

STULZ

CLIMATE. CUSTOMIZED.



CyberCool 2

Original instructions

Precision Chillers

Scroll compressor

400V/50Hz/3Ph/N/PE

Index G42
Issue 9.2019



ABOUT STULZ

Since it was founded in 1947, the STULZ company has evolved into one of the world's leading system suppliers of air-conditioning technology.

Since 1974 the group has seen continual international expansion of its air conditioning technology business, specialising in A/C for data centres and telecommunications installations.

STULZ has ten production plants (2 in Germany, Italy, the USA, Great Britain, Spain, 2 in China, Brazil and India) and twenty subsidiaries (in Germany, France, Italy, Great Britain, Belgium, Brazil, the Netherlands, New Zealand, Mexico, Austria, Poland, Spain, Singapore, China, India, Indonesia, South Africa, Sweden, Australia and the USA).

The company also co-operates with sales and service partners in over 140 other countries, and therefore boasts an international network of air-conditioning specialists.

Editor

**STULZ GmbH
Holsteiner Chaussee 283
22457 Hamburg**

The high-end chiller

Dear customer,

we are pleased that you have decided for a CyberCool 2 Chiller from STULZ.
The units, which were produced in Hamburg, have been developed especially for use in Data Centers and industry and satisfy all requirements for efficiency and reliability.

For general inquiries our hotline is available
at **+49 40 5585-5000**
Our service hours are weekdays from 7am – 4pm.

For further information concerning our
products and services visit our website :
www.stulz.com






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Subject to technical modifications.

1. Safety

1.1 Marking

 DANGER	threatening danger, grievous bodily harm and death
 WARNING	dangerous situation, grievous bodily injury
 CAUTION	dangerous situation, light bodily injury
 NOTICE	material damage, important information and application notice
 ESD NOTE	risk of damaging electronical components

1.2 Safety instructions

These operating instructions contain basic information which is to be complied with for installation, operation and maintenance. They must therefore be read and complied with by the fitter and the responsible trained staff/operators before assembly and commissioning. They must be permanently available at the place where the system is used.

DANGER

- Works have to be carried out by competent staff only.
- Safety devices may not be bypassed.

1.3 Handling refrigerants

- Get qualified refrigeration technicians to carry out the work.
- Wear safety glasses and safety gloves.
- Liquid refrigerant must not get onto the skin (risk of burns).
- Do not inhale refrigerant vapours.
- Refrigerants have a narcotic effect when inhaled in high concentrations.
- If unavoidable work is required in the presence of a high concentration of refrigerant, breathing apparatus must be worn. This does not mean simple filter masks. Comply with breathing protection data sheet.
- Do not eat, drink or smoke at work.
- Warning against intentional misuse.
- It is absolutely essential to comply with the first aid measures if accidents occur.
- Refrigerants containing FCs contribute to the global warming and with this to climate changes. The

FCs must therefore be disposed of in accordance with the regulations, i.e. only by companies specially qualified and licensed as recognised disposal companies for refrigerants.

- Responsibility for correct disposal of refrigerant and system parts is incumbent on the operator.

1.4 Duties of the operator

The following requirements relate to the operation of refrigerating plants within the European Community.

- The used components must correspond to the pressure equipment guide-line 2014/68/EU and EN 378 part 1-4.
- Independent of the design, the equipment and inspection before the delivery, also the operator of such plants has duties according to EN 378 and national regulations.

This concerns the installation, the operation and the repeated inspection:

- Installation: according to EN 378
- Operation: Determination of emergency measures (accidents, malfunctions)
Creation of an abbreviated instruction and notification (template page)
 - a. A unit protocol must be kept.
 - b. To be stored in the proximity of the unit
 - c. Access for competent staff in case of repairs and repeated inspection must be ensured.
- Repeated inspection: according to EN 378
The operator is responsible for the execution.

The operator must ensure that all maintenance, inspection and assembly work is carried out by authorised and qualified specialist staff who have made an in-depth study of the operating instructions.

Independent conversion and manufacture of replacement parts

The system may only be converted or modified after consultation with STULZ. Original replacement parts and replacement parts/accessories authorised by STULZ are an aid to safety.

2. Transport / Storage

2.1 Delivery of units

Stulz chiller units are delivered unpacked and with pre-installed lifting lugs.

i NOTICE

The refrigerant circuit is filled with R410A refrigerant ready for use.

The chiller is labelled as follows.

- | | |
|-----------------------------|--|
| 1) Stulz logo | |
| 2) Stulz order number | • Due to the pre-filled refrigerant, the unit is marked as transport of dangerous goods. |
| 3) Type of unit | |
| 4) Packing piece - contents | • The refrigerant is non-flammable and non-toxic. |
| 5) Warning symbols | |
- For special shipping indication, please contact our sales department.
 - Special transport regulations must be checked country-specifically.

i NOTICE

When delivery is accepted, check the unit against the consignment papers for completeness and for external damage and record it on the consignment papers in the presence of the freight forwarder.

- You receive the consignment papers with the delivery of the chiller unit.
- The shipment is made ex works, in case of shipment damages, please assert your claim towards the carrier.

2.2 Storage

If you put the unit into intermediate storage before the installation, the following measures have to be carried out to protect the unit from damage and corrosion:

- the storage point must not be exposed to direct sunlight. Observe the storage conditions in the chapter "Application limits".
- store the unit packaged to avoid the risk of corrosion.
- make sure that the water connections are provided with protective hoods.

2.3 Transport

⚠ DANGER

Mortal danger by crushing

A defective lifting device can lead to the uncontrolled fall of the chiller unit.
Do not stay under suspended loads!

The Stulz chiller units can be lifted and moved by lifting devices with ropes or belts.

- take care that the unit is in an upright position at the transport.

Construction sizes 3 and 4

For the transport, there are openings in the base frame, through which steel tubes must be pushed. The steel tubes are not delivered and must be provided by the customer.

Requirements for the steel tubes:

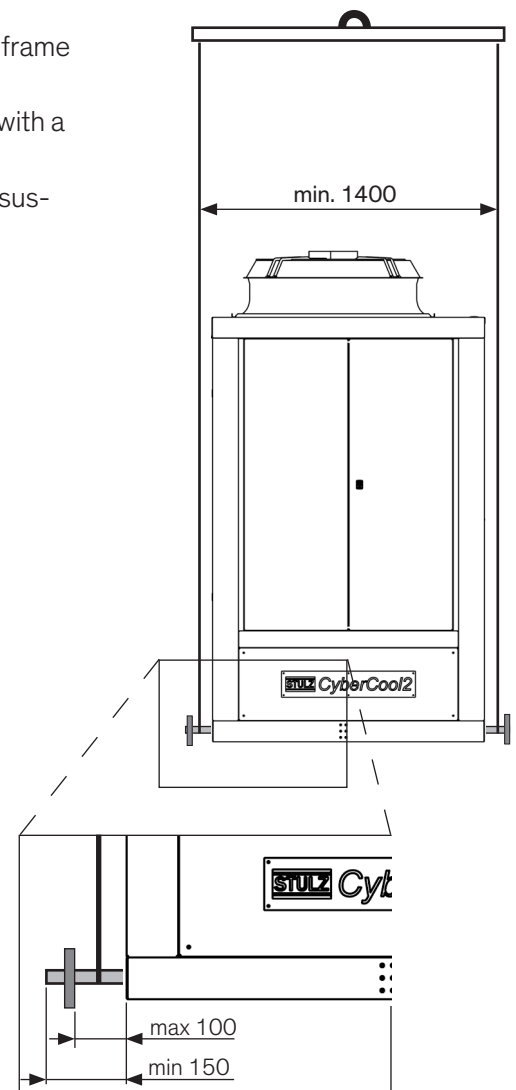
Length: minimum 1600 mm
Diameter: < 50 mm, according to unit net weight
Wall thickness: according to unit net weight

To prevent the ropes from sliding off the steel tubes, fasten a clamp at the end of the tubes.

Position of the clamps: maximum 100 mm distance from the base frame

The lifting device must consist of one (size 3) or two cross beams, with a minimum length of 1400 mm.

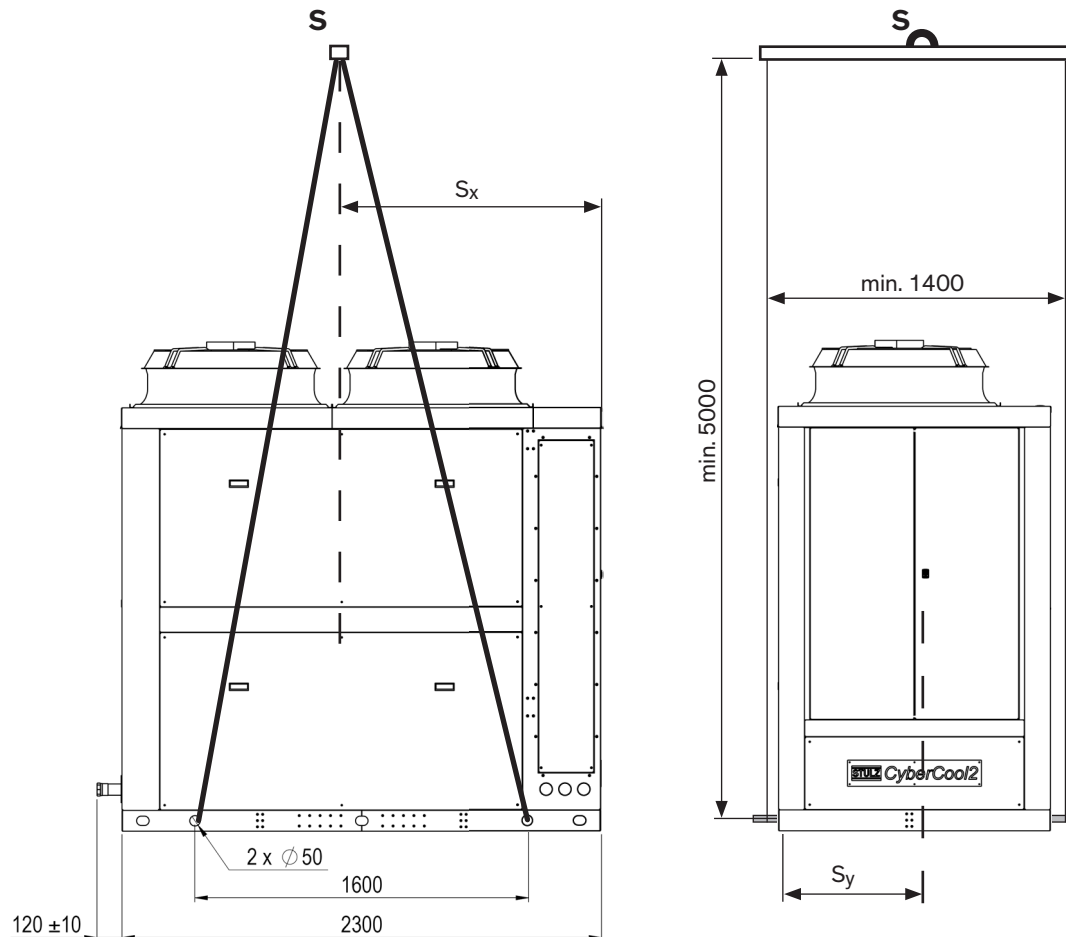
The drawings on the following pages show the dimensions for the suspension points and the position of the centre of gravity.



i NOTICE

- **Consider also the weight of the cross beam when you order the crane.**
- The rope forces are higher than the weight forces according to the geometry.
- Due to the risk of scratching the side planking, we advise, not to use chains.

Construction size 3

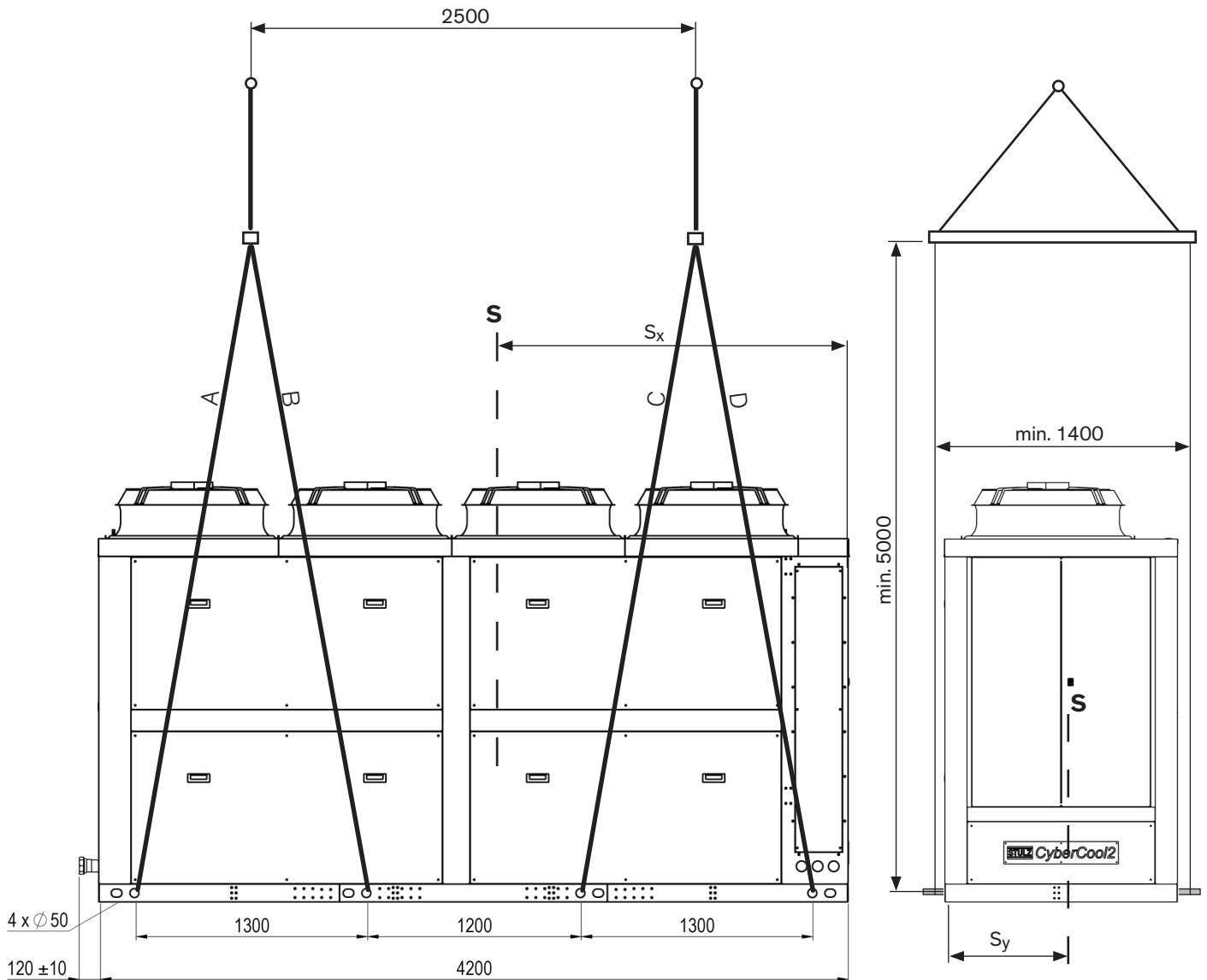


Model	S _x [mm]	S _y [mm]	G [kg]
CSO 541 ASN	957	572	915
CSO 621 ASN	959	572	926
CSO 801 ASN	970	582	948
CSO 541 ASF	998	627	1057
CSO 621 ASF	999	627	1068
CSO 801 ASF	1012	639	1090
CQO 541 ASN	957	572	924
CQO 621 ASN	959	572	935
CQO 541 ASF	998	627	1068
CQO 621 ASF	999	627	1079

G: unit transport weight
S: centre of gravity

The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

Construction size 4



Model	S _x [mm]	S _y [mm]	G [kg]
CSO 1102 ASN	1702	630	1550
CSO 1302 ASN	1737	614	1602
CSO 1102 ASF	1785	736	1830
CSO 1302 ASF	1820	720	1882
CQO 802 ASN	1650	650	1442
CQO 1102 ASN	1702	630	1565
CQO 802 ASF	1730	760	1722
CQO 1102 ASF	1785	736	1849

The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

G: unit transport weight
S: centre of gravity

The ropes or belts named by A, B, C and D must have the same length.

Construction sizes 5 - 7

For the transport, lifting lugs are mounted at the base frame where the ropes/belts must be attached. The number of lifting lugs varies according to the construction size.

The lifting device must consist of two cross beams.

The drawings on the following pages show the dimensions for the suspension points and the position of the centre of gravity.



Suspension at the lifting lugs

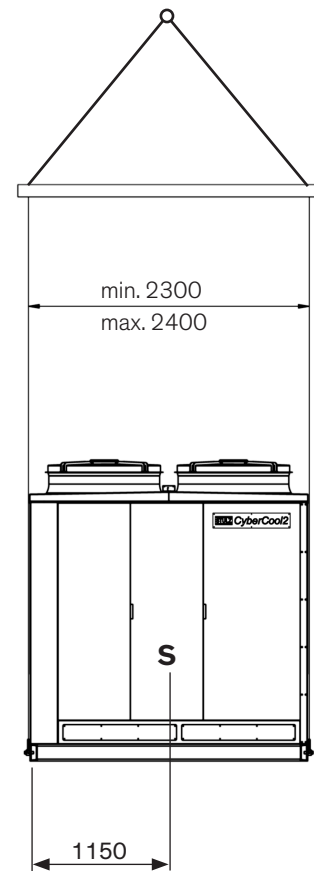
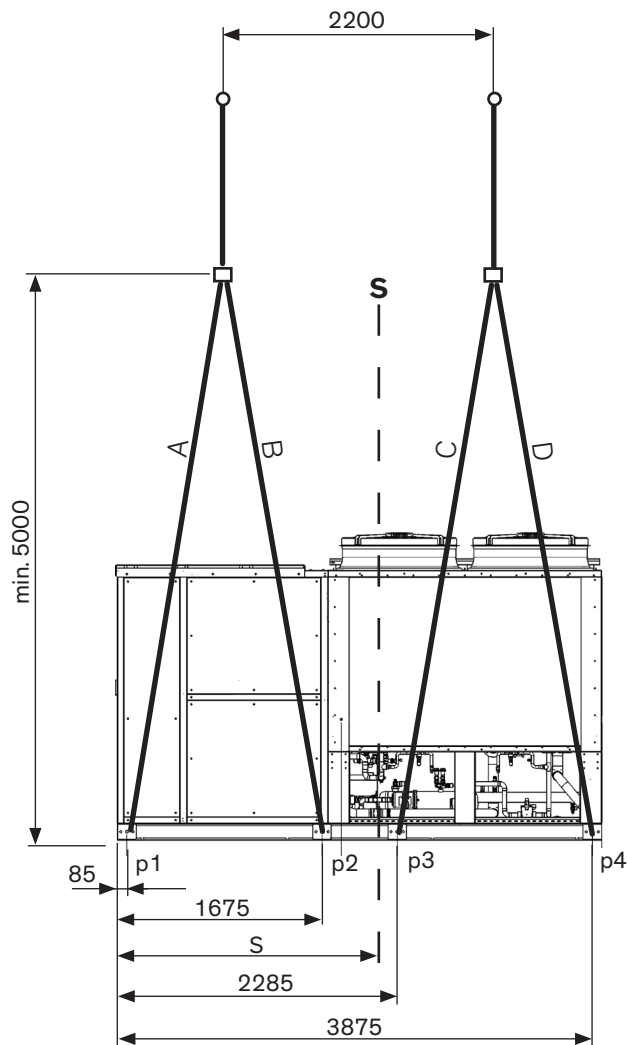


- After installation, remove the lifting lugs and keep them for future transport.

i NOTICE

- **Consider also the weight of the cross beams when you order the crane.**
- The rope forces are higher than the weight forces according to the geometry.
- Due to the risk of scratching the side planking, we advise, not to use chains.

Construction size 5



Model	S [mm]	G [kg]
CSO 1602 ASN	1730	3081
CSO 1902 ASN	1700	3123
CSO 2402 ASN	1720	3177
CSO 1602 ASF	1860	3520
CSO 1902 ASF	1850	3562
CSO 2402 ASF	1850	3615
CQO 1302 ASN	1680	2808
CQO 1602 ASN	1710	3112
CQO 1902 ASN	1720	3154
CQO 1302 ASF	1920	3247
CQO 1602 ASF	1860	3555
CQO 1902 ASF	1860	3597

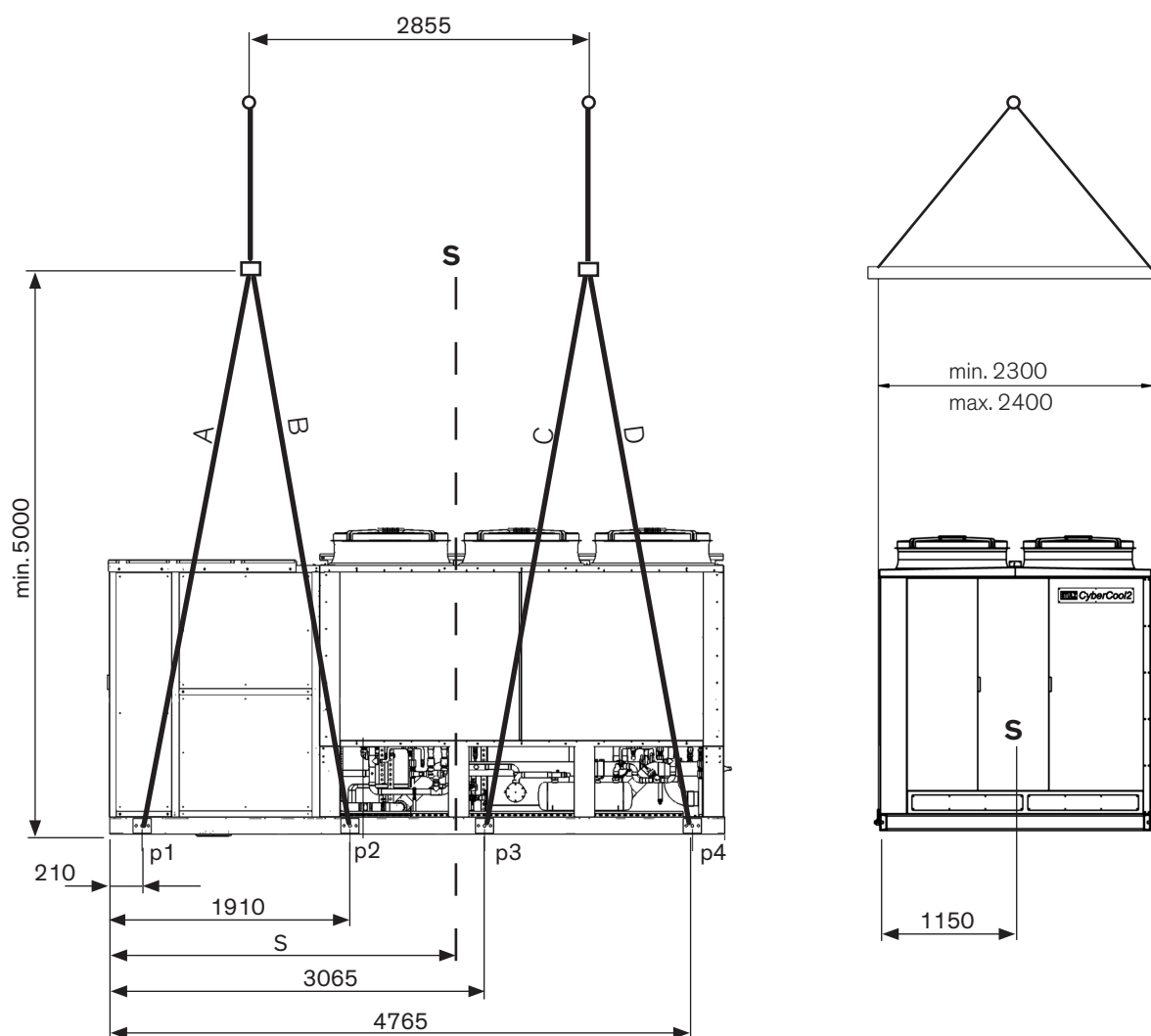
G: unit transport weight

S: centre of gravity

The ropes or belts named by A, B, C and D must have the same length.

The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

Construction size 6



Model	S [mm]	G [kg]
CSO 2802 ASN	2200	3741
CSO 3702 ASN	1900	4276
CSO 4002 ASN	1950	4044
CSO 2802 ASF	2300	4323
CSO 3702 ASF	2000	4858
CSO 4002 ASF	2050	4626
CQO 2402 ASN	2180	3713
CQO 2802 ASN	2200	3779
CQO 3702 ASN	1880	4319
CQO 2402 ASF	2290	4295
CQO 2802 ASF	2300	4366
CQO 3702 ASF	2000	4907

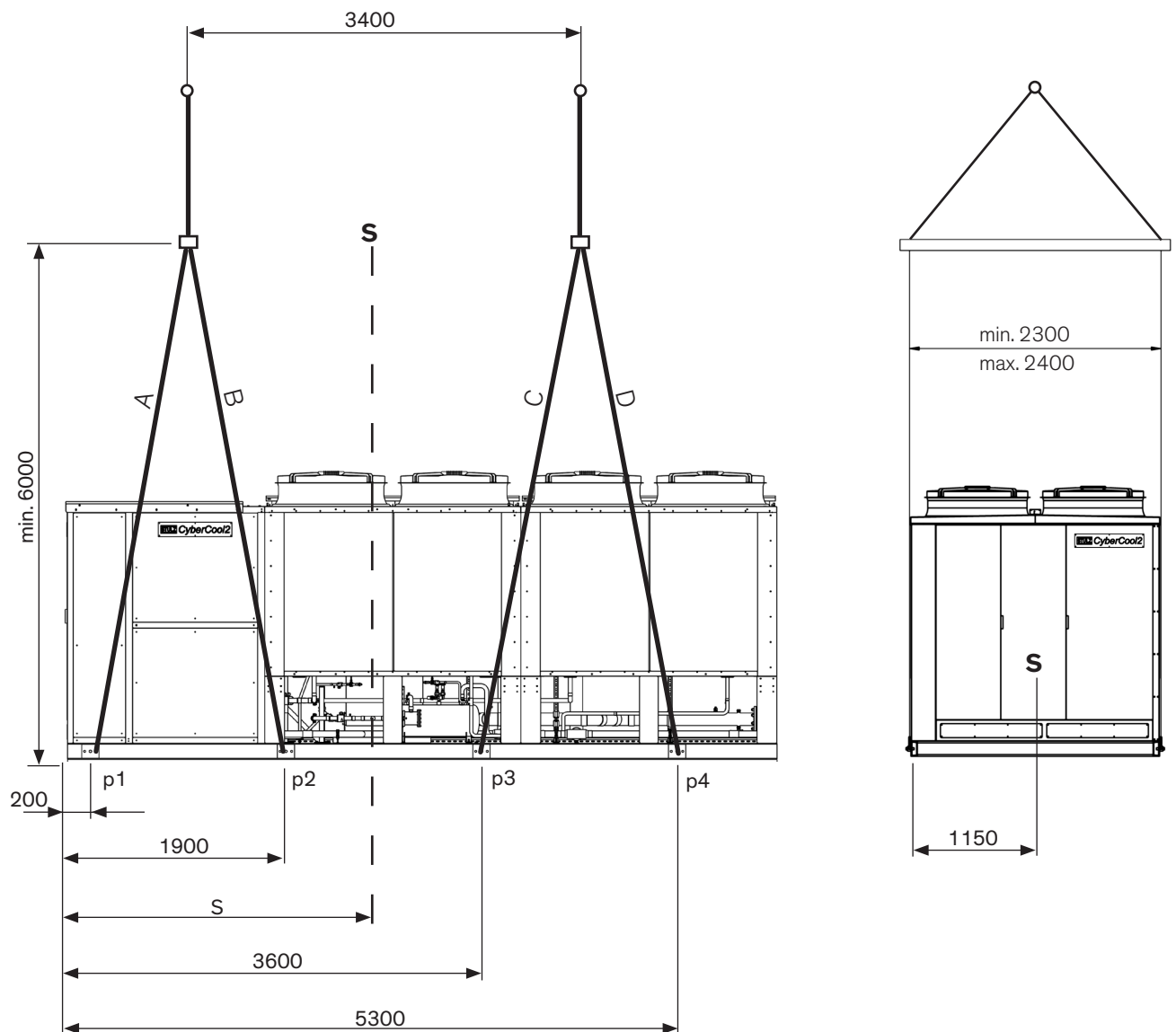
G: unit transport weight

S: centre of gravity

The ropes or belts named by A, B, C and D must have the same length.

