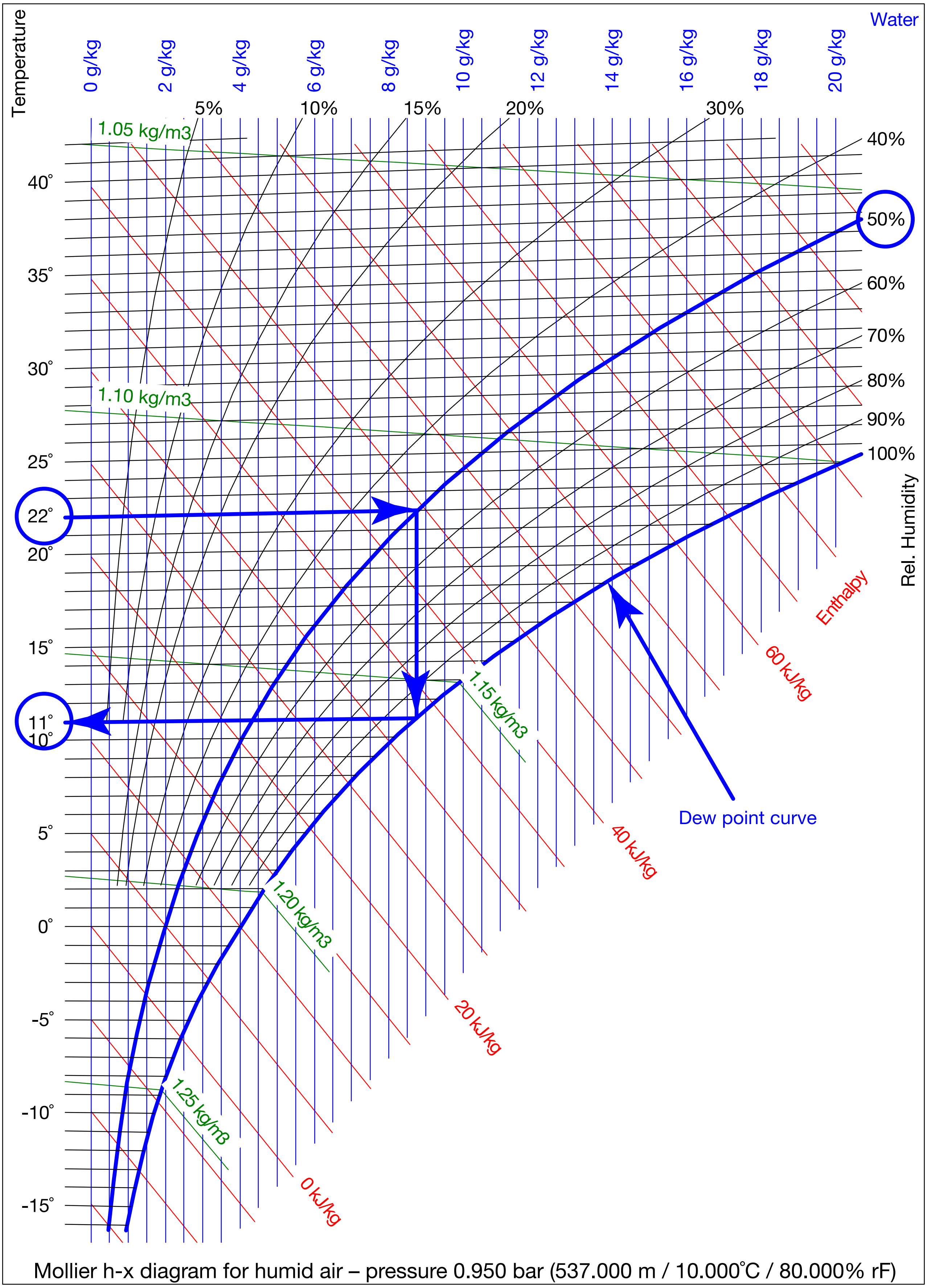

Fig. 2: Mollier h-x diagram for humid air

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3.2 Air routing

In order to ensure adequate cooling in the server enclosure, it is important to ensure that the hot air from the fans of the installed equipment is routed directly via the LCP Hybrid and is prevented from accumulating inside the server enclosure.

Targeted air routing in the server enclosure has a major effect on the heat loss to be dissipated. It is therefore important to assemble the device and the additional installed equipment in the server enclosure as described in section 5.2 "Assembly procedure".

In order to ensure targeted air routing in the system, the server enclosure should be divided vertically into warm air and cold air sections. The division is accomplished in the rear section of the server assembly to the left and right of the 482.6 mm (19") level using air baffle plates, which, depending on the enclosure width and the number of server enclosures to be cooled, can be ordered as accessories (see section 12 "Accessories").

This prevents the hot air from flowing back at the sides adjacent to the server installations and forming hot spots (fig. 3).

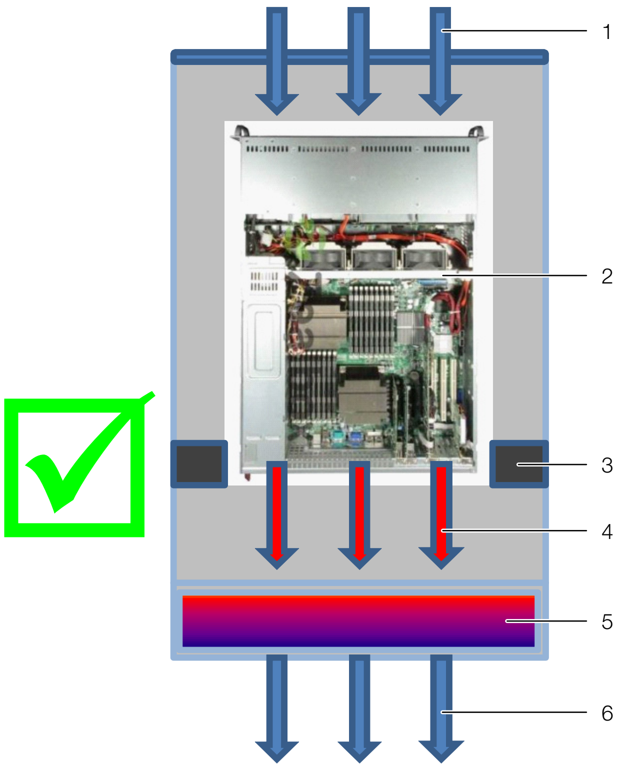

Fig. 3: Correct arrangement of the partitioning plates (air baffle plates)

Key
1 Cold ambient air
2 Installed devices
3 Partitioning plates in the rear section
4 Hot airflow
5 LCP Hybrid with air/water heat exchanger
6 Cooled air

If the air baffle plates remain in the front section of the server enclosure, hot spots may form in the server enclosure (fig. 4).

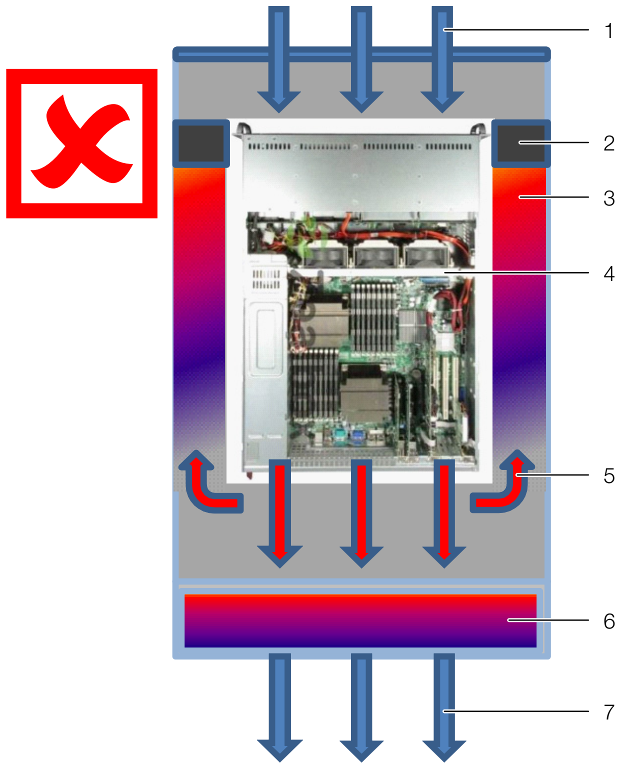

Fig. 4: Incorrect arrangement of the partitioning plates (air baffle plates)

Key
1 Cold ambient air
2 Partitioning plates in the front section
3 Formation of a hot spot
4 Installed devices
5 Misdirected hot airflow
6 LCP Hybrid with air/water heat exchanger
7 Cooled air

If devices which require sideways air throughput are built into the server enclosure (e.g. switches, router, etc.), these may be cooled via targeted repositioning of the air baffle plates.

Note:
When using devices which require sideways air throughput, repositioning of the air baffle plates means that the entire width of the heat exchanger is not used to optimum effect.

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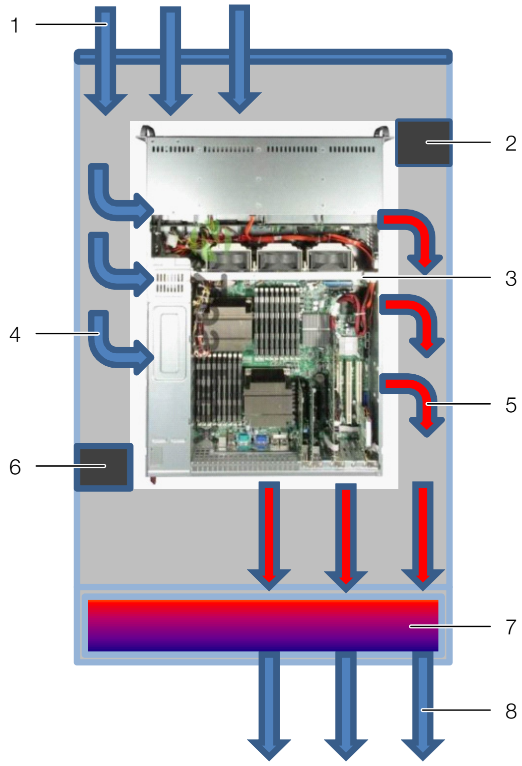

Fig. 5: Arrangement of the partitioning plates (air baffle plates) for devices with sideways air throughput

Key

1 Cold ambient air
2 Partitioning plate in the front section
3 Installed devices
4 Cold airflow in the server enclosure
5 Hot airflow in the server enclosure
6 Partitioning plate in the rear section
7 LCP Hybrid with air/water heat exchanger
8 Cooled air

Additionally, please observe the following regarding installed equipment in the server enclosure:

- Ensure that the 482.6 mm (19") equipment is distributed as evenly as possible inside the server enclosure. This prevents selective loading of the heat exchanger.
- Install heavy equipment with high heat generation at the bottom of the server enclosure, and passive components with low heat generation at the top.
- If the server enclosure is not fully populated, seal the open height units (U) in the 482.6 mm (19") level with blanking plates, available as Rittal accessories (see section 12 "Accessories").

> Note:
> Foam strips may also be used as an alternative to air baffle plates.

3.3 Equipment assembly

3.3.1 Unit components

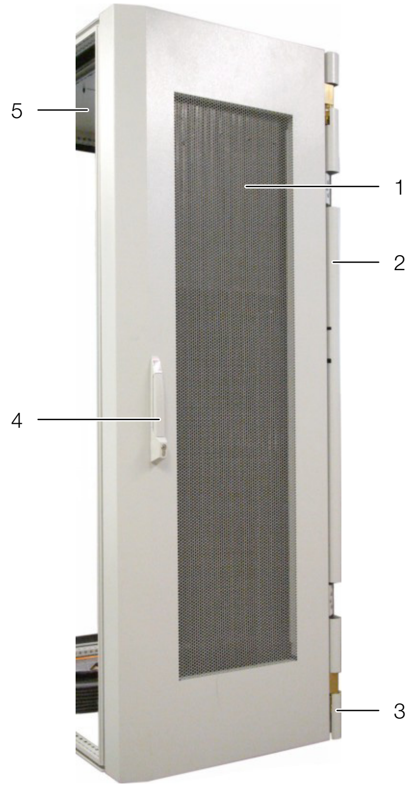

Fig. 6: LCP Hybrid – Door closed

Key

1 LCP door with air/water heat exchanger
2 Door bracket
3 Cooling water connection
4 Door handle
5 Server enclosure

The Liquid Cooling Package is comprised of a rear door with heat exchanger and a side frame.
The door is fitted with a special door bracket at the rear of the server enclosure, and seals the server enclosure with 4-point locking.
There is a maintenance door fitted on the inside of the Liquid Cooling Package. Whilst closed, this provides access protection for the heat exchanger.

