

ServeCool

Energy-efficient air conditioning for data centres

Design Handbook



Hoval



ServeCool SW

3

Air-conditioning unit for indirect free cooling with fresh air in combination with adiabatic and mechanical cooling



ServeCool SWP

15

Air-conditioning unit for indirect free cooling with fresh air in combination with adiabatic and mechanical cooling, with integrated adiabatic pump



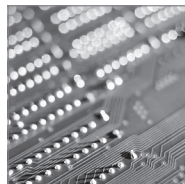
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ServeCool SW

Air-conditioning unit for indirect free cooling with fresh air in combination with adiabatic and mechanical cooling

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A

1 Use

1.1 Intended use

ServeCool SW is an air-conditioning unit for cooling data centres. It cools the IT environment indirectly with high-efficiency plate heat exchangers. This means the air in the server room is completely separated from the fresh air outside, which eliminates the possibility of dust or variations in fresh air humidity affecting highly sensitive IT equipment. The system uses the interaction of different resources for cooling with minimal energy consumption depending on the current environmental conditions:

- Indirect free cooling with fresh air
- Indirect adiabatic cooling
- Mechanical aftercooling via cooling coil (for covering load peaks)

The ServeCool SW is suitable for use in data centres with one hundred to several thousand square metres of air-conditioned IT area. The system's cooling power can be scaled up as required simply by connecting several units in series.

In order to maintain defined air humidity values in the server room, the ServeCool SW can activate an external humidifier (option).

Also included under intended use are compliance with the installation, commissioning, operating and maintenance provisions (operating instructions).

Any usage over and above this use is considered to be not as intended. The manufacturer can accept no liability for damage resulting from improper use.

1.2 User group

The unit may only be installed, operated and serviced by authorised and trained specialist personnel who are familiar with the unit and aware of the risks involved. The operating instructions are for operating engineers and technicians as well as specialists in building, heating and ventilation technology.

2 Construction and operation

The ServeCool SW has been specially designed for energy-efficient cooling of data centres. It fulfils the following functions:

- Cooling in recirculation operation (with connection to on site water supply and on site chilled water system)
- Filtering of the extract air
- Actuation of a humidifier (optional)

The unit cools in recirculation operation, which means it draws in extract air from the server room, cools it and blows it back into the room as supply air. Depending on the current temperature and humidity conditions, various cooling processes will be taking place simultaneously.

Indirect free cooling with fresh air

The unit draws in cool fresh air. This flows through the two plate heat exchangers, thereby cooling the supply air flow, and is then blown back outside.

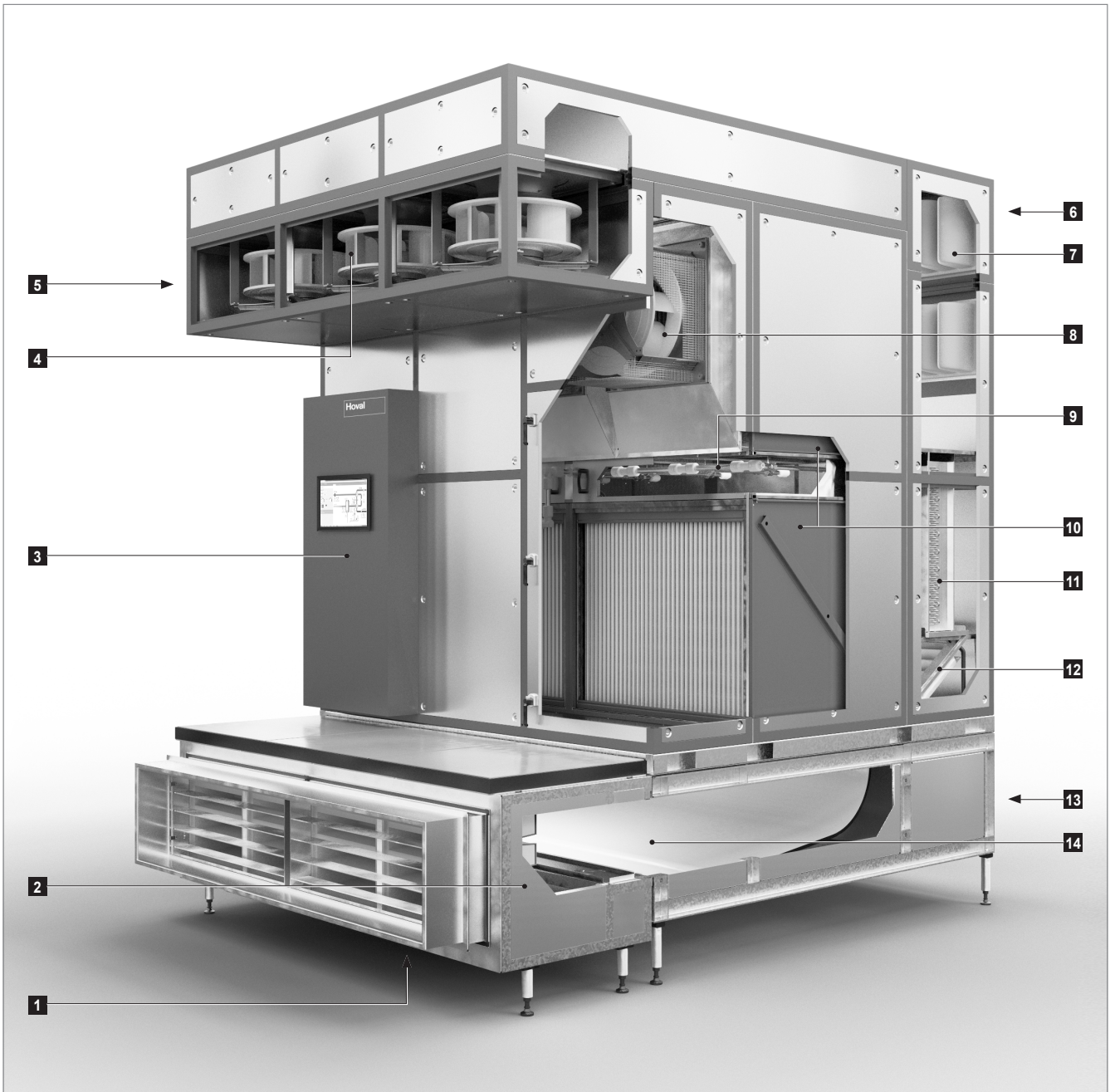
Indirect adiabatic cooling

The evaporative cooling (adiabatic system) is operating: water is sprayed into the fresh air flow. Evaporation of the water cools the air; the additional cooling capacity is transferred to the supply air via the plate heat exchanger. On site central water supply with a redundant pumping station supplies the adiabatic system with water. The pressure of the supply water is used directly at the spray nozzles for spraying the heat exchanger with water.

Mechanical aftercooling

The supply air undergoes mechanical aftercooling via a cooling coil in order to cover load peaks.

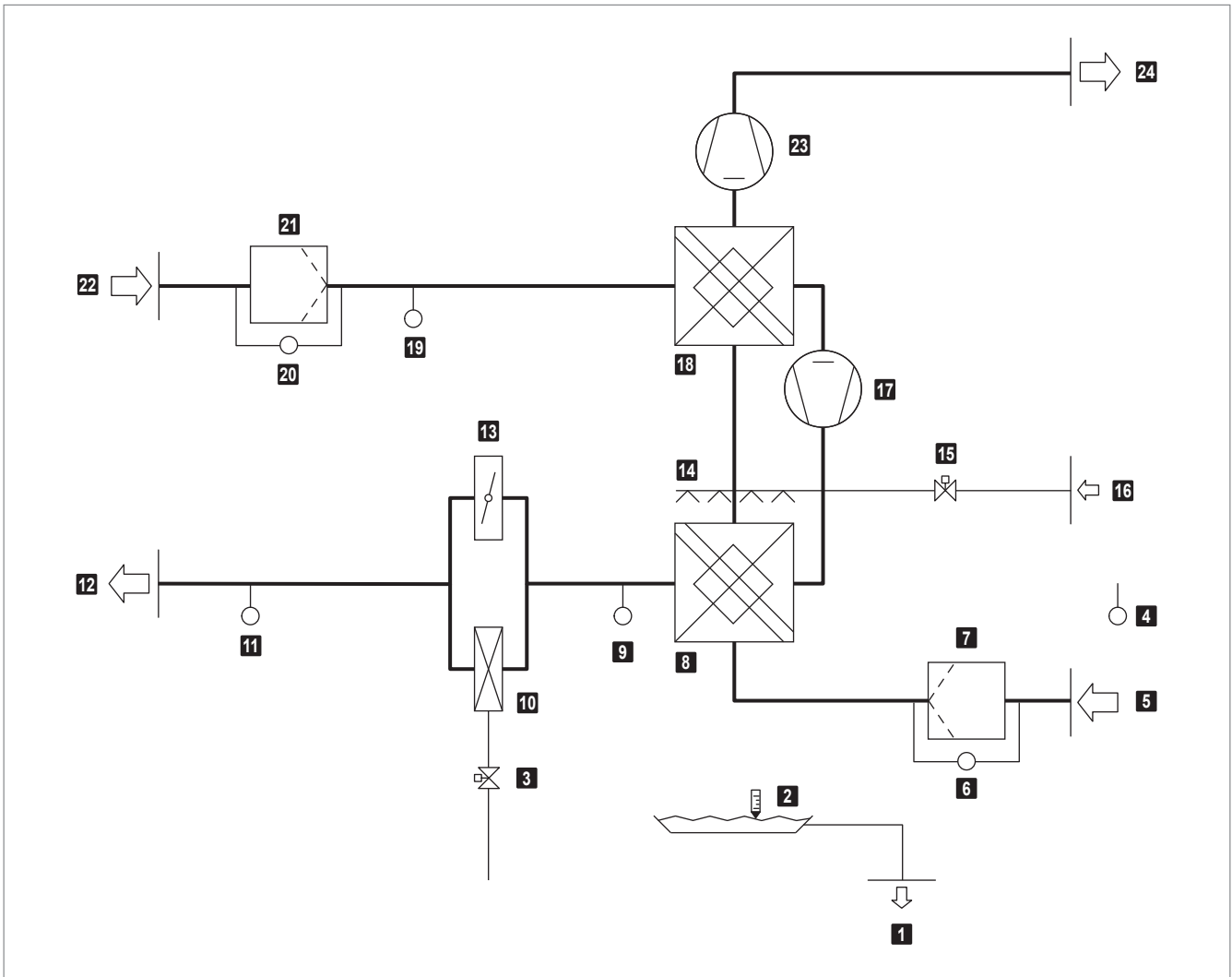
2.1 Construction



- | | |
|--------------------------------------|--------------------------------------|
| 1 Drain | 8 Supply air fans |
| 2 Fresh air box | 9 Spray nozzles |
| 3 Control box | 10 Plate heat exchangers |
| 4 Exhaust air fans | 11 Cooling coil |
| 5 Exhaust air duct connection | 12 Bypass damper |
| 6 Extract air duct connection | 13 Supply air duct connection |
| 7 Extract air filter | 14 Trough |

Fig. A1: ServeCool SW construction

2.2 Function diagram



- | | |
|---|--|
| 1 Drain | 13 Bypass damper with actuator |
| 2 Trough with liquid level switch | 14 Spray nozzles |
| 3 Cooling valve (option) | 15 Feed valve |
| 4 Fresh air combination sensor (temperature, humidity) | 16 Water supply |
| 5 Fresh air | 17 Supply air fan |
| 6 Filter monitoring fresh air (option) | 18 Plate heat exchanger 2 |
| 7 Fresh air filter (option) | 19 Extract air combination sensor (temperature, humidity) |
| 8 Plate heat exchanger 1 | 20 Filter monitoring extract air |
| 9 Energy monitoring combination sensor (temperature, humidity) | 21 Extract air filter |
| 10 Cooling coil | 22 Extract air |
| 11 Supply air combination sensor (temperature, humidity) | 23 Exhaust air fan |
| 12 Supply air | 24 Exhaust air |

Fig. A2: Function diagram

2.3 Operating modes

The ServeCool control system controls the unit according to demand and depending on the operating conditions. The integrated unit controller or higher-level building management system allow the following operating modes to be specified:

Operating mode	Description	Use
Summer operation	<p>The unit uses the following cooling processes depending on the temperature and moisture conditions:</p> <ul style="list-style-type: none"> ■ Indirect free cooling with fresh air ■ Indirect adiabatic cooling ■ Mechanical aftercooling (for covering load peaks) <p>The chiller for supplying the cooling coil and the water supply are in operation.</p>	During the hot season
Winter operation	<p>The unit uses the following cooling processes depending on the temperature and moisture conditions:</p> <ul style="list-style-type: none"> ■ Indirect free cooling with fresh air ■ Mechanical aftercooling (for covering load peaks) <p>The chiller for supplying the cooling coil is in operation. There is no need for a water supply.</p>	During the cold season and in transitional periods

Table A1: Operating modes

3 Technical data

3.1 Type code

SW - 25 / KS ...	
Unit type	ServeCool SW
Unit size	25
Cooling coil	Standard
Further options	

Table A2: Type code

3.2 Application limits

Fresh air temperature	min.	°C	-30
	max.	°C	45
Extract air temperature	max.	°C	45
Supply air temperature	min.	°C	15

Table A3: Application limits in operation

3.3 Air flow rate, electrical connection

Unit type		SW-25	
Nominal air flow rate	Supply air	m ³ /h	25750
	Fresh air	m ³ /h	22000
Electrical connection	Supply voltage	V AC	3 × 400
	Permitted voltage tolerance	%	± 10
	Frequency	Hz	50
	Current consumption (at nominal air flow rate)	A	32.4
	Power consumption (at nominal air flow rate)	kW	20.4
Extract air filter	Filter class	ISO coarse 60 %	
	Filter monitoring factory setting	Pa	200
Fresh air filter (option)	Filter class	ISO ePM ₁₀ 65 %	
	Filter monitoring factory setting	Pa	350

Table A4: Air flow rate, electrical connection

3.4 Sound level

Unit type			SW-25
Sound pressure level (at a distance of 5 m) ¹⁾		dB(A)	60
Total sound power level ²⁾		dB(A)	82
Octave sound power level	63 Hz	dB	52.4
	125 Hz	dB	72.8
	250 Hz	dB	72.5
	500 Hz	dB	70.6
	1000 Hz	dB	70.5
	2000 Hz	dB	66.2
	4000 Hz	dB	58.6
	8000 Hz	dB	48.2

1) with hemispherical radiation in a low-reflection environment (enveloping surface process)
2) determined by intensity process

Table A5: Sound level (fresh air, discharge side)



Note

To reduce the noise level at night, the speed of the exhaust air fans can be limited to an adjustable set value using the control system.

3.5 Cooling capacity

Cooling capacity	Total	120 kW
	Free and adiabatic cooling	108 kW
	Mechanical	12 kW
Operating point	Extract air conditions	38 °C / 18 %rh
	Supply air conditions	24 °C / 40 %rh
	Fresh air conditions	35 °C / 22 %rh
Cooling coil data	Supply/return temperature	14/20 °C
	Water quantity	1873 l/h
	Water pressure drop	0.44 kPa

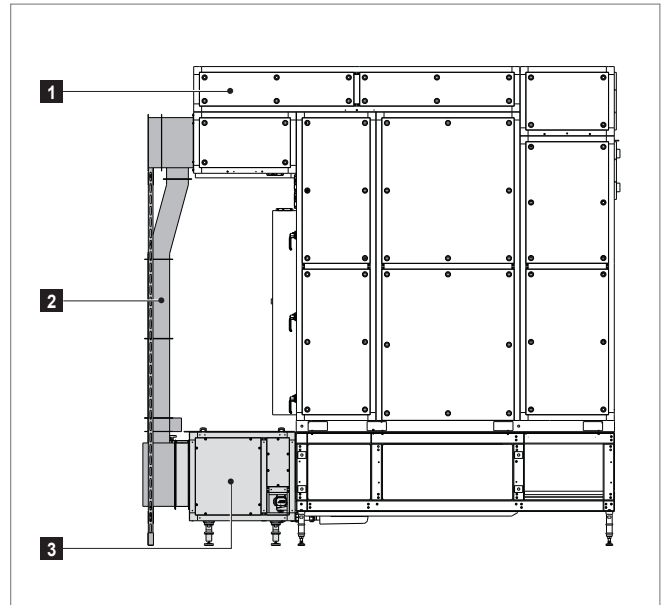
Table A6: Cooling capacity



Note

The cooling capacity varies depending on the ambient conditions. For data tables of further operating points, refer to section F 'System design'.