The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

Construction size 6½



Model	S [mm]	G [kg]
CSO 4202 ASN	2410	4540
CSO 4202 ASF	2660	5374

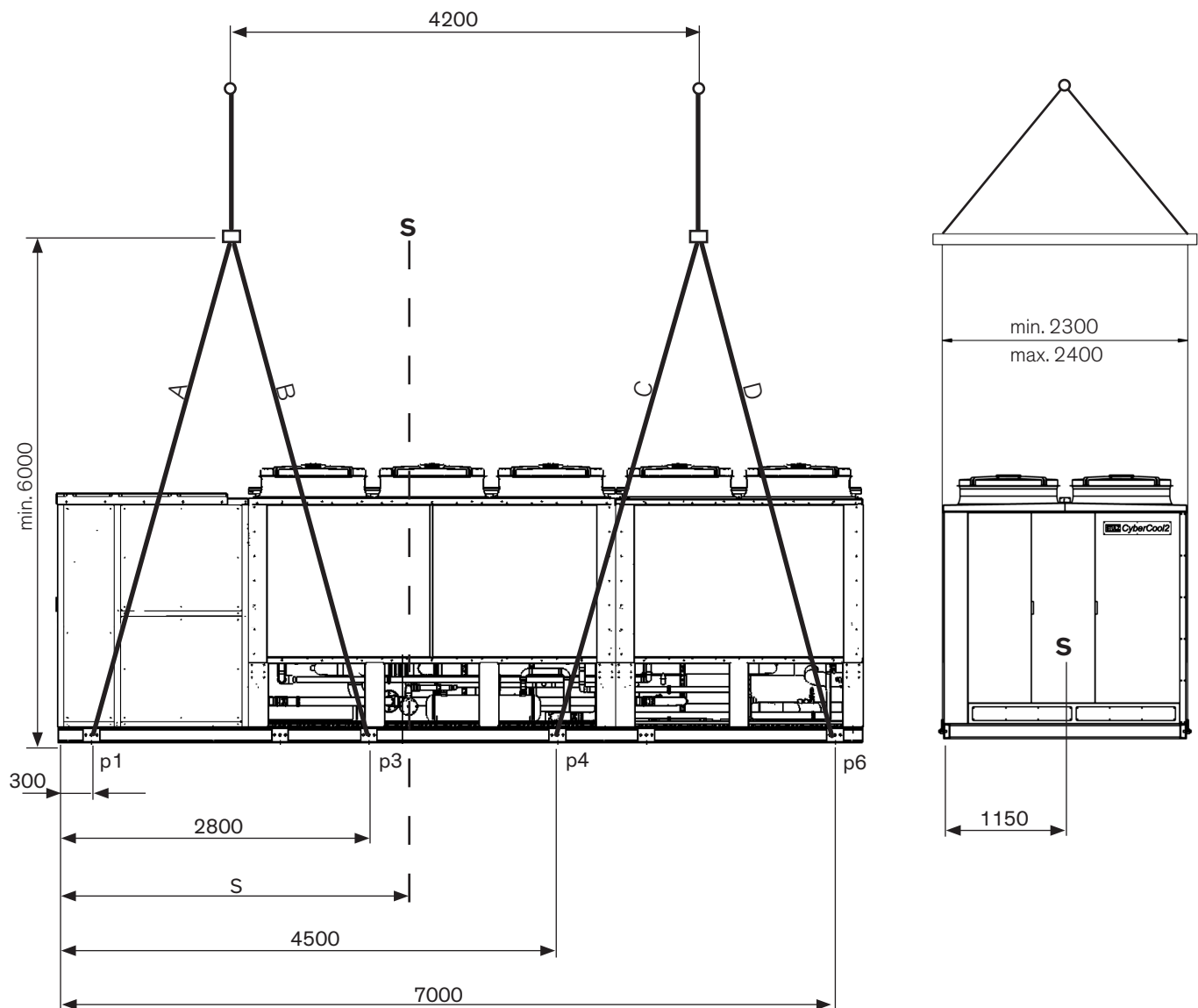
The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

G: unit transport weight

S: centre of gravity

The ropes or belts named by A, B, C and D must have the same length.

Construction size 7



Model	S [mm]	G [kg]
CSO 4602 ASN	2630	5503
CSO 5002 ASN	2830	5182
CSO 5902 ASN	2640	5765
CSO 4602 ASF	2950	6477
CSO 5002 ASF	3130	6145
CSO 5902 ASF	2950	6738
CQO 4002 ASN	2790	5035
CQO 4602 ASN	2630	5558
CQO 5002 ASN	2830	5234
CQO 4002 ASF	3095	6017
CQO 4602 ASF	2950	6542
CQO 5002 ASF	3130	6207

G: unit transport weight
S: centre of gravity

The ropes or belts named by A, B, C and D must have the same length.

The co-ordinates of the centre of gravity are indicated with a tolerance of ± 50 mm.

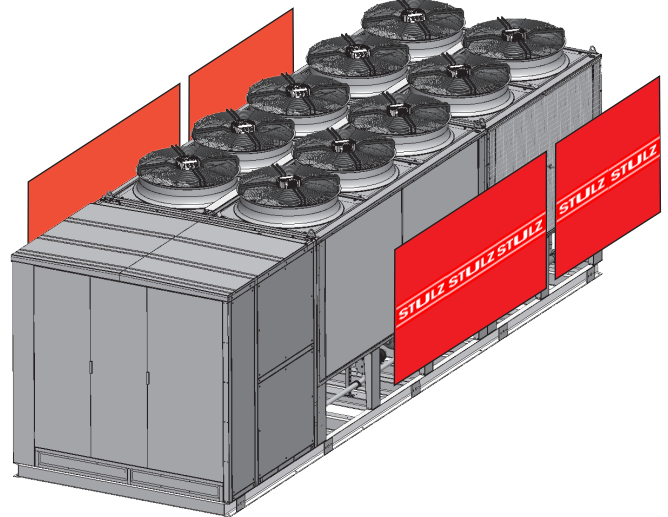
Transport protection

At the delivery the chiller is equipped with flexible plates made of polypropylene, which are fixed at the condenser coils. If the unit is equipped with the option "coil protection grille" the protection grilles must be unscrewed to remove the polypropylene plates.

- Remove these plates before start-up.



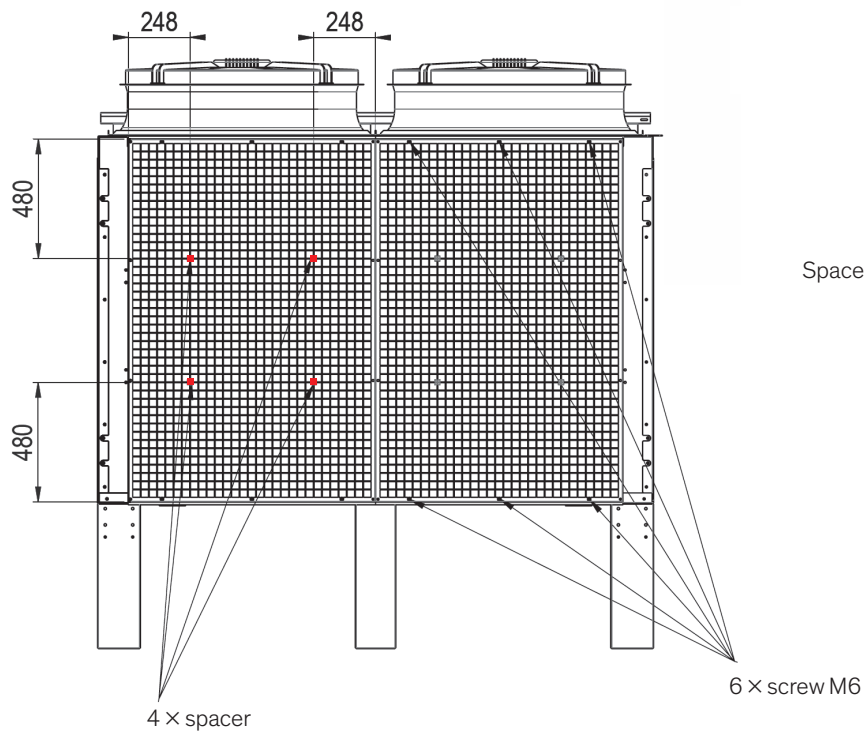
Coil protection grille (optional)
+ housing protection grille (optional)



Option: Coil protection grille

The spacers are enclosed in the electrical cabinet.

- Unscrew the coil protection grille (6 screws).
- Remove the transport protection plates.
- Place the spacers (4 pieces each) on the protection grille.
- Fix the coil protection grille.

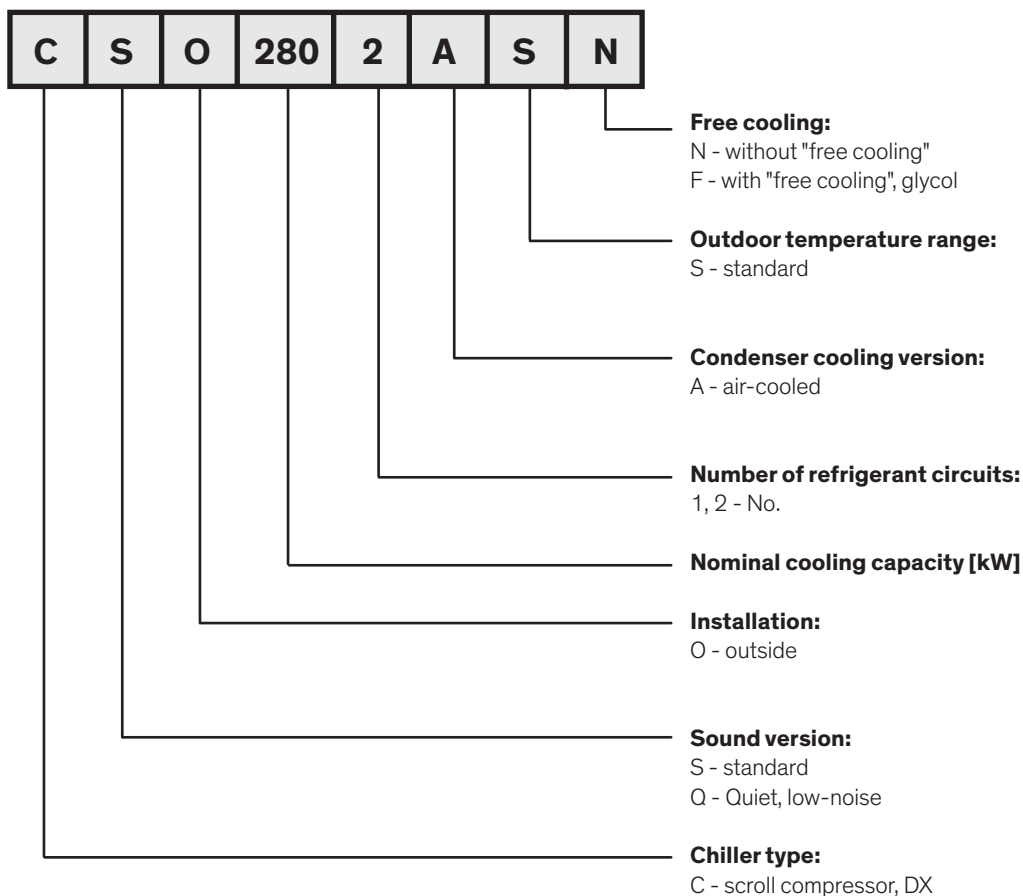


3. Description

3.1 Type code

The type code represents the unit variant of your chiller unit and can be found on the type plate. The type plate is located on the inner side of the left the door of the electric cabinet.

			Typenschild/type plate plaque d'appareil	
		Lieferant manufacturer vendeur	STULZ GmbH Hamburg Holsteiner Chaussee 283, D-22457 Hamburg	
Unit type	_____	Typ type type	CSO 2802 ASN	Versorgungsspannung supply voltage tension de service 400 V ± 10% 50 Hz ± 1%
internal part no.	_____	Artikel-Nr. Item-no. numéro d'article	1300010	Kältemittel refrigerant refrigerant R410A
Order number + alternative	_____	Kommission/Alt commission/alt commission/alt	0530111234/01	Max. Betriebsdruck HD max. operation pressure HP pression de fonction max. HP 32 bar
		Baujahr model modele	2019	Max. Betriebsdruck ND max. operation pressure LP pression de fonction max. BP 14 bar
Serial no.	_____	S. Nr. s.-no. no. serie	 1234567890	Temperatur min/max Temperature min/max Température min/max -10/100 °C
				Made in Germany



3.2 Intended use

This chiller unit is used for the chilled water production and for the chilled water temperature control. The chiller is designed for outdoor installation. Any use beyond this is not deemed to be use as intended. STULZ is not liable for any damage resulting from such misuse. The operator alone bears the risk.

3.3 Chiller design

The chillers of the CyberCool2 series with scroll compressors exist in 5 construction sizes, which differ by their dimensions, design and cooling capacity. An overview of the construction sizes 3 to 7 can be seen on pages 35/36.

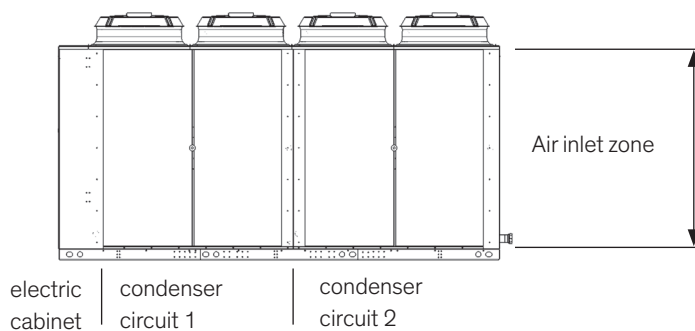
The side, on which the electric cabinet is located, is named front side in these operating instructions.

The compressors are installed in a separate cabinet, which can be accessed in the unit sizes 5 - 7 by removing four panels. Each panel is fixed by eight allen screws.

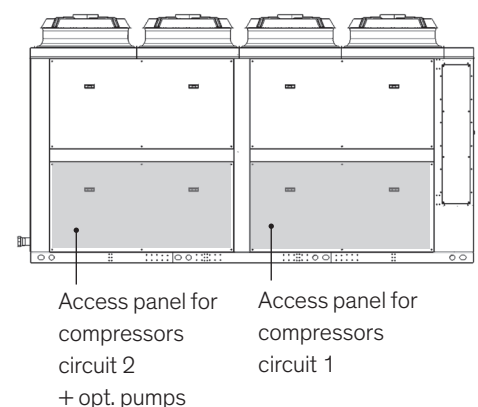
In the compressor cabinet there are high pressure switches for each compressor and a low pressure switch with automatic reset function for each refrigerant circuit.

Basic design for construction size 3 and 4

Right side view:

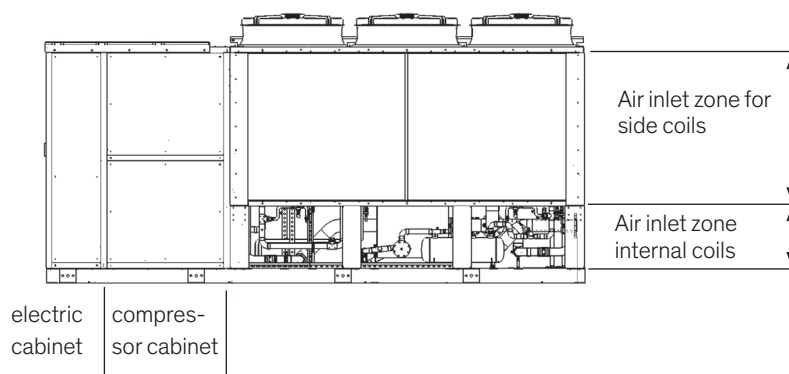


Left side view:



Basic design for construction sizes 5 to 7

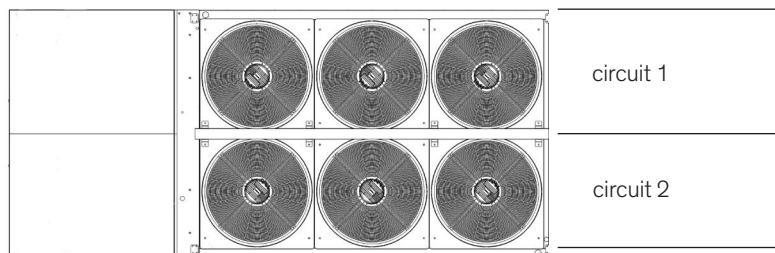
View of the right side:



The components of the first refrigerant circuit are mainly located on the left side of the chiller, the components of the second refrigerant circuit mainly on the right side.

Top view:

Component
location of :



Versions

The standard version for water chillers with scroll compressors has a unit designation, which takes the following pattern: CSO _ _ _ _ ASN. There are two more versions which can be combined among each other in any way.

1. Free cooling version CSO/CQO _ _ _ _ ASF

This version additionally contains a free cooling coil for each refrigerant circuit. The free cooling coils are connected in parallel in the water-side circuit. During free cooling mode, two motor-driven 2-way valves (size 3 and 4: one 3-way valve) direct the water volume flow completely through the free cooling coils, before it flows through the evaporator. If free cooling is not possible due to a high outside temperature, the water volume flow is directed to the evaporator via a bypass line parallel to the free cooling coils.

A control valve is installed in the liquid line and ensures in mixed operation to maintain the condensation pressure, independent of the fan speed.

2. Low noise version CQO _ _ _ _ ASN/ASF

In contrast to the standard chillers of the same construction size, these units work with a reduced air flow.

At approximately the same cooling capacity, a reduction of roughly 10% in sound pressure level is achieved compared to the standard chillers.

Refrigerant circuit

The chiller contains two separated refrigerant circuits which are identically composed. Both refrigerant circuits can be individually operated, which offers the possibility of a capacity grading and which increases the reliability. The operating hours record of the compressors enables equal utilization of both refrigerant circuits by sequencing.

An electronic expansion valve is also part of the standard equipment as a filter dryer with replaceable cartridge and a sight glass with humidity indication.

Each refrigerant circuit disposes of the following safety devices:

- low pressure switch
- high pressure limiter with reset button
- safety valve

Compressor

In units of size 3 and 4 there are two scroll compressors per refrigerant circuit, which can be separately switched on and off.

In units of size 5 - 7 there are four or six scroll compressors, i. e. two or three per refrigerant circuit, which can be separately switched on and off.

In combination with the possibility, to individually operate the refrigerant circuits the total capacity can be graded in steps of 25 resp. 16,7%.

The compressor contains a crankcase heater.

Construction size 5 to 7

The compressor cabinet is cooled by air intake grilles in the base and air outlet grilles to the condenser fan intake area on both sides. The temperature in the compressor cabinet is measured by a sensor in the ceiling area.



Air outlet grille

Evaporator

In the C7000 controller an anti freeze control can be adjusted which activates the pump in case of a low water temperature.



Air inlet grille

Condenser

Construction size 3 and 4

The necessary air for cooling is drawn in across the condenser coils placed on the right side and blown vertically upward through speed-controlled axial fans (EC technology). The condenser coil consists of a micro-channel coil completely made of aluminium.

Construction size 5 to 7

The necessary air for cooling is drawn in across the condenser coils placed on the long side and blown vertically upward through speed-controlled axial fans (EC technology). The W-shaped arrangement of the micro-channel coils completely made of aluminium increases the heat exchange surface which gets in contact with intake air and improves the energy efficiency.

Electric cabinet

The electric cabinet is divided into a load section and a control section with separate door. The load section contains a power switch, operable from outside which locks the cabinet door when switched on.

A thermostatically controlled air/water heat exchanger for cooling at high ambient temperatures is situated inside the electric cabinet on the left side.



Fan, aspirating warm air out of the electric cabinet

Sensors

The following sensors are installed in the chiller as standard:

for each refrigerant circuit:

- condensation pressure → for condenser fan control
- suction gas temperature
- suction gas pressure (evaporation pressure) } to control the expansion valve

Chilled water circuit:

- chilled water inlet temperature
- chilled water outlet temperature
- flow sensor
- frost protection thermostat
- intermediate temperature (free cooling)

In units with free cooling exists an additional sensor for the chilled water temperature which is measured at the free cooling coil outlet.

Air temperatures:

- electric cabinet inside temperature
- compressor housing temperature
- outdoor temperature

Setting of the safety devices

Refrigerant		R410A
Low pressure switch		
releases at	bar	3,0
automatic reset at	bar	6,0
High pressure limiter		
releases at	bar	36
manual reset possible at	bar	29
Safety valve		
releases at	bar	40

4. Technical Data

4.1 Application limits

Storage conditions:

Temperature [°C]:	-20 - +45
Humidity [% rel. h.]:	5 - 95

Type of network:

TN-S; TN-C-S

Voltage:

400V/50Hz/3ph/N/PE

Voltage tolerancy:

+/- 10 % (not for permanent operation)

Frequency tolerancy: +/- 1 %

Rated ultimate short-circuit breaking capacity (I_{cu}):

25 kA

Required minimum thermal load:

20% of nominal cooling capacity

Chilled water conditions:

Max. temperature at the unit inlet:	+26 °C
Temperature difference:	4–8 K
Max. water pressure:	10 bar
Max. glycol content:	35%
with special pumps:	to 50%

Max. temperature at the unit outlet: 20 °C

at maximum compressor capacity, water volume flow according to design conditions 18/12°C and outdoor temperature 35°C. The temperatures may vary during the start phase.

Requirements for electric network and UPS systems:

- the output voltage of the electric network or UPS system must be grounded neutral (wye).
- the voltage distortions must be within the limits stated below and no inadmissibly high DC voltage portions may exist.

transient peak over-voltage phase to ground:

max. 4 kV (1,2/50µs wave form; Z= 12 Ohms in acc. to ANSI)

transient peak over-voltage phase to phase:

max. 2 kV (1,2/50µs wave form; Z=2 Ohms in acc. to ANSI)

ripple voltage phase to ground:

$dV/dt < 1V/\mu s$ ($\equiv 1000V/ms$)
voltage harmonics: THD(V) < 8%

- all-pole sinus filters must be provided at the UPS system output.

The warranty is invalidated for any possible damage or malfunction that may occur during or in consequence of operation outside the application limits.

Air conditions and water volume flows

Minimal outdoor temperature: – 10 °C (optionally –40 °C)

Models CSO ... ASN (1)		541	621	801	1102	1302	1602	1902
Max. outdoor temperature (a)	°C	48,9	47,6	45,1	48,9	47,6	49,2	48
max. water volume flow (b)	m³/h	12,7	14,7	17,7	25,4	29,3	38,3	44,2
min. water volume flow (c)	m³/h	6	6,9	8,3	12	13,8	18	20,8

Models CSO ... ASN (1)		2402	2802	3702	4002	4202	4602	5002	5902
Max. outdoor temperature (a)	°C	45,6	48,2	45,6	44,7	46,2	48,3	47,5	45,8
max. water volume flow (b)	m³/h	53,3	65,7	82,1	87,4	93,1	107,5	116,5	133,7
min. water volume flow (c)	m³/h	25,2	30,9	38,7	41,3	43,9	50,6	54,9	63,1

Models CSO ... ASF (2)		541	621	801	1102	1302	1602	1902
Max. outdoor temperature (a)	°C	48,9	47,6	45,1	48,9	47,6	49,2	48
max. water volume flow (b)	m³/h	13,7	15,8	19,1	27,4	31,6	41,3	47,7
min. water volume flow (c)	m³/h	6,5	7,5	9	12,9	14,9	19,5	22,5

Models CSO ... ASF (2)		2402	2802	3702	4002	4202	4602	5002	5902
Max. outdoor temperature (a)	°C	45,6	48,2	45,6	44,7	46,2	48,3	47,5	45,8
max. water volume flow (b)	m³/h	57,6	70,9	88,6	94,3	100,4	116,1	125,7	144,3
min. water volume flow (c)	m³/h	27,2	33,4	41,8	44,5	47,3	54,6	59,3	68,1

Models COO ... ASN (1)		541	621	802	1102	1302	1602
Max. outdoor temperature (a)	°C	46,3	44,6	49,6	46,3	49,3	47,1
max. water volume flow (b)	m³/h	12,2	13,9	17,6	24,4	30,1	37
min. water volume flow (c)	m³/h	5,8	6,6	8,3	11,5	14,2	17,5

Models COO ... ASN (1)		1902	2402	2802	3702	4002	4602	5002
Max. outdoor temperature (a)	°C	45,5	47,4	45,8	42,5	47,4	45,9	44,9
max. water volume flow (b)	m³/h	42,4	55,1	63,1	77,7	91,7	103,3	111,5
min. water volume flow (c)	m³/h	20	26	29,8	36,7	43,2	48,7	52,7

(1) Water, without free cooling

(2) Water/ethylen glycol 30% (EG30), with free cooling

(a) full load at 18°C/12°C water temperature inlet/outlet

(b) full load at 18°C/14°C water temperature inlet/outlet (min. dTw), outdoor temperature 35°C

(c) full load at 18°C/10°C water temperature inlet/outlet (max. dTw), outdoor temperature 35°C

Models CQO ... ASF (2)		541	621	802	1102	1302	1602
Max. outdoor temperature (a)	°C	46,3	44,6	49,6	46,3	49,3	47,1
max. water volume flow (b)	m³/h	13,2	15	19	26,3	32,5	39,9
min. water volume flow (c)	m³/h	6,2	7,1	9	12,4	15,3	18,8

Models CQO ... ASF (2)		1902	2402	2802	3702	4002	4602	5002
Max. outdoor temperature (a)	°C	45,5	47,4	45,8	42,5	47,4	45,9	44,9
max. water volume flow (b)	m³/h	45,7	59,5	68,1	83,8	99	111,5	120,4
min. water volume flow (c)	m³/h	21,6	28,1	32,1	39,6	46,6	52,6	56,9

NOTICE

Observe the following limits for the water circuit of the chiller.