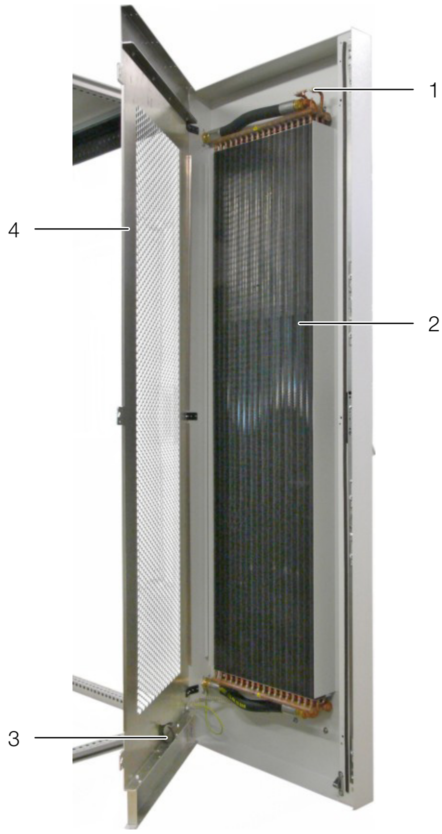

Fig. 7: LCP Hybrid – Maintenance door open

Key
1 Vent valves
2 Air/water heat exchanger with heat pipes
3 Ventilation hose
4 Maintenance door

3.3.2 Air/water heat exchanger with cold water connection

The air/water heat exchanger is fitted as a rear door in the Liquid Cooling Package. The cooling water connection is connected to the main inlet and return connections by two DN 25 (G1") externally threaded pipes. The connection nozzles are positioned vertically downwards.

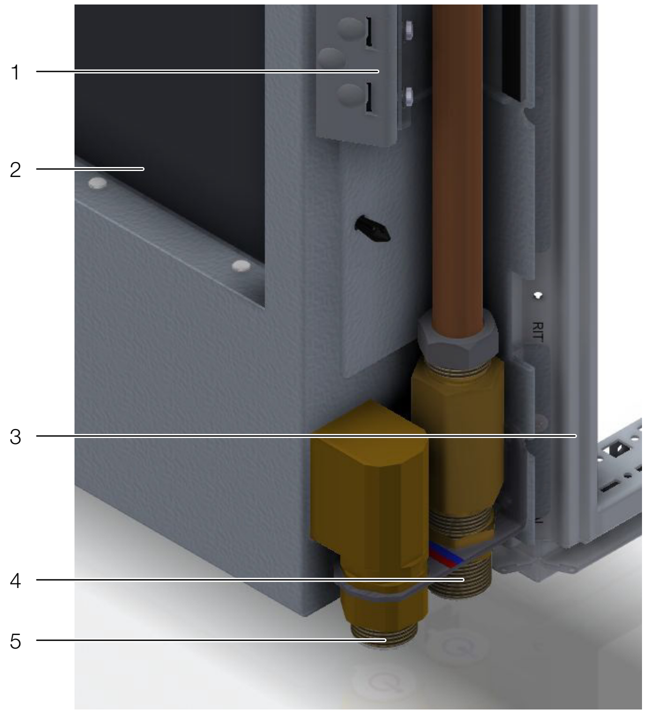

Fig. 8: Connection nozzles at the bottom of the LCP Hybrid

Key
1 Door bracket hinge
2 LCP Hybrid
3 Server enclosure
4 Cooling water connection, inlet
5 Cooling water connection, return

The cooling water is generally connected to the cold water system using an optional connection hose. Alternatively, the LCP Hybrid may also be connected on-site with the installed pipework.

3.4 Proper and improper usage

The Liquid Cooling Package is used to dissipate high heat losses and for the effective cooling of the waste air from IT components built into a server enclosure.

The unit is state of the art and built according to recognised safety regulations. Nevertheless, improper use can pose a threat to the life and limb of the user or third parties, or result in possible damage to the system and other property.

Consequently, the unit must only be used properly and in a technically sound condition! Any malfunctions which impair safety should be rectified immediately. Follow the operating instructions!

Proper use also includes following the operating instructions and fulfilling the inspection and maintenance conditions.

Inappropriate use can be dangerous. Examples of inappropriate use include:
– Use of impermissible tools.
– Improper operation.
– Improper rectification of malfunctions
– Use of replacement parts which are not authorised by Rittal GmbH & Co. KG.

3.5 Supply scope of a Liquid Cooling Package

The Liquid Cooling Package supply includes:

Qty.	Parts
1	Liquid Cooling Package, ready for connection
1	Cover
1	Assembly instructions
5	Posidrive raised countersunk screw
3	Contact washer
7	Screw
1	Bleed tool

Tab. 1: Supply scope of an LCP Hybrid

4 Transportation and handling

4.1 Transportation

The Liquid Cooling Package is delivered on a pallet in a protective box.

Caution!
Because of its height and narrow base, the Liquid Cooling Package is subject to tipping. Risk of toppling, especially after the unit is removed from the pallet!

Caution!
Transportation of the Liquid Cooling Package without a pallet:
Use only suitable and technically sound lifting gear and load-bearing devices with sufficient load capacity.

4.2 Unpacking

- Remove the unit's packaging materials but not the mounting aid.

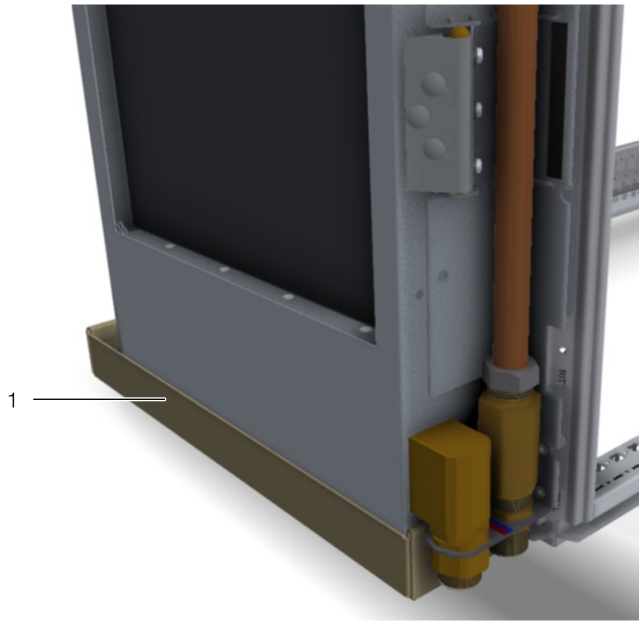

Fig. 9: Mounting aid

Note:
After unpacking, the packaging materials must be disposed of in an environmentally friendly way. They consist of the following materials:
Wood, polythene, polypropylene, corrugated cardboard, steel.

- Check the unit for any damage that may have occurred during transport.

Note:
Damage and other faults, e.g. incomplete delivery, should be reported immediately, in writing, to the shipping company and to Rittal GmbH & Co. KG.

- Place the unit in its intended location.

5 Assembly and siting

5.1 General

5.1.1 Installation site requirements

In order to ensure problem-free operation of the Liquid Cooling Package, the following conditions for the installation location should be observed:

Supply connections required at the installation site

Type of connection	Connection description:
Cooling water connection:	15°C inlet temperature (depending on relative humidity) Max. 6 bar permissible operating pressure Volumetric flow: depending on design (see section 13.2 "Characteristic curves and tables") DN 25 (G1") external pipe thread

Tab. 2: Supply connections required at the installation site

Note:
Please also observe the instructions and data relating to the cold water connection as outlined in section 6.1 "Cooling water connection".

Recommendation:
To facilitate easy servicing of the Liquid Cooling Package, maintain a distance of at least 1 m between the rear of the device and the nearest wall.

Floor conditions

- The floor of the installation space should be rigid and level.
- Choose the installation site so that the unit is not situated on a step or uneven surface, etc.

Recommendation:
Room temperature +22°C at 47% relative air humidity, according to ASHRAE guidelines. The room temperature must correspond to the required air intake temperature.

Caution! Risk of tipping over!
Stand-alone enclosures should be secured to the floor to prevent them tipping over.

5.1.2 Installation guidelines

The positioning in the rack aisles must be considered when planning the layout. In particular, care should be taken to ensure that external air streams are not pointing directly at the rear of the LCP Hybrid. Such counterflows prevent hot air from being expelled by the LCP Hybrid, leading to the formation of a hot spot inside the server enclosure.

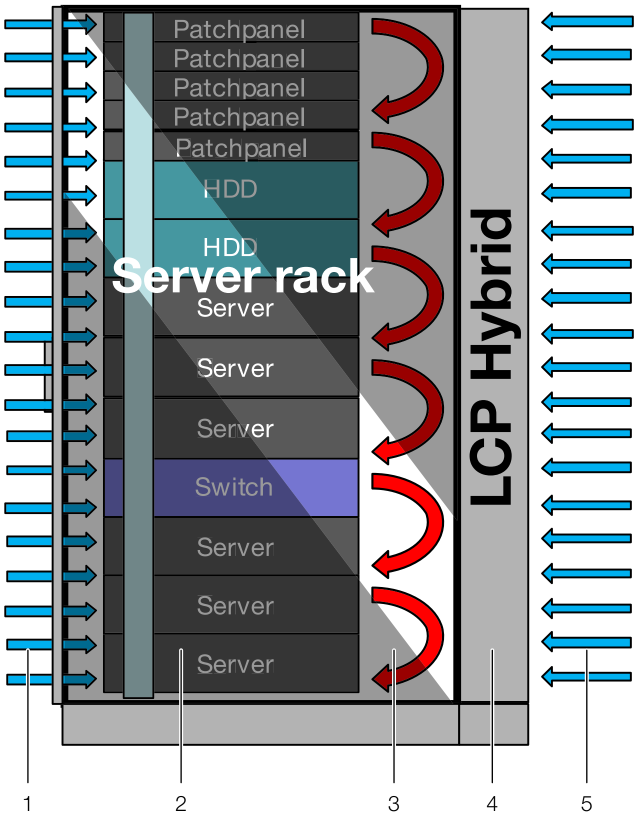

Fig. 10: Incorrect external air stream

Key

1 Cold ambient air
2 Server rack with installed equipment
3 Hot spot caused by failure to expel hot air
4 LCP Hybrid with air/water heat exchanger
5 External air stream onto the LCP Hybrid

A serial layout is the best option. This means that cold air produced by the LCP Hybrid is drawn in by a server enclosure positioned behind it. The LCP Hybrid installed there cools the air from this enclosure, and so on.

If several server enclosures are positioned adjacent to one another, each enclosure must be partitioned separately. To this end, we recommend using a partition between two enclosures, and a corresponding side panel as the termination.

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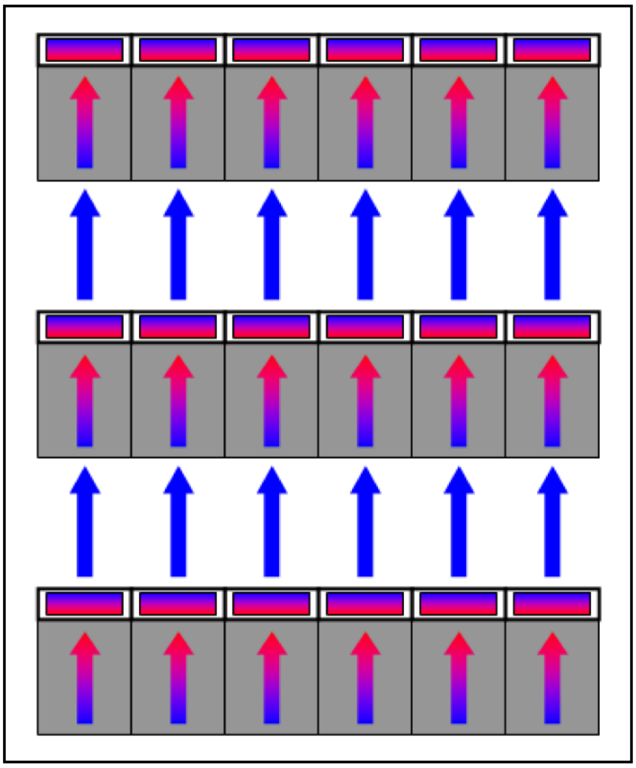

Fig. 11: Serial layout

5.2 Assembly procedure

5.2.1 General

Before the Liquid Cooling Package can be bayed onto a server enclosure, the following work should be carried out:

– Seal the server enclosure,
– Dismantle the rear server enclosure door, if available
– Remove the lock pieces with the divided rear door and
– Fit the side panels.

After baying the Liquid Cooling Package, the optional air routing kit may be installed.

5.2.2 Seal the server enclosure

In order to ensure targeted air routing in the system, the server enclosure is vertically divided into hot air and cold air zones by sealing the 482.6 mm (19") level.

Proceed as follows to seal the 482.6 mm (19") level:

- If the server enclosure is only partially configured, seal the open sections of the 482.6 mm (19") level using blanking plates. Screw these tightly into the server rack from the rear.

Note:
Blanking plates in the various height units (U) and narrow air baffle plates are available as Rittal accessories (see section 12 "Accessories").

- Secure one air baffle plate from the LCP Hybrid accessories to one of the rear supports in the server rack (fig. 12).

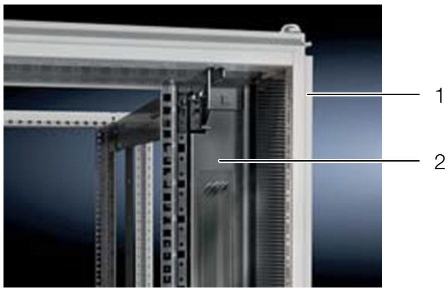

Fig. 12: Air baffle plate in the server rack

Key
1 Server rack
2 Air baffle plate

If devices which require cooling via sideways air throughput (e.g. switches, router, etc.) are built into the server enclosure, the air baffle plates will need to be repositioned to allow for cooling (fig. 5):

- Attach the air baffle plate in the front section on one side of the server rack.
- Attach the air baffle plate in a suitable place in the rear section on the other side of the server rack.