3.6 Dimensions and weights

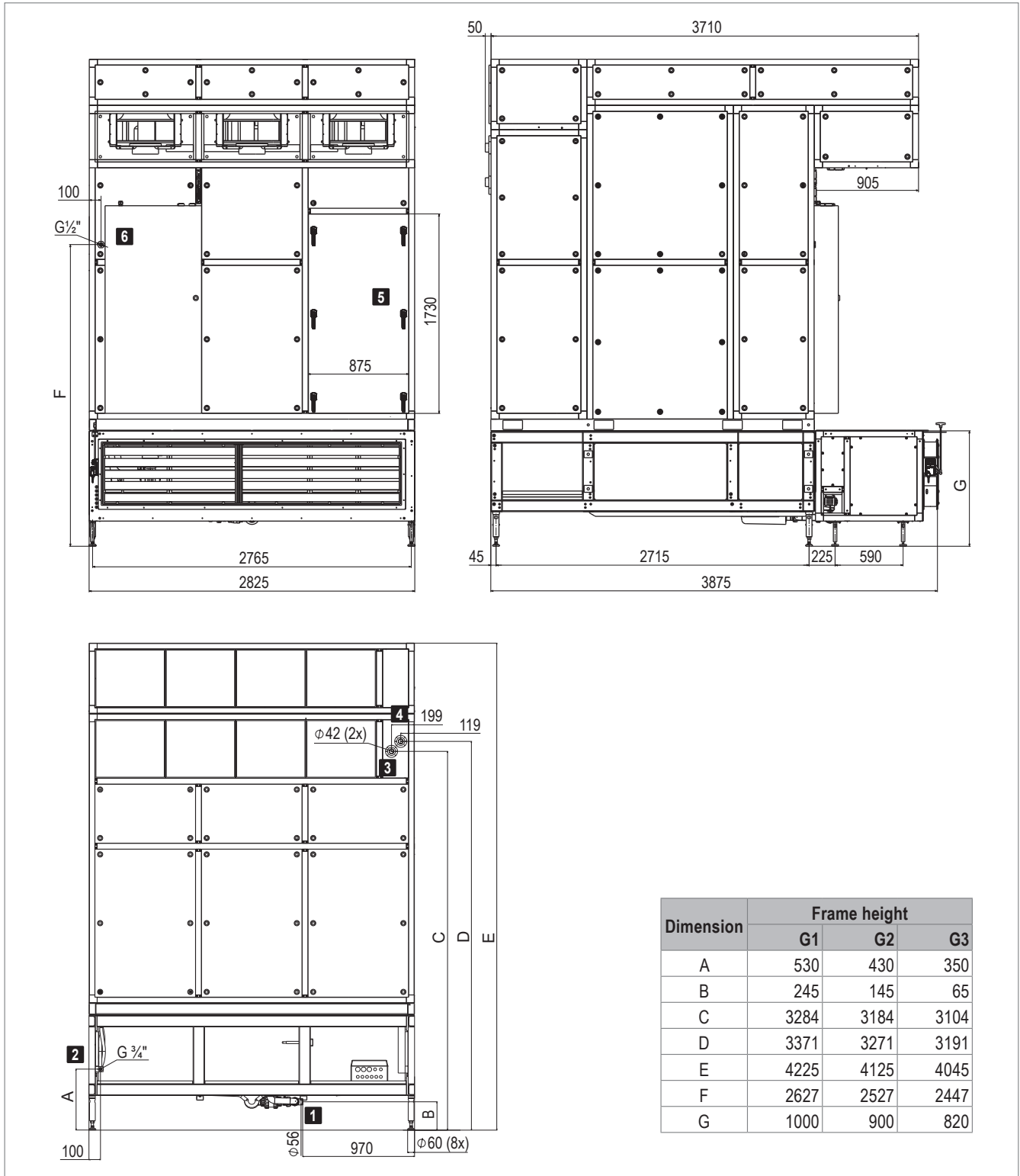


- 1 ServeCool unit
- 2 Condensation prevention system (option)
- 3 Fresh air box (option)

Fig. A3: Components

Unit type			SW-25
Components	ServeCool unit	kg	3650
	Condensation prevention system	kg	230
	Fresh air box	kg	265
Water capacity	Cooling coil	kg	40
	Trough	kg	250
Total		kg	4435

Table A7: Weights



Dimension	Frame height		
	G1	G2	G3
A	530	430	350
B	245	145	65
C	3284	3184	3104
D	3371	3271	3191
E	4225	4125	4045
F	2627	2527	2447
G	1000	900	820

- 1** Drain
- 2** Condensate connection
- 3** Cooling coil return
- 4** Cooling coil flow
- 5** Tower access door
- 6** Water supply

Fig. A4: Dimensional drawing (dimensions in mm)

4 Specification texts

ServeCool SW

Innovative air-conditioning unit for recirculation cooling in data centres subject to a high temperature load. The unit uses various cooling processes: indirect free cooling with fresh air via high-performance plate heat exchanger is supplemented by indirect adiabatic cooling as well as mechanical cooling.

The ServeCool SW consists of the following components:

- Base frame
- Tower
- Extract air box
- Exhaust air box
- Control system
- Optional components

Base frame

Support frame construction of galvanized steel sections, welded and bolted; fitted with eyelets for crane transport and installation on site.

The base frame contains:

Trough:

Fibre-glass-reinforced, insulated plastic trough with liquid level switch for monitoring the level, including integrated drain and emergency overflow.

Legs:

Adjustable legs for levelling and aligning the device on uneven surfaces.

Tower

Support frame construction of stainless-steel sections, welded.

Panel construction set up in supporting frame of aluminium sections, connected together and bolted; with insulation made of water-expanded polyurethane. The casing complies with air leakage class L3 acc. to EN 1886 and fire protection class B-s3, d0 acc. to EN 13501-1:2002.

The tower contains:

Supply air fans:

Designed as maintenance-free, direct-drive radial fans with high-efficiency EC motors, backwards-curved, 3D contoured blades and a free-running rotating wheel made of a high-performance composite material; infinitely variable (3 pieces).

2 crossflow plate heat exchangers

In waterproof design for indirect free cooling of the supply air for data centres. Exchanger package consists of epoxy-coated aluminium plates with pressed-in spacers. The plates are connected by a double fold, which gives several times the material thickness at the air entry and exit. The corners of the exchanger package are cast into the extruded aluminium hollow sections of the casing with a sealing compound to form a water-tight seal. The stainless steel side walls have a high-quality paint coating and are bolted flush with the above and sealed to make them water-tight. Thus the exchangers are resistant to pressures up to 2500 Pa.

Accumulating condensate is collected in a stainless-steel channel and drained outside by a hose trap. The crossflow plate heat exchangers are Eurovent-certified and achieve efficiency class H1 to EN 13053.

Adiabatic system:

Spray humidifier comprising pipes and tangential full cone nozzles, made of a fully demineralised water-resistant plastic, mounted in a stainless-steel frame; activated by a valve with actuator and limit switches; pressure-resistant up to 16 bar (corresponding to DIN EN 12201-2). The connection system is certified according to DVGW guidelines.

Cooling coil:

Comprising copper pipes and aluminium fins with collecting channel for condensate drain made from stainless steel; hose trap with connection to trap of plate heat exchanger. The condensation drain is supplied by the client.

Bypass damper:

Lamellar damper for directing the supply air flow through the cooling coil or the bypass; including actuator with open/closed feedback. The damper fulfils leakage class 2 according to DIN EN 1751. Channelling the air through the bypass minimises the air-side pressure drop when no mechanical cooling is required.

Access opening:

Tower access door: large access opening for easy access to the supply air fans, the crossflow plate heat exchangers and to the components of the adiabatic system for maintenance.

Control box with unit controller as part of the ServeCool control system:

- Control box made of sheet steel, powder-coated with textured paint in Hoval red (RAL 3000).
- Unit controller wired ready-to-connect for the following components:
 - Supply air fans
 - Exhaust air fans
 - Feed valve
 - Liquid level switch
 - Cooling valve
 - Bypass damper actuator
 - Extract air combination sensor (temperature, humidity)
 - Energy monitoring combination sensor (temperature, humidity)
 - Supply air combination sensor (temperature, humidity)
 - Fresh air combination sensor (temperature, humidity)
 - Filter monitoring extract air
 - Filter monitoring fresh air
- Volt-free signalling contacts
- Pre-wired network connection to spring-type terminals
- Network connection socket with pre-laid Cat.6A patch cable pre-installed in control box
- Accessible cable feed-through system, consisting of plate and inserts

Extract air box

Support frame construction of aluminium sections, attached and bolted, insulated panel construction.

The extract air box contains:

Extract air filter:

Configured as a ISO coarse 60% bag filter, including differential pressure switches for filter monitoring.

Exhaust air box

Support frame construction of aluminium sections, attached and bolted, insulated panel construction.

The exhaust air box contains:

Exhaust air fans:

Designed as maintenance-free, direct-drive radial fans with high-efficiency EC motors, backwards-curved, 3D contoured blades and a free-running rotating wheel made of a high-performance composite material; infinitely variable (3 pieces).

Options for the unit

Extract air filter AM:

Extract air filter configured as ISO ePM₁₀ 65% compact filter instead of ISO coarse 60%, for optimised filtering of the recirculated air.

Frame height:

Modified height of the base frame for adapting to the structure of the false floor (820 mm or 900 mm).

Cooling valve:

Non-pressure dependent compensating and control valve as automatic combination valve for control and hydraulic balancing, comprising linear control valve, pressure controller with integrated diaphragm and actuator.

Fresh air box:

Support frame construction of aluminium sections, attached and bolted, insulated panel construction; fitted with eyelets for crane transport and assembly on site.

For directly connecting the fresh air intake to the ServeCool unit; equipped with adjustable feet for adapting to the frame height. The fresh air box contains the fresh air filter, configured as a ISO ePM₁₀ 65% compact filter and the fresh air damper for closing the fresh air opening during maintenance work.

Condensation prevention system:

Mixed air duct made from Sendzimir-galvanised sheet steel; insulated in the area in direct contact with fresh air; with 1 P30 flange each for exhaust air and fresh air duct connection; includes 2 dampers with continuous actuators; mixed air duct supported on site by mounting rails.

The control function is integrated in the control system; an additional combination sensor (temperature, humidity) is installed in the fresh air box to measure the air intake temperature in the plate heat exchanger.

 ServeCool control system

Control system for the energy-optimised operation of Hoval ServeCool, designed as a decentralised system, with the following main features:

- Unit controller integrated in the control box for autonomous and individual control of each unit, with continuous measurement of all relevant parameters and alarm management. The unit controller has the following properties:
 - 32-bit CPU
 - Data transfer rates of 10/100 Mbps, auto-negotiation and auto-MDI(X)
 - Separate Ethernet interfaces with 2 MAC IDs
 - Programming compliant with IEC 61131-3
 - Extra storage via SD card
 - Transfer performance: Class D acc. to EN 50173
 - Bus connection: 2 x RJ-45
 - Protocols: EtherNet/IP, Modbus/TCP (UDP)
- Visualisation and intuitive operation of the unit via the integrated web application with graphical user interface (web GUI), which enables fast access to the individual data points via structured grouping. Any web browser can be used for access via the interface directly on the unit.
- Every control component is simply to be replaced in the event of a fault as only standard components are used.
- Possibility of visualisation, set value specification, alarm management, group switching or maintenance management via a building management system; simple connection of the units via the BMS interface (option).
- Simple integration into the Datacenter Infrastructure Management (DCIM).
- Automatic switchover to local operation in the event of communication failure or a fault with the BMS; the control functionality is retained.
- Switch for manual switchover between local operation and BMS operation.
- Combination sensor (temperature, humidity): 4...20 mA interfaces with monitoring of the life zero point for low breakdown susceptibility.
- When carrying out maintenance, the building infrastructure (Ethernet) is not required as ServeCool has its own service port on the control panel which is not connected to the building network.
- The following control functions are performed by the unit controller:
 - Control of the supply air temperature with extract air temperature limiting and fixed setting of the supply air volume flow
 - Fire control: Connection for an external signal to shut the plant down in the event of a fire
- Units are fully prewired, tested and ready to be connected
- Electrical documentation supplied in the control box

 Options for the control system

Source changeover:

For redundant power supply, it is possible to switch over between two alternative electrical power supply pathways. The switchover time between the two power supplies can be adjusted in seconds. The switchover only takes place if the phase sequence check and phase monitoring enable the switching. The voltage supply for the controller is maintained during the switchover.

Actuation of humidifier type 1:

Electrical components installed in the control box and fully prewired for actuation of an ultrasound humidifier with approx. 5 kg/h humidification performance.

Actuation of humidifier type 2:

Electrical components and software interface for transmission of signals between the Hoval ServeCool and an external humidifier (e.g. 0...10 V or 0...20 mA); electrical components installed in the control box and fully prewired.

Protection module:

Surge voltage protection for protecting the unit against surge voltages from atmospheric discharges and switching operations.

Control box with BMS interface

For a simple, secure connection between the control system and the building management system. The following components are installed in the control box:

- Main switch
- Controller
- Switch with 16 ports
- Fuse for power supply unit
- Socket for service laptop
- Voltage monitoring for power supply
- CAT6a network structure
- Physical separation of the networks

Technical data

- Nominal air flow rate supply air: _____ m³/h
- Nominal air flow rate fresh air: _____ m³/h
- Cooling capacity: _____ kW
 - at supply air temperature: _____ °C
 - at supply air humidity: _____ %rh
 - at fresh air temperature: _____ °C
 - at fresh air humidity: _____ %rh

Dimensions

- ServeCool (footprint x height): 3875 × 2825 × 4225 mm
- Maintenance area supply air side: 2825 × 1000 mm
- Maintenance area fresh air side: 2825 × 1200 mm

Weight

ServeCool: 4435 kg

Electrical connection

- Supply voltage: 3 × 400 VAC / 50 Hz
- Current consumption: max. 32.4 A
- Power consumption: max. 20.4 kW

Sound data

- Sound pressure level at 5 m distance from unit: 60 dB(A)
- Total sound power level: 82 dB(A)

Plate heat exchangers

- Fresh air temperature at free cooling limit: _____ °C
- Fresh air relative humidity: _____ %rh
- Extract air temperature: _____ °C
- Extract air relative humidity: _____ %rh
- Heat recovery efficiency dry fresh air side/extract air side at nominal air flow rate: _____ / _____ %
- Pressure drop fresh air side/extract air side at nominal air flow rate: _____ / _____ Pa

Technical data cooling coil

- Cooling capacity, total: _____ kW
- Cooling capacity, sensitive: _____ kW
- Flow/return: _____ / _____ °C
- Supply air temperature: _____ °C
 - for inlet temperature: _____ °C
 - with rel. inlet humidity: _____ %rh
- Operating pressure: _____ kPa



ServeCool SWP

Air-conditioning unit for indirect free cooling with fresh air in combination with adiabatic and mechanical cooling, with integrated adiabatic pump

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B

1 Use

1.1 Intended use

ServeCool SWP is an air-conditioning unit for cooling data centres. It cools the IT environment indirectly with high-efficiency plate heat exchangers. This means the air in the server room is completely separated from the fresh air outside, which eliminates the possibility of dust or variations in fresh air humidity affecting highly sensitive IT equipment. The system uses the interaction of different resources for cooling with minimal energy consumption depending on the current environmental conditions:

- Indirect free cooling with fresh air
- Indirect adiabatic cooling
- Mechanical aftercooling via cooling coil (for covering load peaks)

The ServeCool SWP is suitable for use in data centres with one hundred to several thousand square metres of air-conditioned IT area. The system's cooling power can be scaled up as required simply by connecting several units in series.

In order to maintain defined air humidity values in the server room, the ServeCool SWP can activate an external humidifier (option).

Also included under intended use are compliance with the installation, commissioning, operating and maintenance provisions (operating instructions).

Any usage over and above this use is considered to be not as intended. The manufacturer can accept no liability for damage resulting from improper use.

1.2 User group

The unit may only be installed, operated and serviced by authorised and trained specialist personnel who are familiar with the unit and aware of the risks involved. The operating instructions are for operating engineers and technicians as well as specialists in building, heating and ventilation technology.

2 Construction and operation

The ServeCool SWP has been specially designed for energy-efficient cooling of data centres. It fulfils the following functions:

- Cooling in recirculation operation (with connection to on site water supply and on site chilled water system)
- Filtering of the extract air
- Actuation of a humidifier (optional)

The unit cools in recirculation operation, which means it draws in extract air from the server room, cools it and blows it back into the room as supply air. Depending on the current temperature and humidity conditions, various cooling processes will be taking place simultaneously.

Indirect free cooling with fresh air

The unit draws in cool fresh air. This flows through the two plate heat exchangers, thereby cooling the supply air flow, and is then blown back outside.

Indirect adiabatic cooling

The evaporative cooling (adiabatic system) is operating: water is sprayed into the fresh air flow. Evaporation of the water cools the air; the additional cooling capacity is transferred to the supply air via the plate heat exchanger.