Chilled water quality

Water properties and ingredients		
Carbonate hardness	°dH	<4
Carbonate hardness when adding inhibitors	°dH	<20
Total hardness	°dH	<15
pH value		7.0 - 9.0
pH value with light metal*		7.0 - 7.5
Chloride content	mg/l	<100
Chloride content with austenitic steels	mg/l	<50
Free chlorine	mg/l	<0.05
Hydrogen sulphide	mg/l	<0.05
Ammonia (NH ₃ /NH ₄ ⁺)	mg/l	<0.05
Sulphate	mg/l	<100
Manganese	mg/l	<0.05
Iron	mg/l	<0,2
Sulphide	mg/l	<0.05
Free aggressive carbonic acid	mg/l	<15
Suspended solids	mg/l	<20
Number of germs	cfu/ml	<1000
Electric conductivity without inhibitors	µS/cm	10 - 500
Electric conductivity with inhibitors	µS/cm	<2200

cfu - colony forming units

*aluminium or titanium.

All data refer exclusively to the chiller.

NOTICE

- Check the water quality regularly.

4.2 Technical data

NOTICE

The data are for chiller units in basic version.

Design conditions

- (1): Chilled water inlet/outlet: 18°C/12°C, outdoor temperature 35°C, water 0% ethylen glycol
- (2): Sound pressure level (full load) in 1 m distance under free field conditions (according to ISO 3744)
- (3): Sound power level (full load) under free field conditions (according to ISO 3744)
- (4): Water inlet temperature 18°C, glycol content 30%, outdoor temperature 6°C

Transport weight = net weight + weight of refrigerant charge

Operating weight = transport weight + weight of water content

CSO ... ASN

Model		541	621	801	1102	1302	1602	1902
Cooling capacity (1)	kW	57	66	79	115	132	175	202
Total power consumption (1)	kW	14	17	22	29	33	44	51
Compressor COP (1)		4,5	4,4	3,9	4,5	4,4	4,6	4,5
Chiller EER (1)		4	3,93	3,53	4,01	3,93	3,99	3,99
Sound pressure level (2)	dB(A)	66	66	66	67	67	70	70
Sound power level (3)	dB(A)	84	84	84	86	86	90	90
Chilled water circuit								
Water volume flow (1)	m³/h	8,2	9,6	11,6	16,5	19,1	25,1	29,4
Water pressure drop (1)	kPa	41	40,3	41	44,6	46,2	48,1	50,4
Water circuit content, unit side	dm³	14,5	15,8	22,8	37,6	50,6	53,3	69,9
Refrigerant circuit								
Refrigerant		R410A						
Refrigerant charge (per circuit)	kg	14,6	15,7	17,8	14,5	15,7	25,6	28,4
No. of circuits		1	1	1	2	2	2	2
Oil charge (per circuit)	dm³	6,5	6,5	6,5	6,5	6,5	9,75	9,75
Compressor								
No. of compressors		2			4		6	
Capacity control	%	0 - 50 - 100			0 - 25 - 50 - 75 - 100		0 - 16,7... 82,3 - 100	
Power consumption (1)	kW	12,8	15,3	20,6	25,6	30,5	38	45,1
Nominal power	kW	19,7	22,9	28,5	39,4	45,8	59	68,7
Nominal current	A	42	44	62	84	88	126	132
Condenser fans								
No. of fans		2			4		4	
Air volume flow	m³/h	25.000			50.000		88.000	
Power consumption	kW	1,3			2,6		6	
Nominal power	kW	1,7			3,4		8,4	
Nominal current	A	2,9			5,6		12,8	
Unit data								
Voltage supply		400V/50Hz/3Ph/N/PE						
Operating current (OA) (1)	A	26,1	29,4	38,2	52,1	58,8	80,7	90,5
max operating current (RLA)	A	32,3	36,8	45,2	63,6	72,7	99,3	112,9
Locked rotor current (LRA)	A	125,1	133,8	160,2	151,2	163,1	179,8	195
Length	mm	2300			4200		3950	
Width	mm	1300			1300		2300	
Height	mm	2350			2350		2510	
Construction size		3			4		5	
Transport weight	kg	915	926	948	1550	1602	3081	3123
Operating weight	kg	981	994	1023	1589	1655	3137	3196

CSO ... ASN

Model		2402	2802	3702	4002	4202	4602	5002	5902
Cooling capacity (1)	kW	245	299	373	398	420,5	490	531	611
Total power consumption (1)	kW	67	77	103	112	107,6	126	139	165
Compressor COP (1)		4	4,3	3,9	3,8	4,4	4,4	4,2	4
Chiller EER (1)		3,65	3,87	3,64	3,56	3,91	3,9	3,81	3,71
Sound pressure level (2)	dB(A)	70	72	72	72	74	74	74	74
Sound power level (3)	dB(A)	90	92	92	92	95	95	95	95
Chilled water circuit									
Water volume flow (1)	m³/h	35,8	43,3	53,5	57,4	60,3	70,4	76,3	87,9
Water pressure drop (1)	kPa	57,7	69,8	79,1	81	122,2	68,5	69,6	69,3
Water circuit content, unit side	dm³	75,7	118,6	157,9	168,1	182,1	244,2	248,6	268,4
Refrigerant circuit									
Refrigerant		R410A							
Refrigerant charge (per circuit)	kg	30,8	47,1	53,4	56,3	57,2	77,5	78,3	90,7
No. of circuits		2							
Oil charge (per circuit)	dm³	9,75	10,14	14,01	12,6	12,6	20,4	12,6	18,9
Compressor									
No. of compressors		6			4	4	6	4	6
Capacity control in steps of	%	16,7			25	25	16,7	25	16,7
Power consumption (1)	kW	60,9	69,2	94,1	103,3	95,1	111,1	124,9	151,1
Nominal power	kW	85,8	99,3	131,4	139,6	-	162	174	209,4
Nominal current	A	186	204	240	261,6	-	291	330,4	392,4
Condenser fans									
No. of fans		4	6			8	10		
Air volume flow	m³/h	88.000	132.000			176.000	220.000		
Power consumption	kW	6	9			13	15		
Nominal power	kW	8,4	12,6			15,4	21		
Nominal current	A	12,8	19,2			25,6	32		
Unit data									
Voltage supply		400V/50Hz/3Ph/N/PE							
Operating current (OA) (1)	A	116,8	146,3	178,0	191	188,4	219,9	236,9	283,5
max operating current (RLA)	A	138	176,5	208,4	221,2	240,6	265,9	285,4	334,4
Locked rotor current (LRA)	A	238,9	298,2	375,7	456,7	463,8	459,1	591,4	550,1
Length	mm	3950	5030			6170	7250		
Width	mm	2300	2300			2300	2300		
Height	mm	2510	2510			2510	2510		
Construction size		5	6			6½	7		
Transport weight	kg	3177	3741	4276	4044	4540	5503	5182	5765
Operating weight	kg	3256	3866	4442	4221	4731	5760	5443	6047

CSO ... ASF

Model		541	621	801	1102	1302	1602	1902
Cooling capacity (1)	kW	57	66	79	115	132	175	202
Free cooling capacity (4)	kW	54	57	60	109	114	155	164
Total power consumption (1)	kW	15	17	23	30	34	45	52
Compressor COP (1)		4,5	4,4	3,9	4,5	4,4	4,6	4,5
Chiller EER (1)		3,87	3,82	3,46	3,88	3,82	3,84	3,86
Sound pressure level (2)	dB(A)	68	68	68	69	69	74	74
Sound power level (3)	dB(A)	86	86	86	88	88	94	94
Chilled water circuit								
Water volume flow (1)	m³/h	8,9	10,2	12,4	17,8	20,5	26,8	30,9
Water pressure drop (1)	kPa	42,8	42	42,8	47	48,1	50,6	52,6
Water pressure drop free cooling (4)	kPa	78	85	99	82	91	71	76
Water circuit content, unit side	dm³	63	64,3	71,3	134,6	147,6	160,6	177,2
Refrigerant circuit								
Refrigerant		R410A						
Refrigerant charge (per circuit)	kg	14,6	15,7	17,8	14,5	15,7	25,6	28,4
No. of circuits		1	1	1	2	2	2	2
Oil charge (per circuit)	dm³	6,5	6,5	6,5	6,5	6,5	9,75	9,75
Compressor								
No. of compressors		2		4		6		
Capacity control	%	0 - 50 - 100			0 - 25 - 50 - 75 - 100		0 - 16,7... 82,3 - 100	
Power consumption (1)	kW	12,8	15,3	20,6	25,6	30,5	38	45,1
Nominal power	kW	19,7	22,9	28,5	39,4	45,8	59	68,7
Nominal current	A	42	44	62	84	88	126	132
Condenser fans								
No. of fans		2		4		4		
Air volume flow	m³/h	25.000			50.000		88.000	
Power consumption	kW	2,1			4,3		8	
Nominal power	kW	1,9			7,4		11,5	
Nominal current	A	2,9			11,4		17,6	
Unit data								
Voltage supply		400V/50Hz/3Ph/N/PE						
Operating current (OA) (1)	A	27,1	30,5	39,3	54,3	60,9	83,7	93,5
max operating current (RLA)	A	35,2	39,7	48,1	69,4	78,5	104,1	117,7
Locked rotor current (LRA)	A	126,2	134,8	161,3	153,3	165,3	182,8	197,9
Length	mm	2300			4200		3950	
Width	mm	1300			1300		2300	
Height	mm	2350			2350		2510	
Construction size		3			4		5	
Transport weight	kg	1057	1068	1090	1830	1882	3520	3562
Operating weight	kg	1124	1136	1165	1972	2037	3689	3748

CSO ... ASF

Model		2402	2802	3702	4002	4202	4602	5002	5902
Cooling capacity (1)	kW	245	299	373	398	420,5	490	531	611
Free cooling capacity (4)	kW	176	275	285	290	333	425	438	459
Total power consumption (1)	kW	69	80	105	114	111	130	144	169
Compressor COP (1)		4	4,3	3,9	3,8	4,4	4,4	4,2	4
Chiller EER (1)		3,56	3,74	3,55	3,48	3,79	3,77	3,7	3,62
Sound pressure level (2)	dB(A)	74	76	76	76	75	78	78	78
Sound power level (3)	dB(A)	94	96	96	96	96	98	98	98
Chilled water circuit									
Water volume flow (1)	m³/h	37,3	45,9	57,3	61,1	65	75,1	81,4	93,5
Water pressure drop (1)	kPa	60,3	73,9	85,7	87,4	132,3	73,9	75,1	74,4
Water pressure drop free cooling (4)	kPa	89	117	144	152	162	105	109	115
Water circuit content, unit side	dm³	183	273,9	313,2	323,4	390,3	506,8	511,2	531
Refrigerant circuit									
Refrigerant		R410A							
Refrigerant charge (per circuit)	kg	30,8	47,1	53,4	56,3	57,2	77,5	78,3	90,7
No. of circuits		2							
Oil charge (per circuit)	dm³	9,75	10,14	14,01	12,6	12,6	20,4	12,6	18,9
Compressor									
No. of compressors		6			4	4	6	4	6
Capacity control in steps of	%	16,7			25	25	16,7	25	16,7
Power consumption (1)	kW	60,9	69,2	94,1	103,3	95,1	111,1	124,9	151,1
Nominal power	kW	85,8	99,3	131,4	139,6	-	162	174	209,4
Nominal current	A	186	204	240	261,6	-	291	330,4	392,4
Condenser fans									
No. of fans		4	6			8	10		
Air volume flow	m³/h	88.000	132.000			176.000	220.000		
Power consumption	kW	8	11,9			15,9	19,9		
Nominal power	kW	11,5	17,3			23	28,8		
Nominal current	A	17,6	26,4			35,2	44		
Unit data									
Voltage supply		400V/50Hz/3Ph/N/PE							
Operating current (OA) (1)	A	119,7	150,7	182,5	195,5	193,3	227,3	244,3	290,9
max operating current (RLA)	A	142,8	183,7	215,6	228,4	250,2	277,9	297,4	346,4
Locked rotor current (LRA)	A	241,8	302,6	380,1	461,2	469,8	466,5	598,8	557,5
Length	mm	3950	5030			6170	7250		
Width	mm	2300	2300			2300	2300		
Height	mm	2510	2510			2510	2510		
Construction size		5	6			6½	7		
Transport weight	kg	3615	4323	4858	4626	5374	6477	6145	6738
Operating weight	kg	3808	4611	5187	4966	5784	7009	6682	7296

CQO ... ASN

Model		541	621	802	1102	1302	1602
Cooling capacity (1)	kW	55	62	79	110	137	169
Total power consumption (1)	kW	15	18	20	30	33	44
Compressor COP (1)		4,1	3,9	4,5	4,1	4,7	4,2
Chiller EER (1)		3,69	3,5	3,93	3,71	4,14	3,85
Sound pressure level (2)	dB(A)	63	63	64	64	66	66
Sound power level (3)	dB(A)	81	81	83	83	86	86
Chilled water circuit							
Water volume flow (1)	m³/h	7,9	9	11,4	15,8	19,5	24
Water pressure drop (1)	kPa	43,7	43,7	43,7	43,5	46,4	46,5
Water circuit content, unit side	dm³	14,5	15,8	30,6	37,6	50,6	53,3
Refrigerant circuit							
Refrigerant		R410A					
Refrigerant charge (per circuit)	kg	14,6	15,7	14,5	14,5	22,7	25,6
No. of circuits		1	1	2	2	2	2
Oil charge (per circuit)	dm³	6,5	6,5	3,54	6,5	6,5	9,75
Compressor							
No. of compressors		2		4		6	
Capacity control in steps of	%	50		25		16,7	
Power consumption (1)	kW	13,6	16,3	17,4	27,1	29	40
Nominal power	kW	16,6	19,3	24	33,2	38,6	49,9
Nominal current	A	42	44	60	84	88	126
Condenser fans							
No. of fans		2		4		4	
Air volume flow	m³/h	17.700		36.000		64.000	
Power consumption	kW	1		1		2	
Nominal power	kW	1,7		3,4		8,4	
Nominal current	A	2,9		5,6		12,8	
Unit data							
Voltage supply		400V/50Hz/3Ph/N/PE					
Operating current (OA) (1)	A	25,9	29,9	34,2	51,8	56,3	77,3
max operating current (RLA)	A	32,3	36,8	47,5	63,6	79,9	99,3
Locked rotor current (LRA)	A	124,5	133,5	101,1	150,4	161,1	176
Length	mm	2300		4200		3950	
Width	mm	1300		1300		2300	
Height	mm	2350		2350		2510	
Construction size		3		4		5	
Transport weight	kg	924	935	1442	1565	2808	3112
Operating weight	kg	991	1004	1474	1605	2862	3169

CQO ... ASN

Model		1902	2402	2802	3702	4002	4602	5002
Cooling capacity (1)	kW	193	250	286	352	418	471	508
Total power consumption (1)	kW	52	65	78	107	107	127	141
Compressor COP (1)		4	4,4	3,9	3,5	4,4	4	3,8
Chiller EER (1)		3,73	3,83	3,65	3,28	3,92	3,71	3,59
Sound pressure level (2)	dB(A)	66	68	68	68	69	69	69
Sound power level (3)	dB(A)	86	89	89	89	91	91	91
Chilled water circuit								
Water volume flow (1)	m³/h	27,4	35,7	40,8	50,3	59,4	66,9	72,3
Water pressure drop (1)	kPa	47,9	57,7	64,8	72,9	84,1	64,9	65,5
Water circuit content, unit side	dm³	69,9	75,7	118,6	157,9	168,1	244,2	248,6
Refrigerant circuit								
Refrigerant		R410A						
Refrigerant charge (per circuit)	kg	28,4	44,7	47,1	53,4	67,2	77,5	78,3
No. of circuits		2						
Oil charge (per circuit)	dm³	9,75	9,75	10,14	14,01	12,6	20,4	12,6
Compressor								
No. of compressors		6				4	6	4
Capacity control in steps of	%	16,7				25	16,7	25
Power consumption (1)	kW	47,9	59,3	72	100,8	97,2	117,3	131,6
Nominal power	kW	58	73,5	85,5	111,9	120	139,8	151,6
Nominal current	A	132	186	204	240	261,6	291	330,4
Condenser fans								
No. of fans		4	6			10		
Air volume flow	m³/h	64.000	96.000			160.000		
Power consumption	kW	2	4			6		
Nominal power	kW	8	13			21		
Nominal current	A	12,8	19,2			32		
Unit data								
Voltage supply		400V/50Hz/3Ph/N/PE						
Operating current (OA) (1)	A	88,8	109,1	142,8	178,7	177,3	213,3	232,5
max operating current (RLA)	A	112,9	144,4	176,5	208,4	234	265,9	285,4
Locked rotor current (LRA)	A	192,6	231,8	293,9	374,8	445,2	451,2	584,6
Length	mm	3950	5030			7250		
Width	mm	2300	2300			2300		
Height	mm	2510	2510			2510		
Construction size		5	6			7		
Transport weight	kg	3154	3713	3779	4319	5035	5558	5234
Operating weight	kg	3228	3792	3904	4486	5212	5817	5498

CQO ... ASF

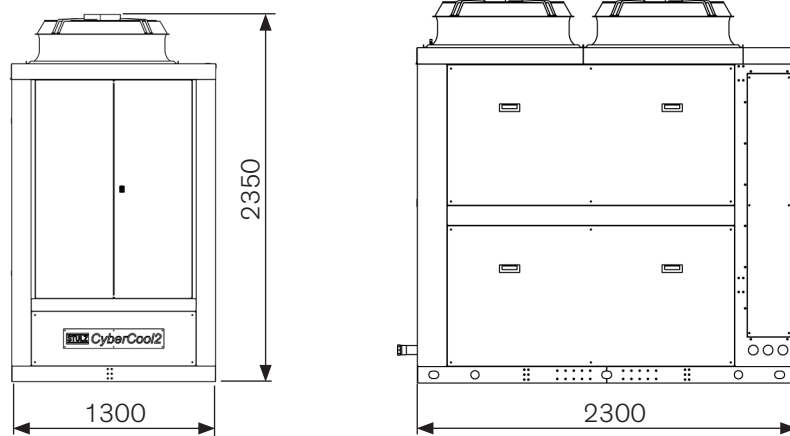
Model		541	621	802	1102	1302	1602
Cooling capacity (1)	kW	55	62	78	110	137	169
Free cooling capacity (4)	kW	51	53	81	92	124	134
Total power consumption (1)	kW	15	18	22	30	34	45
Compressor COP (1)		4,1	3,9	4,5	4,1	4,7	4,2
Chiller EER (1)		3,58	3,41	3,63	3,67	3,97	3,73
Sound pressure level (2)	dB(A)	66	66	65	65	71	71
Sound power level (3)	dB(A)	84	84	84	84	91	91
Chilled water circuit							
Water volume flow (1)	m³/h	8,5	9,7	12,3	17	21,5	26,2
Water pressure drop (1)	kPa	41	41	38	45,6	49,9	49,7
Water pressure drop free cooling (4)	kPa	74	81	61	80,4	70,4	75,8
Water circuit content, unit side	dm³	63	64,3	144,8	144,8	156,4	172,2
Refrigerant circuit							
Refrigerant		R410A					
Refrigerant charge (per circuit)	kg	14,6	15,7	14,5	14,5	22,7	25,6
No. of circuits		1	1	2	2	2	2
Oil charge (per circuit)	dm³	6,5	6,5	3,54	6,5	6,5	9,75
Compressor							
No. of compressors		2		4		6	
Capacity control in steps of	%	50		25		16,7	
Power consumption (1)	kW	13,6	16,3	17,4	27,1	29	40
Nominal power	kW	16,6	19,3	24	33,2	38,6	49,9
Nominal current	A	42	44	60	84	88	126
Condenser fans							
No. of fans		2		4		4	
Air volume flow	m³/h	17.700		36.000		64.000	
Power consumption	kW	1,1		2,1		3,2	
Nominal power	kW	3,7		7,4		11,5	
Nominal current	A	5,7		11,4		17,6	
Unit data							
Voltage supply		400V/50Hz/3Ph/N/PE					
Operating current (OA) (1)	A	25,9	29,9	34,2	51,8	56,3	77,3
max operating current (RLA)	A	32,3	36,8	47,5	63,6	79,9	99,3
Locked rotor current (LRA)	A	124,5	133,5	101,1	150,4	161,1	176
Length	mm	2300		4200		3950	
Width	mm	1300		1300		2300	
Height	mm	2350		2350		2510	
Construction size		3		4		5	
Transport weight	kg	1068	1079	1722	1849	3247	3555
Operating weight	kg	1135	1147	1874	1991	3411	3726

CQO ... ASF

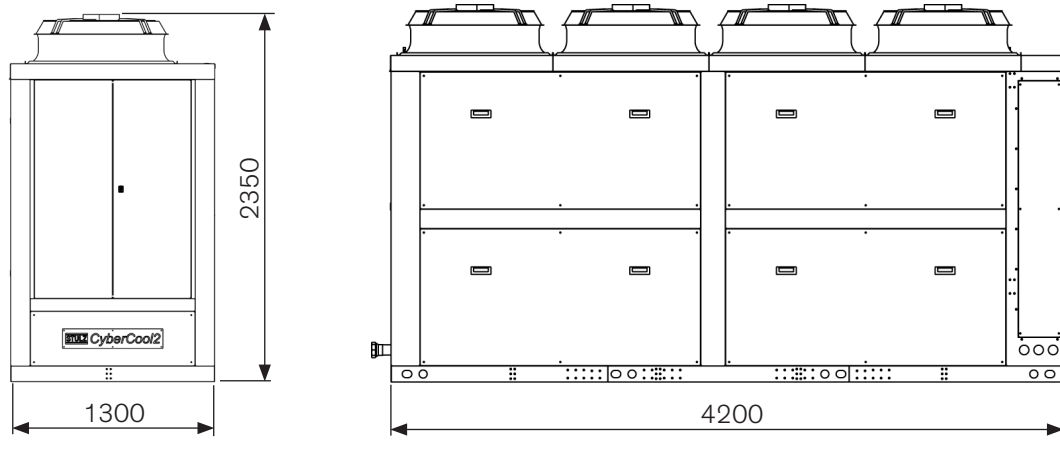
Model		1902	2402	2802	3702	4002	4602	5002
Cooling capacity (1)	kW	193	250	286	352	418	471	508
Free cooling capacity (4)	kW	141	216	225	238	350	364	372
Total power consumption (1)	kW	53	68	81	110	110	131	145
Compressor COP (1)		4	4,2	4	3,5	4,3	4	3,8
Chiller EER (1)		3,63	3,7	3,55	3,21	3,79	3,61	3,5
Sound pressure level (2)	dB(A)	71	71	71	71	73	73	73
Sound power level (3)	dB(A)	91	92	92	92	94	94	94
Chilled water circuit								
Water volume flow (1)	m³/h	29,6	38,5	44,1	54,3	64,1	72,2	78
Water pressure drop (1)	kPa	35	48	53	65	74	60	61
Water pressure drop free cooling (4)	kPa	58	82	94	119	100	90	93
Water circuit content, unit side	dm³	177,6	266,6	310,5	314,1	500,8	507,2	513
Refrigerant circuit								
Refrigerant		R410A						
Refrigerant charge (per circuit)	kg	28,4	44,7	47,1	53,4	67,2	77,5	78,3
No. of circuits		2						
Oil charge (per circuit)	dm³	9,75	9,75	10,14	14,01	12,6	20,4	12,6
Compressor								
No. of compressors		6				4	6	4
Capacity control	%	16,7				25	16,7	25
Power consumption (1)	kW	47,9	59,3	72	100,8	97,2	117,3	131,6
Nominal power	kW	58	74	86	111,9	120	139,8	151,6
Nominal current	A	132	186	204	240	261,6	291	330,4
Condenser fans								
No. of fans		4	6			10		
Air volume flow	m³/h	64.000	96.000			160.000		
Power consumption	kW	3,2	4,8			8,1		
Nominal power	kW	11,5	17,3			28,8		
Nominal current	A	17,6	26,4			44		
Unit data								
Voltage supply		400V/50Hz/3Ph/N/PE						
Operating current (OA) (1)	A	88,8	109,1	142,8	178,7	177,3	213,3	232,5
max operating current (RLA)	A	112,9	144,4	176,5	208,4	234	265,9	285,4
Locked rotor current (LRA)	A	192,6	231,8	293,9	374,8	445,2	451,2	584,6
Length	mm	3950	5030			7250		
Width	mm	2300	2300			2300		
Height	mm	2510	2510			2510		
Construction size		5	6			7		
Transport weight	kg	3597	4295	4366	4907	6017	6542	6207
Operating weight	kg	3785	4575	4657	5239	6543	7079	6749