5.2.3 Dismantle the rear server enclosure door

For baying the LCP Hybrid, the rear door of the server enclosure (if available) will need to be removed. The frame of the LCP Hybrid is bayed to the server enclosure frame in place of the existing server door.

Proceed as follows to dismantle the server enclosure door:

- Remove the sealing bungs from the four door hinges using an appropriate tool (e.g. screwdriver).
- Release and open the server enclosure door.
- On each hinge, loosen the locking screw used to secure it to the server enclosure.

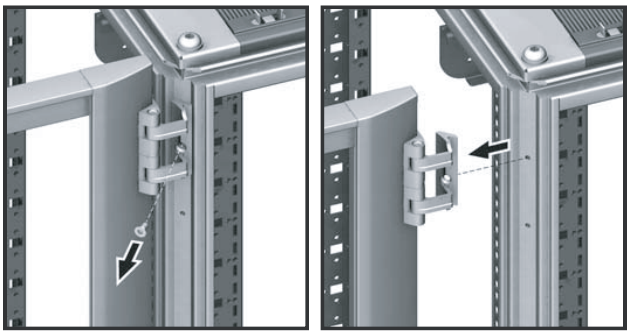

Fig. 13: Removing a door hinge

Note:
Support the server enclosure door so that it will not fall as the hinges are loosened. If necessary, work with a second person.

- Remove the server enclosure door from the enclosure, including the hinges, to the rear.
- If divided rear doors were fitted to the server enclosure, the lock pieces in the centre will additionally need to be removed.

5.2.4 Fit the door latch mechanisms

To lock the LCP Hybrid with the server enclosure, the four lock pieces included with the supply are mounted on the handle side.

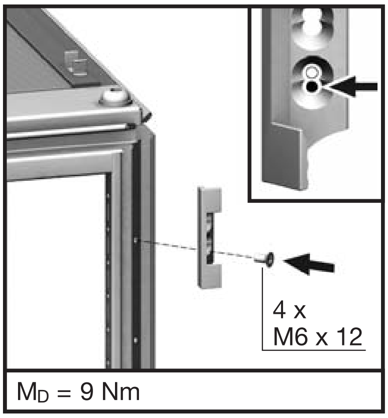

Fig. 14: Lock piece

- Rotate the first lock piece so that the "L" marking is legible.
- Screw the lock piece through the bottom opening on one of the four mounting positions in the server enclosure.
- In the same way, attach the three other lock pieces to the lock side of the server enclosure.

5.2.5 Fit the LCP Hybrid

> Note:
> At least two people must work together to install the LCP Hybrid.

- Leaving the LCP Hybrid in its packaging, position it behind the server enclosure on which it is to be fitted.
- Open the packaging.
- With at least two people, lift the LCP Hybrid out of the packaging and set it upright.
- Rotate the LCP Hybrid on the mounting aid, in such a way that the mounting points and the cooling water connections are on the right-hand side.
- Push the LCP Hybrid against the server enclosure on the mounting aid, and align it in such a way that the mounting points in the door hinge of the LCP Hybrid are aligned with the corresponding openings in the server enclosure.

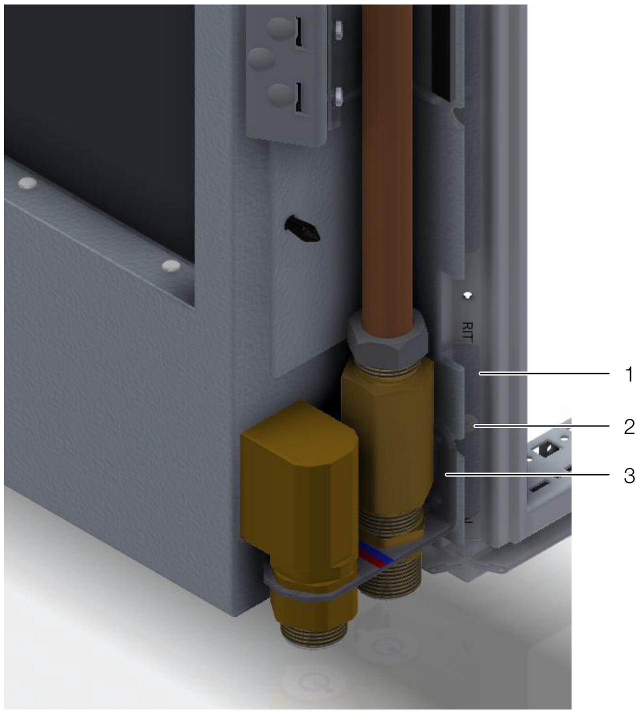

Fig. 15: Mounting the LCP Hybrid – Exterior

Key

1 Server enclosure
2 Mounting point
3 Door hinge

- Screw the LCP Hybrid onto the four mounting points to which standard server enclosure door hinges are attached.

The LCP Hybrid is additionally screw-fastened to the inside of the server enclosure at the top and bottom.

- Swing the LCP Hybrid away from the server enclosure to give you access to the rear of the server enclosure.
- Secure the LCP Hybrid on the inside top using two screws included with the supply.

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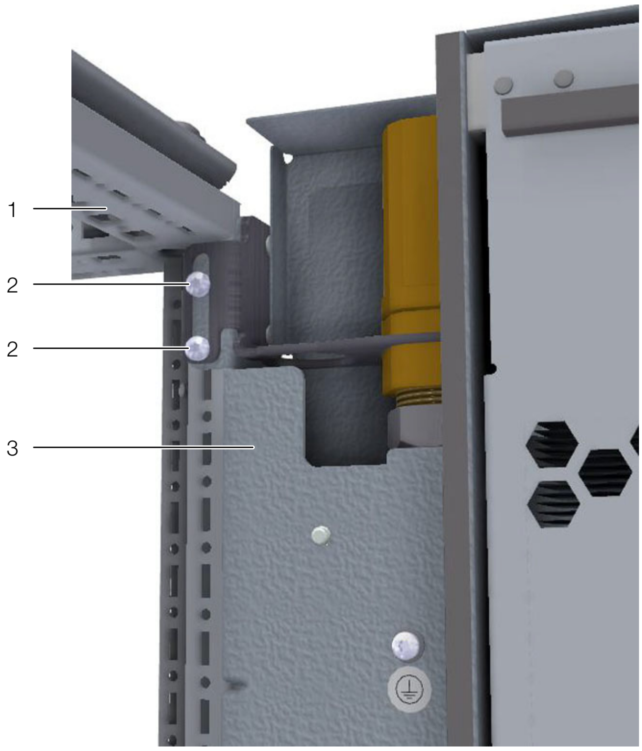

Fig. 16: Mounting the LCP Hybrid – Inside top

Key
1 Server enclosure
2 Assembly screws (2x)
3 LCP Hybrid

■ Secure the LCP Hybrid at the inside bottom using two screws included with the supply.

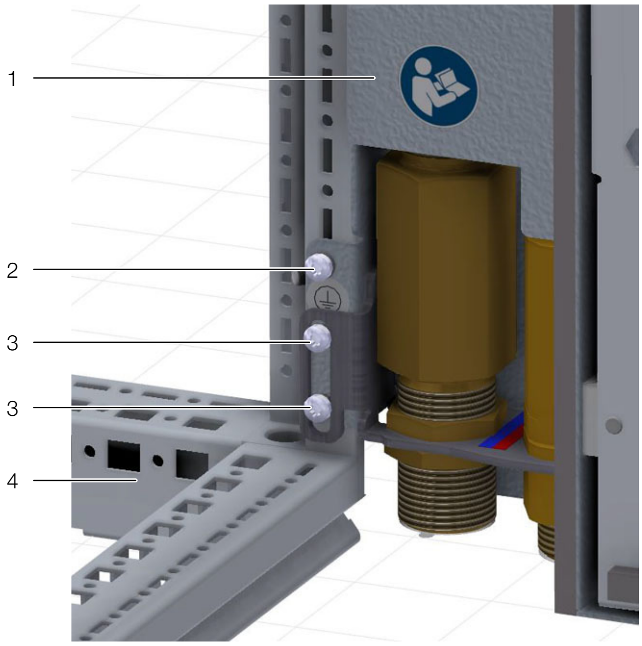

Fig. 17: Mounting the LCP Hybrid – Inside bottom

Key
1 LCP Hybrid
2 Position for potential equalisation
3 Assembly screws (2x)
4 Server enclosure

5.2.6 Fitting the potential equalisation

In order to ensure reliable potential equalisation between the server enclosure and the LCP Hybrid, it is additionally necessary to fit the special potential equalisation screw.

■ Screw the potential equalisation screw and contact washer included with the supply into the point marked with an earth symbol above the bottom two assembly screws, as far as they will go (fig. 17, item 2).

5.2.7 Install the air routing kit (optional)

It is also important to ensure correct routing of the heated air through the LCP Hybrid for the devices installed at the top and bottom of the server enclosure. To this end, the air routing kit (3311.160) available as an accessory should be mounted at the rear on the inside of the server enclosure frame.

■ First, insert one air baffle plate each from above into the corresponding fastening plate.

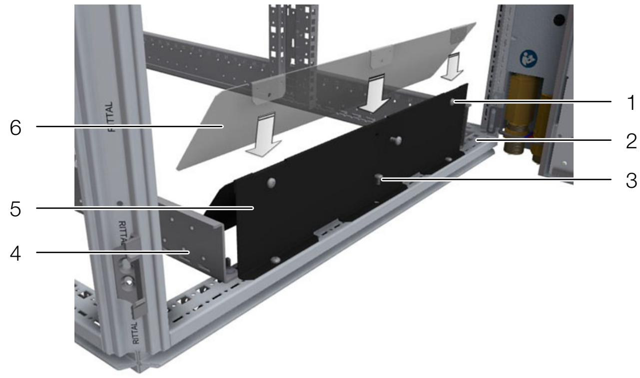

Fig. 18: Air routing kit at the bottom of the server enclosure

Key
1 Assembly screw, air baffle plate – fastening plate (3x)
2 Server enclosure
3 Assembly screw, fastening plate – server enclosure (3x)
4 482.6 mm (19") level
5 Fastening plate
6 Air baffle plate

■ Secure the air baffle plate in this position using a total of three assembly screws.

■ Mount the fastening plate, including the air baffle plate, at the bottom rear of the server enclosure frame, and secure it in this position, likewise with three assembly screws.

Note:
The side position of the air baffle plate is determined by the 482.6 mm (19") chassis.

■ Fit the second air baffle plate in the server enclosure as outlined above.

5.2.8 Remove the mounting aid

■ Finally, remove the mounting aid beneath the Liquid Cooling Package.

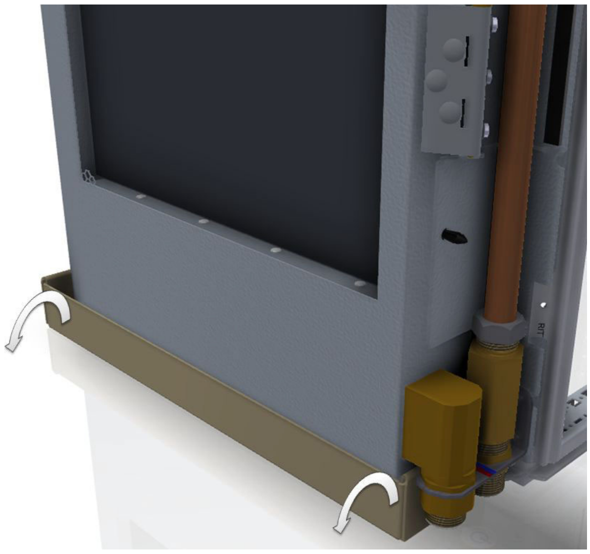

Fig. 19: Mounting aid on the LCP Hybrid

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6 Installation

6.1 Cooling water connection

The Liquid Cooling Package is connected to the cold water network via two DN 25 (G1") threaded pipe connections (external thread) on the inlet and return (on the underside of the unit). The connection nozzles are positioned vertically downwards. If there is a raised floor present, connection to the on-site cold water network is made in a downward direction.

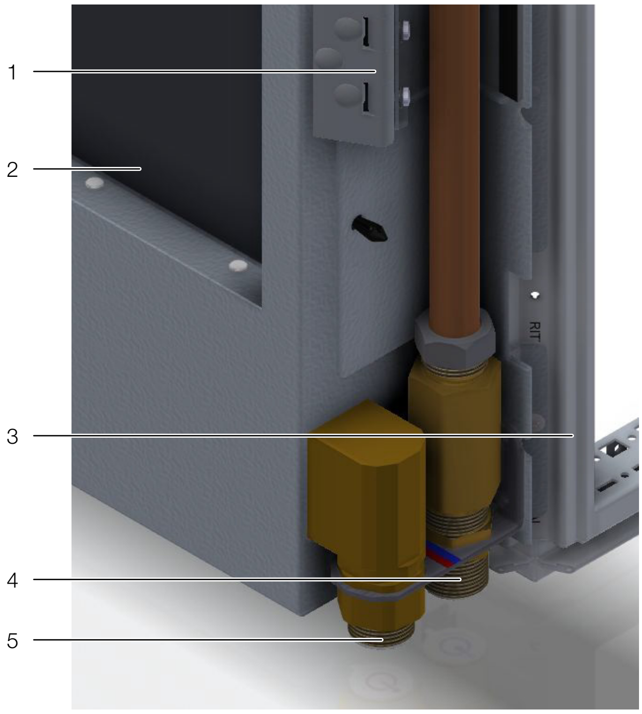

Fig. 20: Cold water network connection

Key
1 Door bracket hinge
2 LCP Hybrid
3 Server enclosure
4 Cooling water connection, inlet
5 Cooling water connection, return

Caution!
When installing, observe the applicable specifications concerning water quality and water pressure.