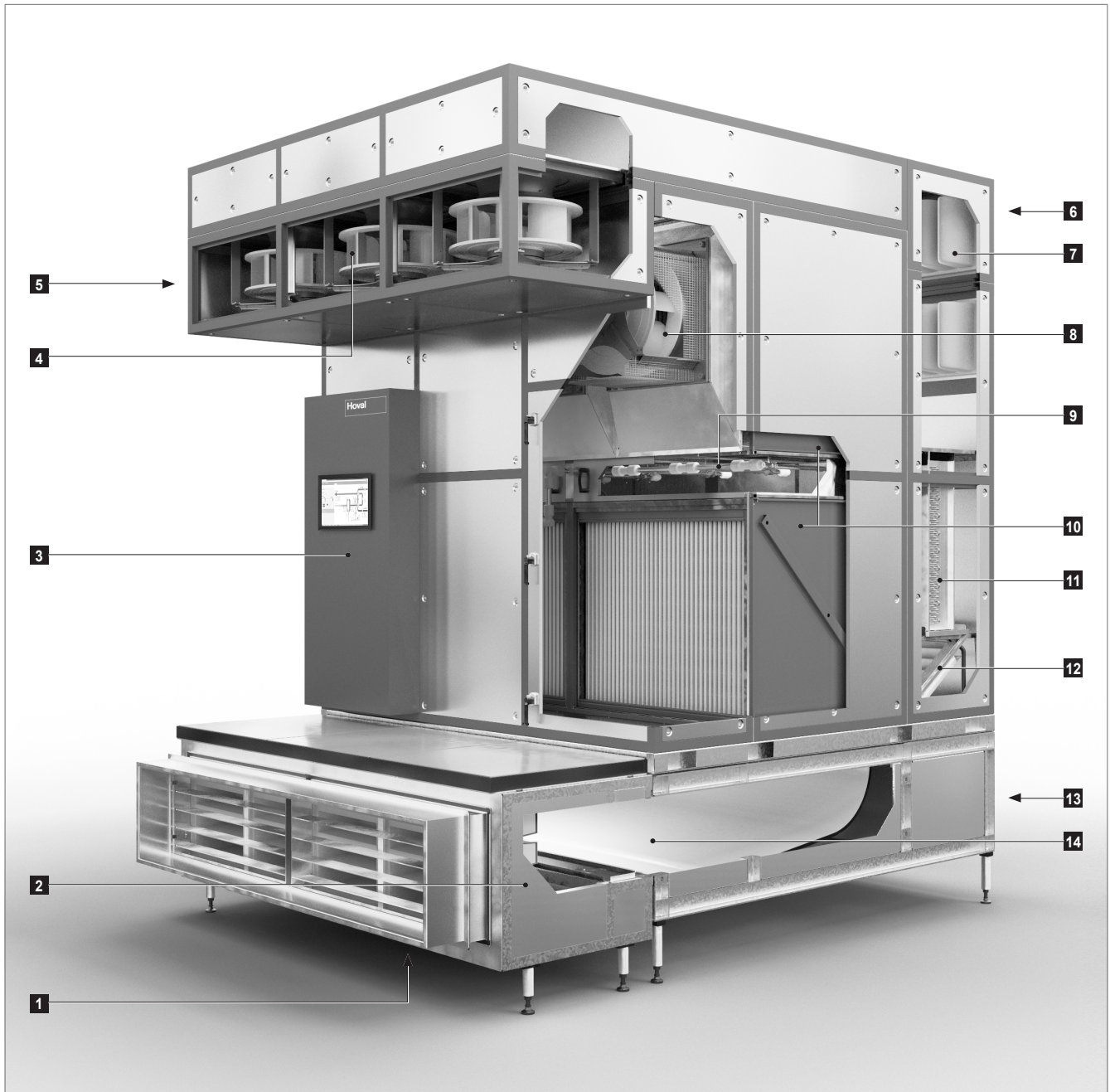
A circulating water pump integrated in the unit supplies the adiabatic system with water. This means the spray nozzles are independent from the supply pressure of the water supply in the building.

The water supply and discharge pipe on site can be configured with a smaller size than for the ServeCool SW, because the sludge removal of the trough can be enabled by the control for each individual unit.

Mechanical aftercooling

The supply air undergoes mechanical aftercooling via a cooling coil in order to cover load peaks.

2.1 Construction



1 Drain valve with drain

2 Fresh air box

3 Control box

4 Exhaust air fans

5 Exhaust air duct connection

6 Extract air duct connection

7 Extract air filter

8 Supply air fans

9 Spray nozzles

10 Plate heat exchangers

11 Cooling coil

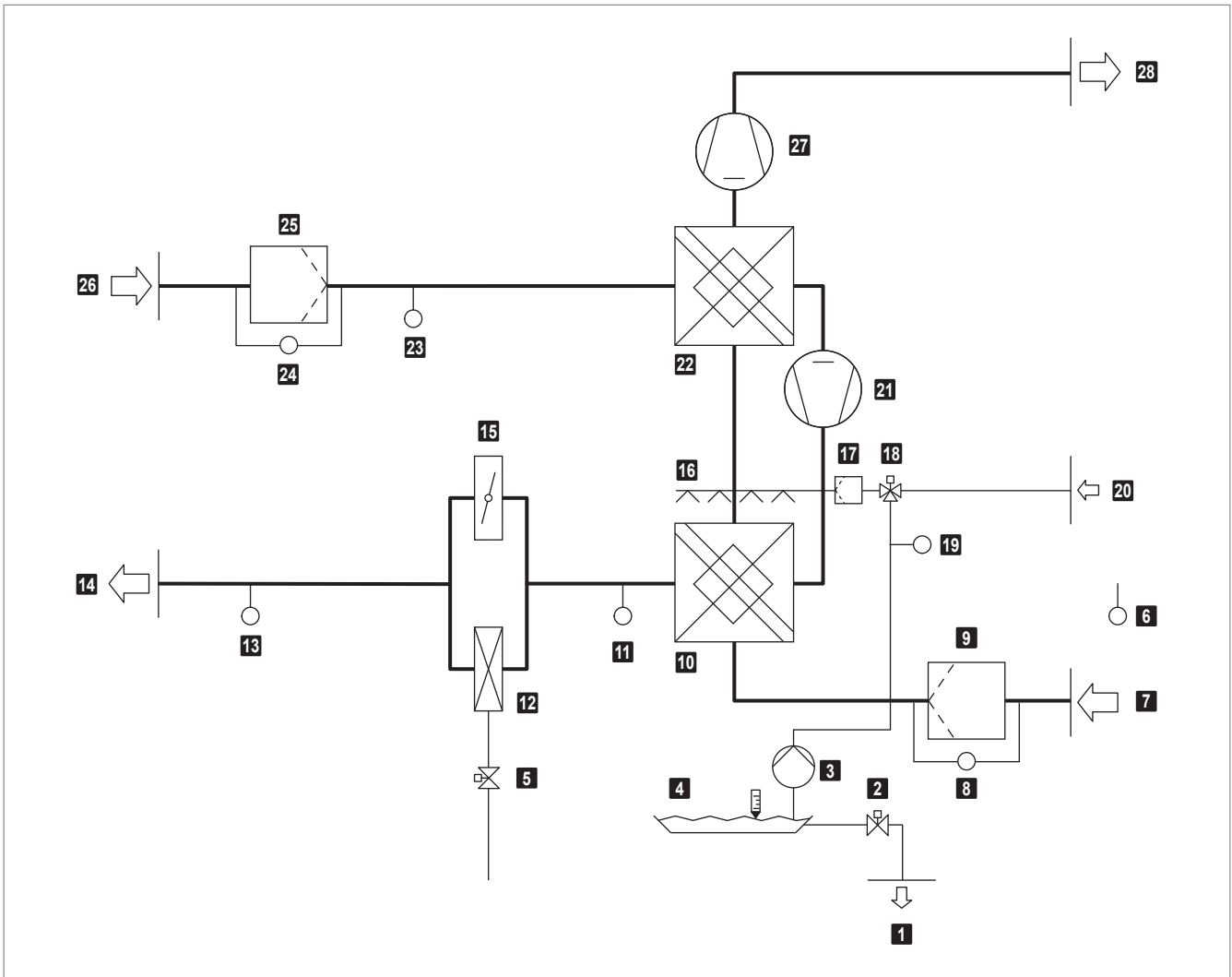
12 Bypass damper

13 Supply air duct connection

14 Adiabatic pump and trough

Fig. B1: ServeCool SWP construction

2.2 Function diagram



- | | |
|--|--|
| 1 Drain | 15 Bypass damper with actuator |
| 2 Drain valve | 16 Spray nozzles |
| 3 Adiabetic pump | 17 Water filter |
| 4 Trough with liquid level switch | 18 Feed valve |
| 5 Cooling valve (option) | 19 Conductance measurement |
| 6 Fresh air combination sensor (temperature, humidity) | 20 Water supply |
| 7 Fresh air | 21 Supply air fan |
| 8 Filter monitoring fresh air (option) | 22 Plate heat exchanger 2 |
| 9 Fresh air filter (option) | 23 Extract air combination sensor (temperature, humidity) |
| 10 Plate heat exchanger 1 | 24 Filter monitoring extract air |
| 11 Energy monitoring combination sensor (temperature, humidity) | 25 Extract air filter |
| 12 Cooling coil | 26 Extract air |
| 13 Supply air combination sensor (temperature, humidity) | 27 Exhaust air fan |
| 14 Supply air | 28 Exhaust air |

Fig. B2: Function diagram

2.3 Operating modes

The ServeCool control system controls the unit according to demand and depending on the operating conditions. The integrated unit controller or higher-level building management system allow the following operating modes to be specified:

Operating mode	Description	Use
Summer operation	<p>The unit uses the following cooling processes depending on the temperature and moisture conditions:</p> <ul style="list-style-type: none"> ■ Indirect free cooling with fresh air ■ Indirect adiabatic cooling ■ Mechanical aftercooling (for covering load peaks) <p>The chiller for supplying the cooling coil and the water supply are in operation.</p>	During the hot season
Winter operation	<p>The unit uses the following cooling processes depending on the temperature and moisture conditions:</p> <ul style="list-style-type: none"> ■ Indirect free cooling with fresh air ■ Mechanical aftercooling (for covering load peaks) <p>The chiller for supplying the cooling coil is in operation. There is no need for a water supply.</p>	During the cold season and in transitional periods

Table B1: Operating modes

3 Technical data

3.1 Type code

SWP - 25 / KS ...	
Unit type	ServeCool SWP
Unit size	25
Cooling coil	Standard
Further options	

Table B2: Type code

3.2 Application limits

Fresh air temperature	min.	°C	-30
	max.	°C	45
Extract air temperature	max.	°C	45
Supply air temperature	min.	°C	15

Table B3: Application limits in operation

3.3 Air flow rate, electrical connection

Unit type		SWP-25	
Nominal air flow rate	Supply air	m ³ /h	25750
	Fresh air	m ³ /h	22000
Electrical connection	Supply voltage	V AC	3 × 400
	Permitted voltage tolerance	%	± 10
	Frequency	Hz	50
	Current consumption (at nominal air flow rate)	A	34.4
	Power consumption (at nominal air flow rate)	kW	21.2
Extract air filter	Filter class	ISO coarse 60 %	
	Filter monitoring factory setting	Pa	200
Fresh air filter (option)	Filter class	ISO ePM ₁₀ 65 %	
	Filter monitoring factory setting	Pa	350

Table B4: Air flow rate, electrical connection

3.4 Sound level

Unit type			SWP-25
Sound pressure level (at a distance of 5 m) ¹⁾		dB(A)	60
Total sound power level ²⁾		dB(A)	82
Octave sound power level	63 Hz	dB	52.4
	125 Hz	dB	72.8
	250 Hz	dB	72.5
	500 Hz	dB	70.6
	1000 Hz	dB	70.5
	2000 Hz	dB	66.2
	4000 Hz	dB	58.6
	8000 Hz	dB	48.2

1) with hemispherical radiation in a low-reflection environment (enveloping surface process)
2) determined by intensity process

Table B5: Sound level (fresh air, discharge side)



Note

To reduce the noise level at night, the speed of the exhaust air fans can be limited to an adjustable set value using the control system.

3.5 Cooling capacity

Cooling capacity	Total	120 kW
	Free and adiabatic cooling	108 kW
	Mechanical	12 kW
Operating point	Extract air conditions	38 °C / 18 %rh
	Supply air conditions	24 °C / 40 %rh
	Fresh air conditions	35 °C / 22 %rh
Cooling coil data	Supply/return temperature	14/20 °C
	Water quantity	1873 l/h
	Water pressure drop	0.44 kPa

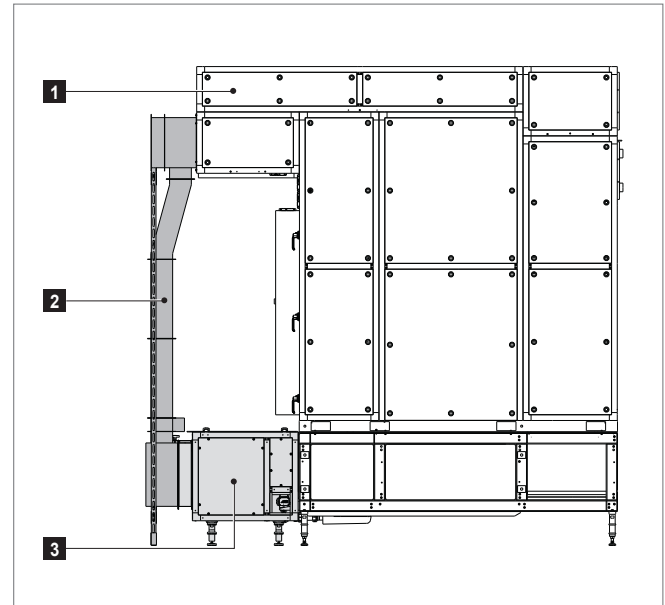
Table B6: Cooling capacity



Note

The cooling capacity varies depending on the ambient conditions. For data tables of further operating points, refer to section F 'System design'.

3.6 Dimensions and weights



- 1 ServeCool unit
- 2 Condensation prevention system (option)
- 3 Fresh air box (option)

Fig. B3: Components

Unit type			SWP-25
Components	ServeCool unit	kg	3700
	Condensation prevention system	kg	230
	Fresh air box	kg	265
Water capacity	Cooling coil	kg	40
	Trough	kg	250
Total		kg	4485

Table B7: Weights

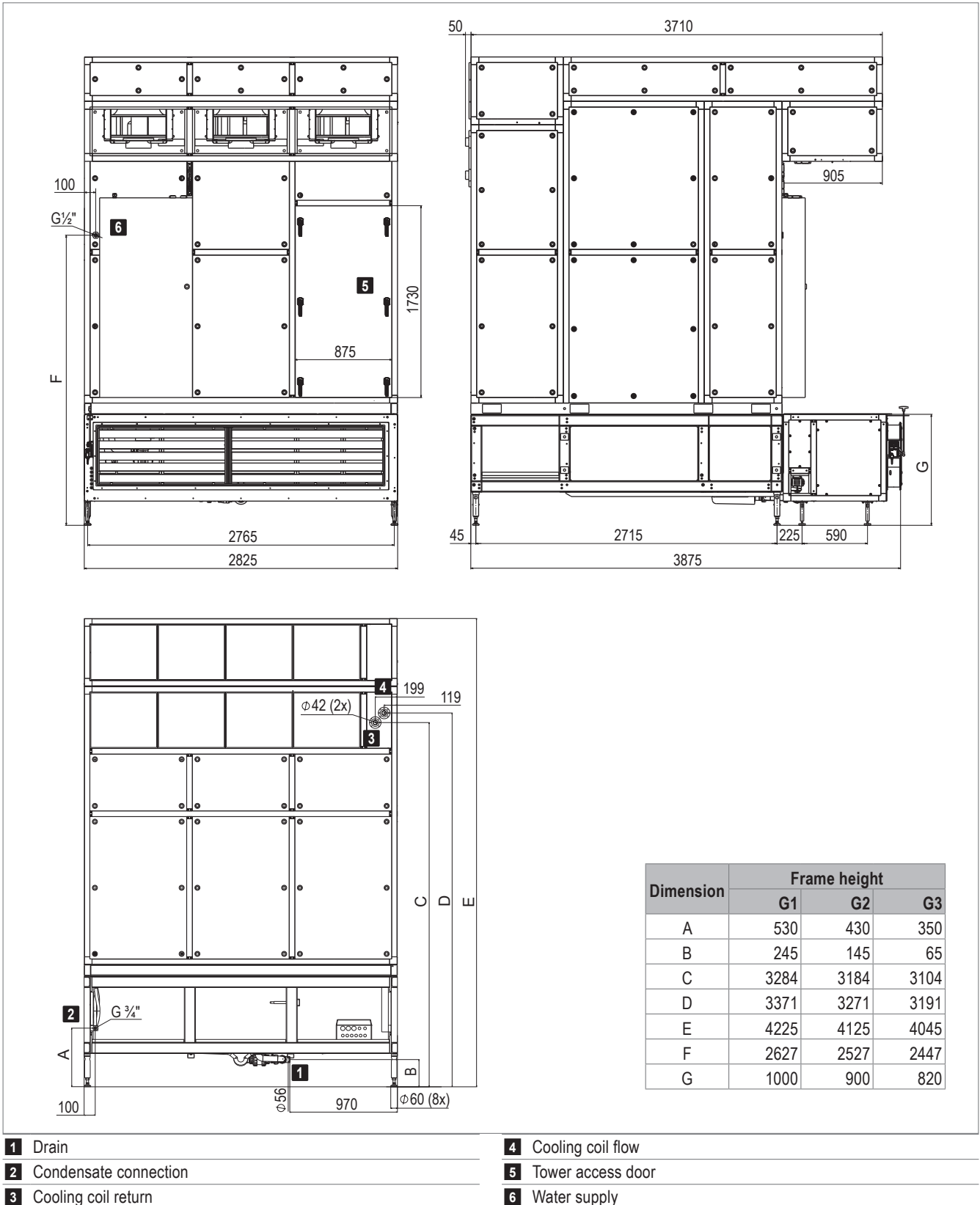


Fig. B4: Dimensional drawing (dimensions in mm)

4 Specification texts

ServeCool SWP

Innovative air-conditioning unit for recirculation cooling in data centres subject to a high temperature load. The unit uses various cooling processes: indirect free cooling with fresh air via high-performance plate heat exchanger is supplemented by indirect adiabatic cooling as well as mechanical cooling.