4.3 Dimensional drawings

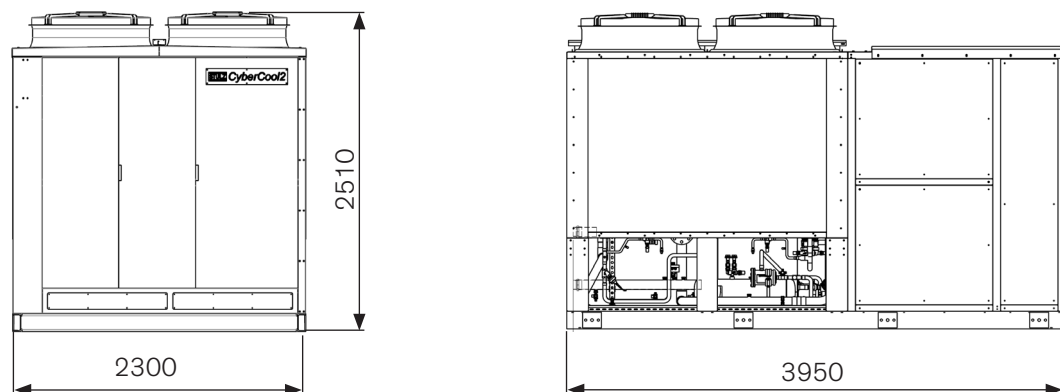
Construction size 3



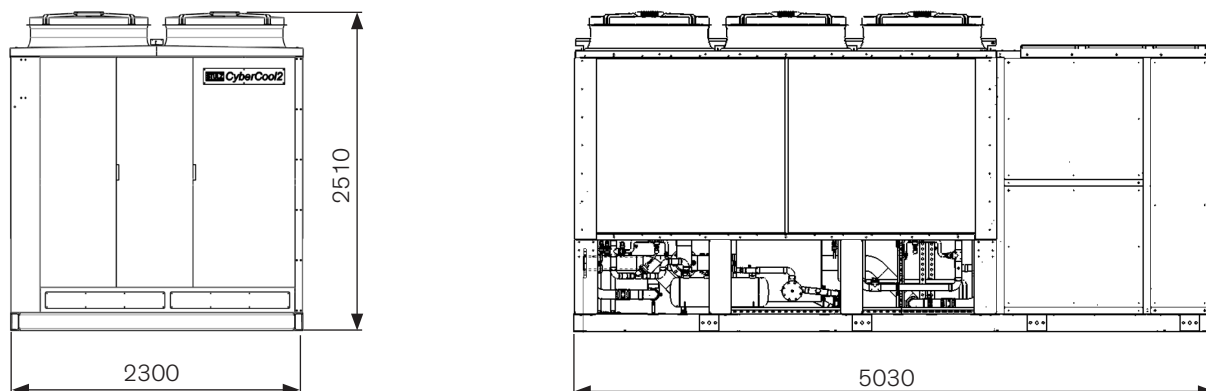
Construction size 4



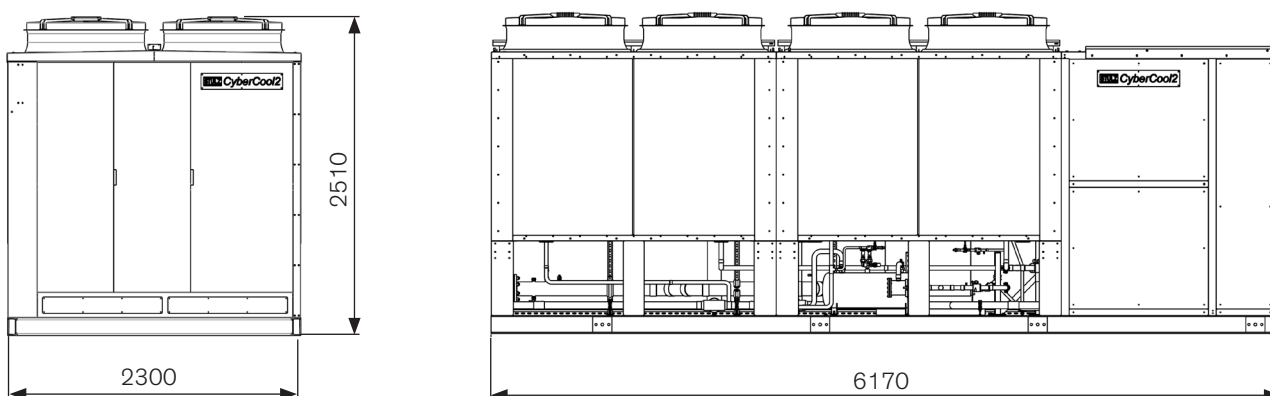
Construction size 5



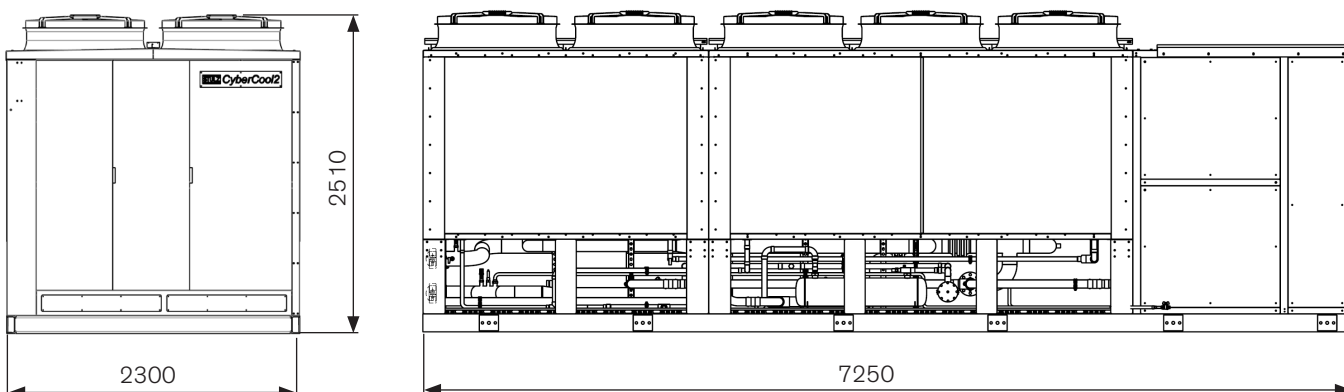
Construction size 6



Construction size 6½



Construction size 7



5. Installation

5.1 Positioning

The fins of the air-cooled free cooling coils are made of a high-quality aluminum alloy. Depending on the site, an extended protection against corrosion may be necessary.

In the vicinity of industrial plants or waste incinerators, elevated levels of carbon dioxide, carbon monoxide, ammonia, nitrogen oxides, hydrocarbons, sulphur compounds, fluorides and chlorine can occur, which lead to corrosion of the aluminum fins.

Equally, increased concentrations of chlorides occur near the sea which lead to pitting in aluminium fins.

Additional environmental factors such as heat, humidity and pollution can even intensify corrosive processes.

NOTICE

- Check whether you need an anti-corrosion coating for the air side heat exchanger coils at the planned installation site. The option "anti-corrosion coating" is described in chapter 11.4.

The chiller unit is designed for the outside installation on a level base. For an even weight distribution, a base plate made of concrete is necessary.

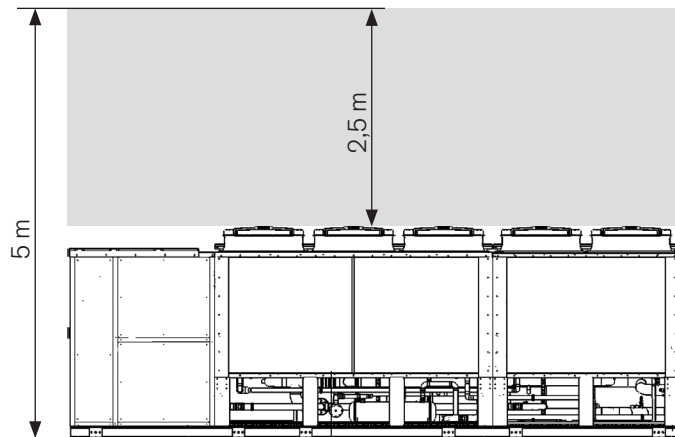
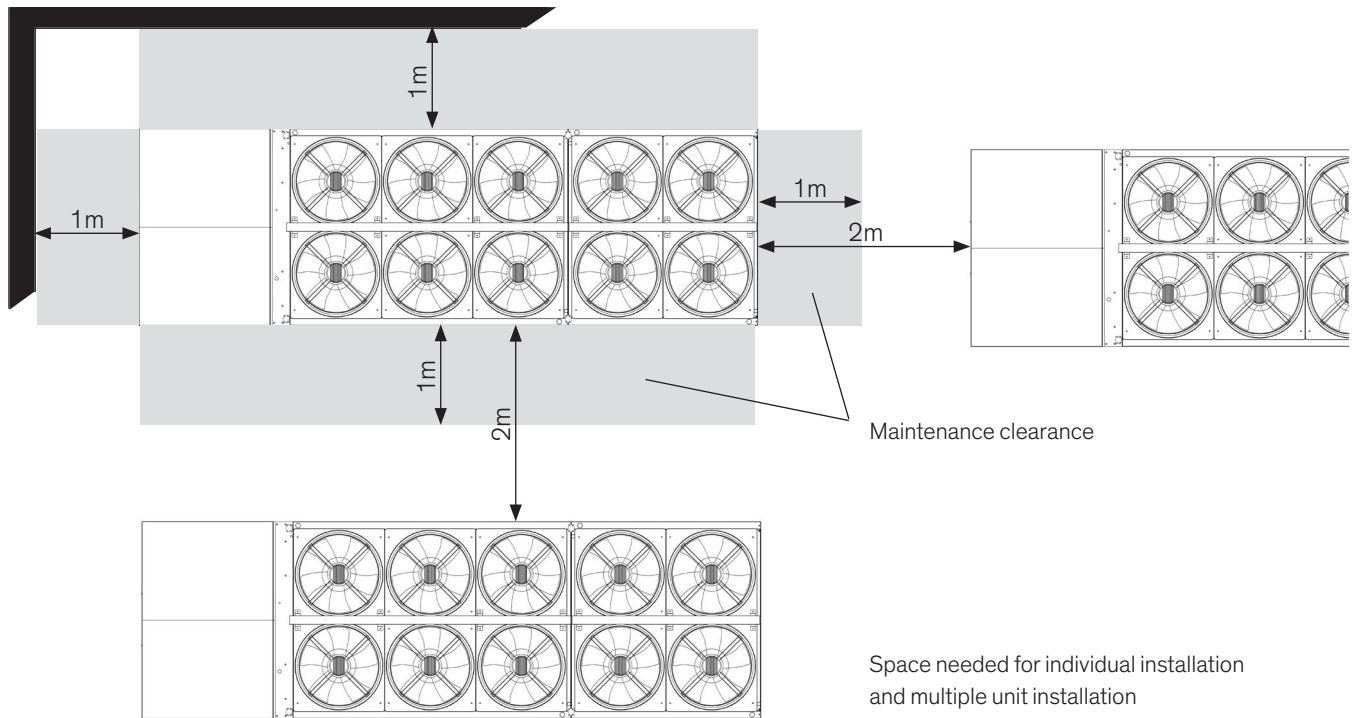
- Check that the installation site is appropriated for the unit weight, which you can read in the technical data.
- The unit should not be placed, related to the wind direction, behind heat emitting devices (e.g. chimneys) or sources of dirt (e.g. exhalation outlet hoods). Greasy and floating particles contained in the air will otherwise deposit on the condenser fins and reduce the heat transmission.
- Installation sites, which are subject to heavy snow-drifts, are unsuitable in the same way as sites where inundations can take place.
- Further make sure that the site does not encourage a short-circuit of air from the air discharge to the condenser intake by aerodynamically disadvantageous conditions.

NOTICE

Screwed pipe joints can loosen by long transportation distances.

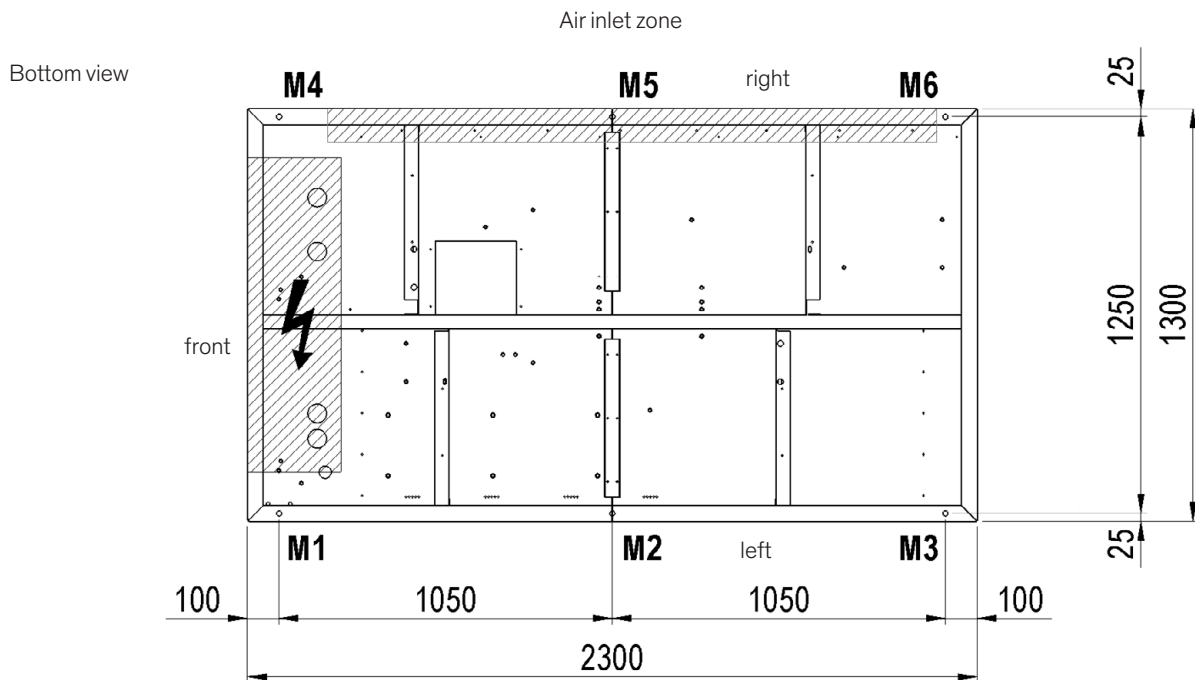
- Before final commissioning, check all screwed pipe joints in the refrigerant circuit and chilled water circuit on tightness.

- Take into account the necessary clearances for the maintenance and the air flow. Keep a clearance of 1 m around the unit to every side.
- Above the fans a clearance of 2,5 m is required.



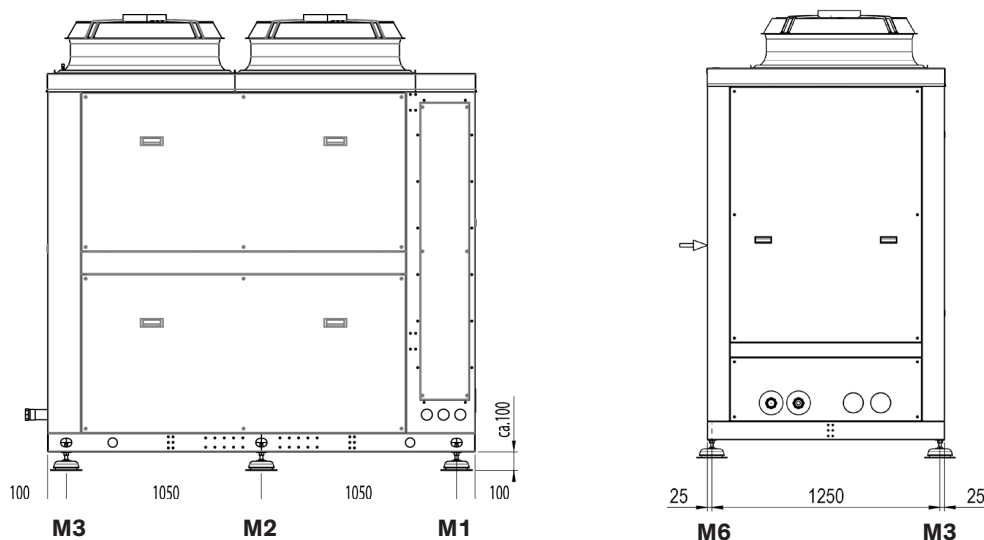
5.2 Weights on the supports

Construction size 3

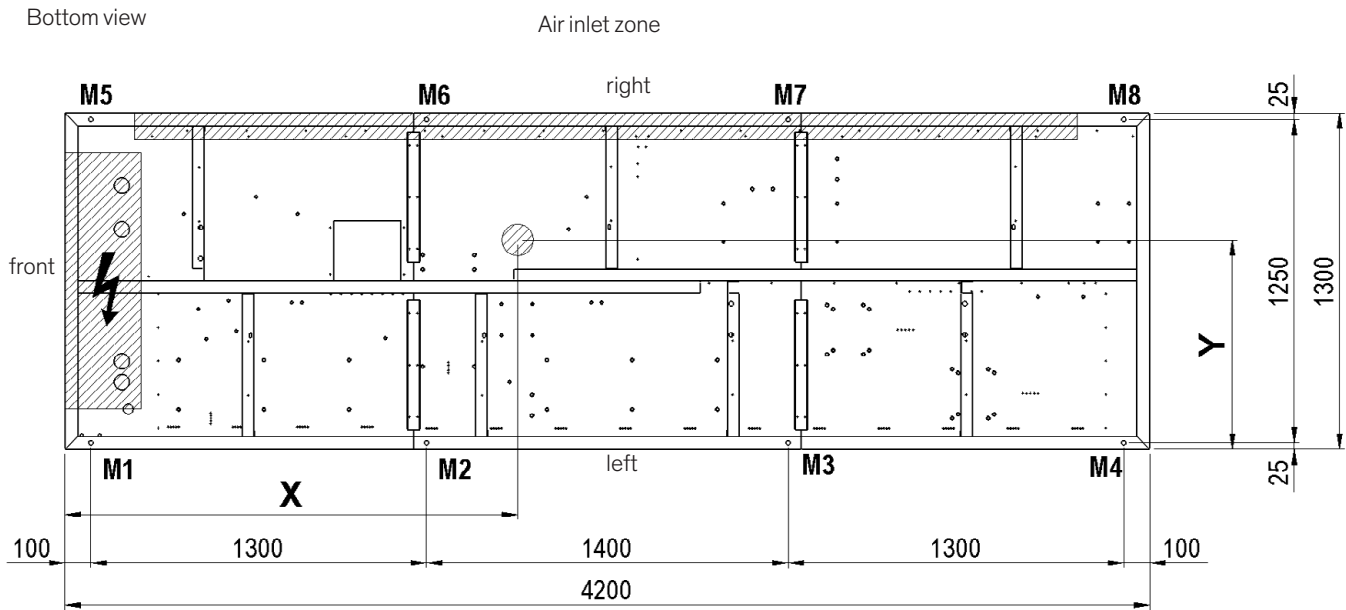


Model		M1	M2	M3	M4	M5	M6
CSO 541 ASN	kg	220	168	119	193	156	125
CSO 621 ASN	kg	220	171	122	196	158	127
CSO 801 ASN	kg	223	172	126	201	164	134
CSO 541 ASF	kg	224	173	126	226	203	171
CSO 621 ASF	kg	228	175	128	227	206	173
CSO 801 ASF	kg	228	178	134	233	214	181
CQO 541 ASN	kg	222	170	120	195	158	126
CQO 621 ASN	kg	222	173	123	198	160	128
CQO 541 ASF	kg	226	175	127	228	205	173
CQO 621 ASF	kg	230	177	129	229	208	175

The weights are indicated with a tolerance of $\pm 5\%$.

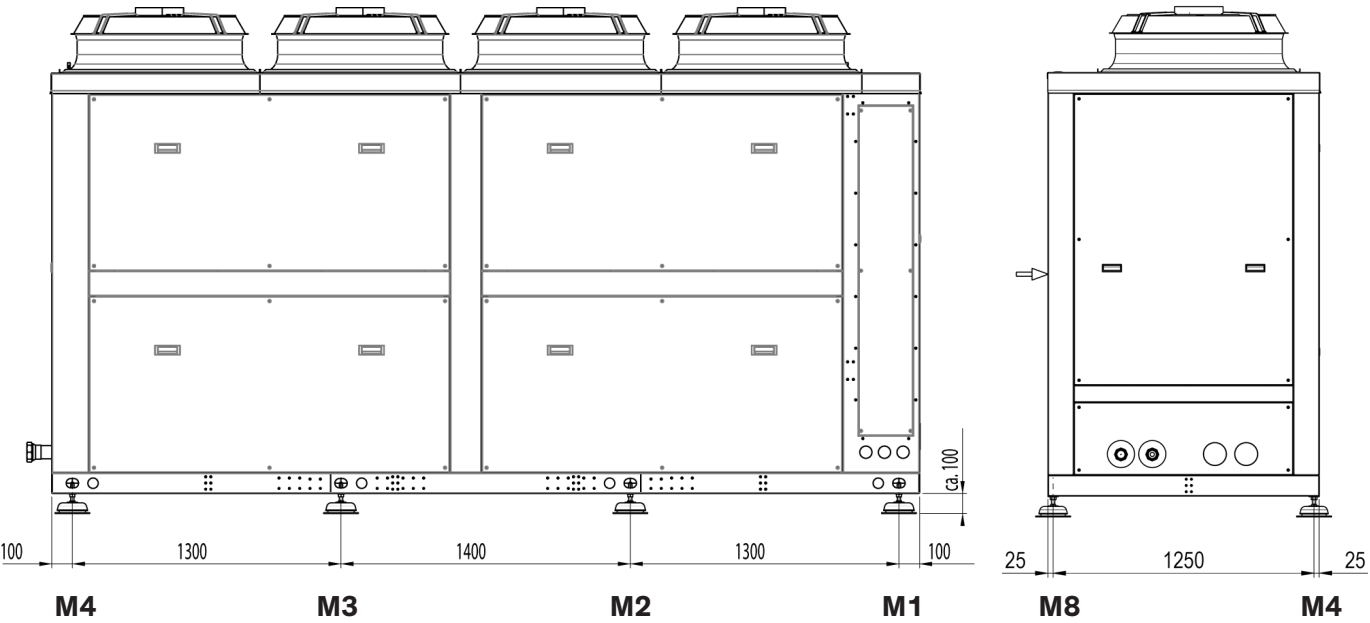


Construction size 4

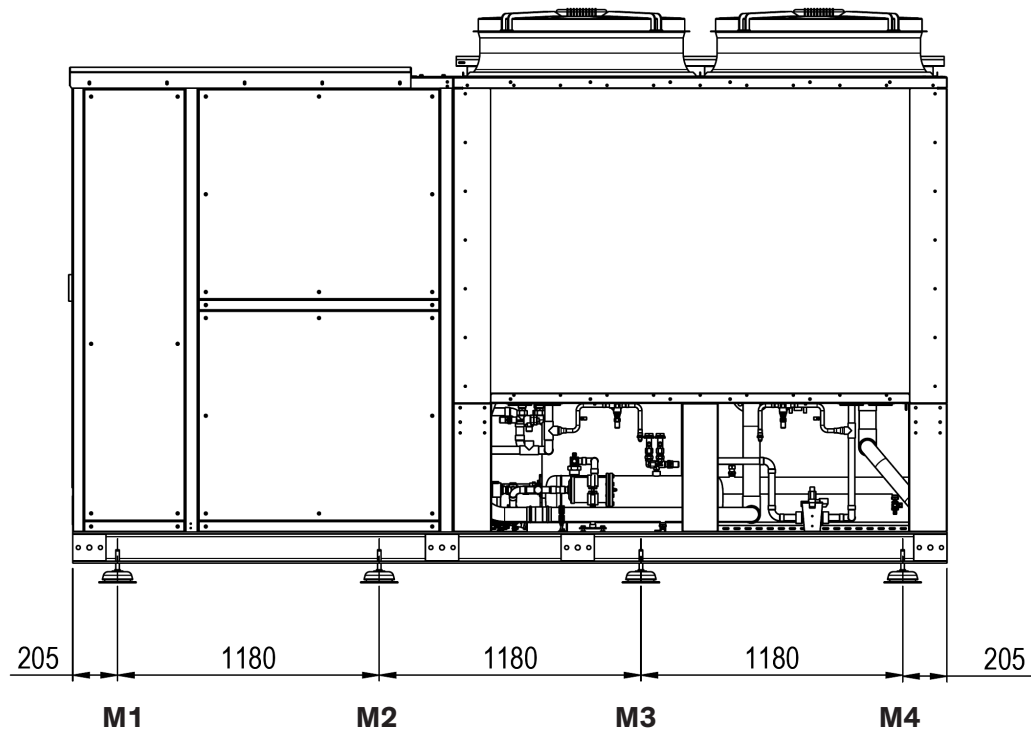


Model		M1	M2	M3	M4	M5	M6	M7	M8
CSO 1102 ASN	kg	139	254	233	135	148	280	256	148
CSO 1302 ASN	kg	146	269	248	146	150	282	260	150
CSO 1102 ASF	kg	148	267	245	146	209	389	356	209
CSO 1302 ASF	kg	155	276	253	154	215	399	366	216
CQO 802 ASN	kg	121	213	229	115	140	270	246	143
CQO 1102 ASN	kg	140	256	235	136	149	282	258	149
CQO 802 ASF	kg	135	246	229	124	199	380	348	210
CQO 1102 ASF	kg	150	270	248	148	211	393	360	211

The weights are indicated with a tolerance of $\pm 5\%$.