Caution!
Connection of the LCP Hybrid to the cooling water supply may only be carried out by properly trained staff.

Recommendation:
Ideally, Liquid Cooling Packages should be connected to the cooling water circuit via a water/water heat exchanger when using a water/glycol mixture.
Benefit:
– Reduction of water volumes in the secondary circuit,
– Setting of a defined water quality,
– Setting of a defined inlet temperature and
– Setting of a defined volumetric flow.

Tichelmann principle and hydraulic balancing

For an efficient cold water supply to the Liquid Cooling Package, the cold water system must be hydraulically balanced. If the hydraulics are not balanced, the LCP systems will not be supplied homogeneously with the required volume of cold water. This will adversely affect efficient operation.

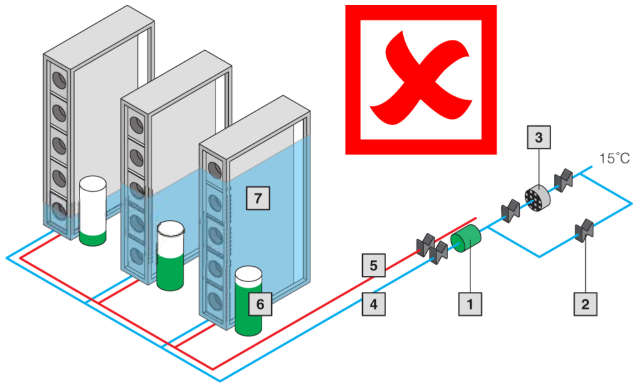

Fig. 21: Cooling distribution without hydraulic balancing

Key
1 Circulating pump
2 Shut-off valve
3 Fine filter
4 Return
5 Supply
6 Pump pressure
7 Appliance to be cooled (LCP Hybrid)
8 Pipe friction pressure factor
9 Opening of control valve
10 Control valve

Here, hydraulic balancing can be achieved via balancing valves.

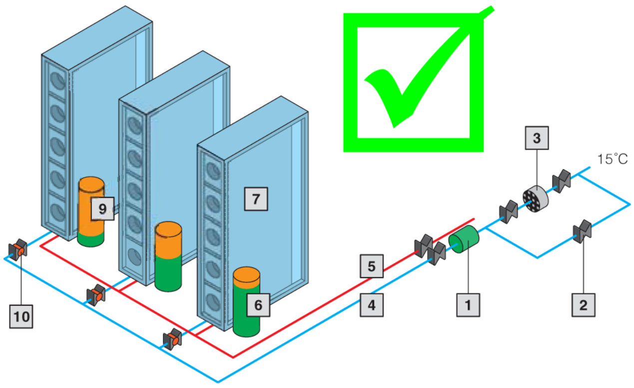

Fig. 22: Cooling distribution with hydraulic balancing

However, if the individual connection lines for the LCP systems are laid according to the "Tichelmann" connection principle, hydraulic balancing is not necessary. With this connection variant, all individual connection lines have the same pressure loss.

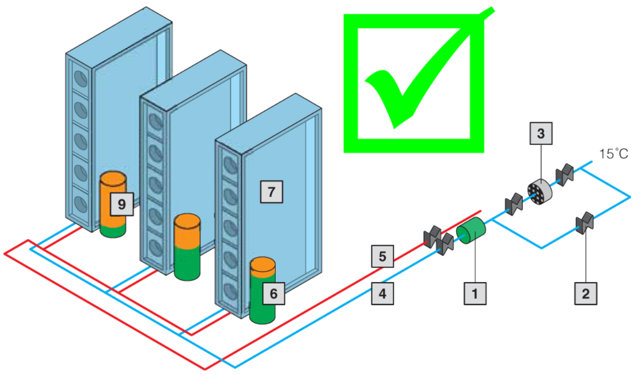

Fig. 23: Cooling distribution with Tichelmann principle

Notes on water quality

For safe operation, it is vital that the requirements of Directive VDI 2035-2 are observed.

Note:
The maximum permissible working pressure (PS1) of the LCP Hybrid is 6 bar. Membrane expansion tanks and safety valves must be used to ensure that this pressure is not exceeded.

Note:
Before commencing operation with water, all supply lines must be adequately flushed.

Detailed diagrams and tables showing cooling output and pressure loss can be found in section 13.2 "Characteristic curves and tables".

6.2 Bleeding the air from the heat exchanger

Two vent valves are installed at the uppermost point of the heat exchanger package in the Liquid Cooling Package. The unit is delivered with these valves fully closed, but they must be opened prior to commissioning.

Warning! Danger of cut wounds, especially from the sharp edges of the heat exchanger module!
Put on protective gloves before beginning assembly or cleaning work!

Proceed as follows to bleed the device:

- Swing the LCP Hybrid away from the server enclosure.
- Remove the three assembly components from the inner maintenance door of the LCP Hybrid and open the maintenance door.
- Remove the vent hose included with the supply from the inside of the maintenance door.

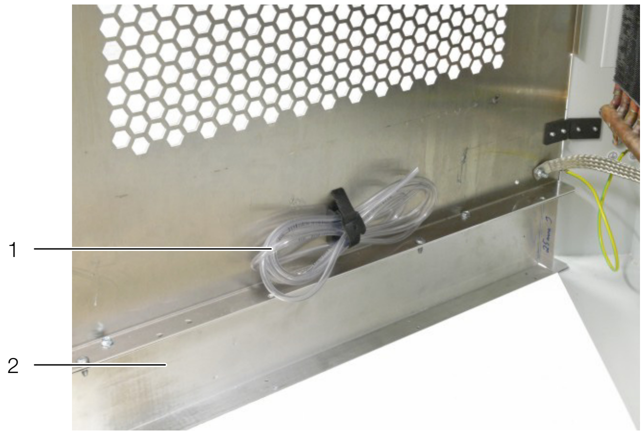

Fig. 24: Vent hose on the LCP Hybrid

Key

1 Vent hose
2 Maintenance door

- Connect the vent hose to the collective vent of the heat exchanger from below.

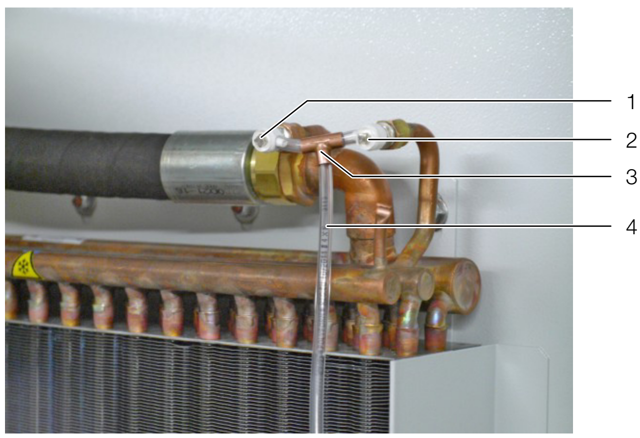

Fig. 25: Vent valves on the LCP Hybrid

Key

1 Vent valve 1
2 Vent valve 2
3 Collective vent
4 Vent hose

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- Position a collecting vessel underneath the open end of the vent hose to collect any escaping water.
- Open the two vent valves using the supplied bleed tool until you hear the hiss of escaping air.
- Wait until water escapes from the vent hoses, then close the valves again completely.
- Next, open both vent valves again slightly and check whether any more air escapes.
- If so, hold the vent valves open until water escapes again.
- Repeat this process until there are no bubbles visible in the vent hose for a significant period of time, ensuring that there is no air left in the system.
- Once you have finished the vent process, remove the vent hose again, and secure it to the inside of the maintenance door.
- Close the inner maintenance door of the Liquid Cooling Package.
- Swing the LCP Hybrid towards the server enclosure and close the door.

Note:
The system is usually bled during the course of commissioning. This process may need to be repeated if the device is failing to supply the desired cooling output (see section 8 "Troubleshooting").

6.3 Installing the cover

Once all the installation work is complete, the cover is fitted over the door hinge.

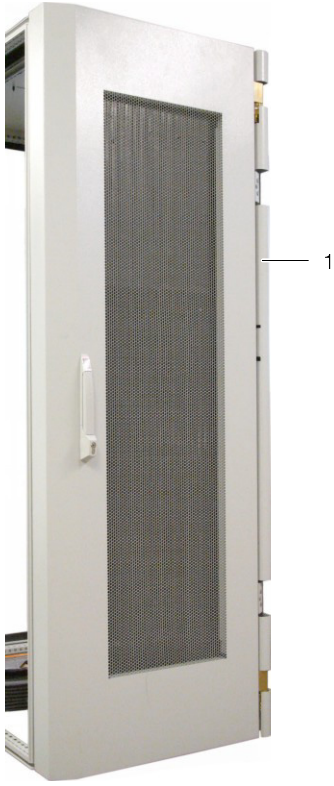

Fig. 26: Cover on the LCP Hybrid

Key
1 Cover

- Position the cover over the entire height of the door hinge at the side.
- Secure the cover with the screws supplied loose.
- Create potential equalisation using the screw and contact washer supplied loose.

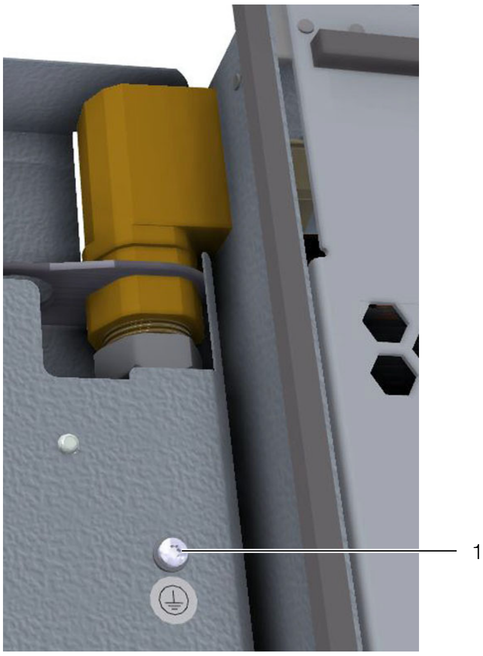

Fig. 27: Cover on the LCP Hybrid

Key

1 Screw and contact washer for potential equalisation

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7 Commissioning checklist

Rittal GmbH & Co. KG hopes that this checklist will help its customers and cooperation partners install and operate the products of the Liquid Cooling Package family successfully.

Before the installation:

Are shut-off valves installed in the flow and return?

These valves make it easier to replace or repair the Liquid Cooling Package without the need to shut off the entire cold water supply.

Is there a taco-setter installed in the return of each Liquid Cooling Package?

The taco-setter ensures a constant volumetric flow and helps to maintain the hydraulic balance of the system, especially when operating with other types of units, such as convectors.

Note:
If the pipework for the Liquid Cooling Package is laid according to the Tichelmann principle, a taco-setter is not necessary.

Is the water supply properly insulated?

Proper insulation protects against condensate formation, especially on the cooling water inlet components.

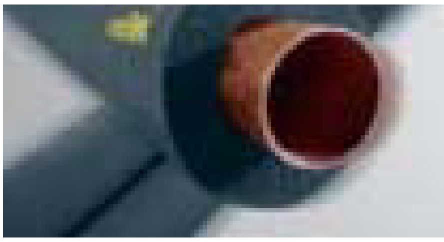

Photo: Amacell

Are the permissible bending radii of the hoses adhered to?

The hoses must not be kinked too tightly, otherwise the flow volume may be impaired and the materials may fatigue prematurely.

Is there a good water supply available which meets the quality requirements?

Water quality determines the lasting reliability of the system. It ensures that no undesirable corrosion or harmful deposits will occur. The exact manufacturer's recommendations regarding water quality can be found in section 13.1 "Hydrological information" of the assembly and operating instructions of your Liquid Cooling Package. It is important to ensure that the recommended water quality is maintained even after installation.

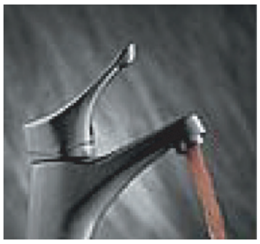

Photo: Honeywell

Was the pipework sufficiently flushed before the Liquid Cooling Package was connected?

It is important to clean or flush the water circuits appropriately, especially for new installations. Experience has shown that there are often remnants of sealants, lubricants, and even metal chips in new systems, which may lead to a premature failure of the Liquid Cooling Package. Cleaning the cold water system carefully before connecting the Liquid Cooling Package ensures reliable operation later.

If the water quality of the primary cold water supply is inadequate, was a separate water circuit with a water/water heat exchanger installed?

If the cold water supply is strongly contaminated, it may make sense to install a second, high quality cold water circuit which is connected to the primary circuit via a water/water heat exchanger. Even in this case, the water circuit on the Liquid Cooling Package side must be carefully cleaned before connecting the device. Our recommendations regarding water quality in section 13.1 "Hydrological information" of the assembly and operating instructions of your Liquid Cooling Package apply to this procedure as well.