The ServeCool SWP consists of the following components:

- Base frame
- Tower
- Extract air box
- Exhaust air box
- Control system
- Optional components

Base frame

Support frame construction of galvanized steel sections, welded and bolted; fitted with eyelets for crane transport and installation on site.

The base frame contains:

Trough:

Fibre-glass-reinforced, insulated plastic trough with liquid level switch for monitoring the level, including integrated drain and emergency overflow.

Adiabatic pump:

Configured as high-performance centrifugal pump with fully demineralised water-resistant plastic housing and open impeller. Configuration with stainless steel shaft without seal, only mounted in the motor.

Legs:

Adjustable legs for levelling and aligning the device on uneven surfaces.

Tower

Support frame construction of stainless-steel sections, welded.

Panel construction set up in supporting frame of aluminium sections, connected together and bolted; with insulation made of water-expanded polyurethane. The casing complies with air leakage class L3 acc. to EN 1886 and fire protection class B-s3, d0 acc. to EN 13501-1:2002.

The tower contains:

Supply air fans:

Designed as maintenance-free, direct-drive radial fans with high-efficiency EC motors, backwards-curved, 3D contoured blades and a free-running rotating wheel made of a high-performance composite material; infinitely variable (3 pieces).

2 crossflow plate heat exchangers

In waterproof design for indirect free cooling of the supply air for data centres. Exchanger package consists of epoxy-coated aluminium plates with pressed-in spacers. The plates are connected by a double fold, which gives several times the material thickness at the air entry and exit. The corners of the exchanger package are cast into the extruded aluminium hollow sections of the casing with a sealing compound to form a water-tight seal. The stainless steel side walls have a high-quality paint coating and are bolted flush with the above and sealed to make them water-tight. Thus the exchangers are resistant to pressures up to 2500 Pa.

Accumulating condensate is collected in a stainless-steel channel and drained outside by a hose trap. The crossflow plate heat exchangers are Eurovent-certified and achieve efficiency class H1 to EN 13053.

Adiabatic system:

Spray humidifier comprising pipes and tangential full cone nozzles, made of a fully demineralised water-resistant plastic, mounted in a stainless-steel frame; activated by a valve with actuator and limit switches; pressure-resistant up to 16 bar (corresponding to DIN EN 12201-2). The connection system is certified according to DVGW guidelines. A fine water filter is installed in the supply line to the tangential full cone nozzles.

Cooling coil:

Comprising copper pipes and aluminium fins with collecting channel for condensate drain made from stainless steel; hose trap with connection to trap of plate heat exchanger. The condensation drain is supplied by the client.

Bypass damper:

Lamellar damper for directing the supply air flow through the cooling coil or the bypass; including actuator with open/closed feedback. The damper fulfils leakage class 2 according to DIN EN 1751. Channelling the air through the bypass minimises the air-side pressure drop when no mechanical cooling is required.

Access opening:

Tower access door: large access opening for easy access to the supply air fans, the crossflow plate heat exchangers and to the components of the adiabatic system for maintenance.

Control box with unit controller as part of the ServeCool control system:

- Control box made of sheet steel, powder-coated with textured paint in Hoval red (RAL 3000).
- Unit controller wired ready-to-connect for the following components:
 - Supply air fans
 - Exhaust air fans
 - Feed valve
 - Drain valve
 - Conductance measurement
 - Adiabatic pump
 - Liquid level switch
 - Cooling valve
 - Bypass damper actuator
 - Extract air combination sensor (temperature, humidity)
 - Energy monitoring combination sensor (temperature, humidity)
 - Supply air combination sensor (temperature, humidity)
 - Fresh air combination sensor (temperature, humidity)
 - Filter monitoring extract air
 - Filter monitoring fresh air
- Volt-free signalling contacts
- Pre-wired network connection to spring-type terminals
- Network connection socket with pre-laid Cat.6A patch cable pre-installed in control box
- Accessible cable feed-through system, consisting of plate and inserts

Extract air box

Support frame construction of aluminium sections, attached and bolted, insulated panel construction.

The extract air box contains:

Extract air filter:

Configured as a ISO coarse 60% bag filter, including differential pressure switches for filter monitoring.

Exhaust air box

Support frame construction of aluminium sections, attached and bolted, insulated panel construction.

The exhaust air box contains:

Exhaust air fans:

Designed as maintenance-free, direct-drive radial fans with high-efficiency EC motors, backwards-curved, 3D contoured blades and a free-running rotating wheel made of a high-performance composite material; infinitely variable (3 pieces).

Options for the unit

Extract air filter AM:

Extract air filter configured as ISO ePM₁₀ 65% compact filter instead of ISO coarse 60%, for optimised filtering of the recirculated air.

Frame height:

Modified height of the base frame for adapting to the structure of the false floor (820 mm or 900 mm).

Cooling valve:

Non-pressure dependent compensating and control valve as automatic combination valve for control and hydraulic balancing, comprising linear control valve, pressure controller with integrated diaphragm and actuator.

Fresh air box:

Support frame construction of aluminium sections, attached and bolted, insulated panel construction; fitted with eyelets for crane transport and assembly on site.

For directly connecting the fresh air intake to the ServeCool unit; equipped with adjustable feet for adapting to the frame height. The fresh air box contains the fresh air filter, configured as a ISO ePM₁₀ 65% compact filter and the fresh air damper for closing the fresh air opening during maintenance work.

Condensation prevention system:

Mixed air duct made from Sendzimir-galvanised sheet steel; insulated in the area in direct contact with fresh air; with 1 P30 flange each for exhaust air and fresh air duct connection; includes 2 dampers with continuous actuators; mixed air duct supported on site by mounting rails.

The control function is integrated in the control system; an additional combination sensor (temperature, humidity) is installed in the fresh air box to measure the air intake temperature in the plate heat exchanger.

ServeCool control system

Control system for the energy-optimised operation of Hoval ServeCool, designed as a decentralised system, with the following main features:

- Unit controller integrated in the control box for autonomous and individual control of each unit, with continuous measurement of all relevant parameters and alarm management. The unit controller has the following properties:
 - 32-bit CPU
 - Data transfer rates of 10/100 Mbps, auto-negotiation and auto-MDI(X)
 - Separate Ethernet interfaces with 2 MAC IDs
 - Programming compliant with IEC 61131-3
 - Extra storage via SD card
 - Transfer performance: Class D acc. to EN 50173
 - Bus connection: 2 x RJ-45
 - Protocols: EtherNet/IP, Modbus/TCP (UDP)
- Visualisation and intuitive operation of the unit via the integrated web application with graphical user interface (web GUI), which enables fast access to the individual data points via structured grouping. Any web browser can be used for access via the interface directly on the unit.
- Every control component is simply to be replaced in the event of a fault as only standard components are used.
- Possibility of visualisation, set value specification, alarm management, group switching or maintenance management via a building management system; simple connection of the units via the BMS interface (option).
- Simple integration into the Datacenter Infrastructure Management (DCIM).
- Automatic switchover to local operation in the event of communication failure or a fault with the BMS; the control functionality is retained.
- Switch for manual switchover between local operation and BMS operation.
- Combination sensor (temperature, humidity): 4...20 mA interfaces with monitoring of the life zero point for low breakdown susceptibility.
- When carrying out maintenance, the building infrastructure (Ethernet) is not required as ServeCool has its own service port on the control panel which is not connected to the building network.
- The following control functions are performed by the unit controller:
 - Control of the supply air temperature with extract air temperature limiting and fixed setting of the supply air volume flow
 - Fire control: Connection for an external signal to shut the plant down in the event of a fire
- Units are fully prewired, tested and ready to be connected
- Electrical documentation supplied in the control box

Options for the control system

Source changeover:

For redundant power supply, it is possible to switch over between two alternative electrical power supply pathways. The switchover time between the two power supplies can be adjusted in seconds. The switchover only takes place if the phase sequence check and phase monitoring enable the switching. The voltage supply for the controller is maintained during the switchover.

Actuation of humidifier type 1:

Electrical components installed in the control box and fully prewired for actuation of an ultrasound humidifier with approx. 5 kg/h humidification performance.

Actuation of humidifier type 2:

Electrical components and software interface for transmission of signals between the Hoval ServeCool and an external humidifier (e.g. 0...10 V or 0...20 mA); electrical components installed in the control box and fully prewired.

Protection module:

Surge voltage protection for protecting the unit against surge voltages from atmospheric discharges and switching operations.

Control box with BMS interface

For a simple, secure connection between the control system and the building management system. The following components are installed in the control box:

- Main switch
- Controller
- Switch with 16 ports
- Fuse for power supply unit
- Socket for service laptop
- Voltage monitoring for power supply
- CAT6a network structure
- Physical separation of the networks

Technical data

- Nominal air flow rate supply air: _____ m³/h
- Nominal air flow rate fresh air: _____ m³/h
- Cooling capacity: _____ kW
 - at supply air temperature: _____ °C
 - at supply air humidity: _____ %rh
 - at fresh air temperature: _____ °C
 - at fresh air humidity: _____ %rh

Dimensions

- ServeCool (footprint x height): 3875 × 2825 × 4225 mm
- Maintenance area supply air side: 2825 × 1000 mm
- Maintenance area fresh air side: 2825 × 1200 mm

Weight

ServeCool: 4485 kg

Electrical connection

- Supply voltage: 3 × 400 VAC / 50 Hz
- Current consumption: max. 34.4 A
- Power consumption: max. 21.2 kW

Sound data

- Sound pressure level at 5 m distance from unit: 60 dB(A)
- Total sound power level: 82 dB(A)

Plate heat exchangers

- Fresh air temperature at free cooling limit: _____ °C
- Fresh air relative humidity: _____ %rh
- Extract air temperature: _____ °C
- Extract air relative humidity: _____ %rh
- Heat recovery efficiency dry fresh air side/extract air side at nominal air flow rate: _____ / _____ %
- Pressure drop fresh air side/extract air side at nominal air flow rate: _____ / _____ Pa

Technical data cooling coil

- Cooling capacity, total: _____ kW
- Cooling capacity, sensitive: _____ kW
- Flow/return: _____ / _____ °C
- Supply air temperature: _____ °C
 - for inlet temperature: _____ °C
 - with rel. inlet humidity: _____ %rh
- Operating pressure: _____ kPa



Options

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6 Condensation prevention system	30

1 Type code

SW - 25 / AG . G1 . KV . AK / Q . B1 . SM

Unit type

SW ServeCool SW
SWP ServeCool SWP

Unit size

25

Extract air filter

AG Extract air filter ISO coarse 60 % (standard)
AM Extract air filter ISO ePM₁₀ 65 %

Frame height

G1 Frame height 1000 mm (standard)
G2 Frame height 900 mm
G3 Frame height 820 mm

Cooling valve

KV Cooling valve

Fresh air box

-- Without (standard)
AK Fresh air box
AC Fresh air box and condensation prevention system

Source changeover

-- Without (standard)
Q Source changeover

Actuation of humidifier

-- Without (standard)
B1 Actuation of humidifier type 1
B2 Actuation of humidifier type 2

Protection module

-- Without (standard)
SM Protection module

2 Extract air filter

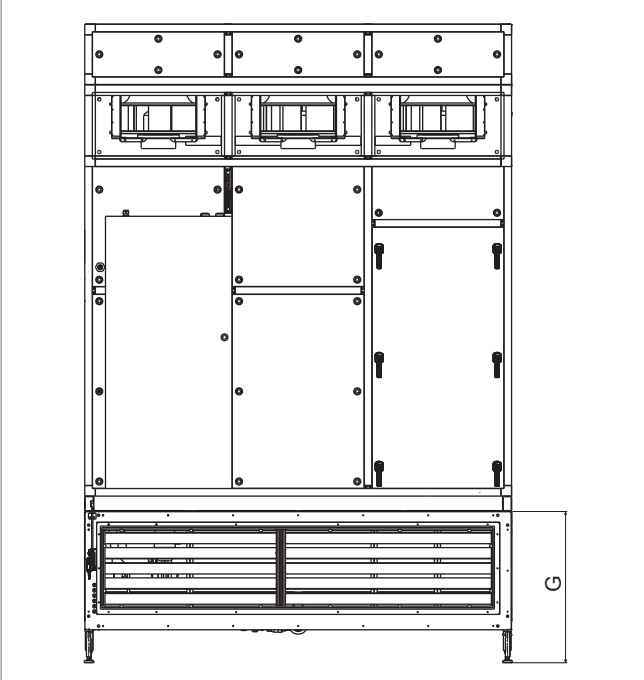
An ultrafine dust filter is installed for filtering the extract air (replaces the standard filter).

Filter class	ISO ePM ₁₀ 65 %
Filter monitoring factory setting	250 Pa

Table C1: Extract air filter technical data

3 Frame height

The base frame can be supplied in 3 versions to adapt the ServeCool unit to the structure of the false floor.



Frame height	G1	G2	G3
Dimension G	1000	900	820

Table C2: Dimensional drawing frame height (dimensions in mm)

4 Cooling valve

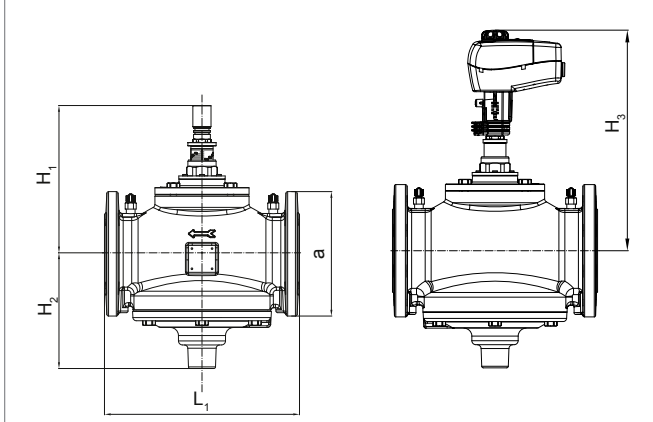
The optionally available cooling valve is a non-pressure-dependent compensating and control valve comprising:

- Linear control valve
- Pressure regulator with integrated diaphragm
- Actuator

The valve is used as an automatic combination valve for control and hydraulic balancing. The valve authority is 100 % ($a = 1$). There is no change in the linear characteristic, irrespective of the settings or the pressure conditions.

Control voltage	0...10 V
Throughflow rate	20000 l/h

Table C3: Cooling valve technical data



DN	L ₁	H ₁	H ₂	H ₃	a (EN 1092-2)	Weight kg
	mm					
65	290	233	172	373	185	38

Fig. C1: Cooling valve dimensional drawing

5 Fresh air box

The fresh air box is used for directly connecting the fresh air intake to the ServeCool unit by means of an air duct produced in a panel design. The following are installed in the fresh air box:

- Fresh air damper for closing the fresh air opening during maintenance work
- Fresh air filter

Filter class	ISO ePM ₁₀ 65 %
Filter monitoring factory setting	350 Pa

Table C4: Fresh air filter technical data

6 Condensation prevention system

On request, ServeCool can be fitted with a condensation prevention system. This is controlled automatically and prevents humidity in the circulating air from condensing even when fresh air temperatures are very low. Free cooling can therefore be used throughout the year without the costly rehumidification of the supply air.

The following components are installed:

- Mixed air duct with 2 dampers incl. actuator for mixing exhaust air with fresh air
- Combination sensor (temperature and humidity) in the fresh air box for monitoring the intake temperature in the plate heat exchanger

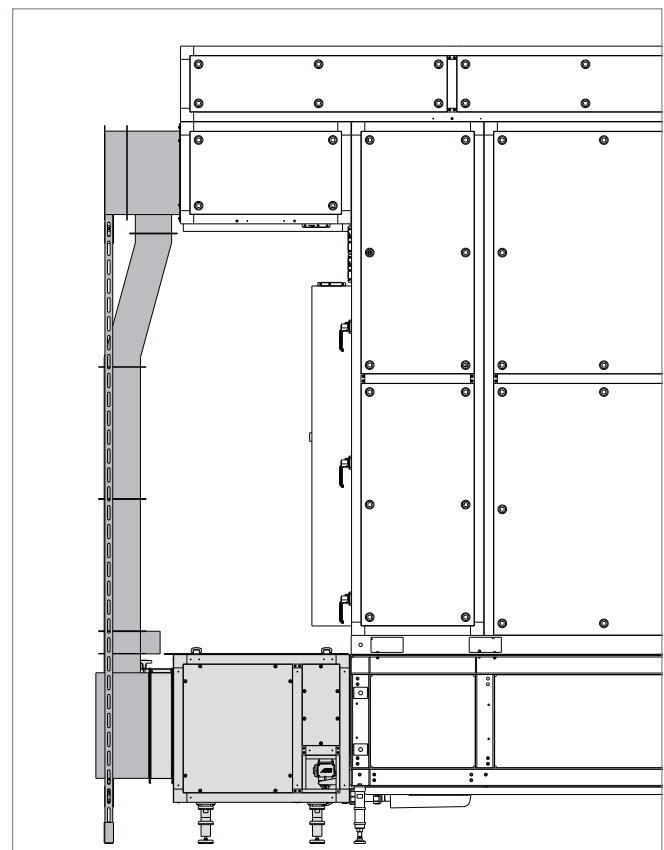


Fig. C2: ServeCool unit with fresh air box and condensation prevention system



Notice

You will find a description of the options for the control system in Section E 'Control systems' of this handbook.