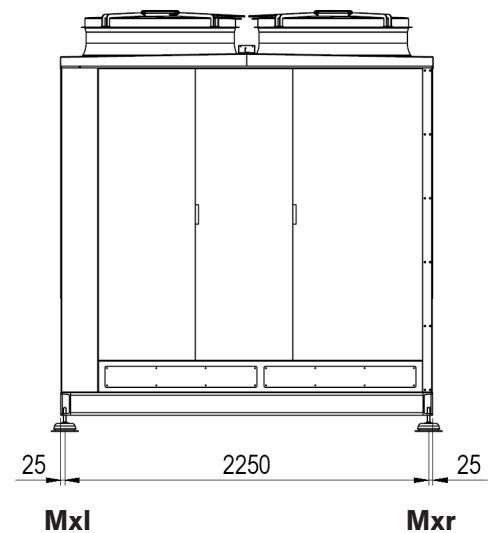


Construction size 5



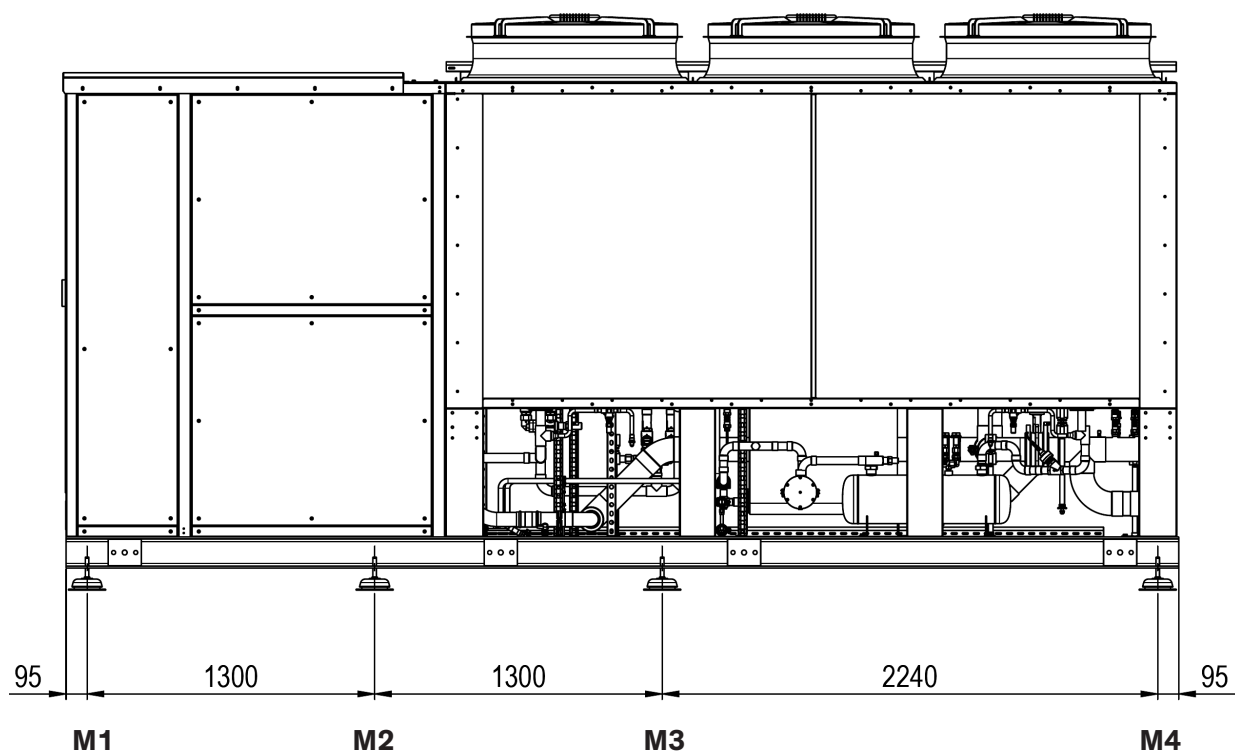
Model		M1	M2	M3	M4
CSO 1602 ASN	kg	427	510	425	206
CSO 1902 ASN	kg	432	520	436	212
CSO 2402 ASN	kg	438	528	444	218
CSO 1602 ASF	kg	446	582	530	286
CSO 1902 ASF	kg	450	592	540	291
CSO 2402 ASF	kg	457	601	549	298
CQO 1302 ASN	kg	385	460	390	196
CQO 1602 ASN	kg	431	515	429	208
CQO 1902 ASN	kg	436	525	440	214
CQO 1302 ASF	kg	409	526	488	281
CQO 1602 ASF	kg	451	588	535	289
CQO 1902 ASF	kg	455	598	546	294

The weights are indicated with a tolerance of $\pm 5\%$.



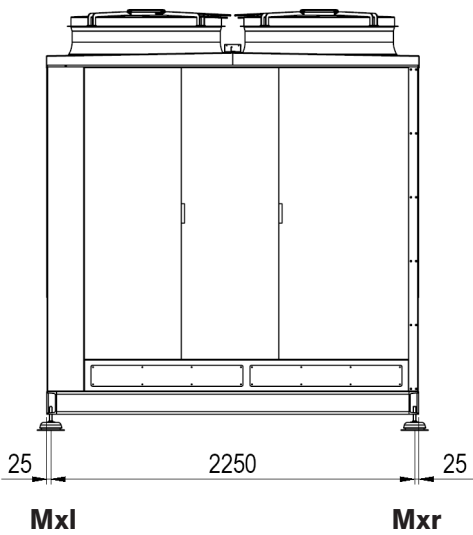
The weight on the support Mxr (M1, M2, M3, M4) is equal to the weight on the support Mxl.

Construction size 6



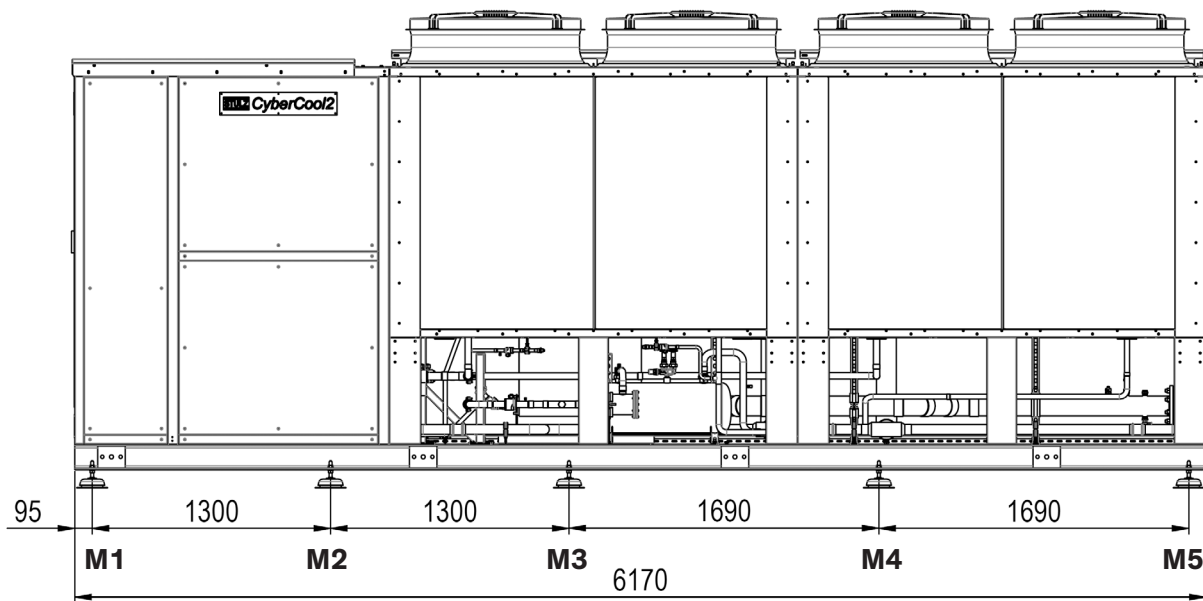
Model		M1	M2	M3	M4
CSO 2802 ASN	kg	450	595	641	247
CSO 3702 ASN	kg	528	725	727	242
CSO 4002 ASN	kg	495	672	695	249
CSO 2802 ASF	kg	460	696	834	317
CSO 3702 ASF	kg	532	825	924	311
CSO 4002 ASF	kg	503	773	889	318
CQO 2402 ASN	kg	445	587	627	239
CQO 2802 ASN	kg	454	601	647	249
CQO 3702 ASN	kg	533	732	734	244
CQO 2402 ASF	kg	462	686	814	324
CQO 2802 ASF	kg	464	703	842	320
CQO 3702 ASF	kg	538	834	934	314

The weights are indicated with a tolerance of ±5%.



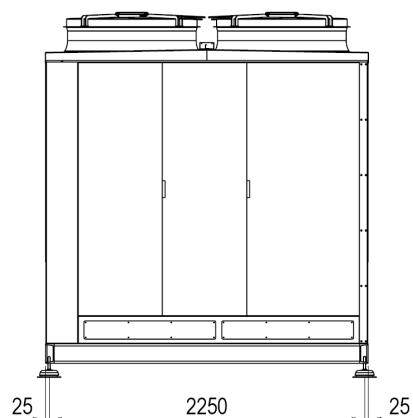
The weight on the support Mxr (M1, M2, M3, M4) is equal to the weight on the support Mxl.

Construction size 6½



Model		M1	M2	M3	M4	M5
CSO 4202 ASN	kg	468	635	588	451	224
CSO 4202 ASF	kg	470	713	748	639	323

The weights are indicated with a tolerance of $\pm 5\%$.

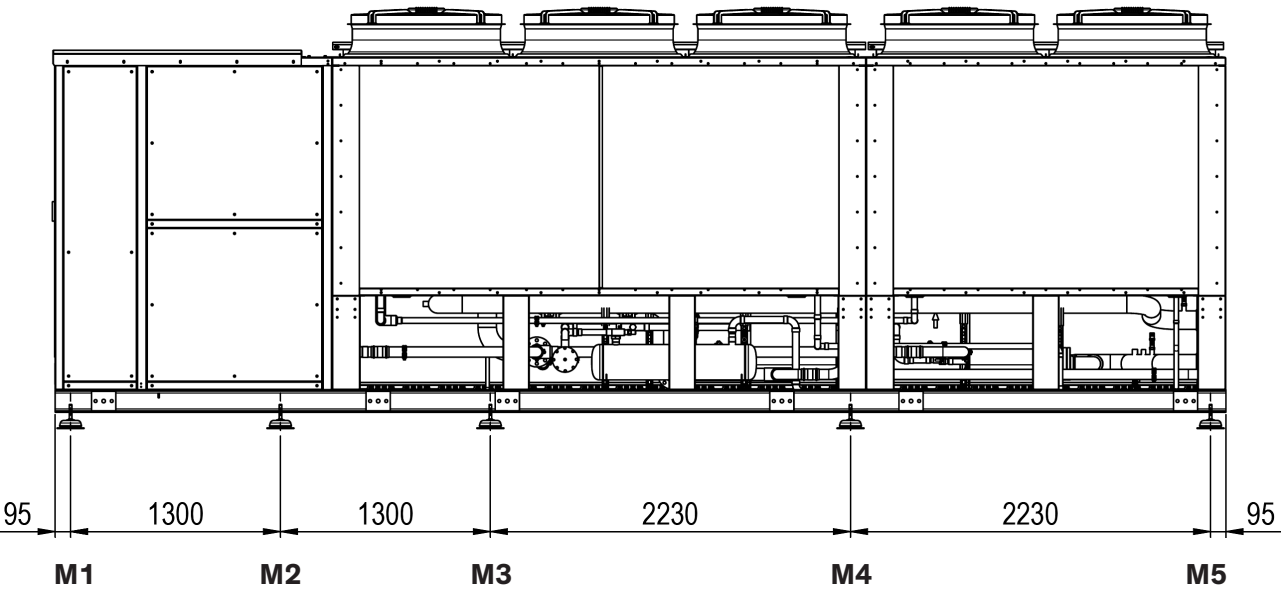


Mxl

Mxr

The weight on the support Mxr (M1, M2, M3 ... M5) is equal to the weight on the support Mxl.

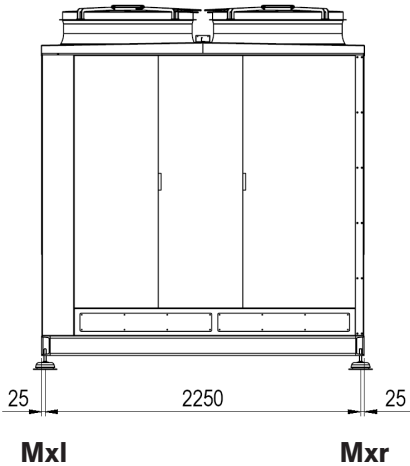
Construction size 7



Model		M1	M2	M3	M4	M5
CSO 4602 ASN	kg	549	670	631	713	319
CSO 5002 ASN	kg	499	601	594	707	320
CSO 5902 ASN	kg	566	696	656	762	341
CSO 4602 ASF	kg	550	745	810	971	430
CSO 5002 ASF	kg	505	677	772	961	428
CSO 5902 ASF	kg	569	773	836	1022	450
CQO 4002 ASN	kg	499	599	570	640	296
CQO 4602 ASN	kg	554	676	637	720	322
CQO 5002 ASN	kg	504	607	600	714	323
CQO 4002 ASF	kg	522	685	752	890	424
CQO 4602 ASF	kg	555	752	818	980	434
CQO 5002 ASF	kg	510	683	779	970	432

The weights are indicated with a tolerance of $\pm 5\%$.

The weight on the support Mxr (M1, M2, M3 ... M5) is equal to the weight on the support Mxl.



5.3 External water circuit

The chilled water circuit of the chiller contains a tube evaporator, several drain valves, several deventilation valves, a flow monitor, a frost protection thermostat and temperature sensors in the inlet and outlet. The frost protection thermostat is adjusted on 4°C in the factory. Below this water inlet temperature, it releases a frost protection management by the controller, which may lead to an antifreeze alarm. The adjusted value can be modified and must be adapted to the local conditions (glycol content).

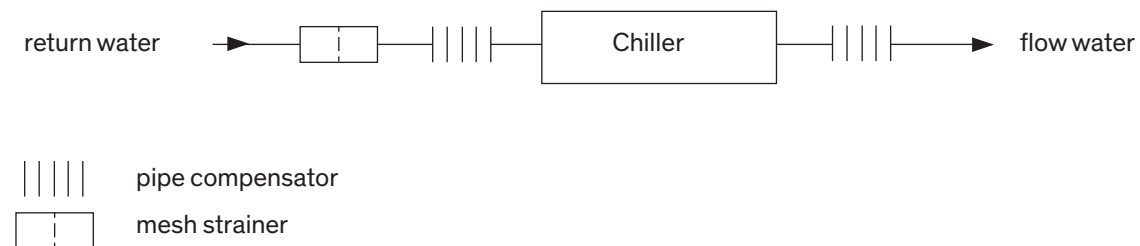
In addition to this, the free cooling version disposes of a motor driven control valve and another temperature sensor in the chilled water circuit.

The following additional components are necessary:

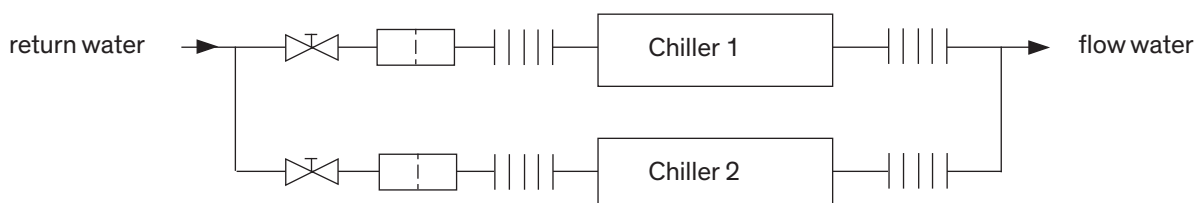
- circulating pump with sufficient delivery height.
- storage tank as an accumulator for heat energy to reduce the on/off cycles of the compressor. A storage tank is recommended if the water volume of the water circuit is less than 10 litres/kW cooling capacity. The storage tank should be lined out with thermal insulation.
- expansion tank with safety valve to ensure a possibility of expansion for the liquid at temperature variations. The expansion tank must be dimensioned in such a way that the water circuit volume can increase by 2% without draining off liquid through the safety valve.
- stop off valves upstream the chiller to be able to take the chiller out of the water circuit in case of repair works without having to drain the entire circuit.
- mesh strainer with mesh size of 600-800 µm in the chilled water inlet

recommended: pipe compensator in the chilled water inlet and outlet

Another criterion for the external water circuit is the water quality. The most sensible component in respect of pollution and corrosion is the plate evaporator, whose heat transmission features deteriorate in this case. The water should be free from solid particles. For this purpose we recommend the installation of a fine mesh strainer upstream the evaporator.



If you connect two or more chillers in parallel, we recommend to install regulating valves to keep the pressure drop of each unit equally high.



Outside temperature sensor

The outside air temperature sensor is located in the bottom section of the chiller.

The location of the sensor must be checked plant-specifically and if necessary be transferred out of the chiller unit. In this case the sensor cable must be correspondingly extended (max. 30 m). A remote outside temperature sensor is also available as an option.

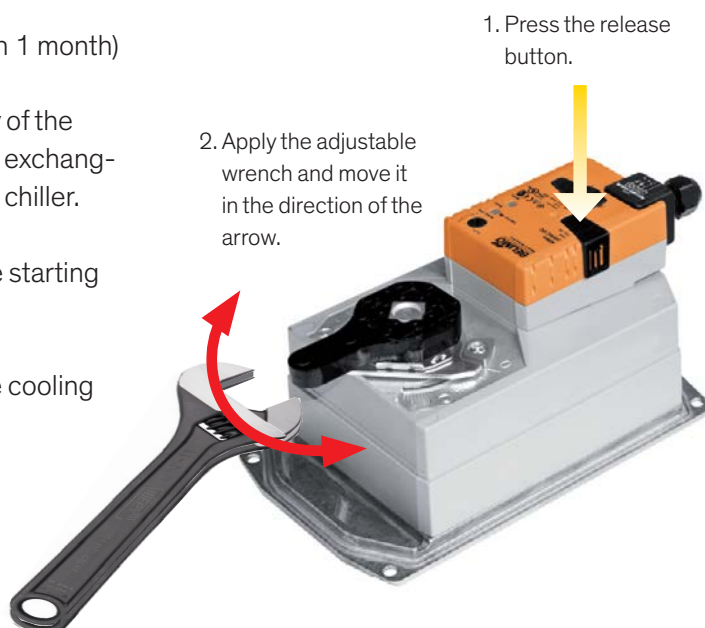
Free cooling valves (only for versions ASF/AHF of construction sizes 5-7)

Longer storage and standstill periods (more than 1 month) lead to the bonding of the valve flaps.

The free cooling valves are located in the vicinity of the compressor cabinet centered below the air heat exchangers. An access is possible via the rear side of the chiller.

- Move both free cooling valves manually before starting the chiller.

During operation, a forced movement of the free cooling valve is configured by default.

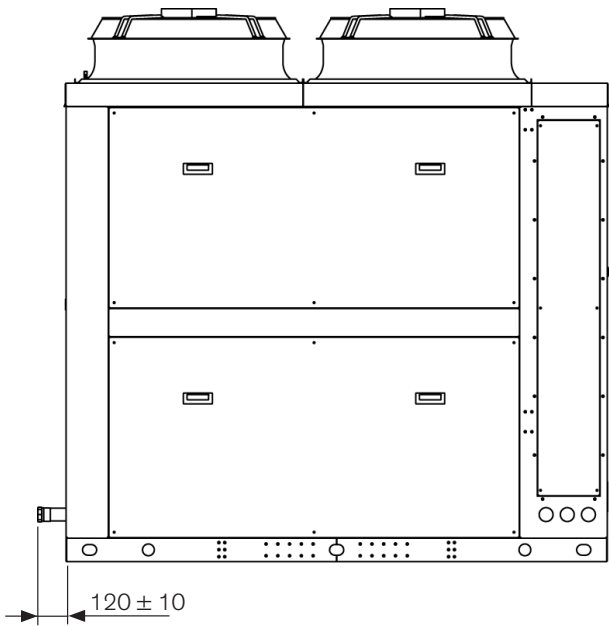


Chilled water connection

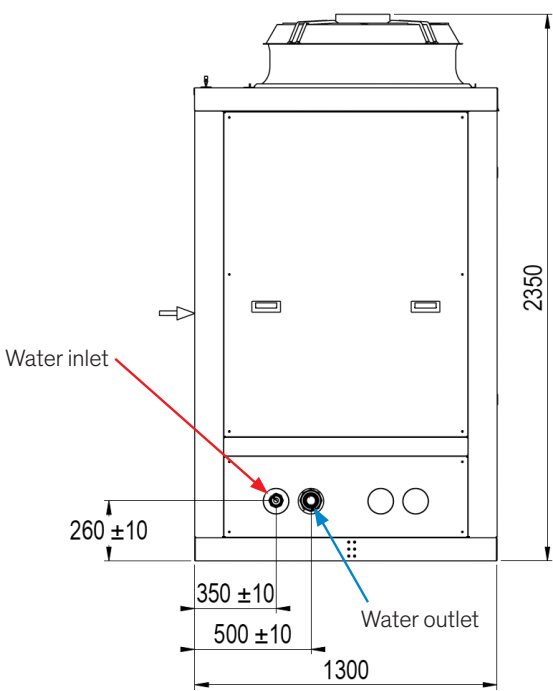
NOTICE

If the unit is equipped with the option "pump", the connection dimensions change.
Ask for a separate drawing.

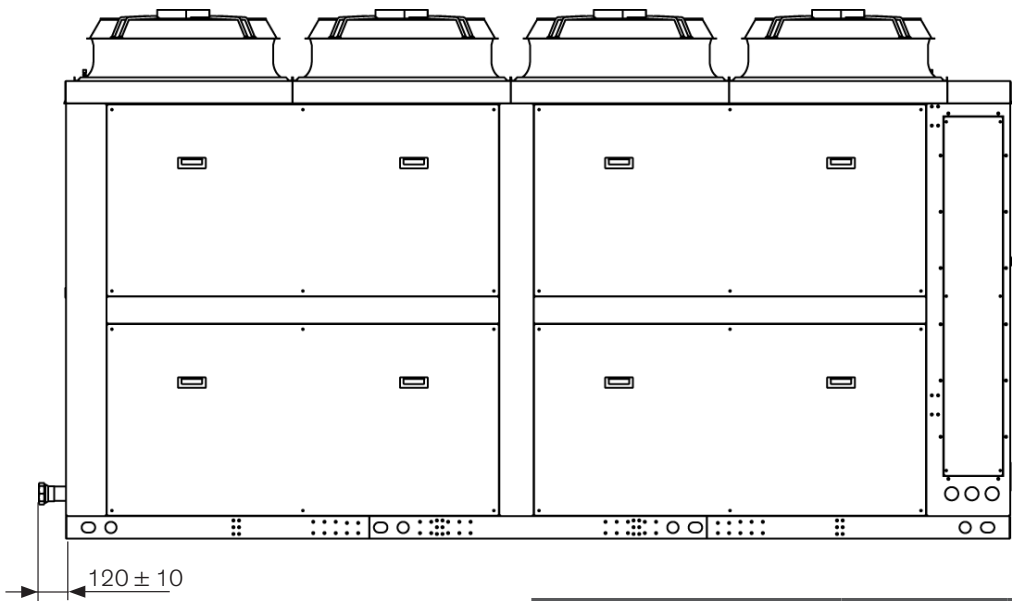
Construction size 3:



Size 3 + 4:
Rear view



Construction size 4:

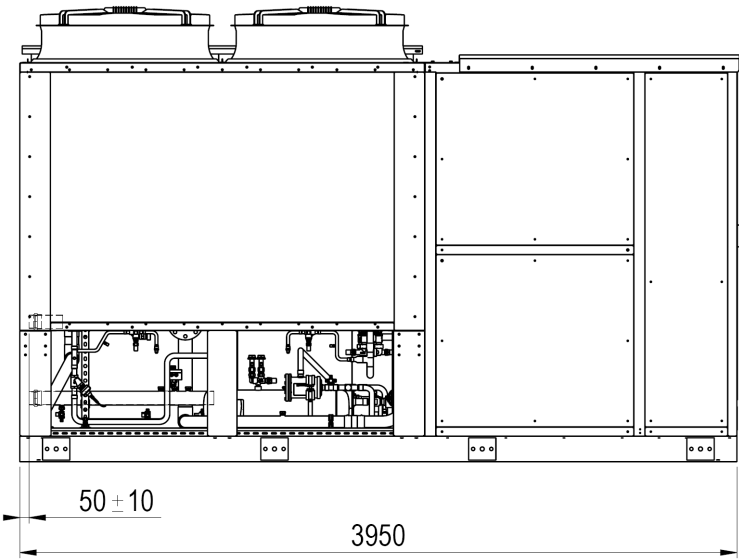


Construction size	3	4
Chilled water connection	G1 1/2" internal thread	G2 1/2" internal thread

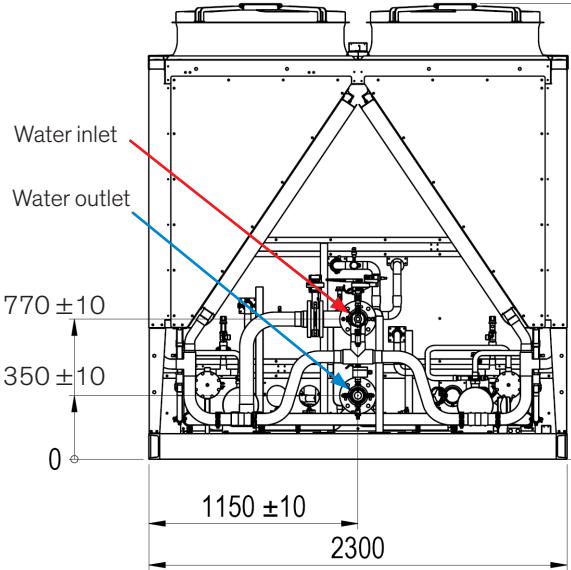
Chilled water connection

Construction size 5:

Side view

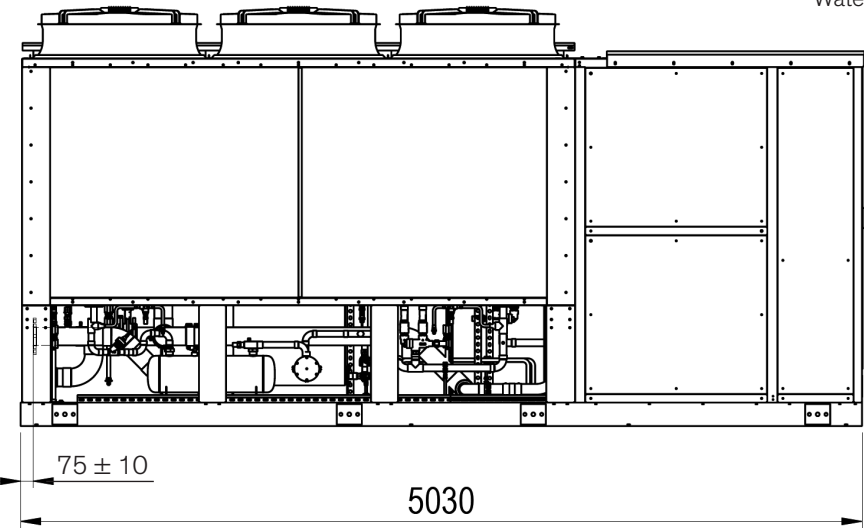


Rear view

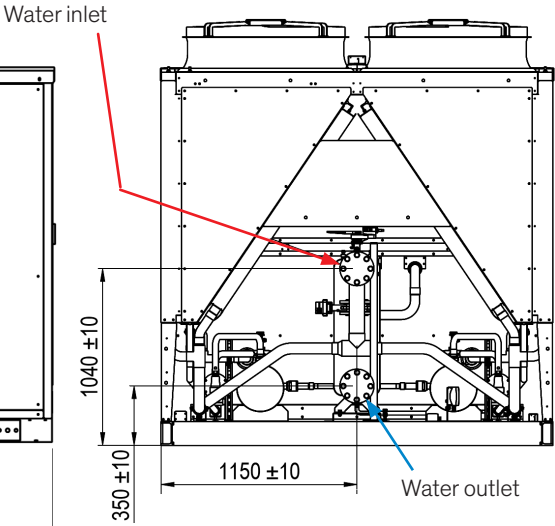


Construction size 6:

Side view

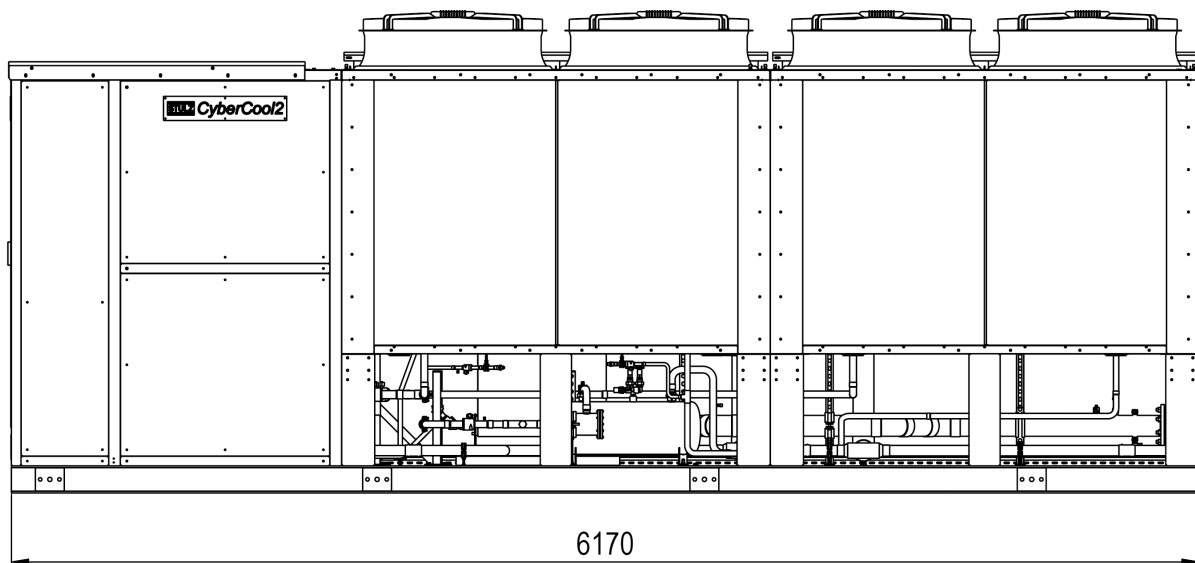


Rear view

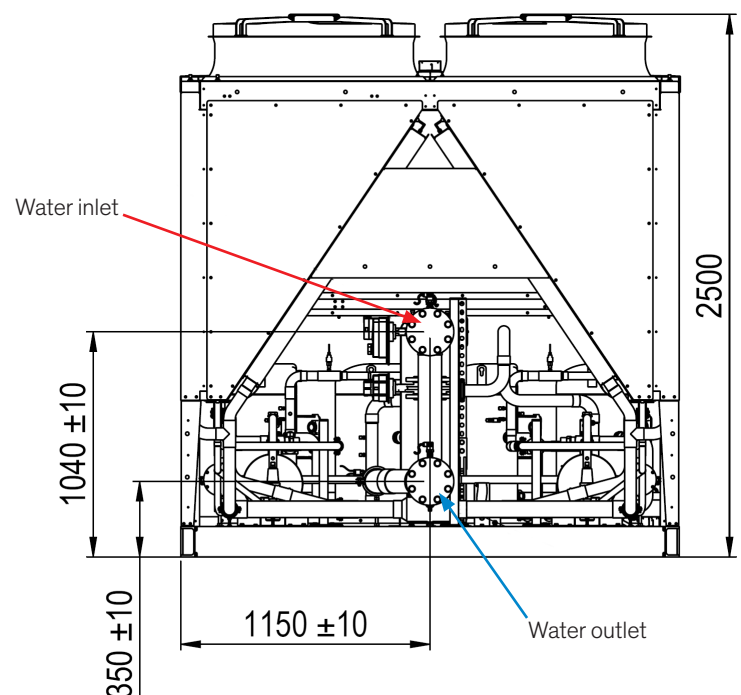


Construction size	5	6		
Type	CSO	CSO 2802	CSO 3702	CSO 4002
Chilled water connection	G2 1/2" internal thread	DN 80 flange	DN 80 flange	DN 80 flange

Construction size	5	6		
Type	CQO	CQO 2402	CQO 2802	CQO 3702
Chilled water connection	G2 1/2" internal thread	G2 1/2" int. thread	DN 80 flange	DN 80 flange

Chilled water connection**Construction size 6½:****Side view****Rear view**

Construction size	6½
Type	CSO 4202
Chilled water connection	DN 100 flange



To avoid misunderstanding:

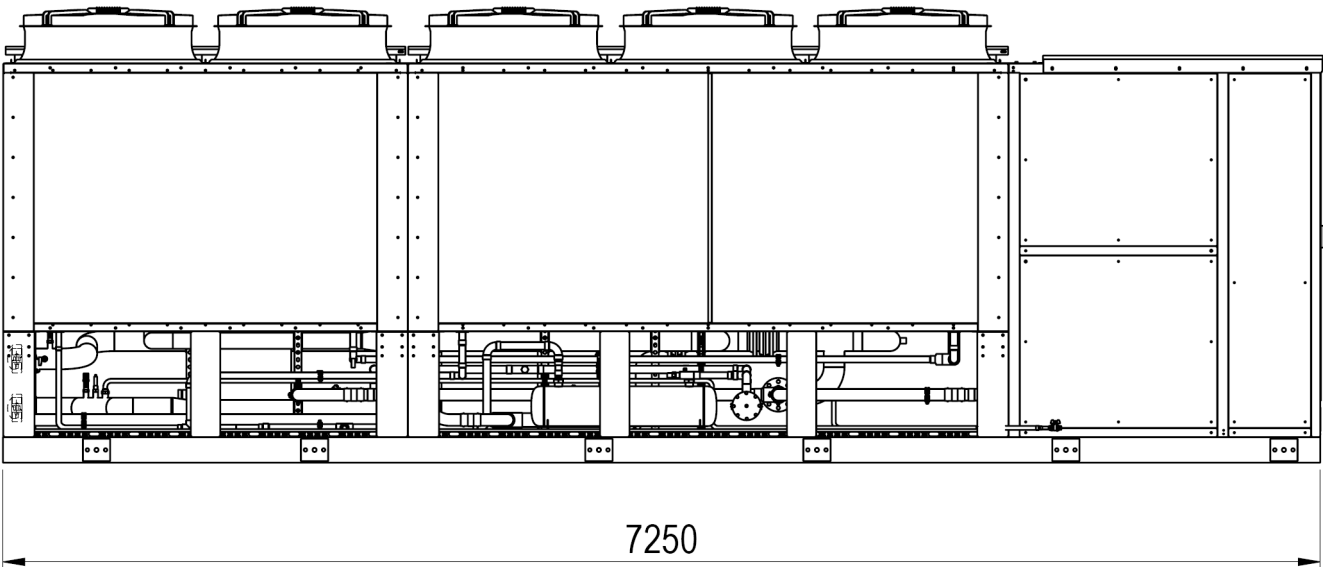
The designation "water inlet" and "water outlet" are chosen, seen from the chiller.

At the water outlet, the chilled water is provided from the chiller.

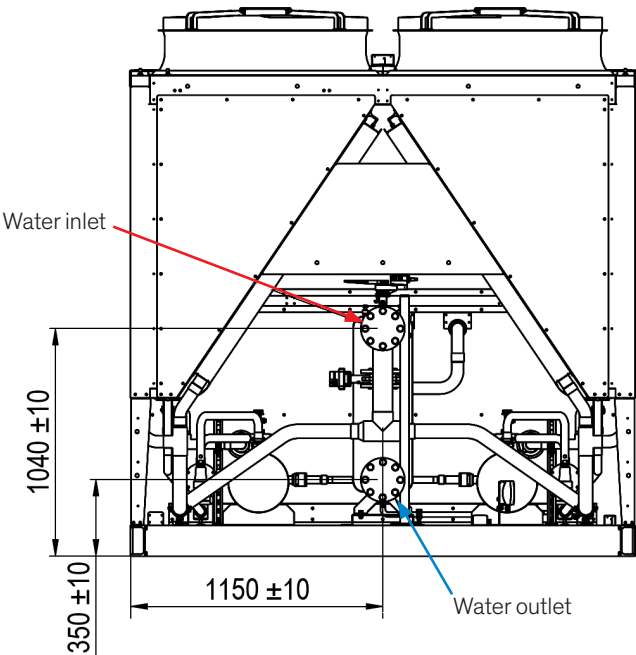
Chilled water connection

Construction size 7:

Side view



Rear view



Construction size	7		
Type	CSO 4602	CSO 5002	CSO 5902
Chilled water connection	DN 100 flange	DN 100 flange	DN 100 flange

Construction size	7		
Type	CQO 4002	CQO 4602	CQO 5002
Chilled water connection	DN 80 flange	DN 100 flange	DN 100 flange

The connection piping should consist of P235 or a similar steel, like the water piping in the chiller, to avoid the risk of corrosion at the transition to the external piping.

The connection is carried out in the shape of flange connections. We recommend to insulate the pipes of the external system, if they get in contact with external air, to prevent the introduction of heat from the ambient air as well as possible.

- Remove the protective hoods from the water pipes.
- Connect the external piping to the chilled water lines of the chiller free of mechanical stress.

5.4 Electrical connection

The power supply system on site and the pre-fuse must be designed for the total current of the unit (see e-data sheet).

Make sure that the power supply corresponds to the indications on the rating plate and that the tolerances according to the „Application limits“ are not exceeded.

The asymmetry of phase between the conductors may amount to 2% maximally.

To determine the asymmetry of phase measure the voltage difference between the phase conductors (L1-L2, L2-L3, L1-L3) and calculate the average value of the measured voltages. With a voltage supply of 400V, the maximum deviation to the average value of the voltages may not exceed 8 V.

DANGER

Mortal danger by electric hazard

Ensure that the power supply at the connection cable is de-energized.

The electric cables are only to be connected by an authorized specialist.

NOTICE

Make sure that the phase rotation is correct, the rotating field must turn right! Otherwise a three phase control device (optional) triggers an alarm. An inverse rotating field would damage the compressor.

NOTICE

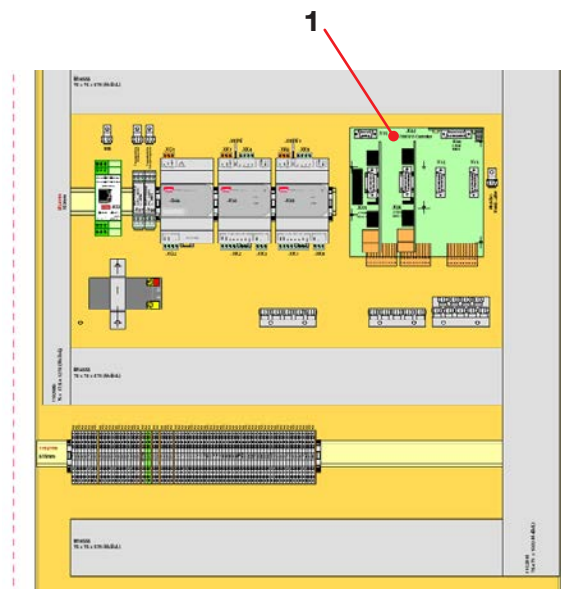
For use of leakage-current (FI) circuit breakers, take into account the EN 50178 5.2.11.2. Only type B pulse-current FI circuit breakers are permitted. FI circuit breakers do not provide protection against bodily harm during operation of the unit or frequency converters.

ESD NOTE

Do not touch electronic components, without taking care of protective ESD measures.

Electronical components:

- C7000 IO controller (1)



Opening the electric cabinet

The switched on main switch prevents opening the left door of the power section. Only, if the main switch is in position "0" you can open the left door of the power section.

The doors of the electric cabinet can be opened by the key which is delivered with the chiller.

1. Insert the key into the lock and turn it by approximately 45 ° clockwise.
2. The handle pops out.
3. Pull out the handle. The door locking mechanism will be released in doing so.
4. The second door of the power section can be opened by turning the inner locking lever counterclockwise.



Electric cabinet key



1.



2.



4.

Connection of the power supply cable

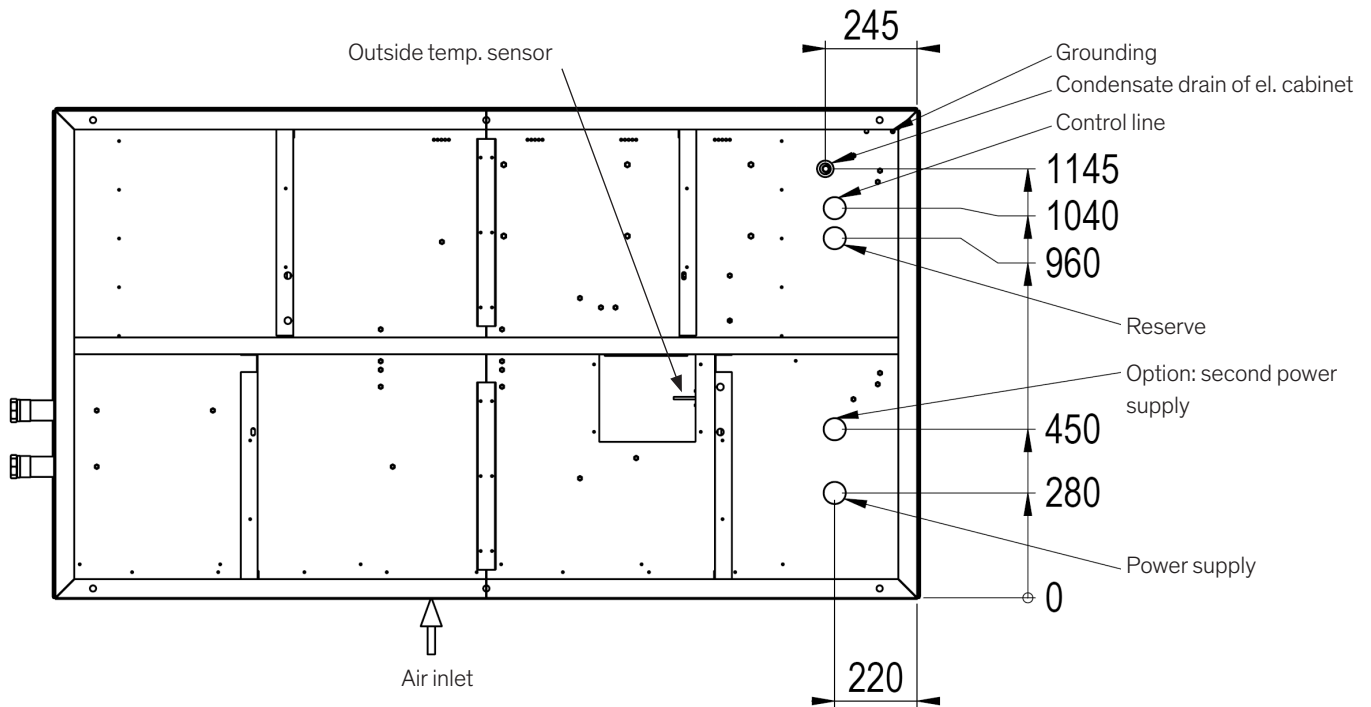
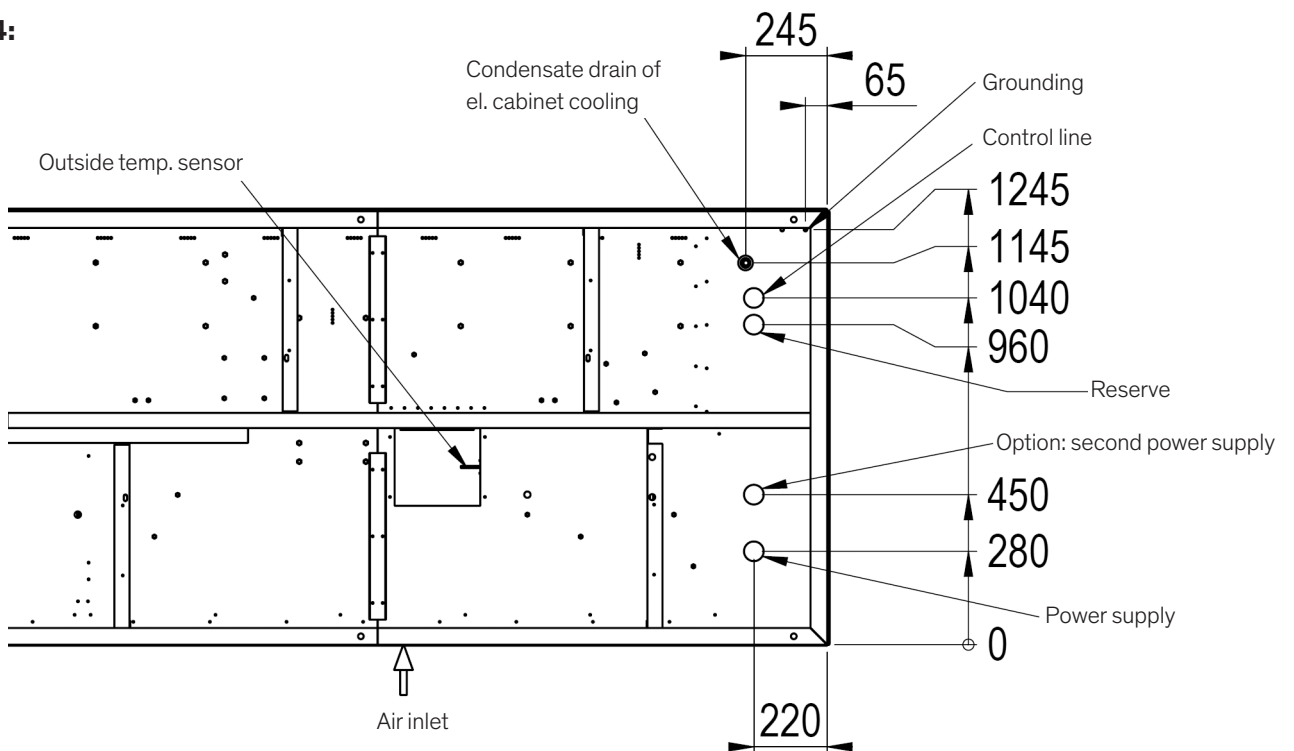
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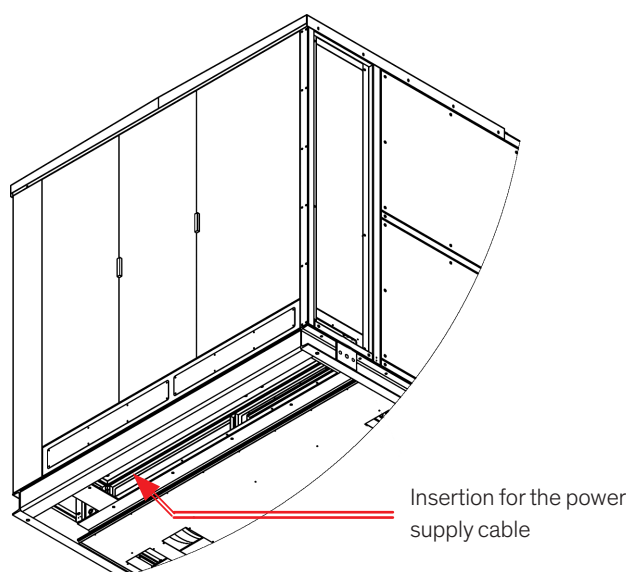
The connection terminals are designed for copper cables.

- route the power supply cable in the unit as shown in the following illustrations and fix it at the unit frame.
- route the electric cable into the electrical box from below and connect the PE conductor at the PE rail, the neutral conductor at the neutral terminal and the three phases to the main switch, in accordance with the wiring diagram (part of the unit documents).
- secure these cables by the pull relief screw.

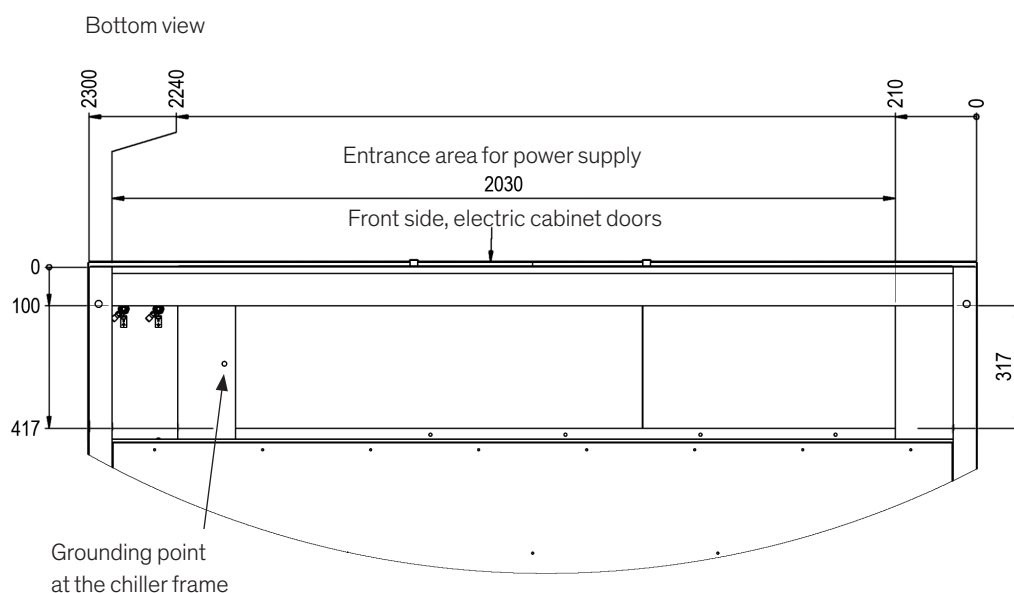
Construction sizes 3 - 4:

The electrical connection lines can be introduced into the electric cabinet from the bottom.
The following bottom views display the apertures.

Size 3:**Size 4:**

Sizes 5 - 7:

In the standard version the power supply cables must be introduced into the electric cabinet from the bottom. As an option you can introduce the power supply cables from the side.



- establish an effective earthing to the unit frame.

Connection of control lines (optional)

If the chiller shall be connected to other Stulz units by the IO bus, to a BMS or contains optional extensions, you must route control lines and connect them in the electric cabinet of the chiller.

- route the control lines in the unit and fix them at the unit frame.
- route the control lines into the electrical cabinet from below and connect them in accordance with the wiring diagram (part of the unit documents).

Pump control

The unit's controller C7000 controls internal and external pumps, as well as monitoring a pump alarm.

System with external pump

Choose a power switch and a contactor in respect of the pump capacity. A power switch and a contactor can be located in the electric box. A completely wired load outlet for external pumps is also available as an optional extra.

i NOTICE

If you do not explicitly order the option "On-Off control for external pump", the power supply to the external pumps cannot come from the main switch of the unit as the main switch is only designed for the current consumption of the standard unit. The pump must be individually provided with safety elements.

- Design the wiring between the controller and the contactor with reference to the connection diagram for the controller and the wiring between the pump and power switch according to the manufacturer's notes.

6. Commissioning

NOTICE

The unit must be installed and connected in accordance with the chapter on „installation“ before initial commissioning.

6.1 Filling of the water circuit

- Check whether you need an anti-freezing agent.

If the water temperature passes under 5°C or if the outside temperature is less than 0°C, you must add an anti-freezing agent. We recommend to add the following quantities of glycol (indicated as percentage of weight of the water quantity):

Ethylene glycol	Water or outside air temperature
20%	until -9,0°C
25%	until -12,3°C
30%	until -16,1°C
35%	until -20,4°C
40%	until -25,2°C
45%	until -30,8°C
50%	until -37,6°C

Propylene glycol	Water or outside air temperature
25%	until -10,7°C
30%	until -14,0°C
35%	until -17,6°C
40%	until -21,5°C
45%	until -26,0°C
50%	until -32,4°C

It is difficult to produce a homogeneous glycol mixture. You can purchase ready-made glycol mixtures.

- calculate the water content of the water circuit and the required amount of glycol.

WARNING

Risk of glycol intoxication

Do not swallow ethylene glycol. Ethylene glycol is highly toxic in oral ingestion.

Lethal dose: 0,4 g ethylene glycol/kg body weight, severe intoxication: already at 0,1 ml/kg.

Glycol is absorbed through the skin. Therefore immediately change clothing soaked with glycol.

Wear protective gloves made of rubber.

Filling and bleeding air

A standard chiller provides vent valves at the evaporator and at the electric cabinet cooler. For accessing the vent valves of the electric cabinet cooler, remove the left side panel of the electric cabinet. For purging the cabinet cooler it is sufficient to open one of the two valves.

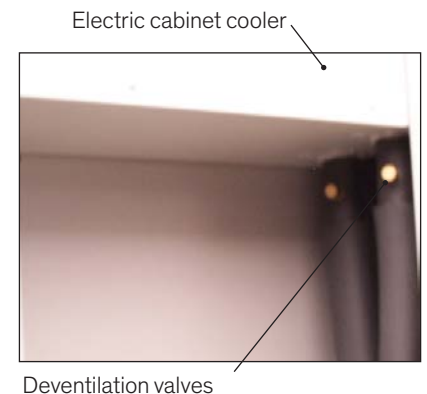
- Open the vent valves. See the exact location of the vent valves in the refrigeration scheme. If the planned filling of water contains glycol, connect fill hoses to the vent valves, to catch the discharging mixture and dispose of it separately.
- Check equally whether the stop valves in the supply line of the cabinet cooler are open.