Was the water prepared/treated with the appropriate additives?

In addition to our recommendations regarding water quality, we recommend that the water be enriched with corrosion inhibitor and/or antifreeze. Also, a treatment to prevent algae and biofilms may be expedient in some cases.

Photo: Clariant

Are unused height units in the bayed server enclosures sealed with vertical blanking plates, and are the side vertical air baffle plates installed?

In order to prevent undesired air short circuits and circulation patterns inside the server enclosure, all unused height units of the 482.6 mm (19") level should be closed off with blanking plates. This prevents the warm air from being routed back in front of the installed equipment. The blanking plates are available in various heights. The vertical air baffle plates installed on each side of the server enclosure ensure that the warm air cannot collect at the sides of the 482.6 mm (19") level. Air baffle plates are available for 2 applications and 2 enclosure widths.

Are all water connections correctly made?

Before water is admitted, and, ideally before the ball valves are opened, be sure to check that all connections are properly made.

Is the server enclosure equipped with suitable doors?

The front side/front door of the server enclosure must have unrestricted air permeability, so that the servers can draw in the cool ambient air at the front.

After admitting cold water:
Are all parts and connections watertight?

Please check to be sure that all parts and connections which carry water are watertight. The Liquid Cooling Package is subject to an individual, comprehensive factory test, which also includes checking for leaks. This additional check serves to locate problems, such as possible transport damage, and to prevent greater damage.

Venting of the Liquid Cooling Package

In order to ensure even water circulation through the circuit and effective heat transfer, the Liquid Cooling Package must be vented during commissioning.

Please feel free to contact Rittal if you have any questions or problems:

For malfunctions and repairs

Rittal Service Department

Tel.: +49(0)2772 505-1855
E-mail: RSI@Rittal-Service.com

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8 Troubleshooting

Malfunction location	Malfunction	Cause of malfunction	Effect	Remedy
Liquid Cooling Package	The unit is not supplying the required cooling output	Air in the system	If there is air in the system, the water cannot circulate properly in the heat exchanger. Thus, it cannot remove heat.	Bleed the air from the heat exchanger.
		Increased pressure loss on the piping network side, e.g. through a clogged filter or incorrectly set flow limiter	The external pumps are not able to pump enough cold water through the Liquid Cooling Package.	Clean the filter, set the flow limiter correctly.
		Air routing not correct	The cooled air passes through unsealed openings past the equipment to the front of the enclosure.	Unused height units in the 482.6 mm (19") level as well as side slots and openings must be sealed using blanking plates or air baffle plates. Both are available as accessories.

In order to prevent malfunctions caused by the cold water system, the following remedies should be implemented.

Malfunction location	Malfunction	Cause of malfunction	Effect	Remedy
Cold water system	Corrosion and contaminants in the cold water system	Insufficient cleaning after a new installation	Unclean and aggressive water leads to a weakening of the material and to improper function.	During initial installation, the pipe network and the system parts should be flushed out before installing the Liquid Cooling Package.
		Improper treatment of the water with corrosion protection additives		Rittal GmbH & Co. KG recommends the installation of filters and the treatment of the water with appropriate corrosion and, if needed, antifreeze additives. The recommended notes regarding water quality are found in section 13.1 "Hydrological information".
		Older systems with existing contaminants		When integrating into existing cold water networks, the use of a water/water heat exchanger is recommended. This forms a second water circuit.

9 Inspection and maintenance

The Liquid Cooling Package is largely maintenance-free.

- An additional external strainer with fine-mesh sieve (0.25 mm) is required if the cooling water is contaminated. This should be cleaned regularly.
- Visually inspect for leaks regularly (annual cycle).
- The maintenance door to the Liquid Cooling Package should be opened at regular intervals and the heat exchanger vacuumed clean.

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10 Storage and disposal

Caution! Risk of damage!
The air/water heat exchanger must not be subjected to temperatures above +70°C during storage.

During storage, the air/water heat exchanger must be laid on its side.
Disposal can be performed at the Rittal plant.
Please contact us for advice.

Emptying:
During storage and transportation below freezing point, the air/water heat exchanger should be drained completely.
To this end, attach two vent hoses to the vent valves of the Liquid Cooling Package and open the valves so that the cooling fluid can run out (see section 6.2 "Bleeding the air from the heat exchanger").

Caution! Risk of environmental contamination!
Refrigerant must not be released from the heat pipes. It must be properly disposed of in accordance with the valid regional regulations.

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11 Technical specifications

11.1 10 kW versions

Technical specifications				
Description/Model No.	TopTherm LCP Hybrid / 3311.610 (2000 mm high, 600 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.710 (2200 mm high, 600 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.810 (2000 mm high, 800 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.910 (2200 mm high, 800 mm wide)			
Dimensions and weight	**3311.610**	**3311.710**	**3311.810**	**3311.910**
(Width x height x depth [mm])	600 x 2000 x 105	600 x 2200 x 105	800 x 2000 x 105	800 x 2200 x 105
Usable U	42	47	42	47
Opening angle of door	135°	135°	135°	135°
Weight [kg]	76	78	78	81
Cooling circuit				
Cooling medium	Water (see Internet for specifications)			
Cold water inlet temperature [°C]	+7…+30 and at least 3 K above the dew points of the ambient and flowing air			
Permissible operating pressure PS1 [bar]	6			
Fill quantity of heat exchanger [l]	8			
Max. volumetric flow of water [l/min]	70			
Fill quantity of heat pipe with R134a [kg]	0.65			
Water connection	DN 25 (G1")			
Rated cooling output				
Cooling output, sensible [kW]	10			
Volumetric flow of cooling water [l/min]	30			
Cold water inlet temperature [°C]	+15			
Volumetric flow of air [m^3/h]	2700 (air from IT equipment)			
Room air temperature [°C]	+24 (air outlet temperature from LCP Hybrid)			
Relative humidity [%]	43			
Other information				
Noise level	Depends on the configuration of the IT rack with equipment			
Colour	RAL 7035			

Tab. 3: Technical specifications for 10 kW versions

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11.2 20 kW versions

Technical specifications				
Description/Model No.	TopTherm LCP Hybrid / 3311.600 (2000 mm high, 600 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.700 (2200 mm high, 600 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.800 (2000 mm high, 800 mm wide)			
Description/Model No.	TopTherm LCP Hybrid / 3311.900 (2200 mm high, 800 mm wide)			
Dimensions and weight	**3311.600**	**3311.700**	**3311.800**	**3311.900**
(Width x height x depth [mm])	600 x 2000 x 105	600 x 2200 x 105	800 x 2000 x 105	800 x 2200 x 105
Usable U	42	47	42	47
Opening angle of door	135°	135°	135°	135°
Weight [kg]	76	81	81	84
Cooling circuit				
Cooling medium	Water (see Internet for specifications)			
Cold water inlet temperature [°C]	+7…+30 and at least 3 K above the dew points of the ambient and flowing air			
Permissible operating pressure PS1 [bar]	6			
Fill quantity of heat exchanger [l]	8			
Max. volumetric flow of water [l/min]	70			
Fill quantity of heat pipe with R134a [kg]	0.65			
Water connection	DN 25 (G1")			
Rated cooling output				
Cooling output, sensible [kW]	20			
Volumetric flow of cooling water [l/min]	58			
Cold water inlet temperature [°C]	+15			
Volumetric flow of air [m^3/h]	4000 (air from IT equipment)			
Room air temperature [°C]	+24 (air outlet temperature from LCP Hybrid)			
Relative humidity [%]	43			
Other information				
Noise level	Depends on the configuration of the IT rack with equipment			
Colour	RAL 7035			

Tab. 4: Technical specifications for 20 kW versions

12 Accessories

Item	Model No.	Qty./Packs of	Remarks
Air baffle plate for TS IT	5501.805	1	Width x height: 600 mm x 2000 mm
Air baffle plate for TS IT	5501.815	1	Width x height: 800 mm x 2000 mm
Air baffle plate for TS IT	5501.825	1	Width x height: 600 mm x 2200 mm
Air baffle plate for TS IT	5501.835	1	Width x height: 800 mm x 2200 mm
Connection hose	3301.351	2	Length 1 m, may be cut to required length.
Air routing kit	3311.160	2	

Tab. 5: Accessories list – Liquid Cooling Package

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13 Further technical information

13.1 Hydrological information

To avoid damages to the system and ensure reliable operation, the provisions of VDI 2035 should be observed for filling and top-up water.

Admissible cooling media

– Saline and low-salinity water based on VDI 2035 plus max. 50 volume percent Antifrogen-N (see table 6).

Recommended cooling medium

– Low-salinity water (demineralised water) based on VDI 2035. Up to a maximum of 50 volume percent Antifrogen-N may be added (see table 6).

	Low-salinity	Saline
Electrical conductivity at 25°C [µS/cm]	< 100	100…1,500
Appearance	Free from sedimenting substances	
pH value at 25°C	8.2…10.0	
Oxygen [mg/l]	< 0.1	< 0.02

Tab. 6: Water specifications

13.2 Characteristic curves and tables

13.2.1 General

All information in the following tables refers to the use of pure water as a cooling medium. The cooling performance data when using a water-glycol mixture is available on request from Rittal.

Proceed as follows to determine the required cooling water temperature:

- Determine the dew point for the room temperature and relative humidity in the room (see section 13.2.2 "Determination of the dew point"). Alternatively, you can use the h-x diagram (fig. 2).
- Determine the minimum admissible cooling water temperature by adding a safety margin of 3°C to this figure.
- Determine the required water throughput and achieved cooling efficiency for the required airside temperature difference ΔT.

If the cooling efficiency determined in this way is 100%, then the air outlet temperature from the LCP Hybrid will be less than, or at the most, equal to the air inlet temperature into the server enclosure.

If the cooling efficiency determined in this way is less than 100%, then the air outlet temperature from the LCP Hybrid will be greater than the air inlet temperature into the server enclosure. The room temperature will rise accordingly over time.

13.2.2 Determination of the dew point

Determination of the dew point for room temperature 20°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
20 / 68.0	40	6 / 42.8
20 / 68.0	45	7.7 / 45.9
20 / 68.0	50	9.3 / 48.7
20 / 68.0	55	10.7 / 51.3
20 / 68.0	60	12 / 53.6

Tab. 7: Determination of the dew point for room temperature 20°C

Determination of the dew point for room temperature 21°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
21 / 69.8	40	6.9 / 44.4
21 / 69.8	45	8.6 / 47.5
21 / 69.8	50	10.2 / 50.4
21 / 69.8	55	11.6 / 52.9
21 / 69.8	60	12.9 / 55.2

Tab. 8: Determination of the dew point for room temperature 21°C

Determination of the dew point for room temperature 22°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
22 / 71.6	40	7.8 / 46
22 / 71.6	45	9.5 / 49.1
22 / 71.6	50	11.1 / 52
22 / 71.6	55	12.5 / 54.5
22 / 71.6	60	13.9 / 57

Tab. 9: Determination of the dew point for room temperature 22°C

Determination of the dew point for room temperature 23°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
23 / 73.4	40	8.7 / 47.7
23 / 73.4	45	10.4 / 50.7
23 / 73.4	50	12 / 53.6
23 / 73.4	55	13.5 / 56.3
23 / 73.4	60	14.8 / 58.6

Tab. 10: Determination of the dew point for room temperature 23°C

Determination of the dew point for room temperature 24°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
24 / 75.2	40	9.6 / 49.3
24 / 75.2	45	11.3 / 52.3
24 / 75.2	50	12.9 / 55.2
24 / 75.2	55	14.4 / 57.9

Tab. 11: Determination of the dew point for room temperature 24°C

Determination of the dew point for room temperature 25°C

Room temperature [°C/°F]	Rel. humidity [%]	Dew point [°C/°F]
25 / 77	40	10.5 / 50.9
25 / 77	45	12.2 / 54
25 / 77	50	13.8 / 56.8

Tab. 12: Determination of the dew point for room temperature 25°C

13.2.3 Pressure loss

Note:
When using a water/glycol mixture (67% water, 33% glycol), the waterside pressure loss must be multiplied by a factor of 1.2.