Transport and installation

1 Installation	32
2 Hydraulic installation	34
3 Electrical installation	36

1 Installation

The unit, which consists of a base frame, tower, extract air box and exhaust air box, is delivered fully assembled on a pallet. The fresh air box (option) is supplied separately.

The following guidelines are important when preparing for installation:

- A crane is required for lifting and transporting the components. A suitable lifting traverse is included with the delivery.
- For transport to the installation site and for precise positioning, it is necessary to have a transport trolley with articulated steering, turntable and drawbar (max. height 110 mm).
- Follow the installation instructions included.

1.1 Installation site

- The unit must be erected at an inside location that is protected against frost.
- Install the unit horizontally.
- Ensure that the installation surface is of sufficient load-bearing capacity. The weight of the unit is distributed over the adjustable feet (see Fig. D1).
- Position the unit in accordance with the airflow direction.
- The unit must be accessible and connecting lines must be able to be dismantled for maintenance and servicing work.

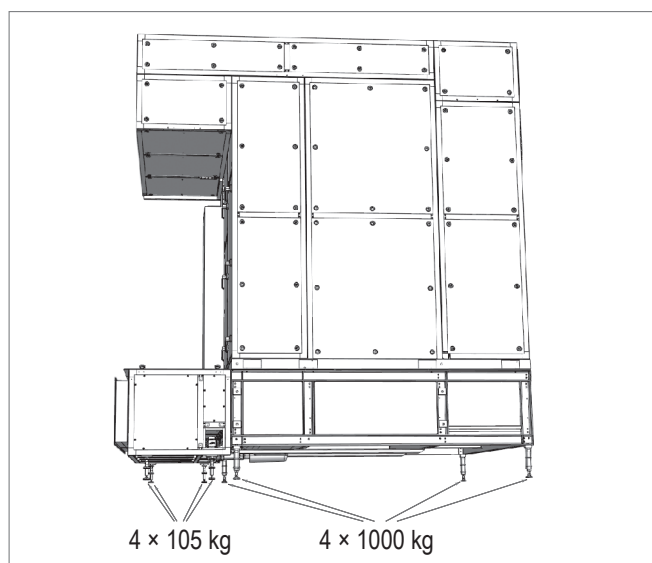


Fig. D1: Load distribution

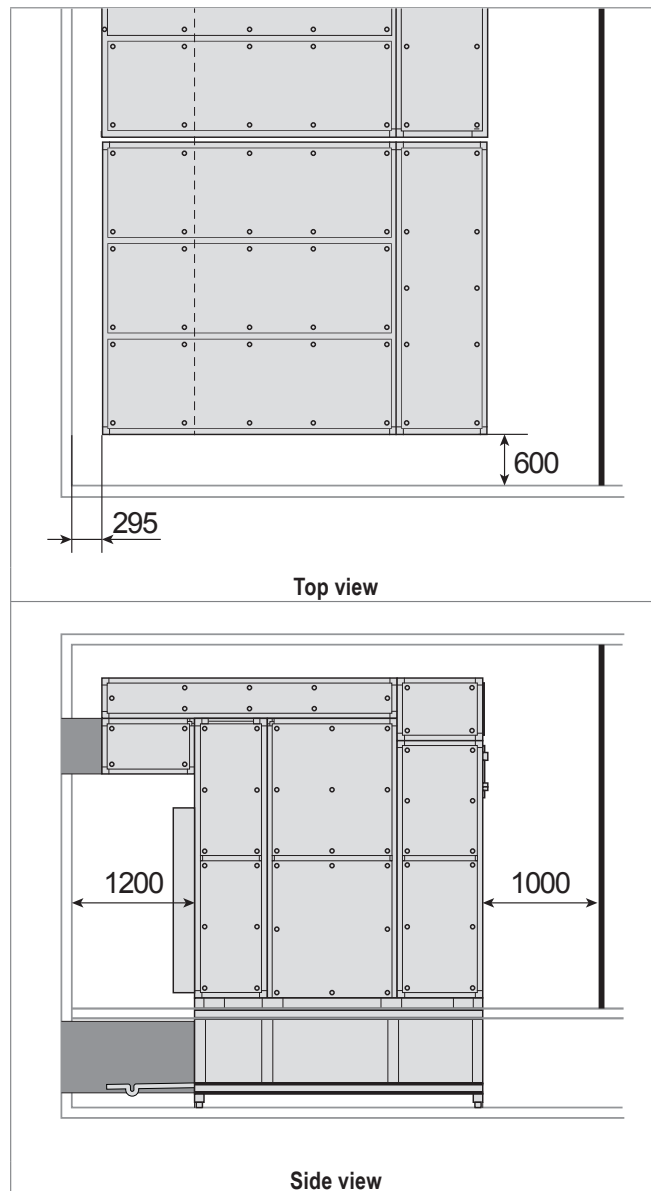


Fig. D2: Space requirements for maintenance and servicing (minimum clearances in mm)

1.2 Connecting the air ducts

- Connect the ServeCool unit to fresh air and extract air ducts installed on site.
- The connection to extract air and supply air ducts installed on site depends on the specific conditions of the plant. Ideally, the unit will draw the extract air directly from the server room and blow air back into the false floor directly.
- If an extract air duct is connected, it must be equipped with inspection openings for the filter change (dimension of the extract air filter: 592 × 490 × 500 mm).
- The unit must not be subjected to the weight of the ducts. Suspend the ducts from the ceiling or support them on the floor.
- Connect the air ducts via the compensators so they are free of tension and vibrations.
- Insulate the fresh air duct including compensator up to the building entry point.



Note

If the ServeCool unit is not equipped with the optional fresh air box, the fresh air must be filtered using systems supplied by the client (filter class ISO ePM₁₀ 65%). Hoval also recommends installing a fresh air damper for closing the fresh air opening during maintenance work.

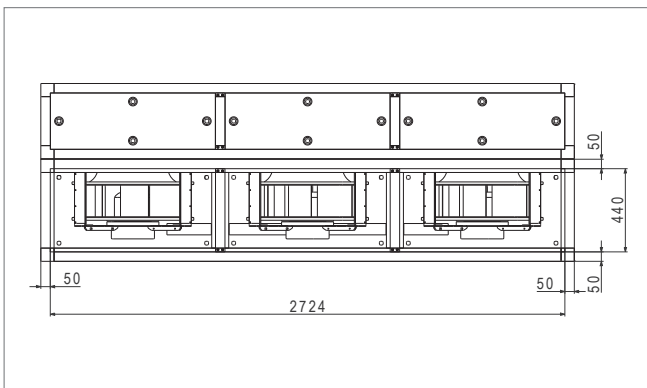


Fig. D3: Dimensional drawing for exhaust air duct (dimensions in mm)

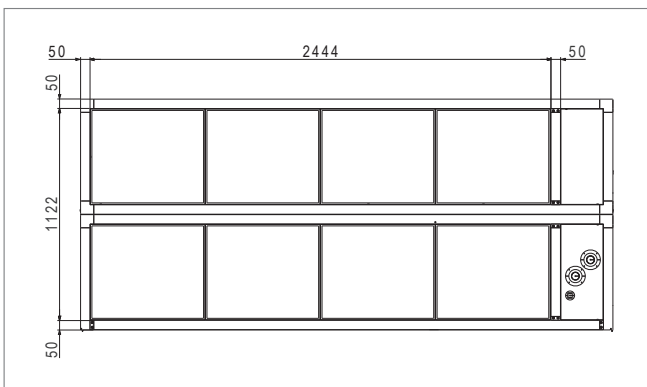
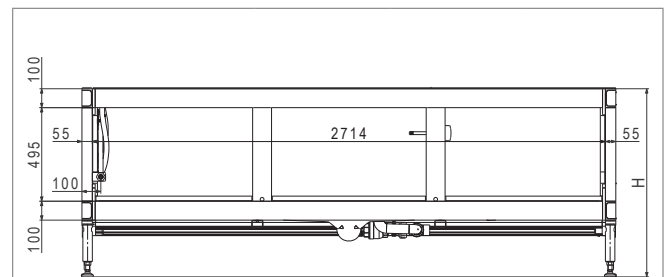
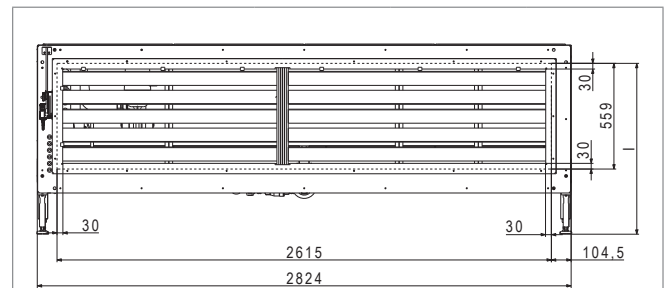


Fig. D4: Dimensional drawing for extract air duct (dimensions in mm) (inspection opening for filter exchange)



Frame height	G1	G2	G3
Dimension H	995	895	815

Fig. D5: Dimensional drawing for supply air duct (dimensions in mm)



Frame height	G1	G2	G3
Dimension I	904	804	724

Fig. D6: Dimensional drawing for fresh air duct (dimensions in mm)

2 Hydraulic installation

2.1 Cooling coil

Connect the cooling coil in accordance with the hydraulic diagram.

Depending on local conditions, check whether compensators for linear expansion are required for the supply and return lines and/or articulated connections are required for the units.

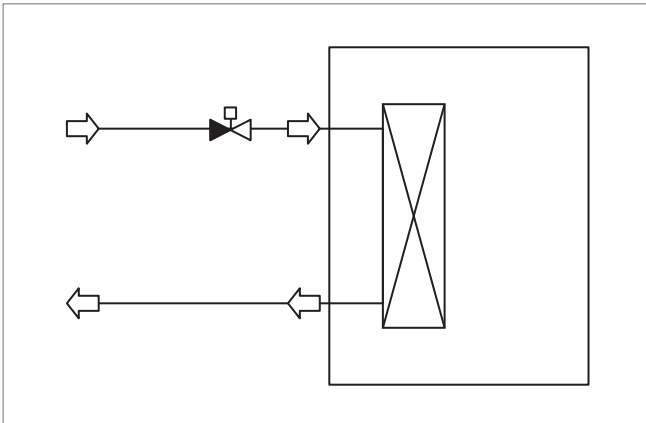


Fig. D7: Connection of the cooling coil

2.2 Condensate connection

Condensate arising in the unit must be removed via a condensate line.

- Adequately size the slope and cross section of the condensate line to prevent a condensate backwash.
- Make sure that the condensate can drain off freely.
- The unit already includes a trap function, so there is no need to provide this function externally.
- Fill the traps (plate heat exchanger and cooling coil) with water before commissioning, after each cleaning operation and after an extended downtime.

Technical data	
Condensate connection	G 3/4" internal thread
Condensate quantity	max. 7 kg/h

Table D1: Condensate connection

2.3 Adiabatic system



Note

Comply with national regulations on drinking water protection. Decouple the adiabatic system from the drinking water system to prevent backflow, force-back or suck-back of impurities into the drinking water.

Water supply

- Connect the ServeCool unit to the water supply.
- Use suitable materials for the supply line (recommended: stainless steel, PE or PVC).
- Depending on local conditions, check whether a compensator and/or articulated connection for linear expansion is required for the supply line.

Technical data		
Supply pressure	Recommendation	2 bar
	max.	4 bar
Supply line connection		G 1/2" internal thread

Table D2: Water supply

Supply pressure	0.5	1	2	3	5	bar
Volume flow	360	511	720	878	1138	l/h

Table D3: Water flow through adiabatic system

Drain

- Dimension the slope and cross-section of the discharge pipe so that there is no backing-up of water.
- Make sure that the water can drain off freely.
- Fill the trap with water before commissioning, after each cleaning operation and after an extended downtime.

2.4 Water quality

The adiabatic cooling requires a demineralised water supply. Hoval recommends the use of rainwater in a storage system.

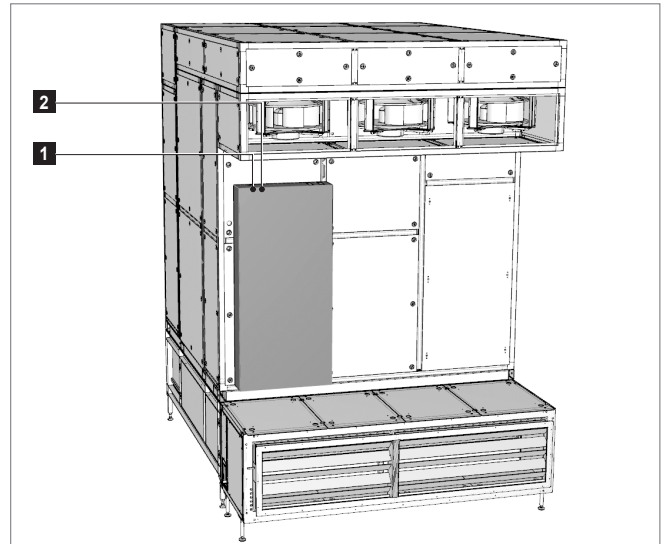
Recommended guidance values for the composition of the circulation water:

Appearance	clear, colourless, without sediment		
pH value			7 – 8.5
Electric conductance at 20 °C		µS/cm	< 250
Total hardness	GH	°dH	< 1
Chloride	Cl ⁻	g/m ³	< 20
Sulphate	SO ²⁻ ₄	g/m ³	< 20
Iron	Fe	mg/l	≤ 0.1
Copper	Cu	mg/l	< 1
Colony count		CFU/ml	< 1000
Legionella		CFU/100 ml	< 100
Concentration figure			5 - 10

Table D4: Composition of the circulation water

3 Electrical installation

- Observe all relevant regulations (e.g. EN 60204-1).
- For long supply lines, select cable cross-sections in accordance with the technical regulations.
- Electrical installation to be carried out according to wiring diagram.
- Route the cables for the control systems separately from mains cables.
- Wire up peripheral components installed in the base frame, in the extract air box and in the exhaust air box to the plug connections in the control box.
- The fresh air combination sensor (temperature and humidity) is supplied loose in the control panel. Install the sensor at a suitable location and wire it to the plug connections in the control box.
- Secure all connections against working loose.

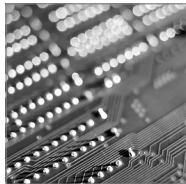


- 1 Cable feedthrough for power supply
- 2 Cable feedthrough for bus cable

Fig. D8: Electrical installation

Designation	Reference	Voltage	Cable	Comments
Power supply		3 × 400 V AC		NYM, max. fusing 40 A
Operation and control	Web browser		CAT6a RJ45	
	BMS integration		CAT6a RJ45	Modbus IP
External signals	Operating signal	24 V / 230 V	2 × 1.0 mm ²	Volt-free, 8 A
	Collective fault signal	24 V / 230 V	2 × 1.0 mm ²	Volt-free, 8 A
Fire control		24 V DC		NYM

Table D5: Cable list for on-site connections



Control system

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1 System structure

The ServeCool control system controls the ServeCool units fully automatically. Depending on the ambient conditions, it controls the interplay between the individual cooling processes and thus ensures demand-driven operation with optimised use of energy.

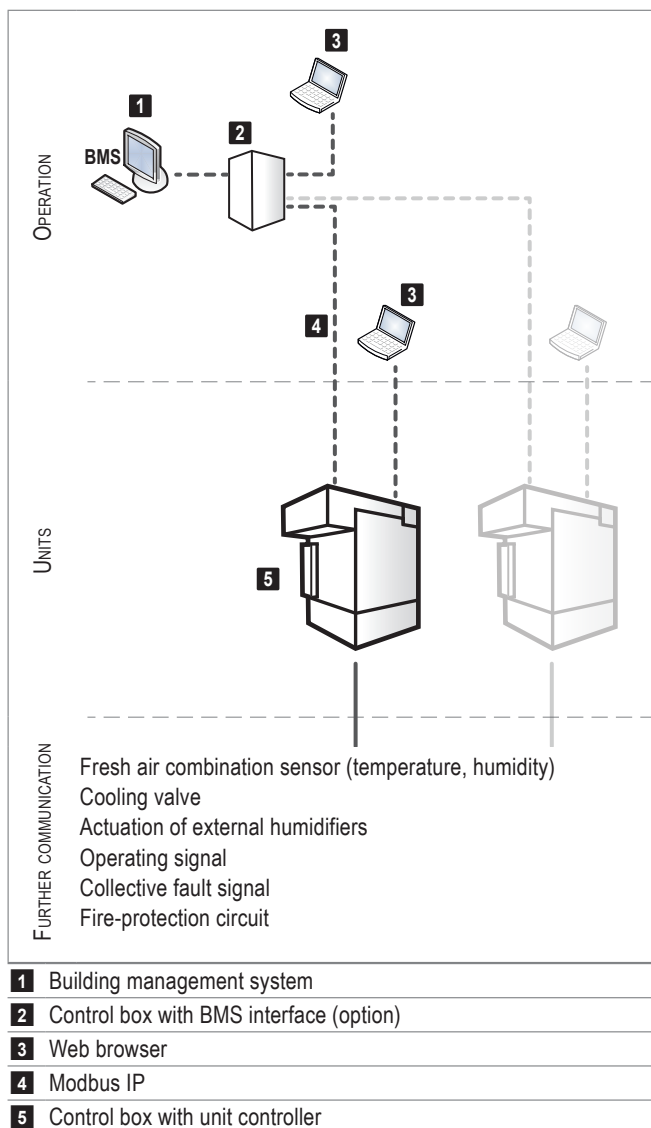


Table E1: System structure

1.1 Basic principles

A unit controller is installed in the control box of each ServeCool unit for autonomous and individual control.