Chilled water lines to the evaporator in the refrigerant section with open stop valves

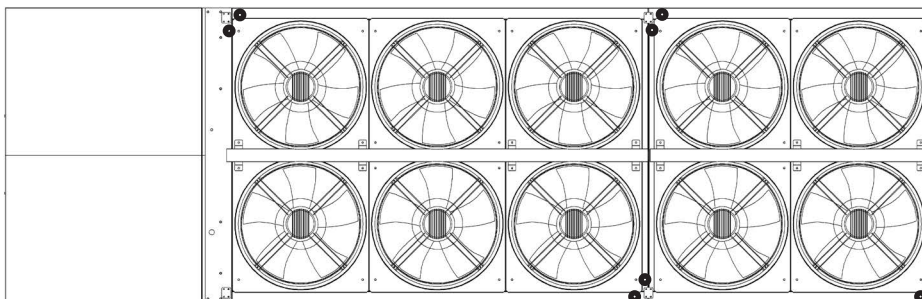
If the chiller is equipped with free cooling, there are also vent valves on top of the free cooling coils. The following drawing illustrates the diagonal arrangement system of the valves.

- Remove the rubber plugs and also connect hoses here, if necessary to catch the mixture.
- Begin filling the water circuit. As soon as liquid comes out of a vent valve for several seconds, this can be closed.



Electric cabinet cooler

Deventilation valves



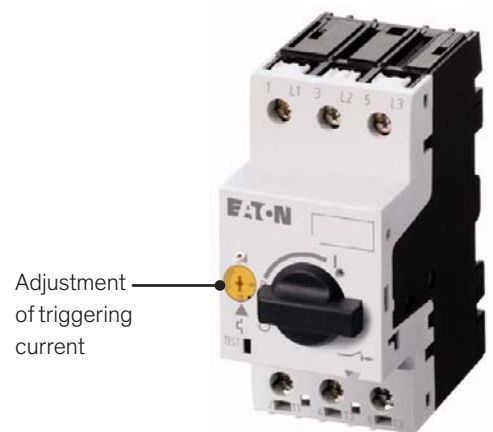
Rubber plug to cover the vent valve openings



Rubber plugs and bleeding line in a chiller with free cooling (on this illustration the condenser fans are not yet installed.)

6.2 Control of the electrical box

- Make sure that the master switch is off and the unit is de-energized.
- Open the electrical compartment door of the unit using the key provided.
- Check whether all power switches and control-circuit fuses in the electrical section of the unit are switched off.
- Check whether the power supply cables and the terminal connections including the PE terminals are tight.
- Retighten all screw connections at the contactors and power switches.
- Verify the smooth function of the contactors.

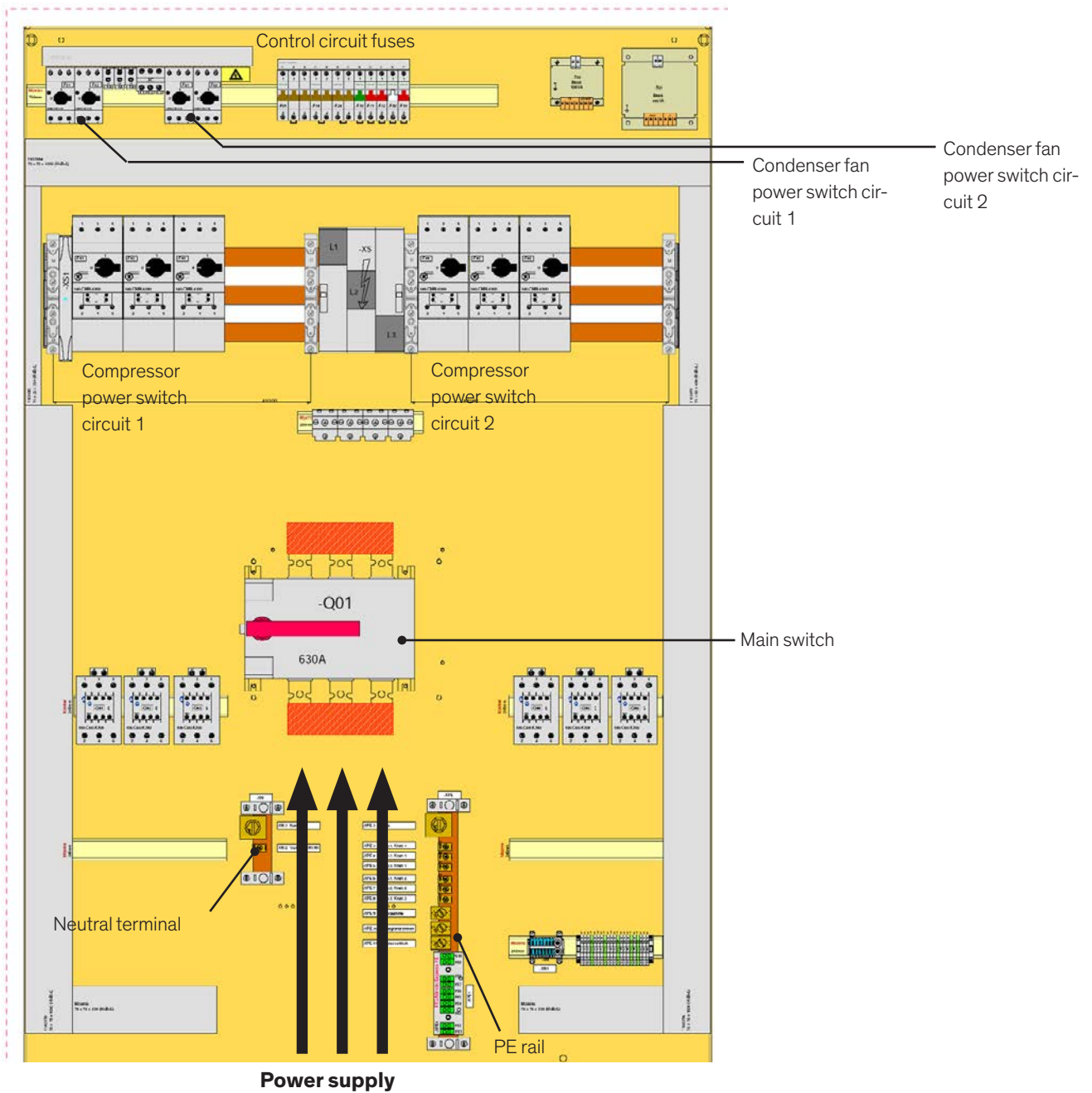


Power switch in position "off"

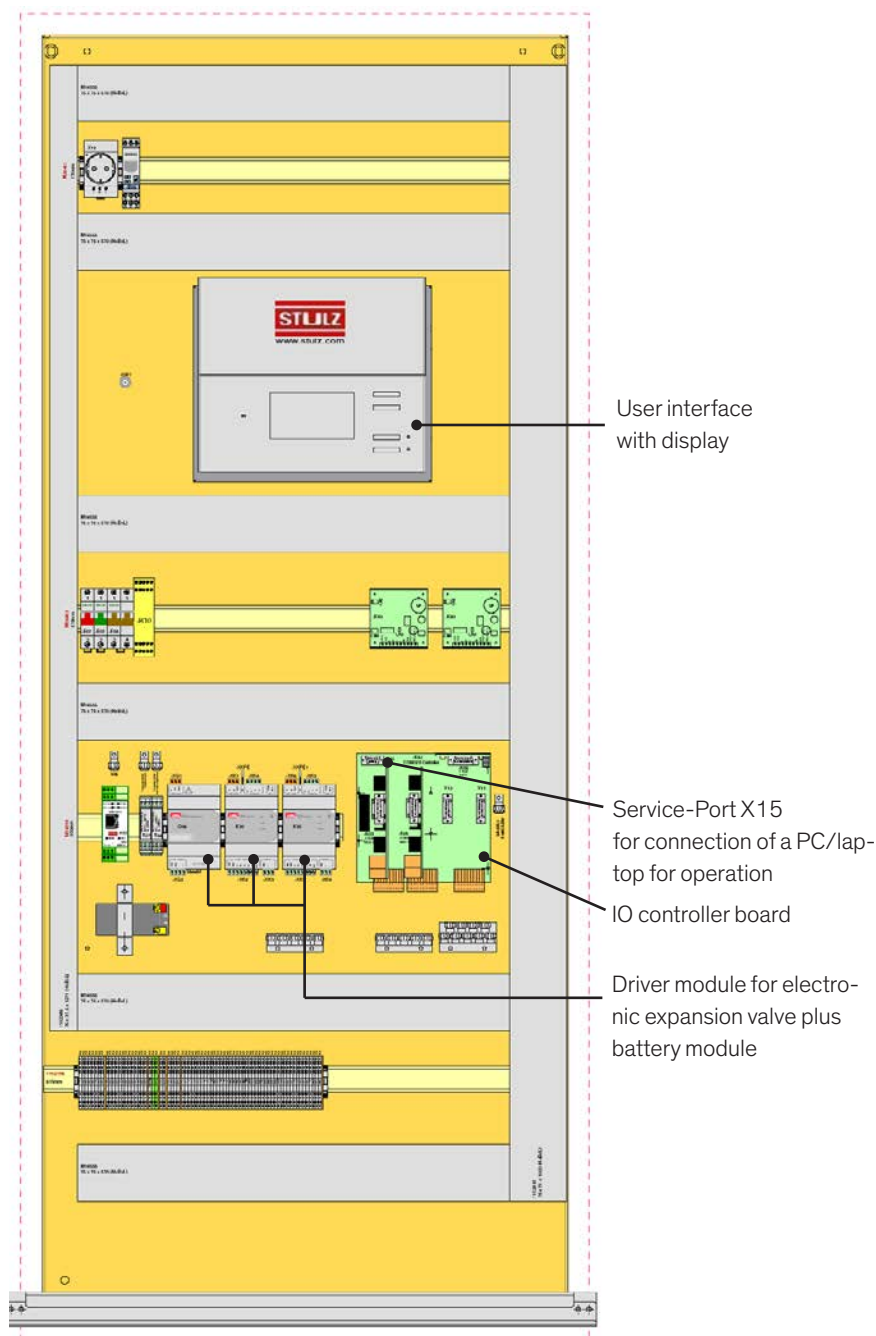
- Check the settings of the power switches according to electrical data sheet (part of the unit documents).
- Switch on the control-circuit fuses. The compressor power switches may not yet be switched on.
- Switch on the chiller unit at the master switch.

The crankcase heater and the controller are now supplied with power, so you can use it for adjustments.

Electrical cabinet power section, left side



Electrical cabinet control section, right side


i NOTICE
Damage to the compressor by liquid refrigerant

If the unit is switched off via the main switch without first switching off the control (start/stop button or „state stop“ command), the expansion valve is closed using the battery. When the battery is discharged, the valve in this case retains its current opening degree. The open expansion valve allows liquid refrigerant to flow into the evaporator.

The electronic expansion valve is supported by a rechargeable battery located in the chiller's electrical box, which is used to close the valve in the event of a power failure.

Full operation of the electronic expansion valve is only guaranteed by a charged battery.

The battery must be recharged after the following events:

- long interim storage of the chiller without connection to a power supply
- a longer power failure (longer than 1 week)
- replacement of the battery

For charging, the chiller must be supplied with power 3 hours before the refrigeration circuits are put into operation. To do this, switch on the main switch and the control fuses. Do not start the regulation (e.g. by pressing the red start/stop button on the C7000AT). The control must remain switched off.

After the expansion valve has been closed using the battery (e.g. after a brief power failure), a charging time of one hour is required to restore full operation of the expansion valve.

Note:

The oil pre-heating time is largely sufficient to recharge a battery which is possibly discharged. For this the control fuse of the controller must be switched on.

Frost protection thermostat

The sensor of the anti-freeze thermostat is an immersion sensor which gets directly in contact with the cold water. The control unit of the anti-freeze thermostat is housed in the control cabinet.

The yellow LED K1 lights up during normal operation.

Below the set value the frost protection mode is triggered and the LED goes out. Above the set value plus the hysteresis, the frost protection mode is cancelled and normal operation is continued.

Factory setting

Setpoint: 4 °C

Controller type "typ": Col

Hysteresis: 5 K

Sensor type "SEn": P.It

Lead compensation resistance "OF.r": 0,3



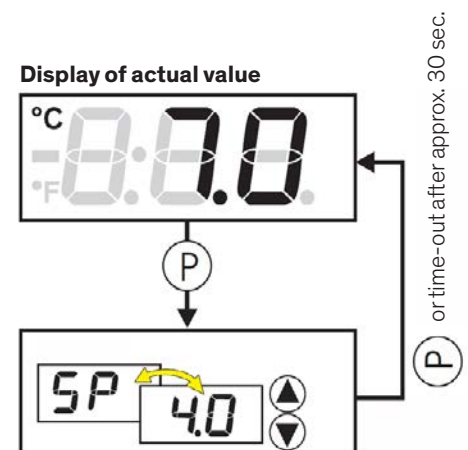
Operation

During operation, the measured value of the chilled water temperature will be shown.

Setting the setpoint:

- Press the "P" key. The set value and "SP" will be displayed alternately.
- Adjust new setpoint by the ▲ and ▼ keys.
- Press "P" key to return to the display of the actual value.

The hysteresis is fixed to 5 Kelvin.



6.3 Oil pre-heating

- To pre-heat the oil, the chiller must be supplied with voltage, the circuit breakers of the compressors must be switched off for safety reasons. In normal operation of the chiller, the oil heater is always in operation when the compressor is switched off.

The control must also remain switched off during the oil pre-heating (by Start/Stop key on the controller), as alarms might unnecessarily occur as soon as a cooling request exists.

Above an outside temperature of 10°C the oil pre-heating must be put into operation 8 hours before the first start of the compressor. Below an outside temperature of 10°C, the chiller requires an oil pre-heating time of 24 hours. During the oil pre-heating time the compressor cabinet should be kept closed.

6.4 Commissioning of the chilled water circuit

Ensure that the water system has been sufficiently filled and that all stop valves are open.

- Check the sense of rotation of the pump and start the pump. If the pump is controlled by the C7000 controller, the manual mode is suitable, because this mode is functional even when the control is switched off, for example during oil pre-heating.
- Notice for speed-controlled pumps:
 - ensure that the standby-reheat is activated.
 - ensure that the condensate plugs have been removed.
- The full functionality of the C7000 controller can only be used by typing text commands into a terminal program (e.g. the terminal program "C7000ConfigTerminal"). For this you need to connect the laptop to the service port X15 of the I/O controller via a null modem cable. (detailed description see controller manual.) You can place the laptop at the bottom in the control section of the electric cabinet.

The following two commands put the pump into operation, each command is sent by pressing the Enter key:

```
pump 1 hand 1
pump 1 handon 1
```

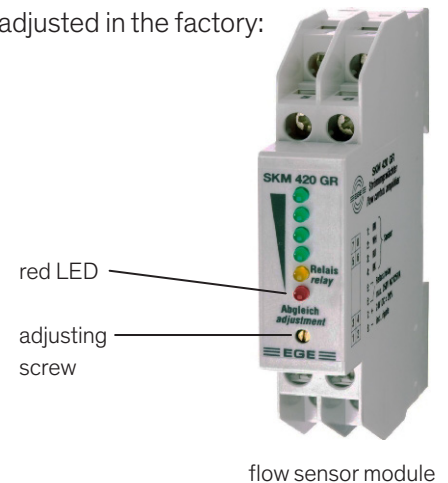
- In the meantime the laptop can be switched off and the connection to the I/O controller can be separated.
- Keep the pump running for 8 hours and clean the implemented filter (recommended part of the external circuit) after this lapse of time.

Setting the minimum water volume flow

The following triggering values for the minimum volume flow have been adjusted in the factory:

Model	Vmin [m³/h]
C_O 541 AS_	3,5
C_O 621 AS_	4,5
C_O 801 AS_	5,5
C_O 1102 AS_	7
C_O 1302 AS_	9
C_O 1602 AS_	10
C_O 1902 AS_	15
C_O 2402 AS_	15

Model	Vmin [m³/h]
C_O 2802 AS_	15
C_O 3702 AS_	25
C_O 4002 AS_	25
C_O 4202 AS_	25
C_O 4602 AS_	30
C_O 5002 AS_	35
C_O 5902 AS_	40



You can modify the triggering value for the water flow alarm at the flow sensor module (illustration right) in the electric cabinet by means of a little screw driver.

- Set the desired minimum flow by using the pump or a valve.
- Now set the adjusting screw so, that the red LED lights up dimly.

If the flow rate is slightly lower, the red LED lights up fully and the water flow alarm is triggered.

- Now adjust the water flow by means of a regulating valve or a speed controlled pump to the necessary value for standard operation. A speed controlled pump can not be controlled by the C7000 controller and requires an external control.

6.5 Commissioning of the refrigerant circuits

- Switch on the circuit breakers of all compressors and the power switches of the condenser fans.
- Adjust the desired return resp. flow water temperature at the controller.
- Check the prerun opening degree of the expansion valve. Reduce the default value (30%) especially after a long downtime and adapt it to the prevailing load conditions.
- Start the chiller unit by pressing the Start/Stop-key on the controller or by typing the command: `state start`.
- First check the correct function of the first refrigerant circuit by switching off the compressors of the second circuit in manual mode and by producing a cooling capacity request (providing approx. 18°C warm water chilled water inlet of the chiller or by setting the water temperature setpoint sufficiently low).

```
comp 2 hand 1
comp 2 handon 0
```

```
comp 4 hand 1
comp 4 handon 0
```

```
comp 6 hand 1
comp 6 handon 0
```

- Check after 20 minutes of operation, whether gas bubbles are visible in the sight glass of the liquid line. If this is the case, refrigerant might have escaped by a leak.
- Check the circuit on leaks, eliminate these and top up the circuit with R410A in regard of the chapter "Maintenance".
- Check the current consumption of the compressors and of the condenser fans comparing it with the values in the technical data.
- Check the oil level at the compressors of the first refrigerant circuit in respect of the right level. The oil sight glass is located in a pipe which connects the compressors of a refrigerating circuit and points to the condenser coils.
The oil level should be between the lower quarter and the upper quarter of the sight glass.

- Connect pressure gauges on the high pressure and low pressure side and verify by reading the pressures, that the saturation temperatures for evaporation (low pressure side) and condensation (high pressure side), which correspond to the measured pressures, are within the following tolerances during the operation.

High pressure side: max. 18 K above the air intake temperature of the condenser

Low pressure side: 3 to 7 K beneath the chilled water flow temperature

Example:

measured on the high pressure side: 31 bar (rel.) (= 32 bar abs.)

corresponding saturation temperature at the dew point according to scale for R410A: 52,3°C

measured air intake temperature at the condenser: 35°C

$$t_{\text{cond}} - t_{\text{air}} = 52.3^{\circ}\text{C} - 35^{\circ}\text{C} = 17.3 \text{ K} \rightarrow \text{ok}$$

measured on the low pressure side: 8.3 bar (rel.) (= 9.3 bar abs.)

corresponding saturation temperature at the dew point according to scale for R410A: 5.0°C

measured flow water temperature at the evaporator outlet: 12°C

$$t_{\text{flow}} - t_{\text{evap.}} = 12^{\circ}\text{C} - 5.0^{\circ}\text{C} = 7 \text{ K} \rightarrow \text{ok}$$

If the tolerances (18 K at the condenser, 7 K at the evaporator) are exceeded, there is a problem of heat transmission. The probable cause is the pollution of the heat exchanger surfaces. Also the superheating may be set too high.

For units with two circuits only (Construction sizes 4 to 7)

- Now switch off the compressors of the first refrigerant circuit by manual mode.

comp 1 hand 1

comp 1 handon 0

comp 3 hand 1

comp 3 handon 0

comp 5 hand 1

comp 5 handon 0

- Check the correct function of the second refrigerant circuit by switching off the manual mode for compressor 2 (possibly 4 and 6) and by producing a cooling capacity request (providing approx. 18°C warm water chilled water inlet of the chiller or by setting the water temperature setpoint sufficiently low).

comp 2 hand 0

comp 4 hand 0

comp 6 hand 0

The compressors of the 2nd circuit will now be started by automatic operation of the C7000 controller.

- Perform the same checks as for the first refrigerant circuit.

For all units

- Switch off the manual mode for all components.

handoff

- Instruct the operational staff of the controller manipulation (refer to the C7000 controller manual).

7. Maintenance

7.1 Safety instructions

All maintenance work has to be carried out under strict compliance with the country-specific accident prevention regulations. In particular we refer to the accident prevention regulations for electrical installations, refrigerating machines and equipment. Non-compliance with the safety instructions can endanger people and the environment.

Maintenance work must only be carried out on the units by authorized and qualified specialist staff.

Procedure instructions

- carry out work on the system only when it is shut down.
- switch off the chiller at the controller and at the master switch.
- display a „DO NOT SWITCH ON“ warning sign.
- switch off power conducting cables to the unit and secure them against being switched on again.
- check to ensure that they are in the de-energized state.

7.2 Maintenance intervals

Component	Maintenance interval		
	half-yearly	yearly	every 5 years
Refrigerant circuit			
Refrigerant charge	X		
Sight glass	X		
LP/HP switch		X	
Safety valve			X
Compressor		X	
Crankcase heater		X	
Oil level	X		
Expansion valve	X		
Air circuit			
Condenser**		X	
Fan		X	
Water circuit			
Tightness	X		
Evaporator		X	
Unit housing			
Electrical box		X	
Unit interior		X	

** depending on environment, in the proximity of trees and in case of low positioning of the chiller, a half-yearly control is required.

7.3 Refrigerant circuit

Refrigerant charge - Tightness, Quantity and Purity

Tightness of the refrigerant circuit

According to article 3 of the EC regulation No. 842 / 2006 the operator must check the refrigerant circuit of the chiller every 6 months for leaks. In the chillers described here, no more than 218kg (2×109 kg) refrigerant R410A are used.

Quantity

An insufficient charge causes the formation of bubbles in the sight glass or in extreme cases the triggering of the LP-switch. An operation with an insufficient refrigerant quantity over a longer period leads to a reduction of cooling capacity and to high superheating temperatures, which have a disadvantageous effect on the compressor lifetime.

If a leak is detected:

- pump down the refrigerant of a refrigerant circuit resp. a closed off section in a suitable pressure vessel (recycling bottle) down to a pressure of 0 bar_{rel}.
- dispose of the refrigerant according to the national regulations.
- repair the leak.
- check the tightness of the refrigerant circuit resp. the closed off section with nitrogen.
- the circuit has to be run dry by several fillings and extractings with high-quality nitrogen.
- change the filter drier cartridge.
evacuate the refrigerant circuit resp. the closed off section by a vacuum pump.
- fill the refrigerant circuit with the refrigerant named on the type plate.

An overfilling of the circuit makes the condensation pressure rise and by that, the power consumption of the compressor. In the extreme the HP-switch triggers.

After repairing a leak, check the refrigeration circuit on tightness within one month.

The following information must be recorded by the operator in writing:

- quantity and type of the used refrigerant
- refilled refrigerant quantity
- recycled refrigerant quantity
- companies or persons which have carried out maintenance
- dates and results of inspections

Purity

Bubbles in the sight glass indicate that the charge is insufficient or that the filter drier is clogged.

A pollution of the filter drier, whose essential task is to clear the refrigerant from impurities and humidity, can be detected by a temperature difference upstream and downstream the filter drier.

- Compare the colour indicator in the centre of the sight glass with the outer ring scale.

Green → ok.

Yellow → humidity critical.

With too much humidity in the circuit, the expansion valve can freeze. In addition to this, the ester oil in the compressor, which gets in touch with the refrigerant, takes up humidity and loses its ability to lubricate.

- Take an oil sample, determine the humidity content and exchange the oil in case of excessive humidity content.
- In this case evacuate the refrigerant completely and recharge it according to the above described evacuation instruction.



Sight glass

Exchange of the filter drier

To exchange the filter drier it is sufficient to evacuate the pipe section in which the filter drier is installed.

- Close the shut off valve at the liquid receiver and the valve in the liquid line upstream the expansion valve.
- By the service valve on the lid of the filter drier, you can evacuate the refrigerant from the section.
- Remove eight M8 screws at the front side and pull out the cartridge.
- Introduce a new cartridge and refill the evacuated refrigerant.
- Open the shut off valves.



Filter drier, service valve

HP switch (high pressure limiter)

When the HP limiter triggers, the compressor is switched off without delay. Before the restart and after the elimination of the error, the HP switch must be reset by pressing the red reset button.

A check of the tripping function of the high pressure limiter (e.g. by cutting down the condenser fan and forcing a high pressure) is not possible without difficulties, as there are, on behalf of the C7000 controller, further monitoring functions via the high pressure sensor, which intervene in the compressor control (high pressure management).

LP switch

Check the correct function of the low pressure switch by stepwise closing the expansion valve of one refrigerant circuit using the manual mode of the C7000 controller, while the compressor is running. Check by means of a pressure gauge connected at the low pressure side in the compressor section, whether the low pressure switch trips at 3 bar. When the LP switch trips, the compressor is switched off without delay.

After the compressor pause (default setting: 180 sec.) has elapsed the compressor is restarted. During the evaluation delay (default setting: 120 sec., possibly raise on 300 sec.) you can stepwise open the expansion valve in manual mode, until you reach a suction pressure of 6 bar (check by suction pressure gauge).

Expansion valve

The refrigerant circuit is equipped with an electronic expansion valve, which controls the superheating in the evaporator. The superheating is adjusted to 5 K at the factory and may not be modified.

- Check the superheating setpoint.
- Check the superheating by the command "eev 1" in the first refrigerant circuit resp. "eev 2" in the second refrigerant circuit. If the superheating is below 3 K or above 7 K for a longer time, the function of the expansion valve is faulty.
- Check whether the refrigerant, pressure sensor and valve type are correctly set in the C7000.
The following valve type "Carel EXV" (valve type: 1) must be set. The following pressure sensor "O... 17,3 barg" (Sensortype evaporating pressure: 4) must be set.
- Switch off all components of the refrigerant circuit and control the expansion valve in manual mode.
- Through control of the sight glass on the valve, check the mechanical operation of the valve.
- Compare the suction pressure measured by the valve sensor with the value of the suction pressure gauge in the compressor section. Compare the suction gas temperature measured by the valve sensor, with the value of a reference sensor at the suction line.

If you can find no deviation at all checks, probably the control module of the valve is defective and must be replaced.

The expansion valve can freeze, if the humidity in the refrigerant circuit is excessive.

DANGER

Do not thaw by soldering flame, danger of explosion !

Thaw with moist warm cloth. Check the sight glass.