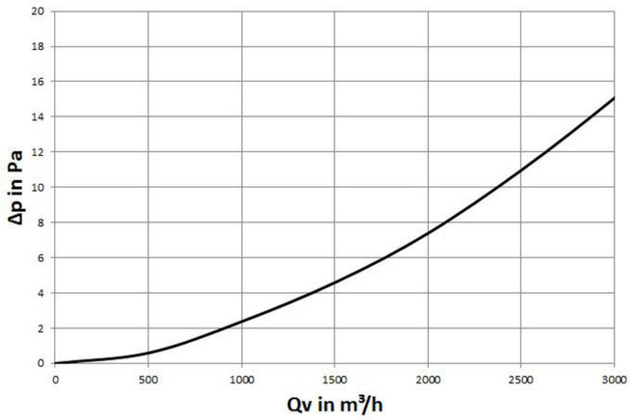

Fig. 28: Airside pressure loss in the "10 kW" version

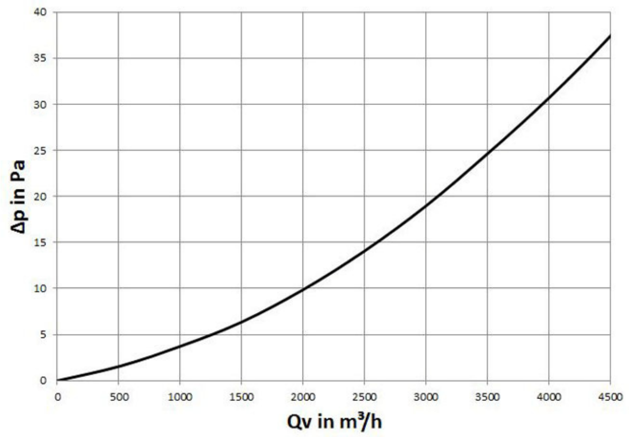

Fig. 29: Airside pressure loss in the "20 kW" version

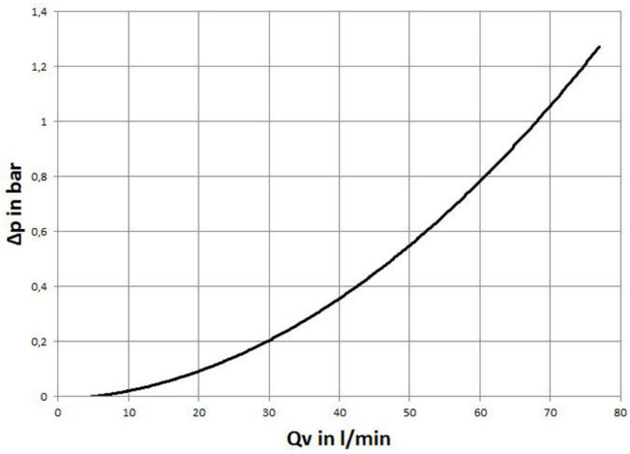

Fig. 30: Upstream pressure loss in the "10 kW" version

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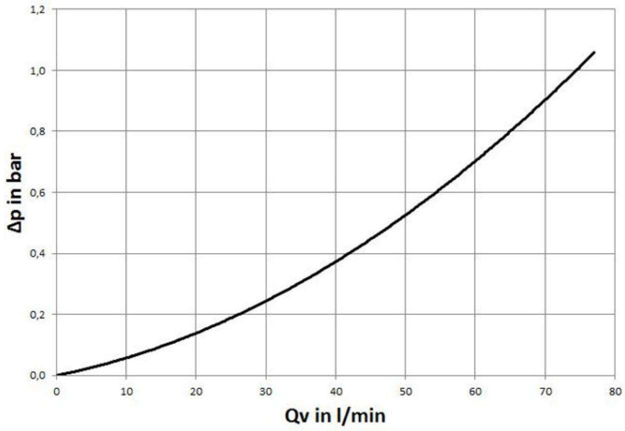

Fig. 31: Upstream pressure loss in the "20 kW" version

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13.2.4 Cooling output at a room temperature of 21°C

10 kW devices 3311.610/710/810/910

Cooling output, sensible [kW]	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	19	19	19	19	19.5	19.5	20
Water volume [l/min]	10	11	14	19	21	28	40
Volumetric airflow [m^3/h]	1200	1200	1200	1300	1300	1300	1300
Air outlet from LCP Hybrid [°C]	21	21	21	21	21	21	21
Air inlet to LCP Hybrid [°C]	33	33	33	33	33	33	33
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 13: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	19	19.5	19	19	19.5	20	20
Water volume [l/min]	10	11	14	19	21	28	40
Volumetric airflow [m^3/h]	1000	1000	1000	1100	1100	1100	1100
Air outlet from LCP Hybrid [°C]	21	21	21	21	21	21	21
Air inlet to LCP Hybrid [°C]	36	36	36	36	36	36	36
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 14: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	**10**	**10**	**10**	**10**	**10**		
Inlet temperature [°C]	12	13	14	15	16		
Return temperature [°C]	17.5	17.5	18	18	18		
Water volume [l/min]	26	30	30	46	58		
Volumetric airflow [m^3/h]	2400	2500	2500	2600	2400		
Air outlet from LCP Hybrid [°C]	21	21	21	21	21		
Air inlet to LCP Hybrid [°C]	33	33	33	33	33		
ΔT air [K]	**12**	**12**	**12**	**12**	**12**		

Tab. 15: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	**10**	**10**	**10**	**10**	**10**		
Inlet temperature [°C]	12	13	14	15	16		
Return temperature [°C]	17.5	18	18	18	19		
Water volume [l/min]	26	30	35	46	58		
Volumetric airflow [m^3/h]	2000	2100	2100	2100	2100		

Tab. 16: Cooling output at full load and a ΔT air of 15 K

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Cooling output, sensible [kW]	10	10	10	10	10		
Air outlet from LCP Hybrid [°C]	21	21	21	21	21		
Air inlet to LCP Hybrid [°C]	36	36	36	36	36		
ΔT air [K]	**15**	**15**	**15**	**15**	**15**		

Tab. 16: Cooling output at full load and a ΔT air of 15 K

20 kW devices 3311.600/700/800/900

Cooling output, sensible [kW]	15	15	15	15	15		
Inlet temperature [°C]	12	13	14	15	16		
Return temperature [°C]	18.5	19	19	19	20		
Water volume [l/min]	32	36	42	50	60		
Volumetric airflow [m^3/h]	3600	3600	3800	3800	3800		
Air outlet from LCP Hybrid [°C]	21	21	21	21	21		
Air inlet to LCP Hybrid [°C]	33	33	33	33	33		
ΔT air [K]	**12**	**12**	**12**	**12**	**12**		

Tab. 17: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	15	15	15	15	15		
Inlet temperature [°C]	12	13	14	15	16		
Return temperature [°C]	19	19	19	20	20		
Water volume [l/min]	32	36	43	48	60		
Volumetric airflow [m^3/h]	3200	3200	3200	3200	3200		
Air outlet from LCP Hybrid [°C]	21	21	21	21	21		
Air inlet to LCP Hybrid [°C]	36	36	36	36	36		
ΔT air [K]	**15**	**15**	**15**	**15**	**15**		

Tab. 18: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	20	20	20	20			
Inlet temperature [°C]	12	13	14	15			
Return temperature [°C]	17.5	18	18	19			
Water volume [l/min]	50	55	60	75			
Volumetric airflow [m^3/h]	4500	4800	4800	4800			
Air outlet from LCP Hybrid [°C]	21	21	21	21			
Air inlet to LCP Hybrid [°C]	33	33	33	33			
ΔT air [K]	**12**	**12**	**12**	**12**			

Tab. 19: Cooling output at full load and a ΔT air of 12 K

EN

Cooling output, sensible [kW]	20	20	20	20			
Inlet temperature [°C]	12	13	14	15			
Return temperature [°C]	18	18.5	18	19			
Water volume [l/min]	48	52	68	75			
Volumetric airflow [m^3/h]	4000	4000	4000	4000			
Air outlet from LCP Hybrid [°C]	21	21	21	21			
Air inlet to LCP Hybrid [°C]	36	36	36	36			
ΔT air [K]	**15**	**15**	**15**	**15**			

Tab. 20: Cooling output at full load and a ΔT air of 15 K

13.2.5 Cooling output at a room temperature of 22°C

10 kW devices 3311.610/710/810/910

Cooling output, sensible [kW]	5	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18	19
Return temperature [°C]	20	20	20	20	20	20	21	21
Water volume [l/min]	9	11	13	15	19	22	28	40
Volumetric airflow [m^3/h]	1300	1300	1300	1300	1300	1300	1300	1300
Air outlet from LCP Hybrid [°C]	22	22	22	22	22	22	22	22
Air inlet to LCP Hybrid [°C]	34	34	34	34	34	34	34	34
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 21: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	5	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18	19
Return temperature [°C]	20.5	20	20	20	20	20.5	21	21
Water volume [l/min]	9	11	13	15	19	22	28	40
Volumetric airflow [m^3/h]	1100	1100	1100	1100	1100	1100	1100	1100
Air outlet from LCP Hybrid [°C]	22	22	22	22	22	22	22	22
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	37	37
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 22: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	10	10	10	10	10			
Inlet temperature [°C]	12	13	14	15	16			
Return temperature [°C]	18	18	19	19	19			
Water volume [l/min]	24	28	30	37	45			

Tab. 23: Cooling output at full load and a ΔT air of 12 K

EN

Cooling output, sensible [kW]	10	10	10	10	10			
Volumetric airflow [m³/h]	2400	2500	2500	2500	2500			
Air outlet from LCP Hybrid [°C]	22	22	22	22	22			
Air inlet to LCP Hybrid [°C]	34	34	34	34	34			
ΔT air [K]	**12**	**12**	**12**	**12**	**12**			

Tab. 23: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	10	10	10	10	10			
Inlet temperature [°C]	12	13	14	15	16			
Return temperature [°C]	18	18.5	19	19	19			
Water volume [l/min]	24	28	30	37	45			
Volumetric airflow [m³/h]	2000	2100	2100	2100	2100			
Air outlet from LCP Hybrid [°C]	22	22	22	22	22			
Air inlet to LCP Hybrid [°C]	37	37	37	37	37			
ΔT air [K]	**15**	**15**	**15**	**15**	**15**			

Tab. 24: Cooling output at full load and a ΔT air of 15 K

20 kW devices 3311.600/700/800/900

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	19	19	20	20	20	20.5	
Water volume [l/min]	32	36	38	40	48	60	
Volumetric airflow [m³/h]	3600	3600	3600	3600	3600	3600	
Air outlet from LCP Hybrid [°C]	22	22	22	22	22	22	
Air inlet to LCP Hybrid [°C]	34	34	34	34	34	34	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 25: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	20	20	20	21	21	21	
Water volume [l/min]	28	32	36	38	46	54	
Volumetric airflow [m³/h]	3100	3100	3100	3100	3100	3100	
Air outlet from LCP Hybrid [°C]	22	22	22	22	22	22	
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 26: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	20	20	20	20			
Inlet temperature [°C]	12	13	14	15			
Return temperature [°C]	18	19	19	19			
Water volume [l/min]	48	48	54	62			
Volumetric airflow [m^3/h]	4500	4500	4500	4500			
Air outlet from LCP Hybrid [°C]	22	22	22	22			
Air inlet to LCP Hybrid [°C]	34	34	34	34			
ΔT air [K]	**12**	**12**	**12**	**12**			

Tab. 27: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	20	20	20	20			
Inlet temperature [°C]	12	13	14	15			
Return temperature [°C]	19	19	19.5	20			
Water volume [l/min]	44	48	52	62			
Volumetric airflow [m^3/h]	4100	4100	4100	4100			
Air outlet from LCP Hybrid [°C]	22	22	22	22			
Air inlet to LCP Hybrid [°C]	37	37	37	37			
ΔT air [K]	**15**	**15**	**15**	**15**			

Tab. 28: Cooling output at full load and a ΔT air of 15 K

13.2.6 Cooling output at a room temperature of 23°C

10 kW devices 3311.610/710/810/910

Cooling output, sensible [kW]	5	5	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18	19	20
Return temperature [°C]	22	22	21	21	21	21	21.5	22	22
Water volume [l/min]	7	8	10	12	14	17	20	26	38
Volumetric airflow [m^3/h]	1200	1200	1200	1200	1200	1200	1200	1200	1200
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	23	23	23
Air inlet to LCP Hybrid [°C]	35	35	35	35	35	35	35	35	35
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 29: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	5	5	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18	19	20
Return temperature [°C]	22.5	19.5	21	21	21	21	22	22	22
Water volume [l/min]	7	11	10	12	14	17	20	26	38

Tab. 30: Cooling output at partial load and a ΔT air of 15 K

EN

Cooling output, sensible [kW]	5	5	5	5	5	5	5	5	5
Volumetric airflow [m^3/h]	1000	1000	1000	1000	1000	1000	1000	1000	1000
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	23	23	23
Air inlet to LCP Hybrid [°C]	38	38	38	38	38	38	38	38	38
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 30: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	10	10	10	10	10				
Inlet temperature [°C]	12	13	14	15	16				
Return temperature [°C]	18.5	19	19.5	19	19				
Water volume [l/min]	21	23	25	46	47				
Volumetric airflow [m^3/h]	2400	2400	2400	2900	2900				
Air outlet from LCP Hybrid [°C]	23	23	23	23	23				
Air inlet to LCP Hybrid [°C]	35	35	35	35	35				
ΔT air [K]	**12**	**12**	**12**	**12**	**12**				

Tab. 31: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	10	10	10	10	10				
Inlet temperature [°C]	12	13	14	15	16				
Return temperature [°C]	19	19	20	19	20				
Water volume [l/min]	21	23	25	46	50				
Volumetric airflow [m^3/h]	2000	2000	2000	2600	2600				
Air outlet from LCP Hybrid [°C]	23	23	23	23	23				
Air inlet to LCP Hybrid [°C]	38	38	38	38	38				
ΔT air [K]	**15**	**15**	**15**	**15**	**15**				

Tab. 32: Cooling output at full load and a ΔT air of 15 K

20 kW devices 3311.600/700/800/900

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	19	19.5	20	20	20.5	21	
Water volume [l/min]	30	32	34	38	46	58	
Volumetric airflow [m^3/h]	3700	3700	3700	3700	3700	3700	
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	
Air inlet to LCP Hybrid [°C]	35	35	35	35	35	35	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 33: Cooling output at partial load and a ΔT air of 12 K