Control box front panel

The following are installed in the control box front panel:

- Main switch
- Control mode switch (local mode / BMS switchover)
- Alarm reset key
- Operation indicator light (green)
- Malfunction indicator light (red)
- HTML interface

3 volt-free signalling contacts are available for a higher-level system:

- Operating signal
- Collective fault signal
- Fire-protection circuit

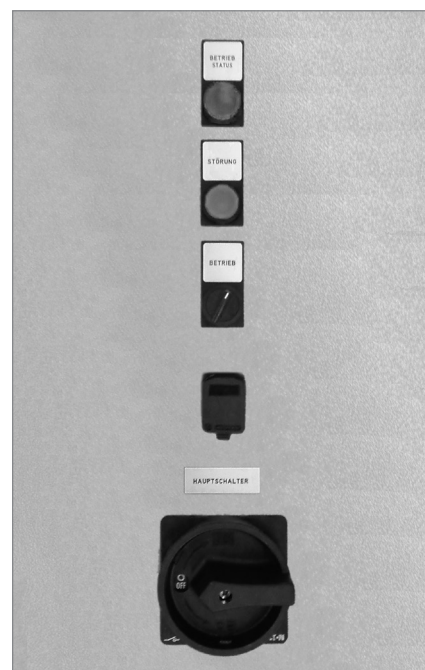


Fig. E1: Display and operating elements in the control box front panel

1.2 Operation

Operation via web browser

The web visualisation of the ServeCool control system can be displayed on any web browser. The operator terminal is a computer connected to the HTML interface in the control box front panel.

The web visualisation offers the following functions:

- Display and setting of operating modes
- Display of temperatures and humidities
- Display and setting of set values and control parameters
- Display and handling of alarms and maintaining an alarm log
- Recording trends
- Differentiated password protection for various operator levels

Integration into the building management system (BMS)

The ServeCool control system can be easily integrated into the building management system. The data is exchanged via the BMS interface (option).

1.3 Control mode

2 different control modes are available in the control system:

Local mode	The unit controller operates autonomously according to the specifications from the internal memory.
BMS mode	The unit controller operates according to the specifications from the building management system. The following set values can be specified independently of one another: <ul style="list-style-type: none"> ■ Operating mode ■ Supply air temperature ■ Supply air humidity ■ Supply air volume flow

Local mode is activated or deactivated using the control mode switch in the control box front panel.

2 Control functions

2.1 Supply air temperature control

The unit controller controls the supply air conditions:

- Supply air temperature
- Supply air humidity (optional, only humidification)

Depending on the current operating mode (winter or summer mode) and the current temperature and moisture conditions, the unit controller controls the interplay of the following components:

- Exhaust air fans for indirect free cooling
- Water circuit for adiabatic cooling
- Cooling valve and position of the bypass damper for mechanical cooling

2.2 Extract air temperature limiting

Extract air temperature limiting reduces the set value for the supply air temperature to an adjustable minimum value according to the extract air temperature.

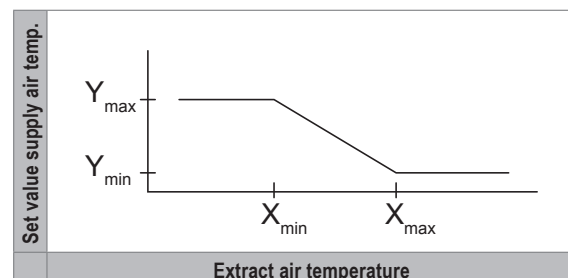


Fig. E2: Extract air temperature limiting

2.3 Supply air volume flow

The unit controller controls the speed of the supply air fans according to the specified set value.

3 Safety functions

3.1 Fire-protection circuit

Connection option for an external signal; the user can set whether the ServeCool unit switches off or if a message is simply generated.

3.2 Operation in the event of communication failure

In the event of communication failure, the ServeCool unit continues to run without interruption in the predefined internal operating state. The control of the supply air temperature remains fully functional.

3.3 Process monitoring

Limits can be set for every value measured by the temperature/humidity combination sensor and for the value calculated for absolute humidity. The cooling process can be monitored on the basis of these values.

3.4 Operation in the event of pump failure (ServeCool SWP)

In the event of a pump fault, the ServeCool unit can either continue operation without adiabatic cooling or perform adiabatic cooling without water circulation (as with the ServeCool SW).

4 Control options

4.1 Source changeover

For redundant power supply, it is possible to switch over between two alternative electrical power supply pathways. The switchover time between the two power supplies can be adjusted in seconds. The switchover only takes place if the phase sequence check and phase monitoring enable the switching. The voltage supply for the controller is maintained during the switchover.

4.2 Actuation of humidifier type 1

Electrical components installed in the control box and fully prewired for actuation of an ultrasound humidifier with approx. 5 kg/h humidification performance.

4.3 Actuation of humidifier type 2

Electrical components and software interface for transmission of signals between the Hoval ServeCool and an external humidifier (e.g. 0...10 V or 0...20 mA); electrical components installed in the control box and fully prewired.

4.4 Protection module

Surge voltage protection for protecting the unit against surge voltages from atmospheric discharges and switching operations.

4.5 Control box with BMS interface

The control box with BMS interface enables a simple, secure connection between the ServeCool control system and the building management system. Only 1 subscriber is integrated into the on-site network for the entire system. The BMS interface offers the following functions:

- Provision of system data for the BMS via defined data points (setpoint, alarms, feedback, etc.)
- Plausibility check for BMS input values
- Monitoring of communication and detection of offline units
- Separation of networks (→ reduced network load)

Modbus IP can be used as the communication protocol (others possible on request).

Power is supplied via an on-site UPS network.

5 Alarms and monitoring

The control system monitors itself. All alarms are registered in the alarm list and displayed by the visualisation on the web browser or in the building management system.

A full alarm list is available on request.



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1 Design example

1.1 Configuration

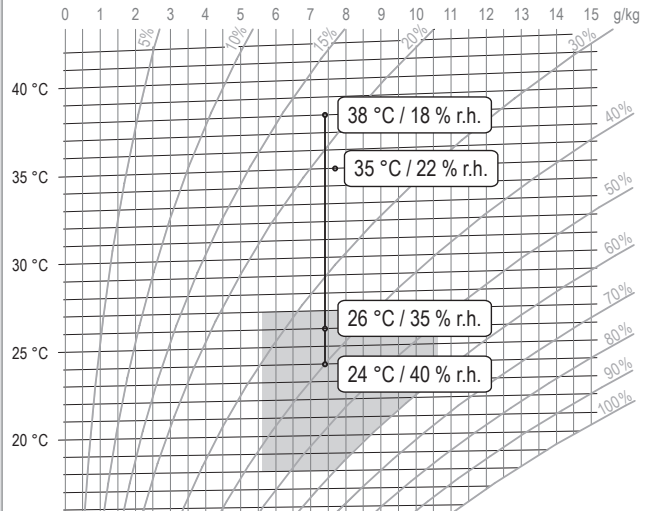
Design data	Example
<ul style="list-style-type: none"> IT infrastructure 	<p>Server room with 60 racks Dimensions of the racks : W × H × D = 800 × 2200 × 1000 mm</p>
<ul style="list-style-type: none"> Heat load 	<p>8 kW per rack 60 × 8 kW = 480 kW</p>
<ul style="list-style-type: none"> Supply and extract air conditions 	<p>Recommendation: air conditions acc. to ASHRAE TC 9.9 A1:</p>
<p>i Note Optimised operating conditions with regard to energy costs are:</p> <ul style="list-style-type: none"> Highest possible supply air temperature Greatest possible temperature difference between supply air and extract air 	
<ul style="list-style-type: none"> Site and configuration conditions 	<p>Location: Frankfurt am Main (DE)</p>
<p>The configuration conditions are based on statistical meteorological data for the location of the data centre (acc. to VDI 4710).</p>	<p>For Frankfurt, the following average fresh air conditions apply for the configuration of cooling units: 35 °C / 22 %rh</p>
<p>i Note For additional safety even under extreme weather conditions, it may be sensible to assume a higher fresh air temperature and humidity in the configuration.</p>	
<p>Supply air conditions To define the supply air temperature, reduce the permitted air temperature at the server inlet by 2 K. Read off the corresponding humidity from the hx diagram (see Fig. F1).</p>	<p>→ Supply air conditions: 24 °C / 40 %rh Supply air flow rate 25750 m³/h</p>

Fig. F1: Recommended air conditions in the server room acc. to ASHRAE TC 9.9 A1, represented in the hx diagram

- Air conditions at the server inlet: max. 26 °C / 35 %rh
- Extract air conditions:..... max. 38 °C / 18 %rh

<p>Total cooling capacity per unit (Q_{tot}) The total cooling power per unit depends on the temperature difference (Δt) between the supply air and extract air. Read off the total cooling capacity from Table F2.</p>	<p>$\Delta t = 38 - 24 = 14 \text{ K}$ → Total cooling capacity per unit Q_{tot}: 120 kW</p>
<p>Required number of units (n) ■ The heat load divided by the total cooling capacity per unit defines the required number of units for cooling the server room.</p>	<p>$n = 480 \text{ kW} : 120 \text{ kW} = 4$</p>
<p>■ An additional, redundant unit is installed to ensure the cooling capacity is achieved even if a unit fails. This guarantees high availability of the overall system.</p>	<p>→ $4 + 1 = 5$ units are installed</p>
<p>Cold supply for mechanical cooling The total cooling capacity per unit Q_{tot} is composed of: – capacity of the free and adiabatic cooling (Q_F) – capacity of the mechanical cooling (Q_M)</p>	
<p>■ From the hx diagram, find the absolute humidity under configuration conditions.</p>	<p>35 °C / 22 %rh → Absolute humidity: 7.7 g/kg</p>
<p>■ Use the information in Table F2 to ascertain what mechanical cooling capacity per unit (Q_M) is required under configuration conditions.</p>	<p>Q_F acc. to table = 108 kW $Q_M = Q_{tot} - Q_F$ $Q_M = 120 \text{ kW} - 108 \text{ kW} = 12 \text{ kW}$</p>
<p>■ Multiply this value by the required number of units (n) to calculate the total mechanical cooling capacity required.</p>	<p>$4 \times 12 \text{ kW} = 48 \text{ kW}$ For redundant supply, 2 chilled water systems with 48 kW cooling capacity each are provided.</p>
<p>■ Select the flow/return temperature and, with reference to the mechanical cooling capacity per unit (Q_M), read off the corresponding water quantity and water pressure drop from Table F8.</p>	<p>For flow/return 14/20 °C and 30 % glycol, the following applies: $m_W = 1873 \text{ l/h}$ $\Delta p_W = 0.44 \text{ kPa}$</p>

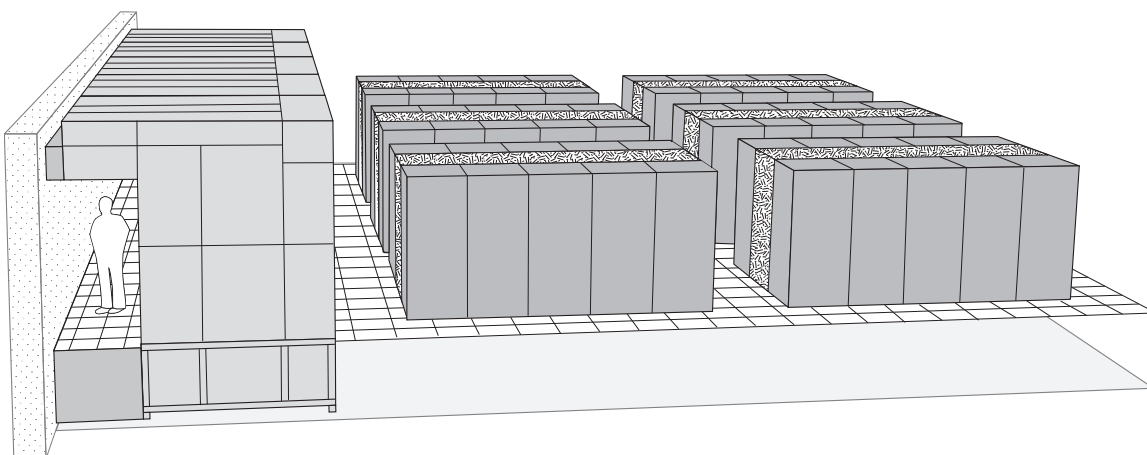


Fig. F2: Schematic diagram of a data centre

1.2 Location

The units are positioned at the end of the server room in a line of technological equipment.

- IT area 165 m²
- Technological equipment 78 m²
- Specific load distribution 2.9 kW/m²

The supply air is distributed throughout the room via the false floor, and the extract air is extracted from under the ceiling. The cold aisle containment prevents the supply air from mixing with the extract air, thereby guaranteeing efficient air conditioning.

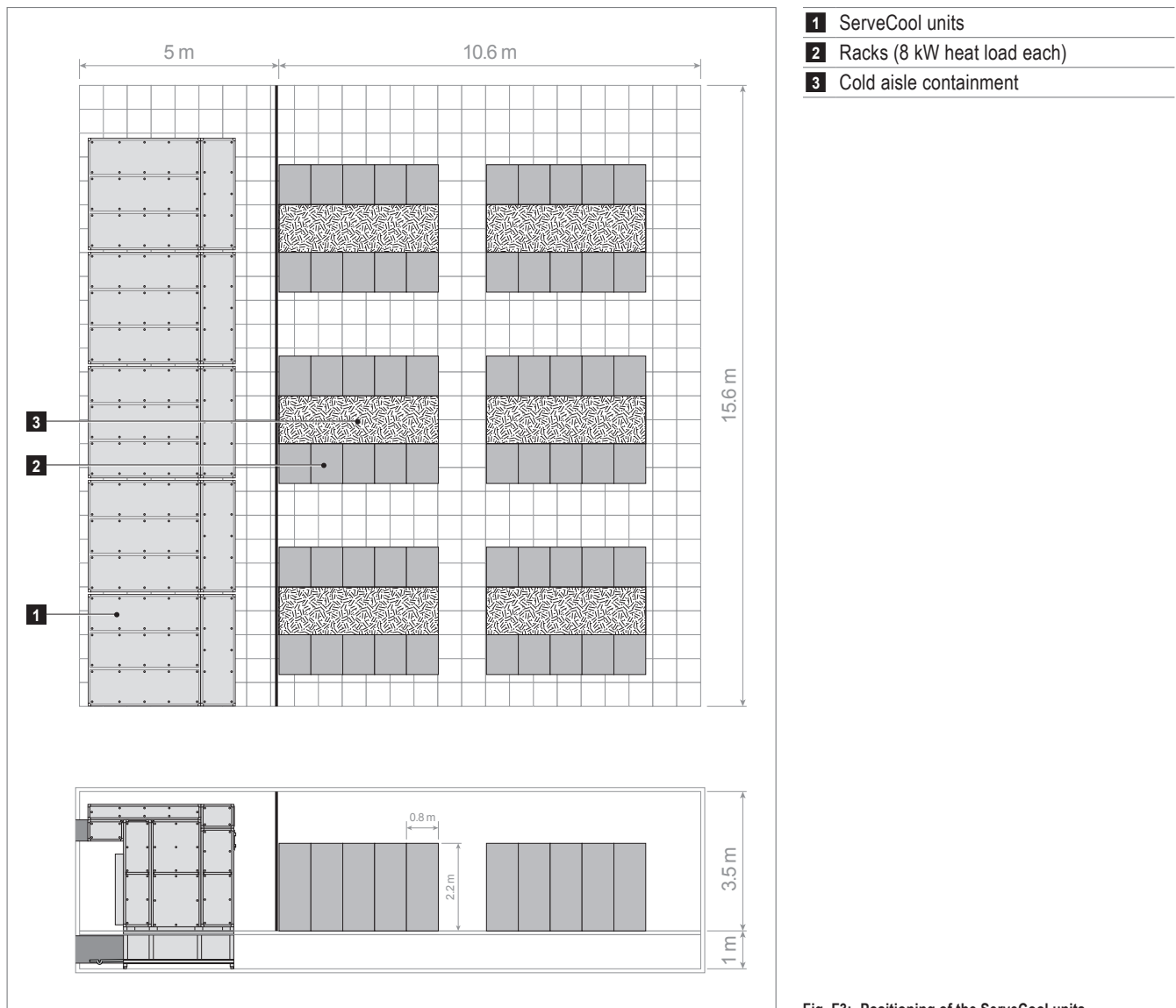


Fig. F3: Positioning of the ServeCool units

1.3 Water treatment

The adiabatic cooling requires a demineralised water supply. The following options are available:

- Using rainwater in a storage system
- Water treatment using a reverse osmosis system which pumps into separately installed water tanks

Guidance values for the water consumption are specified in the following table:

Month	Water consumption in l/h							
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Maximum	61	97	131	150	176	150	120	45
Medium	47	69	86	95	102	86	74	34
Minimum	30	25	30	25	30	25	25	25

Table F1: Water consumption for evaporative cooling per ServeCool unit (reference values for Germany)

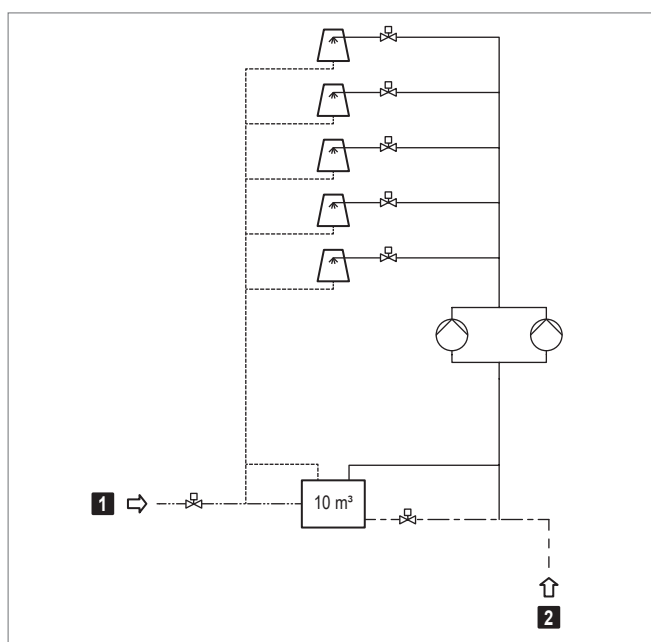
- Assuming the average water consumption in July, this results in:
 $102 \text{ l/h} \cdot 24 \text{ h} = 2448 \text{ l} \rightarrow \text{approx. } 2.5 \text{ m}^3 \text{ per day}$
- Multiplied by the necessary number of units $n = 4$, this produces a daily consumption of approx. 10 m^3 fully demineralised water.

To provide a day's reserve, a storage tank with approx. 10 m^3 volume is installed. For the purposes of redundancy, the storage tank is equipped with a municipal water supply.



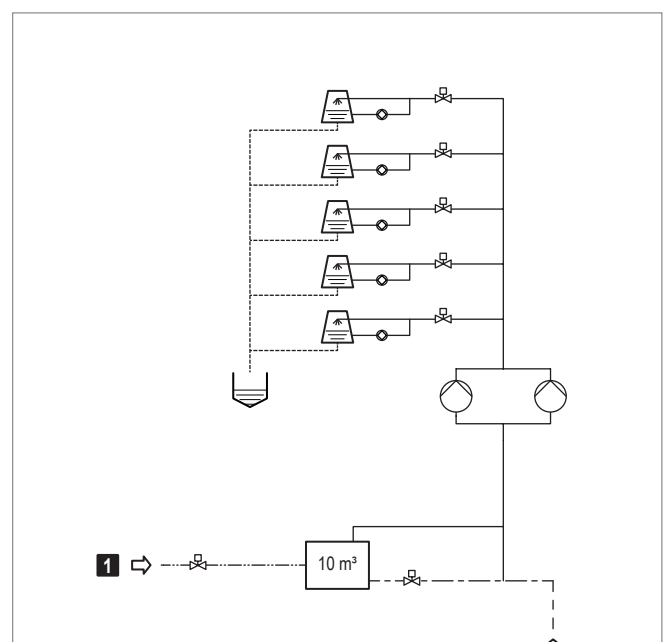
Note

Take account of the local water conditions when configuring and dimensioning the water treatment. The example shown here is intended for guidance. If possible, the redundancy concept should include use of municipal water.



- 1 Water supply (demineralised) 300 l/h
- 2 Municipal water supply

Fig. F4: On site water treatment for ServeCool SWP



- 1 Water supply (demineralised) 300 l/h
- 2 Municipal water supply

Fig. F5: On site water treatment for ServeCool SWP

2 Cooling capacities

2.1 Free and adiabatic cooling

Extract air: 38 °C	Supply air: 24 °C	$\Delta t = 14 \text{ K}$	$Q_{\text{tot}} = 120 \text{ kW}$																		
Fresh air																					
t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤17	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
18	120	120	120	120	120	120	120	120	120	120	120	120	120	117	117	117	117	117	117	117	117
19	120	120	120	120	120	120	120	120	120	120	120	120	117	114	111	111	111	111	111	111	111
20	120	120	120	120	120	120	120	120	120	120	120	120	117	111	108	105	105	105	105	105	105
21	120	120	120	120	120	120	120	120	120	120	120	120	114	111	105	102	100	100	100	100	100
22	120	120	120	120	120	120	120	120	120	120	120	117	114	108	102	100	97	94	94	94	94
23	120	120	120	120	120	120	120	120	120	120	120	114	111	105	102	97	94	91	88	88	88
24	120	120	120	120	120	120	120	120	120	120	117	114	108	105	100	97	91	88	85	82	82
25	120	120	120	120	120	120	120	120	120	120	117	111	108	102	100	94	91	88	82	79	76
26	120	120	120	120	120	120	120	120	120	120	114	111	105	102	97	94	88	85	82	76	73
27	120	120	120	120	120	120	120	120	120	117	111	108	102	100	94	91	88	82	79	76	73
28	120	120	120	120	120	120	120	120	120	114	111	105	102	97	94	91	85	82	79	73	70
29	120	120	120	120	120	120	120	120	117	114	108	105	100	97	91	88	85	79	76	73	70
30	120	120	120	120	120	120	120	120	117	111	108	102	100	94	91	85	82	79	76	70	67
31	120	120	120	120	120	120	120	120	114	111	105	100	97	94	88	85	82	76	73	70	67
32	120	120	120	120	120	120	120	117	111	108	102	100	94	91	88	82	79	76	73	67	64
33	120	120	120	120	120	120	120	114	111	105	102	97	94	91	85	82	79	73	70	67	64
34	120	120	120	120	120	120	117	114	108	105	100	97	91	88	85	79	76	73	70	67	62
35	120	120	120	120	120	120	117	111	108	102	100	94	91	85	82	79	76	70	67	64	62
36	120	120	120	120	120	120	114	111	105	100	97	94	88	85	82	76	73	70	67	64	62
37	120	120	120	120	120	117	111	108	102	100	94	91	88	82	79	76	73	67	64	62	59
38	120	120	120	120	120	114	111	105	102	97	94	88	85	82	79	73	70	67	64	62	59
39	120	120	120	120	117	114	108	105	100	97	91	88	85	79	76	73	70	67	62	59	56
40	120	120	120	120	117	111	108	102	100	94	91	85	82	79	76	70	67	64	62	59	56
41	120	120	120	120	114	111	105	100	97	94	88	85	82	76	73	70	67	64	59	56	53
42	120	120	120	117	111	108	102	100	94	91	88	82	79	76	73	67	64	62	59	56	53
43	120	120	120	114	111	105	102	97	94	91	85	82	79	73	70	67	64	62	59	56	50
44	120	120	117	114	108	105	100	97	91	88	85	79	76	73	70	64	62	59	56	53	50
45	120	120	117	111	108	102	100	94	91	85	82	79	76	70	67	64	62	59	56	53	50
Legend	t = Fresh air temperature in °C x = Fresh air humidity in g/kg																				
Reference:	Supply air flow rate 25750 m³/h																				

Table F2: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

Extract air: **33 °C** Supply air: **21 °C** $\Delta t = 12 \text{ K}$ $Q_{\text{tot}} = 103 \text{ kW}$

Fresh air																					
t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤15	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
16	103	103	103	103	103	103	103	103	103	103	103	99	99	99	99	99	99	99	99	99	99
17	103	103	103	103	103	103	103	103	103	103	103	99	94	94	94	94	94	94	94	94	94
18	103	103	103	103	103	103	103	103	103	103	102	96	90	88	88	88	88	88	88	88	88
19	103	103	103	103	103	103	103	103	103	103	99	94	88	85	82	82	82	82	82	82	82
20	103	103	103	103	103	103	103	103	103	103	96	90	88	82	79	76	76	76	76	76	76
21	103	103	103	103	103	103	103	103	103	99	94	90	85	82	76	73	71	71	71	71	71
22	103	103	103	103	103	103	103	103	103	96	94	88	85	79	73	71	67	65	65	65	65
23	103	103	103	103	103	103	103	103	102	96	90	85	82	76	73	67	65	62	59	59	59
24	103	103	103	103	103	103	103	103	99	94	88	85	79	76	71	67	62	59	56	53	53
25	103	103	103	103	103	103	103	102	96	90	88	82	79	73	71	65	62	59	53	50	47
26	103	103	103	103	103	103	103	99	94	90	85	82	76	73	67	65	59	56	53	47	44
27	103	103	103	103	103	103	103	96	94	88	82	79	73	71	65	62	59	53	50	47	44
28	103	103	103	103	103	103	102	96	90	85	82	76	73	67	65	62	56	53	50	44	41
29	103	103	103	103	103	103	99	94	88	85	79	76	71	67	62	59	56	50	47	44	41
30	103	103	103	103	103	102	96	90	88	82	79	73	71	65	62	56	53	50	47	41	38
31	103	103	103	103	103	99	94	90	85	82	76	71	67	65	59	56	53	47	44	41	38
32	103	103	103	103	103	96	94	88	82	79	73	71	65	62	59	53	50	47	44	38	35
33	103	103	103	103	102	96	90	85	82	76	73	67	65	62	56	53	50	44	41	38	35
34	103	103	103	103	99	94	88	85	79	76	71	67	62	59	56	50	47	44	41	38	32
35	103	103	103	103	96	90	88	82	79	73	71	65	62	56	53	50	47	41	38	35	32
36	103	103	103	99	94	90	85	82	76	71	67	65	59	56	53	47	44	41	38	35	32
37	103	103	103	99	94	88	82	79	73	71	65	62	59	53	50	47	44	38	35	32	29
38	103	103	102	96	90	85	82	76	73	67	65	59	56	53	50	44	41	38	35	32	29
39	103	103	99	94	88	85	79	76	71	67	62	59	56	50	47	44	41	38	32	29	26
40	103	103	96	90	88	82	79	73	71	65	62	56	53	50	47	41	38	35	32	29	26
41	103	99	94	90	85	82	76	71	67	65	59	56	53	47	44	41	38	35	29	26	23
42	103	99	94	88	82	79	73	71	65	62	59	53	50	47	44	38	35	32	29	26	23
43	99	96	90	85	82	76	73	67	65	62	56	53	50	44	41	38	35	32	29	26	20
44	99	94	88	85	79	76	71	67	62	59	56	50	47	44	41	35	32	29	26	23	20
45	96	94	88	82	79	73	71	65	62	56	53	50	47	41	38	35	32	29	26	23	20

Legend t = Fresh air temperature in °C
 x = Fresh air humidity in g/kg

Reference: Supply air flow rate 25750 m³/h

Table F3: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

Extract air: **36 °C** Supply air: **21 °C** $\Delta t = 15 \text{ K}$ $Q_{\text{tot}} = 129 \text{ kW}$

Fresh air																					
t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤ 14	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
15	129	129	129	129	129	129	129	129	129	129	126	123	123	123	123	123	123	123	123	123	123
16	129	129	129	129	129	129	129	129	129	129	123	117	117	117	117	117	117	117	117	117	117
17	129	129	129	129	129	129	129	129	129	126	120	117	112	111	111	111	111	111	111	111	111
18	129	129	129	129	129	129	129	129	129	123	120	114	108	105	105	105	105	105	105	105	105
19	129	129	129	129	129	129	129	129	126	123	117	112	105	103	100	100	100	100	100	100	100
20	129	129	129	129	129	129	129	129	126	120	114	108	105	100	96	94	94	94	94	94	94
21	129	129	129	129	129	129	129	129	123	117	112	108	103	100	94	91	88	88	88	88	88
22	129	129	129	129	129	129	129	126	120	114	112	105	103	96	91	88	85	82	82	82	82
23	129	129	129	129	129	129	129	123	120	114	108	103	100	94	91	85	82	79	77	77	77
24	129	129	129	129	129	129	126	123	117	112	105	103	96	94	88	85	79	77	73	70	70
25	129	129	129	129	129	129	126	120	114	108	105	100	96	91	88	82	79	77	70	67	65
26	129	129	129	129	129	129	123	117	112	108	103	100	94	91	85	82	77	73	70	65	62
27	129	129	129	129	129	126	120	114	112	105	100	96	91	88	82	79	77	70	67	65	62
28	129	129	129	129	129	123	120	114	108	103	100	94	91	85	82	79	73	70	67	62	59
29	129	129	129	129	126	123	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59
30	129	129	129	129	126	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56
31	129	129	129	129	123	117	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56
32	129	129	129	126	120	114	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53
33	129	129	129	123	120	114	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53
34	129	129	126	123	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50
35	129	129	126	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50
36	129	129	123	117	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	50
37	129	126	120	117	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47
38	129	123	120	114	108	103	100	94	91	85	82	77	73	70	67	62	59	56	53	50	47
39	126	123	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50	47	44
40	126	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44
41	123	117	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	47	44	41
42	120	117	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47	44	41
43	117	114	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53	50	47	44	38
44	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	53	50	47	44	41	38
45	114	111	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44	41	38

Legend t = Fresh air temperature in °C
 x = Fresh air humidity in g/kg

Reference: Supply air flow rate 25750 m³/h

Table F4: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

Extract air: **36 °C**

Supply air: **22 °C**

$\Delta t = 14 \text{ K}$

$Q_{\text{tot}} = 120 \text{ kW}$

Fresh air

t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤ 15	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120
16	120	120	120	120	120	120	120	120	120	120	120	117	117	117	117	117	117	117	117	117	117
17	120	120	120	120	120	120	120	120	120	120	120	117	112	111	111	111	111	111	111	111	111
18	120	120	120	120	120	120	120	120	120	120	120	114	108	105	105	105	105	105	105	105	105
19	120	120	120	120	120	120	120	120	120	120	117	112	105	103	100	100	100	100	100	100	100
20	120	120	120	120	120	120	120	120	120	120	114	108	105	100	96	94	94	94	94	94	94
21	120	120	120	120	120	120	120	120	120	120	117	112	108	103	100	94	91	88	88	88	88
22	120	120	120	120	120	120	120	120	120	120	114	112	105	103	96	91	88	85	82	82	82
23	120	120	120	120	120	120	120	120	120	120	114	108	103	100	94	91	85	82	79	77	77
24	120	120	120	120	120	120	120	120	117	112	105	103	96	94	88	85	79	77	73	70	70
25	120	120	120	120	120	120	120	120	114	108	105	100	96	91	88	82	79	77	70	67	65
26	120	120	120	120	120	120	120	117	112	108	103	100	94	91	85	82	77	73	70	65	62
27	120	120	120	120	120	120	120	114	112	105	100	96	91	88	82	79	77	70	67	65	62
28	120	120	120	120	120	120	120	114	108	103	100	94	91	85	82	79	73	70	67	62	59
29	120	120	120	120	120	120	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59
30	120	120	120	120	120	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56
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32	120	120	120	120	120	114	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53
33	120	120	120	120	120	114	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53
34	120	120	120	120	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50
35	120	120	120	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50
36	120	120	120	117	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	50
37	120	120	120	117	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47
38	120	120	120	114	108	103	100	94	91	85	82	77	73	70	67	62	59	56	53	50	47
39	120	120	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50	47	44
40	120	120	114	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44
41	120	117	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	47	44	41
42	120	117	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47	44	41
43	117	114	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53	50	47	44	38
44	117	112	105	103	96	94	88	85	79	77	73	67	65	62	59	53	50	47	44	41	38
45	114	111	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44	41	38

Legend t = Fresh air temperature in °C
x = Fresh air humidity in g/kg

Reference: Supply air flow rate 25750 m³/h

Table F5: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

Extract air: **36 °C** Supply air: **23 °C** $\Delta t = 13 \text{ K}$ $Q_{\text{tot}} = 112 \text{ kW}$

Fresh air																					
t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤ 16	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112	112
17	112	112	112	112	112	112	112	112	112	112	112	112	112	111	111	111	111	111	111	111	111
18	112	112	112	112	112	112	112	112	112	112	112	112	108	105	105	105	105	105	105	105	105
19	112	112	112	112	112	112	112	112	112	112	112	112	105	103	100	100	100	100	100	100	100
20	112	112	112	112	112	112	112	112	112	112	112	108	105	100	96	94	94	94	94	94	94
21	112	112	112	112	112	112	112	112	112	112	112	108	103	100	94	91	88	88	88	88	88
22	112	112	112	112	112	112	112	112	112	112	112	105	103	96	91	88	85	82	82	82	82
23	112	112	112	112	112	112	112	112	112	112	108	103	100	94	91	85	82	79	77	77	77
24	112	112	112	112	112	112	112	112	112	112	105	103	96	94	88	85	79	77	73	70	70
25	112	112	112	112	112	112	112	112	112	108	105	100	96	91	88	82	79	77	70	67	65
26	112	112	112	112	112	112	112	112	112	108	103	100	94	91	85	82	77	73	70	65	62
27	112	112	112	112	112	112	112	112	112	105	100	96	91	88	82	79	77	70	67	65	62
28	112	112	112	112	112	112	112	112	108	103	100	94	91	85	82	79	73	70	67	62	59
29	112	112	112	112	112	112	112	112	105	103	96	94	88	85	79	77	73	67	65	62	59
30	112	112	112	112	112	112	112	108	105	100	96	91	88	82	79	73	70	67	65	59	56
31	112	112	112	112	112	112	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56
32	112	112	112	112	112	112	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53
33	112	112	112	112	112	112	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53
34	112	112	112	112	112	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50
35	112	112	112	112	112	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50
36	112	112	112	112	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	50
37	112	112	112	112	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47
38	112	112	112	112	108	103	100	94	91	85	82	77	73	70	67	62	59	56	53	50	47
39	112	112	112	112	105	103	96	94	88	85	79	77	73	67	65	62	59	56	50	47	44
40	112	112	112	108	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44
41	112	112	112	108	103	100	94	88	85	82	77	73	70	65	62	59	56	53	47	44	41
42	112	112	112	105	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47	44	41
43	112	112	108	103	100	94	91	85	82	79	73	70	67	62	59	56	53	50	47	44	38
44	112	112	105	103	96	94	88	85	79	77	73	67	65	62	59	53	50	47	44	41	38
45	112	111	105	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44	41	38