EN

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	20	20	21	21	22	22	
Water volume [l/min]	28	32	34	36	40	50	
Volumetric airflow [m^3/h]	3200	3200	3200	3200	3200	3200	
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	
Air inlet to LCP Hybrid [°C]	38	38	38	38	38	38	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 34: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	18	18	18	18	18	18	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	19	19	20	20	20	21	
Water volume [l/min]	40	45	50	55	65	75	
Volumetric airflow [m^3/h]	4500	4500	4500	4500	4500	4500	
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	
Air inlet to LCP Hybrid [°C]	35	35	35	35	35	35	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 35: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	20	20	20	20	20	20	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	20	20	20	20	20	21	
Water volume [l/min]	37	40	45	55	75	75	
Volumetric airflow [m^3/h]	4000	4000	4000	4000	4000	4000	
Air outlet from LCP Hybrid [°C]	23	23	23	23	23	23	
Air inlet to LCP Hybrid [°C]	38	38	38	38	38	38	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 36: Cooling output at full load and a ΔT air of 15 K

13.2.7 Cooling output at a room temperature of 24°C

10 kW devices 3311.610/710/810/910

Cooling output, sensible [kW]	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	24	23	23	22	22	22	22
Water volume [l/min]	7	8	8	11	13	16	18

Tab. 37: Cooling output at partial load and a ΔT air of 12 K

EN

Cooling output, sensible [kW]	5	5	5	5	5	5	5
Volumetric airflow [m^3/h]	1200	1300	1300	1300	1300	1300	1300
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	36	36	36	36	36	36	36
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 37: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	24	23	23	22	22	22	22
Water volume [l/min]	6	8	9	11	13	16	20
Volumetric airflow [m^3/h]	1000	1100	1100	1100	1100	1100	1100
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	39	39	39	39	39	39	39
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 38: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	10	10	10	10	10	10	10
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	19	19.5	20	20	21	21	21.5
Water volume [l/min]	20	22	24	26	30	34	40
Volumetric airflow [m^3/h]	2400	2400	2400	2400	2500	2500	2500
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	36	36	36	36	36	36	36
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 39: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	10	10	10	10	10	10	10
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	20	20	20	20	21	21	21
Water volume [l/min]	20	22	24	26	30	38	46
Volumetric airflow [m^3/h]	2100	2100	2100	2100	2200	2200	2200
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	39	39	39	39	39	39	39
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 40: Cooling output at full load and a ΔT air of 15 K

EN

20 kW devices 3311.600/700/800/900

Cooling output, sensible [kW]	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	20	21	21.5	22	22	22.5	23
Water volume [l/min]	23	25	28	30	33	38	42
Volumetric airflow [m^3/h]	3500	3500	3500	3500	3500	3500	3500
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	36	36	36	36	36	36	36
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 41: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	**15**	**15**	**15**	**15**	**15**	**15**	**15**
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	21	21.5	22	22	22	23	23.5
Water volume [l/min]	24	26	28	30	34	38	38
Volumetric airflow [m^3/h]	3000	3000	3000	3000	3000	3000	3000
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	24
Air inlet to LCP Hybrid [°C]	39	39	39	39	39	39	39
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 42: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	**18**	**18**	**18**	**18**	**18**	**18**	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	20	20	20	21	21	22	
Water volume [l/min]	30	34	36	40	46	55	
Volumetric airflow [m^3/h]	4200	4200	4200	4200	4200	4200	
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	
Air inlet to LCP Hybrid [°C]	36	36	36	36	36	36	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 43: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	**20**	**20**	**20**	**20**	**20**	**20**	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	20	20	21	21	21	18	
Water volume [l/min]	40	44	46	54	60	75	
Volumetric airflow [m^3/h]	4500	4500	4500	4500	4500	4500	
Air outlet from LCP Hybrid [°C]	24	24	24	24	24	24	

Tab. 44: Cooling output at full load and a ΔT air of 15 K

EN

Cooling output, sensible [kW]	20	20	20	20	20	20	
Air inlet to LCP Hybrid [°C]	39	39	39	39	39	39	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 44: Cooling output at full load and a ΔT air of 15 K

13.2.8 Cooling output at a room temperature of 25°C

10 kW devices 3311.610/710/810/910

Cooling output, sensible [kW]	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	26	25	24	24	23	23	23
Water volume [l/min]	5	6	7	8	10	12	14
Volumetric airflow [m^3/h]	1200	1200	1200	1300	1300	1300	1300
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	25
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	37
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 45: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	5	5	5	5	5	5	5
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	26	25	25	25	24	24.5	23.5
Water volume [l/min]	5	6	7	8	10	12	14
Volumetric airflow [m^3/h]	1000	1000	1000	1100	1100	1100	1100
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	25
Air inlet to LCP Hybrid [°C]	40	40	40	40	40	40	40
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 46: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	10	10	10	10	10	10	10
Inlet temperature [°C]	12	13	14	15	16	17	18
Return temperature [°C]	20	20	21	21	21.5	22	22
Water volume [l/min]	18	20	22	24	26	30	34
Volumetric airflow [m^3/h]	2400	2500	2500	2500	2500	2500	2500
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	25
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	37
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Tab. 47: Cooling output at full load and a ΔT air of 12 K

EN

Cooling output, sensible [kW]	10	10	10	10	10	10	10
Inlet temperature [°C]	12	13	14	15	16	17	16
Return temperature [°C]	20	20.5	21	21	22	22	22
Water volume [l/min]	20	22	24	26	28	32	38
Volumetric airflow [m^3/h]	2200	2200	2200	2300	2300	2300	2300
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	25
Air inlet to LCP Hybrid [°C]	40	40	40	40	40	40	40
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	**15**

Tab. 48: Cooling output at full load and a ΔT air of 15 K

20 kW devices 3311.600/700/800/900

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	21.5	22	22	23	23	23	
Water volume [l/min]	23	25	26	28	32	35	
Volumetric airflow [m^3/h]	3700	3700	3700	3700	3700	3700	
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 49: Cooling output at partial load and a ΔT air of 12 K

Cooling output, sensible [kW]	15	15	15	15	15	15	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	22	22	22.5	23	23	24	
Water volume [l/min]	24	26	28	30	32	35	
Volumetric airflow [m^3/h]	3200	3200	3200	3200	3200	3200	
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	
Air inlet to LCP Hybrid [°C]	40	40	40	40	40	40	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 50: Cooling output at partial load and a ΔT air of 15 K

Cooling output, sensible [kW]	18	18	18	18	18	18	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	21	21	22	22	22.5	22	
Water volume [l/min]	30	32	34	37	40	50	
Volumetric airflow [m^3/h]	4500	4500	4500	4500	4500	4500	
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	

Tab. 51: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	**18**	**18**	**18**	**18**	**18**	**18**	
Air inlet to LCP Hybrid [°C]	37	37	37	37	37	37	
ΔT air [K]	**12**	**12**	**12**	**12**	**12**	**12**	

Tab. 51: Cooling output at full load and a ΔT air of 12 K

Cooling output, sensible [kW]	**20**	**20**	**20**	**20**	**20**	**20**	
Inlet temperature [°C]	12	13	14	15	16	17	
Return temperature [°C]	22	22	22	22	23	23	
Water volume [l/min]	30	34	36	40	44	50	
Volumetric airflow [m^3/h]	4000	4000	4000	4000	4000	4000	
Air outlet from LCP Hybrid [°C]	25	25	25	25	25	25	
Air inlet to LCP Hybrid [°C]	40	40	40	40	40	40	
ΔT air [K]	**15**	**15**	**15**	**15**	**15**	**15**	

Tab. 52: Cooling output at full load and a ΔT air of 15 K

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13.3 Overview drawing

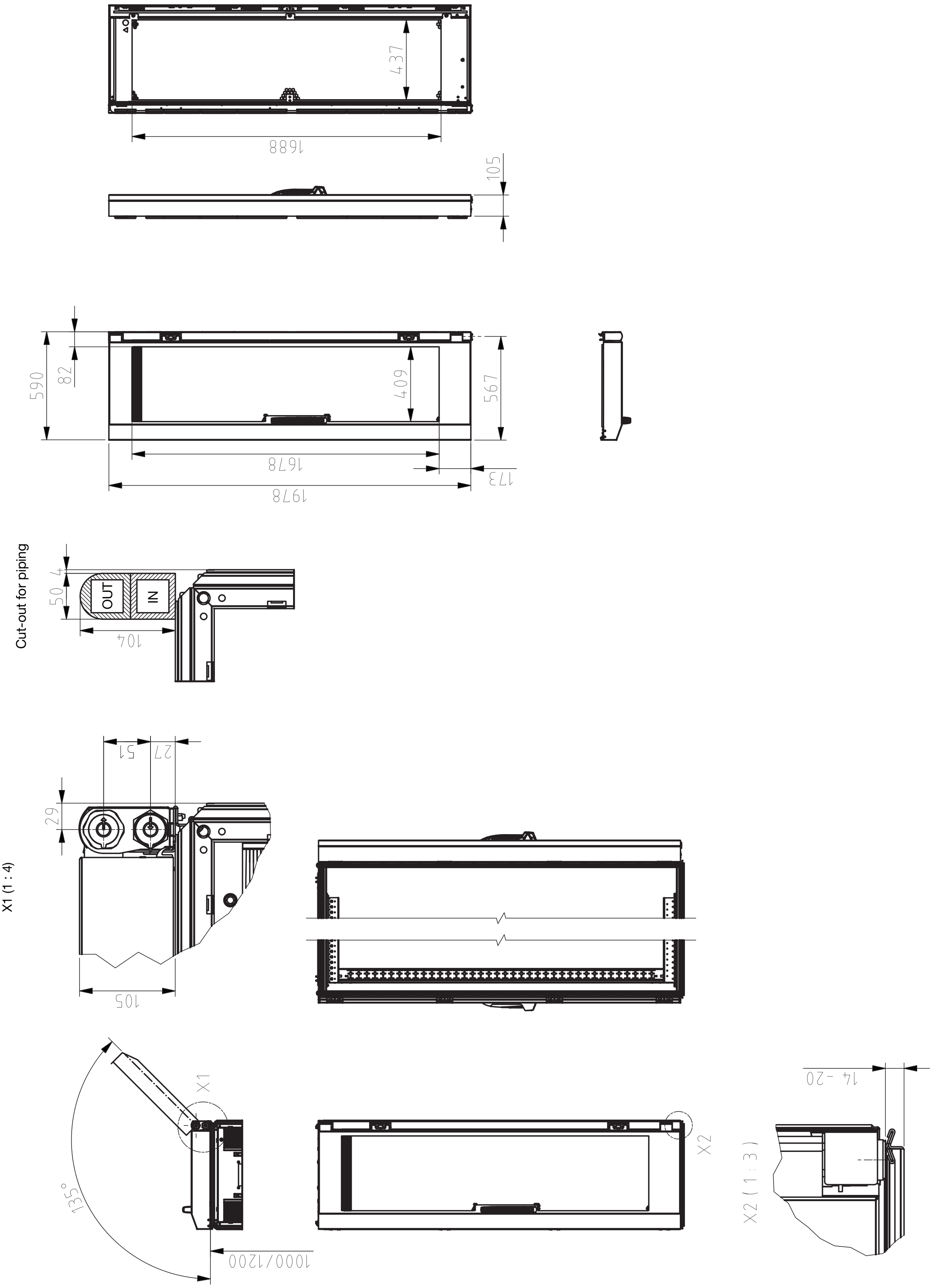

Fig. 32: Overview drawing of LCP Hybrid (600 x 2000)

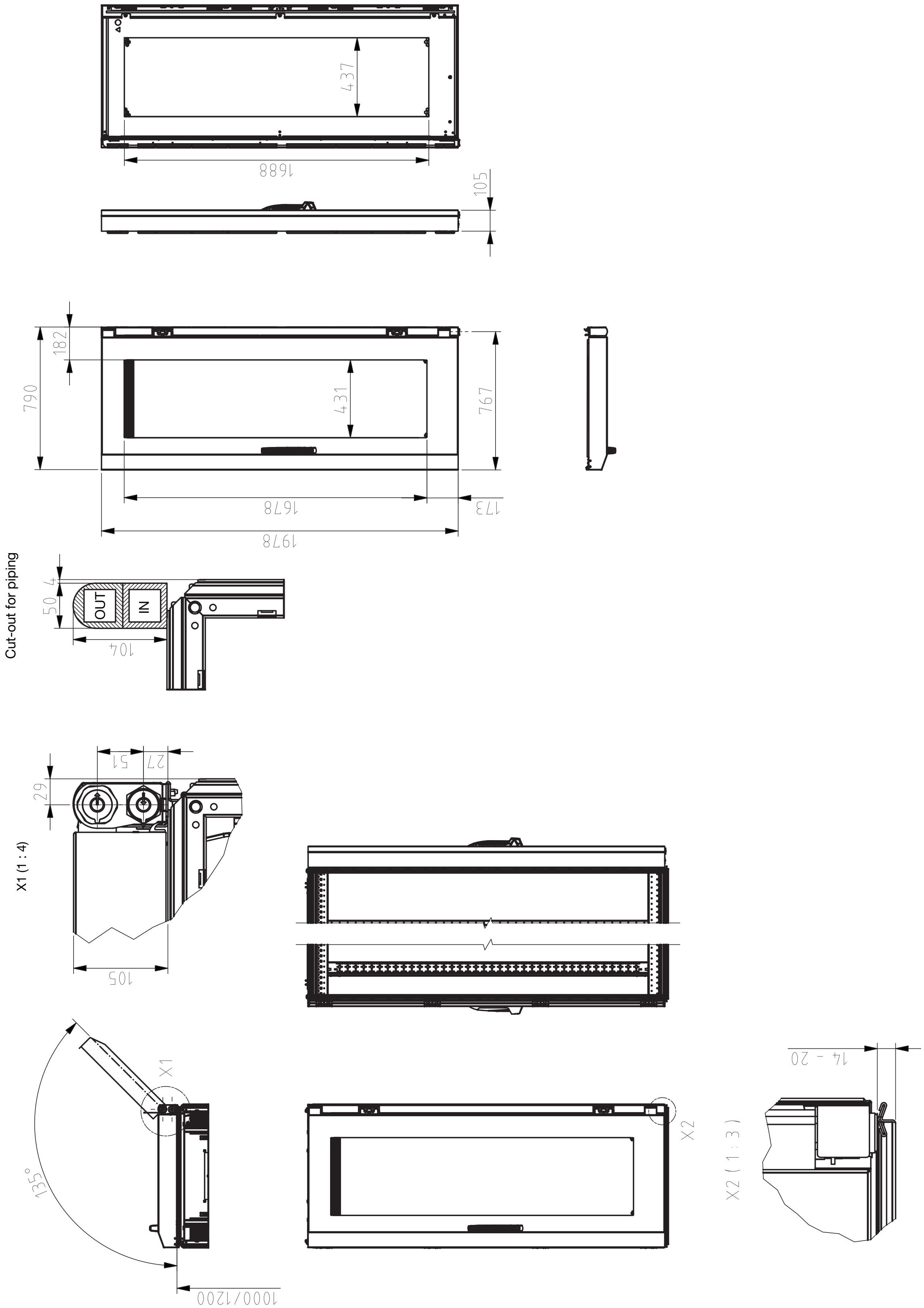

Fig. 33: Overview drawing of LCP Hybrid (800 x 2000)

EN

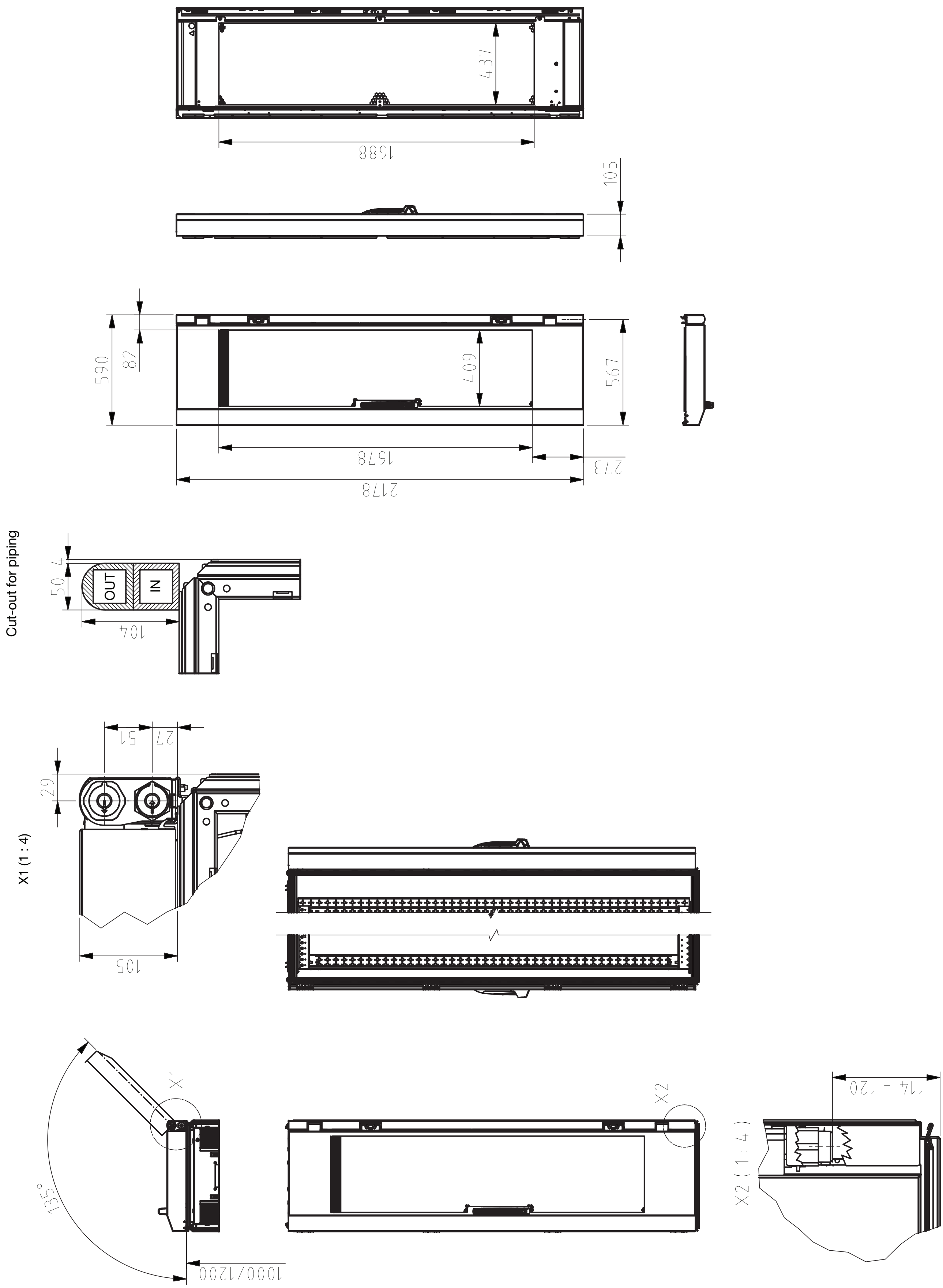

Fig. 34: Overview drawing of LCP Hybrid (600 x 2200)

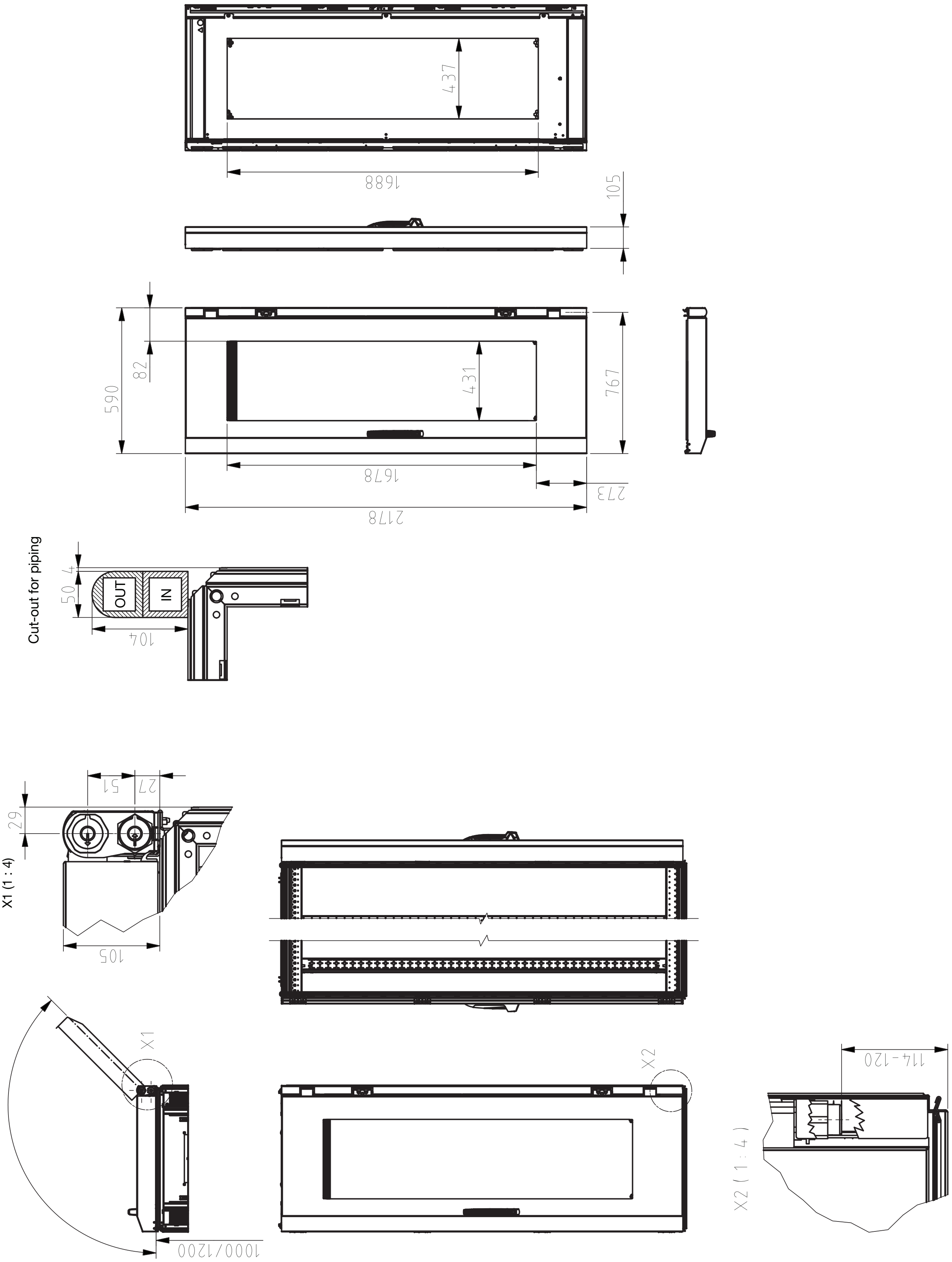

Fig. 35: Overview drawing of LCP Hybrid (800 x 2200)

14 Preparation and maintenance of the cooling medium

Depending on the type of installation to be cooled, certain purity requirements are placed on the cooling water in a recooling system. According to the level of contamination and the size and design of the recooling systems, a suitable process is used to prepare and/or maintain the water. The most common types of contamination and frequently used techniques to eliminate them in industrial cooling are:

Type of impurity	Procedure
Mechanical contamination	Filter the water using: Mesh filter, sand filter, cartridge filter, precoated filter, magnetic filter
Excessive hardness	Soften the water via ion exchange
Moderate content of mechanical contaminants and hardeners	Add stabilisers and/or dispersing agents to the water
Moderate levels of chemical contaminants	Add passifiers and/or inhibitors to the water
Biological contaminants, slime bacteria and algae	Treat the water with biocides

Tab. 53: Cooling water contaminants and treatment procedures

☞ Note:
For the proper operation of a recooling system that uses water on at least one side, the composition of any additive used or system water should not deviate substantially from hydrological data presented in section 13.1 "Hydrological information".

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15 List of spare parts

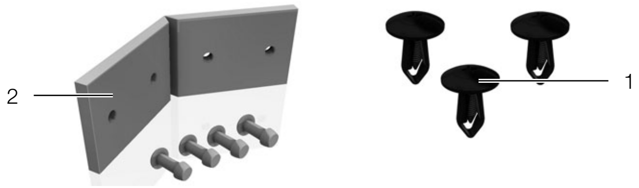

Fig. 36: Overview of spare parts

Key
1 Plastic attachment kit
2 Plastic hinge kit

Note:
As well as the spare part number, the following information must also be provided when ordering spare parts:
– Unit model
– Fabrication number
– Date of manufacture
This information can be found on the rating plate.

16 Glossary

1 U server:

1 U servers are very flat and deep, modern high performance servers, whose height corresponds to one height unit (1 U = 44.54 mm, the smallest standard height division). Typical dimensions are (W x H x D) 482.6 mm (19") x 1 U x 800 mm.

These systems normally include 2 CPUs, multiple GB of RAM and hard drives, so that they require up to 100 m^3/h cooling air at a maximum of 32°C.

482.6 mm (19") level:

The front of the devices built into the server enclosure form the 482.6 mm (19") level.

Blade server:

By orienting dual CPU systems vertically and placing up to 14 units on a common backplane to provide for signal routing and power supply, a blade server is created.

Blade servers can "generate" up to 4.5 kW heat loss per 7 U and 700 mm depth.

Hot spot:

A hot spot is the concentration of thermal energy in a small area.

Hot spots normally lead to local overheating and can cause system malfunctions.

Air/water heat exchanger:

Air/water heat exchangers operate according to the same principle as automobile radiators. A liquid (water) flows through the heat exchanger, while, at the same time, air is blown over its surface area (which is as large as possible), facilitating energy exchange.

Depending on the temperature of the circulating liquid (water), an air/water heat exchanger may either heat or cool the circulated air.

Recooling system:

As an initial comparison, a recooling system is like a refrigerator – although unlike a household refrigerator, a recooling system produces cold water via an active cooling circuit. The thermal energy which is removed from the water is dissipated to the outside by fans. Because of this, it is normally advisable to locate recooling systems outside of buildings.

Recooling systems and air/water heat exchangers form a complete cooling solution.

Switch:

Multiple servers normally communicate with one another and in the network using switches.

Because as many inputs as possible are located on the front of switches, they frequently have an airflow from the side, not "front to back" cooling.

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