Legend t = Fresh air temperature in °C
 x = Fresh air humidity in g/kg

Reference: Supply air flow rate 25750 m³/h

Table F6: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

Extract air: **36 °C** Supply air: **24 °C** $\Delta t = 12 \text{ K}$ $Q_{\text{tot}} = 103 \text{ kW}$

Fresh air																					
t \ x	0.1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
≤ 18	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103	103
19	103	103	103	103	103	103	103	103	103	103	103	103	103	103	100	100	100	100	100	100	100
20	103	103	103	103	103	103	103	103	103	103	103	103	103	100	96	94	94	94	94	94	94
21	103	103	103	103	103	103	103	103	103	103	103	103	103	100	94	91	88	88	88	88	88
22	103	103	103	103	103	103	103	103	103	103	103	103	103	96	91	88	85	82	82	82	82
23	103	103	103	103	103	103	103	103	103	103	103	103	100	94	91	85	82	79	77	77	77
24	103	103	103	103	103	103	103	103	103	103	103	103	96	94	88	85	79	77	73	70	70
25	103	103	103	103	103	103	103	103	103	103	103	100	96	91	88	82	79	77	70	67	65
26	103	103	103	103	103	103	103	103	103	103	103	100	94	91	85	82	77	73	70	65	62
27	103	103	103	103	103	103	103	103	103	103	100	96	91	88	82	79	77	70	67	65	62
28	103	103	103	103	103	103	103	103	103	103	100	94	91	85	82	79	73	70	67	62	59
29	103	103	103	103	103	103	103	103	103	103	96	94	88	85	79	77	73	67	65	62	59
30	103	103	103	103	103	103	103	103	103	100	96	91	88	82	79	73	70	67	65	59	56
31	103	103	103	103	103	103	103	103	103	100	94	88	85	82	77	73	70	65	62	59	56
32	103	103	103	103	103	103	103	103	100	96	91	88	82	79	77	70	67	65	62	56	53
33	103	103	103	103	103	103	103	103	100	94	91	85	82	79	73	70	67	62	59	56	53
34	103	103	103	103	103	103	103	103	96	94	88	85	79	77	73	67	65	62	59	56	50
35	103	103	103	103	103	103	103	100	96	91	88	82	79	73	70	67	65	59	56	53	50
36	103	103	103	103	103	103	103	100	94	88	85	82	77	73	70	65	62	59	56	53	50
37	103	103	103	103	103	103	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47
38	103	103	103	103	103	103	100	94	91	85	82	77	73	70	67	62	59	56	53	50	47
39	103	103	103	103	103	103	96	94	88	85	79	77	73	67	65	62	59	56	50	47	44
40	103	103	103	103	103	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44
41	103	103	103	103	103	100	94	88	85	82	77	73	70	65	62	59	56	53	47	44	41
42	103	103	103	103	100	96	91	88	82	79	77	70	67	65	62	56	53	50	47	44	41
43	103	103	103	103	100	94	91	85	82	79	73	70	67	62	59	56	53	50	47	44	38
44	103	103	103	103	96	94	88	85	79	77	73	67	65	62	59	53	50	47	44	41	38
45	103	103	103	100	96	91	88	82	79	73	70	67	65	59	56	53	50	47	44	41	38

Legend t = Fresh air temperature in °C
 x = Fresh air humidity in g/kg

Reference: Supply air flow rate 25750 m³/h

Table F7: Cooling capacities in kW of the free and adiabatic cooling (Q_F)

2.2 Mechanical cooling

Q _M kW	Flow/return			
	8/14 °C		14/20 °C	
	m _W l/h	Δp _W kPa	m _W l/h	Δp _W kPa
3	538	0.04	537	0.05
4	671	0.07	670	0.07
5	782	0.09	781	0.09
6	938	0.12	937	0.12
7	1073	0.16	1071	0.16
8	1251	0.21	1249	0.21
9	1471	0.28	1469	0.28
10	1564	0.31	1561	0.31
11	1720	0.37	1717	0.37
12	1876	0.44	1873	0.44
13	2033	0.51	2030	0.50
14	2189	0.58	2186	0.58
15	2408	0.70	2404	0.68
16	2533	0.76	2529	0.75
17	2674	0.84	2670	0.83
18	2799	0.92	2795	0.90
19	2971	1.02	2966	1.00
20	3127	1.13	3122	1.10
21	3331	1.26	3325	1.23
22	3440	1.34	3435	1.31
23	3597	1.46	3591	1.42
24	3722	1.55	3716	1.51
25	3909	1.70	3903	1.65
26	4128	1.88	4122	1.82
27	4253	1.99	4247	1.92
28	4378	2.09	4371	2.02
29	4535	2.23	4528	2.16
30	4644	2.33	4637	2.25
31	4848	2.53	4840	2.43
32	5051	2.73	5043	2.62
33	5176	2.85	5168	2.74
34	5317	3.00	5308	2.88
35	5442	3.13	5433	3.00
36	5551	3.24	5542	3.11
37	5786	3.50	5777	3.35
38	5973	3.71	5964	3.55
39	6083	3.84	6073	3.67
40	6255	4.04	6245	3.86

Legend: Q_M = Mechanical cooling capacity per unit
(100 % sensitive to max. 10 g/kg extract air humidity)
m_W = Water quantity
Δp_W = Water-side pressure loss

Reference: Supply air flow rate 25750 m³/h
Water/glycol mixture with 30% glycol

Q _M kW	Flow/return			
	8/14 °C		14/20 °C	
	m _W l/h	Δp _W kPa	m _W l/h	Δp _W kPa
41	6364	4.17	6354	3.99
42	6599	4.46	6588	4.26
43	6755	4.66	6744	4.44
44	6849	4.78	6838	4.56
45	6990	4.96	6979	4.73
46	7193	5.23	7182	4.98
47	7381	5.48	7369	5.22
48	7506	5.66	7494	5.38
49	7662	5.88	7650	5.58
50	7803	6.08	7790	5.77
51	7975	6.33	7962	6.00
52	8131	6.56	8118	6.22
53	8288	6.79	8274	6.44
54	8444	7.03	8431	6.66
55	8601	7.27	8587	6.89
56	8804	7.59	8790	7.18
57	8913	7.77	8899	7.35
58	9101	8.07	9086	7.63
59	9179	8.20	9164	7.75
60	9382	8.54	9367	8.06
61	9601	8.91	9586	8.41
62	9695	9.07	9680	8.56
63	9852	9.34	9836	8.81
64	10008	9.61	9992	9.06
65	10211	9.98	10195	9.40
66	10321	10.18	10304	9.58
67	10493	10.49	10476	9.88
68	10586	10.66	10569	10.04
69	10790	11.04	10772	10.39
70	11009	11.46	10991	10.77
71	11103	11.64	11085	10.94
72	11259	11.95	11241	11.22
73	11447	12.32	11428	11.56
74	11603	12.63	11584	11.85
75	11728	12.88	–	–
76	11884	13.20	–	–
77	12041	13.52	–	–
78	12197	13.84	–	–

Legend: Q_M = Mechanical cooling capacity per unit
(100 % sensitive to max. 10 g/kg extract air humidity)
m_W = Water quantity
Δp_W = Water-side pressure loss

Reference: Supply air flow rate 25750 m³/h
Water/glycol mixture with 30% glycol

Q _M kW	Flow/return			
	8/14 °C		14/20 °C	
	m _W l/h	Δp _W kPa	m _W l/h	Δp _W kPa
79	12354	14.17	–	–
80	12510	14.51	–	–
81	12666	14.84	–	–
82	12823	15.18	–	–
83	12979	15.53	–	–
84	13135	15.87	–	–
85	13292	16.22	–	–
86	13448	16.58	–	–
87	13604	16.93	–	–
88	13761	17.29	–	–
89	13917	17.66	–	–
90	14074	18.02	–	–
91	14230	18.40	–	–
Legend:	Q _M = Mechanical cooling capacity per unit (100 % sensitive to max. 10 g/kg extract air humidity) m _W = Water quantity Δp _W = Water-side pressure loss			
Reference:	Supply air flow rate 25750 m ³ /h Water/glycol mixture with 30% glycol			

Table F8: Mechanical cooling capacities per unit

3 Recommended extract air humidity

The dimensions of a supply air humidifier supplied by the client depend on the dehumidification capacity of the ServeCool unit, and thus the extract air humidity. Hoval recommends complying with the extract air humidities indicated in the following diagram. If these set values are complied with, the dehumidification capacity is 5 kg/h at most.

Note
Set the set value for the extract air humidity at low fresh air temperatures acc. to Fig. F6.

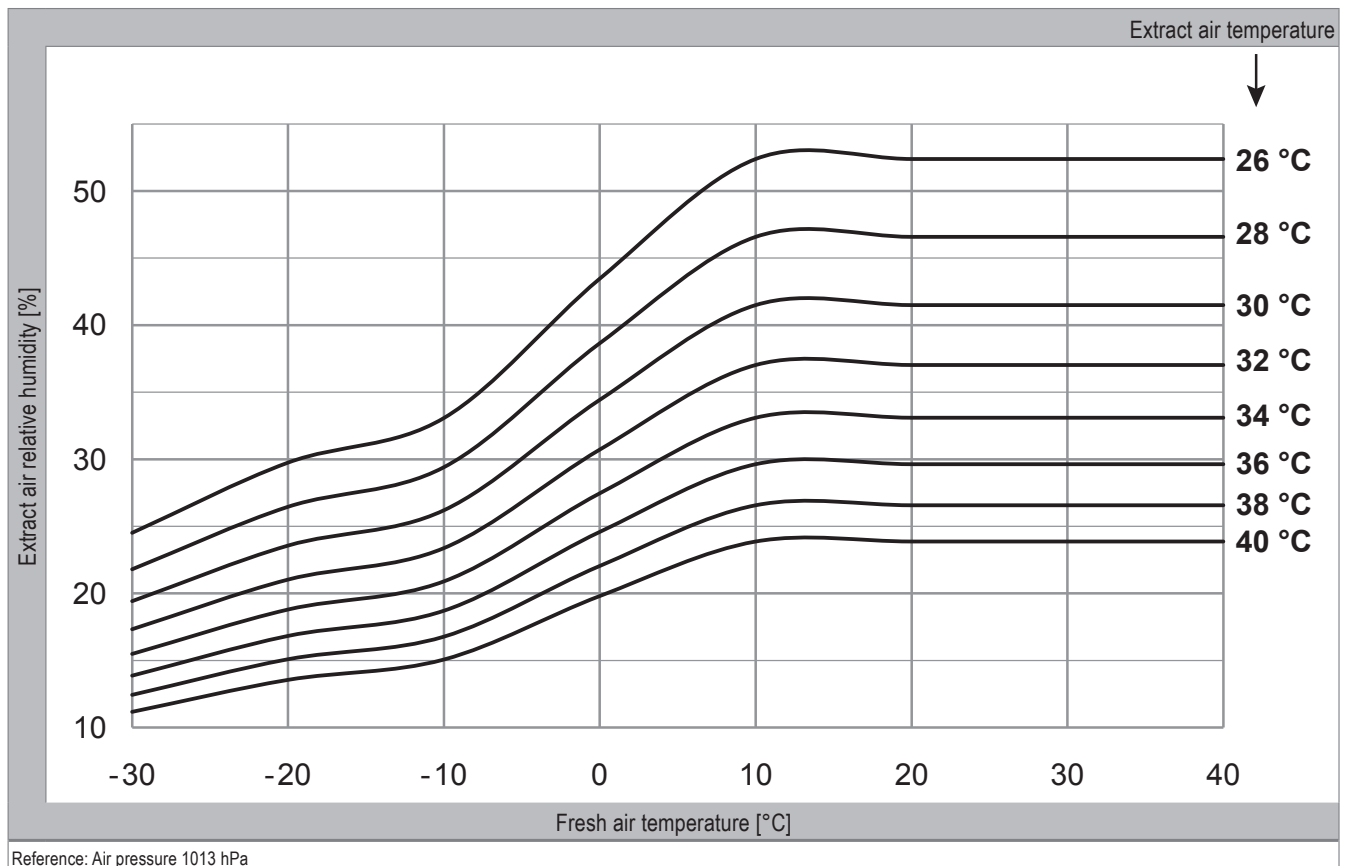


Fig. F6: Recommended extract air humidities depending on the fresh air temperature

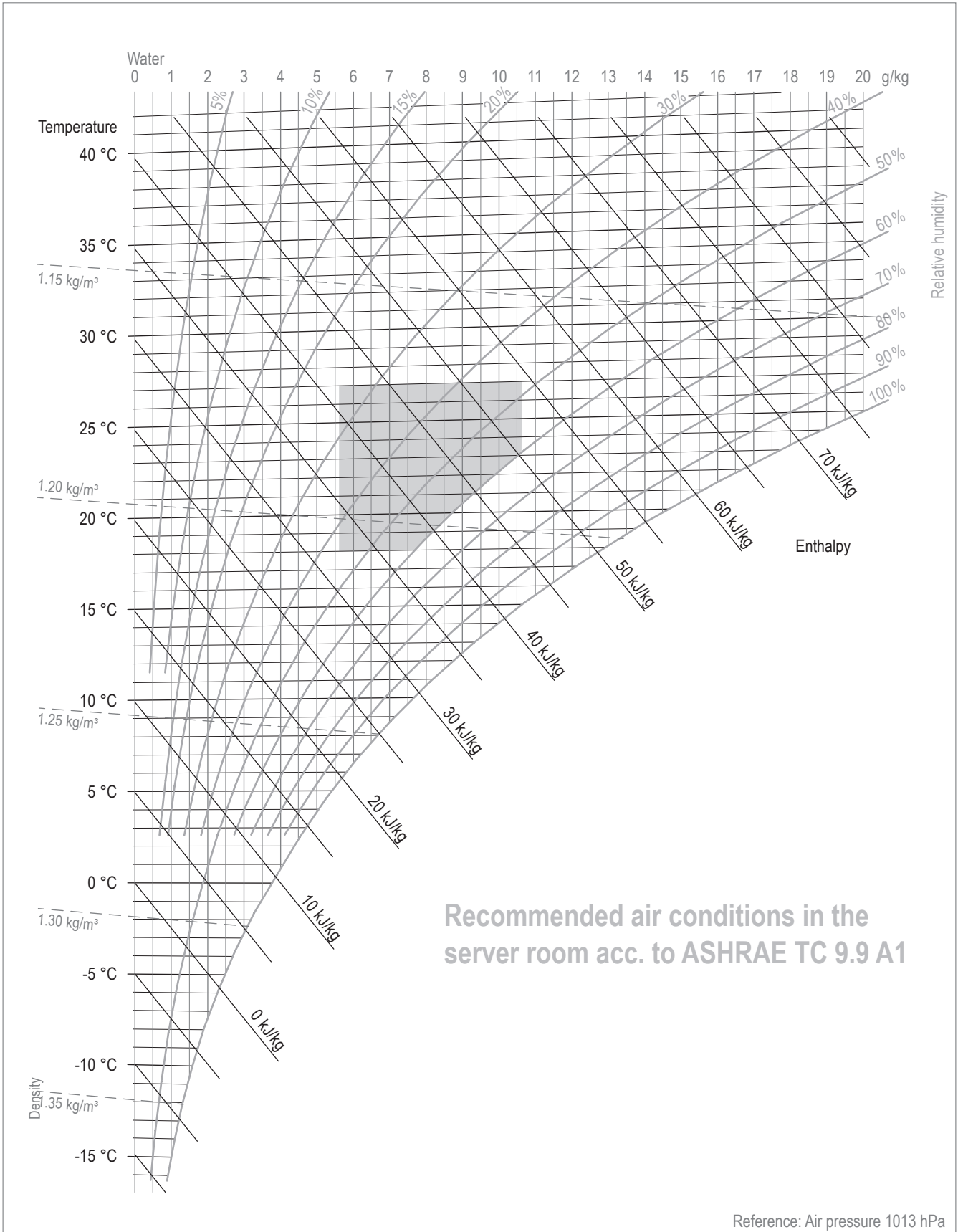
4 Maintenance schedule

Activity	Interval
Change the filters (extract air filter, fresh air filter)	When the 'Filter' alarm is displayed, at least annually
Check the total colony count of the circulating water using Dip slides	Every 3 months (during summer operation)
Check the function of the discharge and trap	Every 6 months
Drain and clean the adiabatic system, clean the water filter	Every 6 months (before and after summer operation)
Comprehensive functional check and cleaning of the unit (fans, actuators, adiabatic pump, spray nozzles, cooling valve, ...)	Annually

Table F9: Maintenance schedule

**Note**

Check whether additional activities are required to comply with national regulations (e.g. hygiene inspections acc. to VDI 6022, ensuring hygienic operation of evaporative cooling systems acc. to VDI 2047-2).



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