Compressor

In the compressor there is an ester oil charge, which does not have to be renewed under normal operation conditions and holds out for the unit's lifetime. However, it is possible that the ester oil, as it reacts hygroscopically, has taken up humidity of the air after repeated recharging of the refrigerant circuit due to repair works. The interaction between ester oil and water results in the formation of acid. Owing to a hyperacidity, corrosive processes take place inside the compressor.

- In this case exchange the ester oil.

Oil level

During unit idleness the oil level should not be below the lower quarter (bottom line) and not rise above the upper line during operation.

Oil type: ICI Emkarate RL 32-3MAF (factory filling)
ICI Emkarate RL 32 CF

- Check the oil level by looking at the sight glass in the oil compensation line (for size 3/4 directly on the compressor).

Crankcase heater

Check the crankcase heater function by measuring the ohmic resistance at the terminals of the auxiliary contactor in the electric cabinet. For the 140W heater the ohmic resistance should approximately be 1,1 kOhm, 1,3 kOhm for the 120W heater and 1,8 kOhm for the 90W heater.

7.4 Air circuit

Condenser and free cooling coil

The air-cooled condenser consists of a microchannel coil. The employed free cooling coils are finned heat exchangers and consist of copper tubes with aluminium fins.

Through the microchannel coil and the free cooling coil flows outside air during operation of the chiller, these coils are exposed to environmental influences. This may result in pollution of the coils depending on the local installation conditions. Pollution worsens the efficiency of the coils and negatively influences the efficiency of the chiller in all modes of operation.

Therefore, we recommend a semi-annual cleaning of the coils depending on the Installation site and degree of contamination of the unit.

Cleaning of the finned heat exchanger and microchannel coil

For cleaning, you will need a high pressure washer with hot water and an adjustable high pressure nozzle. The cleaning is also possible with a high pressure washer without hot water and an adjustable high pressure nozzle.

We recommend an alkaline cleaning and degreasing agent using a high pressure washer with hot water (20°C to max. 40 °C).

The detergent can also be used with cold water, however the cleaning effect is smaller.



WARNING

Chemical burns danger

Observe the safety data sheet and the manufacturer's description of the cleaning agent used, in particular with regard to use and disposal.

For coated finned heat exchangers and microchannel coils, we recommend a cleaning with just warm water without using chemicals.

Procedure

- first clean the coil with a vacuum cleaner and soft nozzle.
- rinse from the inside out and from bottom to top.
- direct the jet of water always vertically on the fins, to not distort the fins.
- allow the detergent to react on the debris about 1-5 minutes, but do not let it dry.

For rinsing, we recommend to use a high pressure washer with hot water of 50-80 °C.

Rinsing with cold water is less effective.

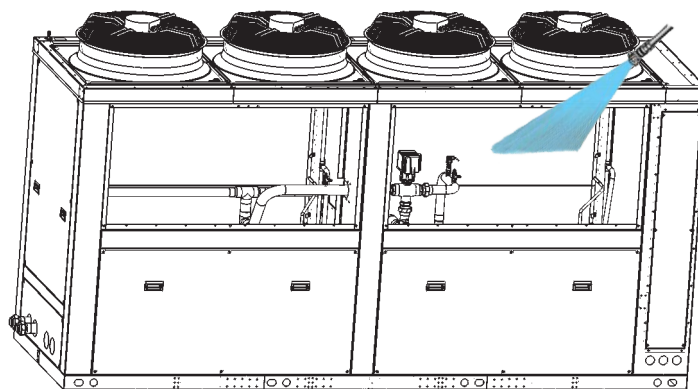
- rinse all wetted surfaces thoroughly.
- rinse the debris from the inside out and from bottom to top, until the exiting water is completely clean.
- drain the water which has accumulated between the coils (sizes 5-7) by removing the plugs at the bottom plate.

We accept no liability for consequential damages and improper application.

Size 4:

left side view,
access by upper panels

In unit size 3 and 4 you get access to the condenser coil after removal of the upper panels (size 3 one panel only) on the left side. Each panel is fixed by 6 screws.

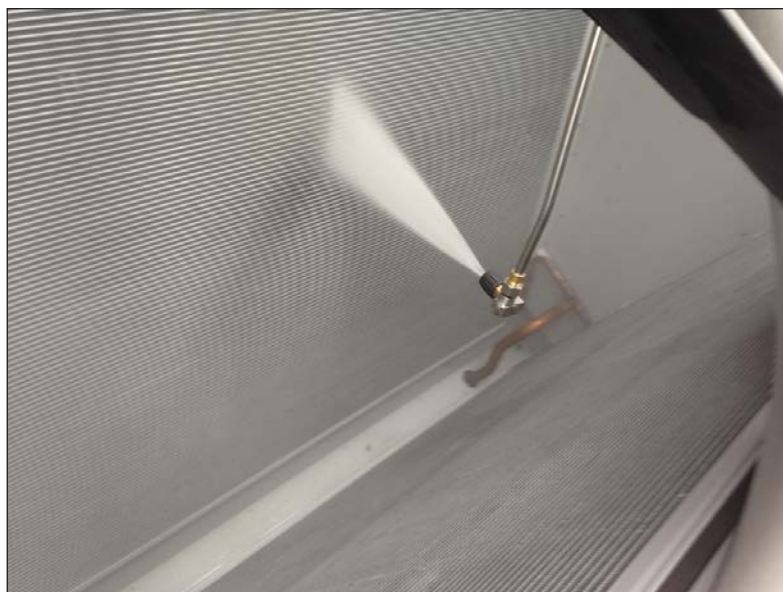
**Size 5-7**

top view,
access by removing or tipping up condenser fans

You must remove a condenser fan for each heat exchanger element in chillers of size 5 - 7, if the chiller is not equipped with movable fans (option).

NOTICE

The rebound of the high pressure cleaner can damage the fins of the opposite coil.

**Removal of a condenser fan (sizes 5 - 7)****WARNING****Risk of injury by burns and rotation**

The electronics housing can get hot.

The fans have an operation delay after the unit is stopped !

You need an appropriate secured access (e.g. working platform) to the chiller top, to dismount a condenser fan for each heat exchanger element.

- open the centrally located cable duct on top of the chiller.

The duct is divided into a part for the power lines and a narrower part for control lines. The fan is connected by a screwed plug connection in the power line part and two screwed plug connections in the control line part.

- disconnect the electrical connections and protect them against damage and humidity.
- completely unscrew the 4 Torx screws of the fan grille
- lift the fan (weight: approx. 30 kg) with another person and place it upside down on a fan next to it.

Condenser fan

The bearings of the fans are lifetime lubricated and do not need maintenance. Check the operation current. An increased operation current indicates a winding short circuit in the fan motor.

Air filter in the compressor cabinet

- Check the filter in the air intake / outlet (see figure on page 21) in terms of pollution (visual inspection).
- Replace the filters (filter class G3) if necessary. The grilles are held by plastic clips and can be removed using a screwdriver.

7.5 Water circuit

Tightness

A lack of water in the circuit is replaced by air, which reduces the heat capacity of the chilled water circuit and is detrimental to the pump. A level indication at the storage tank, if existent, can give information about changes of the water quantity.

- check the water circuit visually for tightness.

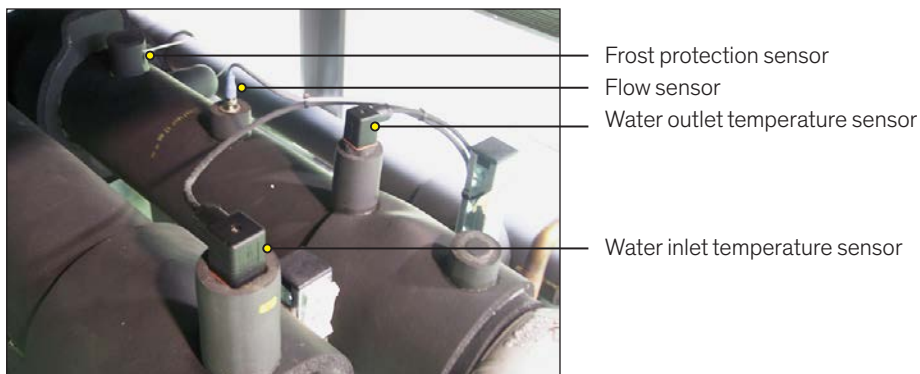
Evaporator

- Check the water side pollution of the tube evaporator by comparing the chilled water inlet temperature to the chilled water outlet temperature at full load.

If the difference is less than 3 K, it indicates a limited heat transmission and thus pollution.

Another possibility to verify this consists in the comparison of the chilled water outlet temperature with the saturated evaporation temperature (by measuring the suction pressure at the low pressure side of the compressor). If this difference exceeds 7 K, the evaporator is probably polluted.

In this case the evaporator has to be cleaned chemically.



Chilled water sensors

Pump (option)

The pump is equipped with permanently lubricated bearings. According to the manufacturer's instructions, the bearings have an expected durability of 20,000 operating hours.

- check the pump for audible and visible wearing.
- replace the bearings with noticeable wearing.
- for instructions on how to replace the bearing see QR-code on the pump or instruction sheet in the e Stulz area.

7.6 Unit housing

DANGER

Mortal danger by electric hazard

When the master switch is switched on and the controller is stopped, the power contactors are live, even if the components are not operating.

At the fan contactor, dangerous voltages occur. Do not open the unit within the first 5 minutes after disconnection of all phases. Due to the EC fans dangerous charges of $>50\mu\text{C}$ can occur for a short time between AC line terminals and PE after disconnection.

Electrical box

- check the connection terminals for tight fixation when the unit is installed and once again after an operation time of 30 days.

CAUTION

The power contactors of the compressors must be checked on smooth operation and worn contacts every 10 years.

Unit interior

Clean pipes simplify the search for leaks.

Vibrations of pipes and circuit components can result in leaks.

- check the pipes for a tight seat.

Condensing air humidity on cold water pipes means a loss of cooling capacity.

- check the insulation of the water piping.

8. Malfunction

Alarm message	Cause for alarm	Cause	Elimination
High pressure # failure	High pressure switch has triggered	1. condenser fan defective.	Check function.
		2. condenser coil soiled.	Clean condenser.
		3. overcharge of refrigerant circuit	Discharge and dispose of refrigerant.
		4. electric connection of high pressure switch loose. Cable defective.	Check connection and cable.
			Press red release button at HP switch after elimination of error.
Low pressure # failure	Low pressure switch has triggered.	1. Insufficient refrigerant charge. Leak in refrigerant circuit.	Repair the leak. Refill refrigerant.
		2. Electric connection of low pressure switch loose. Cable defective.	Check connection and cable.
		3. Expansion valve defective.	Exchange expansion valve.
Power switch comp. #	Compressor power interruptor has triggered.	1. Current too high. Shortcircuit in the cable. Compressor motor defective.	Check compressor motor on voltage continuity and current consumption. Check cable.
		2. Feeding voltage too low.	Check alimentation under load.
Compressor # failure	The soft start module (option) or the protection device has detected an error.	.	Find the exact cause of error.
Sensor # failure	The tolerance to the average value adjustable in the controller has been exceeded.	1. Big difference of measured values in selected zone.	Check measured value with an external measuring instrument.
		2. Sensor defective.	Replace defective sensor.
Sensor # broken	The measured voltage/current is outside the range defined in the controller.	1. Electrical connection defective.	Check connections.
		2. Sensor cable defective.	Check cable on continuity.
		3. Sensor defective.	Check measured value with external thermometer, pressure gauge. Replace defective sensor.
EEV #: Pressure sensor error	The control module of the expansion valve has detected a malfunction of the pressure sensor.	1. Cable breakage or faulty contact 2. Pressure sensor defective.	Check cable and contacts. Replace pressure sensor.
EEV #: Temperature sensor error	The control module has detected a malfunction of the temperature sensor.	1. Cable breakage or faulty contact 2. Temperature sensor defective.	Check cable and contacts. Replace temperature sensor.

stands for a number in case of several components of the same kind.

Alarm message	Cause for alarm	Cause	Elimination
EEV #: Stepper motor error	The control module has detected a malfunction of the stepper motor.	1. Cable breakage or faulty contact 2. Stepper motor defective.	Check cable and contacts. Replace expansion valve.
eev# reliability alarm (Carel EVD)	The C7000 controller can not reach the valve by the Modbus connection.	Bus connection to the valve faulty.	Check bus connection.
Pump # failure	Pump power interruptor (evtl. also the internal pump fault detection) has triggered.	Current too high. Shortcircuit in the cable. Pump motor defective.	Check pump motor on voltage continuity and current consumption. Check cable.
watertemp. inlet # too high	The adjusted limit value has been exceeded.	1. Setpoint adjusted too high. 2. Thermal load by consumer is too high (with flow water control).	Check setpoint setting. Check control mode.
watertemp. inlet # too low	The actual value is below the adjusted limit value.	1. Setpoint adjusted too low. 2. Thermal load by consumer is too low (with flow water control).	Check setpoint setting. Check control mode.
watertemp. outlet # too high	The adjusted limit value has been exceeded.	1. Setpoint adjusted too high. 2. Evaporator soiled on water side. (possibly in combination with return water control) 3. Condenser coil soiled on air side. Air inlet temperature too high. (possibly in combination with return water control)	Check setpoint setting. Check heat transmission at the evaporator by checking the temperature difference between flow water temp. and evaporation temperature. Check heat transmission at the condenser by checking the temperature difference between outdoor air temperature and condensation temperature.
watertemp. outlet # too low	The actual value is below the adjusted limit value.	Setpoint adjusted too low.	Check setpoint setting.
Phase error	Phase monitoring device has detected an error.	Phase failure.	Check the voltage supply.
Water flow alarm	The water flow is less than the limit value set in the flow switch for minimum flow.	1. All pumps have failed. 2. Leakage in the water circuit. 3. Air in the water circuit.	Check pump operation. Check hydraulic circuit on tightness. Purge the circuit by the vent valves.
Buserror	The unit no longer participates in the bus communication.	The bus wiring is defective or incorrectly connected.	Check the bus wiring.
Addressconflict	A bus address has been assigned twice.	-	One of the two identical bus addresses must be changed.
External alarm in # failure	No voltage is present at the digital input for the external alarm #.	1. An external device has triggered a signal. 2. Cable breakage or faulty contact.	Depending on the type of message. Check wiring.

stands for a number in case of several components of the same kind.

Alarm message	Cause for alarm	Cause	Elimination
Frost alarm	The anti freeze thermostat has triggered and the number of allowed pump starts in the context of frost protection management has been exceeded.	Heat load by consumer too low.	Determine the heat load of the consumer.
Condenser # failure	The internal evaluation of the fan has detected an error. Condenser fan power interruptor has triggered. The state display of the fan group „cond #“ gives details to the kind of fault.	1. Modbus connection faulty. 2. Current too high. Shortcircuit in the cable. Fan motor defective. 3. Electronical fan control defective.	Check cable connection on voltage continuity and current consumption. Replace fan.
comp. cabin temp. too high	The adjusted limit value has been exceeded.	1. Ventilation grilles in the compressor cabinet are blocked. 2. The first condenser fan group of a refrigerant circuit is out of operation due to a power switch trip.	Check the grilles on cleanliness. Did the power switch of the first fan group trip? Has the fan group been turned off for maintenance?
elect. cabin temp. too high	The adjusted limit value has been exceeded.	Electric cabinet cooling is down.	Does the electric cabinet fan turn? Purge the cabinet coil.

stands for a number in case of several components of the same kind.


Example how to proceed in the event of the alarm "**Condenser 1 failure**"

```

ioc 01:>cond 1
Condenser fan 1
Configured.....:1
Modbus Address.....:101
number of modbus slaves.....:5
Availability.....: 0 0 0 95 100
.
.
.
Alarm.....:1
Alarm.....:0 1 0 0 0
warning.....:0 1 0 0 0
Alarm availability.....:1 1 1 0 0

```

Fan with
addr. 102



The fans with the addr. 101,
102,103 can not be reached.

The general alarm display for the fan group may have the following causes:

1. Fan circuit breaker has tripped
2. Fan electronics have detected an error.
3. The speed set by the C7000 has not been attained.

Interpretation of the alarm display:

Trigger of the alarm is presumably the fan with the Modbus address 102.

In this case the circuit breaker has also triggered and cut off three fans, which are therefore no longer reachable via Modbus.

9. Dismantling and disposal

The chiller may only be dismantled by qualified specialists.

- switch off the chiller at the controller and at the master switch.
- switch off power conducting cables to the unit and secure them against being switched on again.
- disconnect the chiller from the de-energized network.
- Dispose of the refrigerant in the unit in accordance with the disposal and safety regulations applicable on site.

CAUTION

The refrigerant may not be discharged into the atmosphere, but must be returned to the manufacturer, if it is not reused.

The ester oil in the compressor must also be disposed of. As it contains dissolved refrigerant, it can not be disposed of like usual oils, but must be returned to the oil manufacturer.

CAUTION

If glycol or similar additives had been used, this liquid has to be collected and disposed of in an appropriate manner and may under no circumstances be introduced in the local waste water system.

- disconnect the unit from the external water circuit by closing the external shut-off valves and drain the water circuit of the unit.
- disconnect the depressurized chilled water pipes of the unit from the external system.
- move the unit, as described in the chapter „transport“, with a lifting device of sufficient load-carrying capacity.
- dispose of the chiller in accordance with the disposal and safety regulations applicable on site.

We recommend a recycling company for this. The unit basically contains the raw materials aluminium (heat exchanger coils), copper (pipelines, wiring), iron (panelling, frames) and P235 steel (water piping). The electrical and electronical components installed in the electric cabinet must be separately disposed of according to the European directive 2012/19/EU. The concerned components are marked by the symbol of the crossed-out wheeled bin.

10. Contents of CE Declaration of Conformity

(according to pressure equipment directive 2014/68/EU)

The manufacturer

STULZ GmbH
Holsteiner Chaussee 283
22457 Hamburg



hereby confirms that the units listed below, in the version marketed by us, fulfil the requirements of the harmonised EC directives and EC safety standards listed below.

In the case of a modification of the equipment not co-ordinated with us this declaration loses its validity.

Description of assembly

Chiller unit

Type designation

CyberCool 2

CSO 541 ASN	CSO 541 ASF	CQO 541 ASN	CQO 541 ASF
CSO 621 ASN	CSO 621 ASF	CQO 621 ASN	CQO 621 ASF
CSO 801 ASN	CSO 801 ASF	CQO 802 ASN	CQO 802 ASF
CSO 1102 ASN	CSO 1102 ASF	CQO 1102 ASN	CQO 1102 ASF
CSO 1302 ASN	CSO 1302 ASF	CQO 1302 ASN	CQO 1302 ASF
CSO 1602 ASN	CSO 1602 ASF	CQO 1602 ASN	CQO 1602 ASF
CSO 1902 ASN	CSO 1902 ASF	CQO 1902 ASN	CQO 1902 ASF
CSO 2402 ASN	CSO 2402 ASF	CQO 2402 ASN	CQO 2402 ASF
CSO 2802 ASN	CSO 2802 ASF	CQO 2802 ASN	CQO 2802 ASF
CSO 3702 ASN	CSO 3702 ASF	CQO 3702 ASN	CQO 3702 ASF
CSO 4002 ASN	CSO 4002 ASF	CQO 4002 ASN	CQO 4002 ASF
CSO 4202 ASN	CSO 4202 ASF	CQO 4602 ASN	CQO 4602 ASF
CSO 4602 ASN	CSO 4602 ASF	CQO 5002 ASN	CQO 5002 ASF
CSO 5002 ASN	CSO 5002 ASF		
CSO 5902 ASN	CSO 5902 ASF		

EC type-examination certificate no. (Module B):

PED-B-170

Quality assurance certificate no. (Module D):

PEDD000000T

Name of notified body for inspection and monitoring of the Production Quality Assurance:

DNV GL AS
 Veritasveien 1
 1322 Høvik, Norway

EC-Directives

EC machinery directive 2006/42/EC
 EC directive for low voltage 2014/35/EU
 EC EMC directive 2014/30/EU
 RoHS directive 2011/65/EU
 Energy-related products directive 2013/12/EU

National regulation

BGR 500 chapter 2.35
 BGV A3

Harmonised EN

EN 378 -1, -2, -3, -4
 EN ISO 12100
 EN ISO 13857
 EN 60204 -1
 EN 61000-6-2
 EN 61000-6-4

Year of manufacture:

2019

11. Options

11.1 Option anti vibration mount

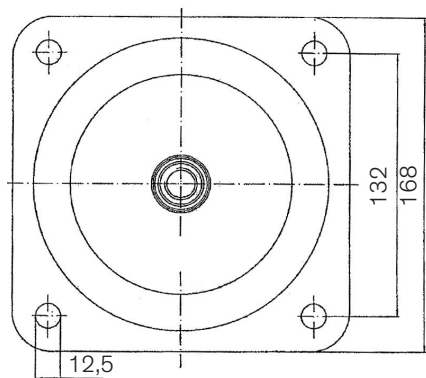
How to install the anti-vibration mounts in five steps:

- 1. drill the fixing holes on the support frame.
- 2. mount the anti-vibration mounts at the chiller.
- 3. place the chiller on the support frame.
- 4. eventually fine-tune the anti-vibration mounts
- 5. fix some anti-vibration mounts on the support frame.

- Drill the fixing holes for the anti-vibration mounts on the support frame, on which the chiller will be positioned according to the drawings below and the drawings in chapter 5.2 "Weights on the supports".
- It is not necessary to fix each anti-vibration mount onto the support frame. But in any case, the four corner mounts should be screwed on.

The anti-vibration mounts protrude the lateral dimensions of the chiller by 59 mm.

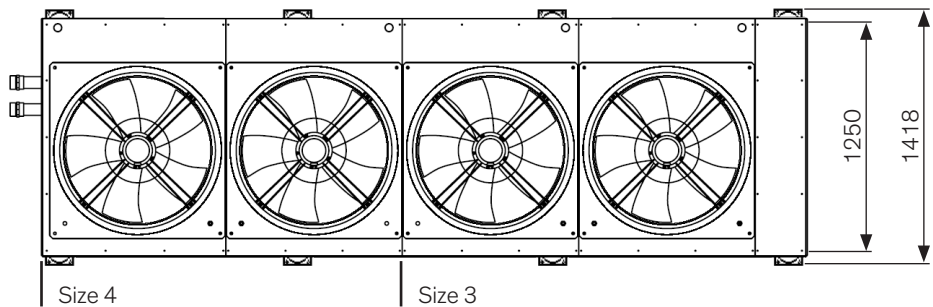
Base plate of anti-vibration mount

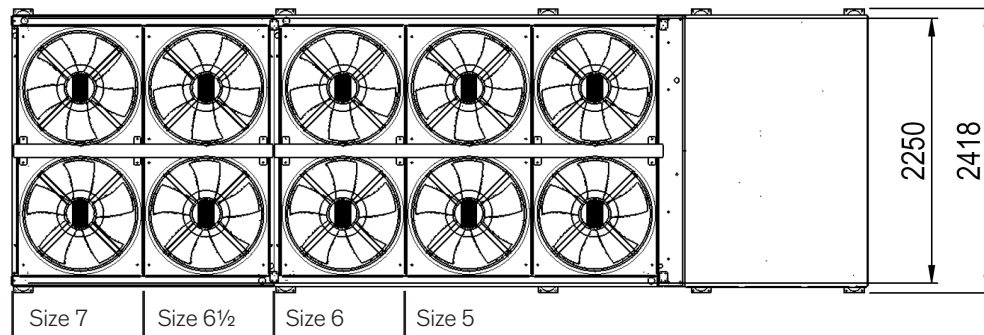


Number of anti-vibration mounts per unit size

Size	3	4	5	6	6½	7
Number	6	8			10	

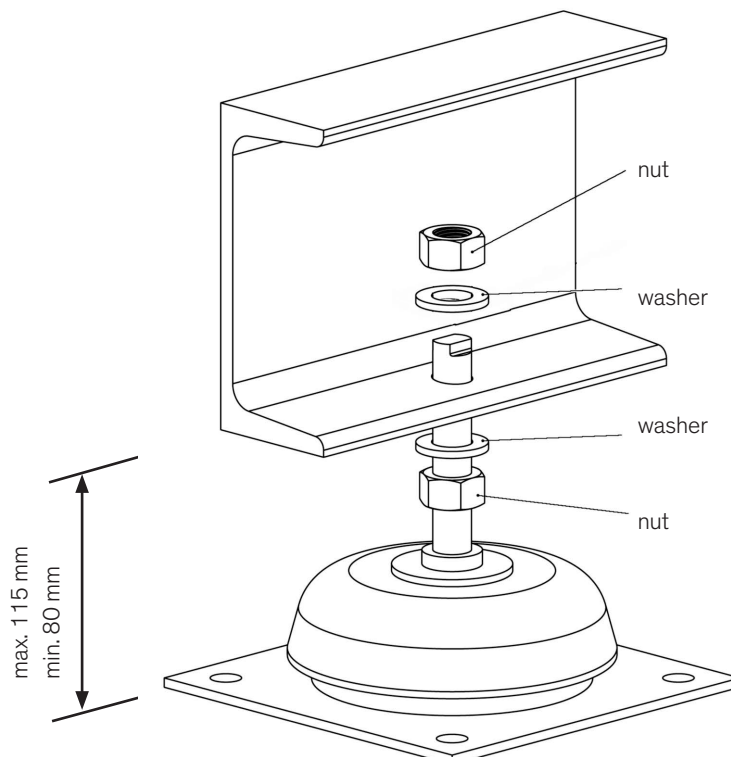
Size 3 - 4:



Size 5 - 7:**Mounting**

The easiest way to mount the anti-vibration mounts is to lift the chiller approximately 1.5 m above the ground and keep it at this height while you fix the mounts.

- The lower nut should be at the same height for all mounts.
- Mark the position in advance on the threaded rod.
- Then attach the anti-vibration mount, in accordance with the drawing below.
- Keep in mind that the anti-vibration mounts under load yield up to 4 mm in height.
- Now position the chiller on the provided support frame and fasten the anti-vibration mounts on this frame.



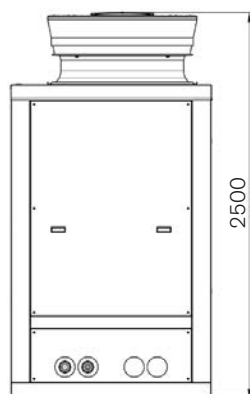
11.2 Option AxiTop

The AxiTop option is a fan extension, which directs the airflow at the outlet so that a laminar flow is produced over a short section.

This will cause a reduction of the sound pressure level and sound power level by 4 dB(A) and a reduction in the fan power consumption by approximately 15%.

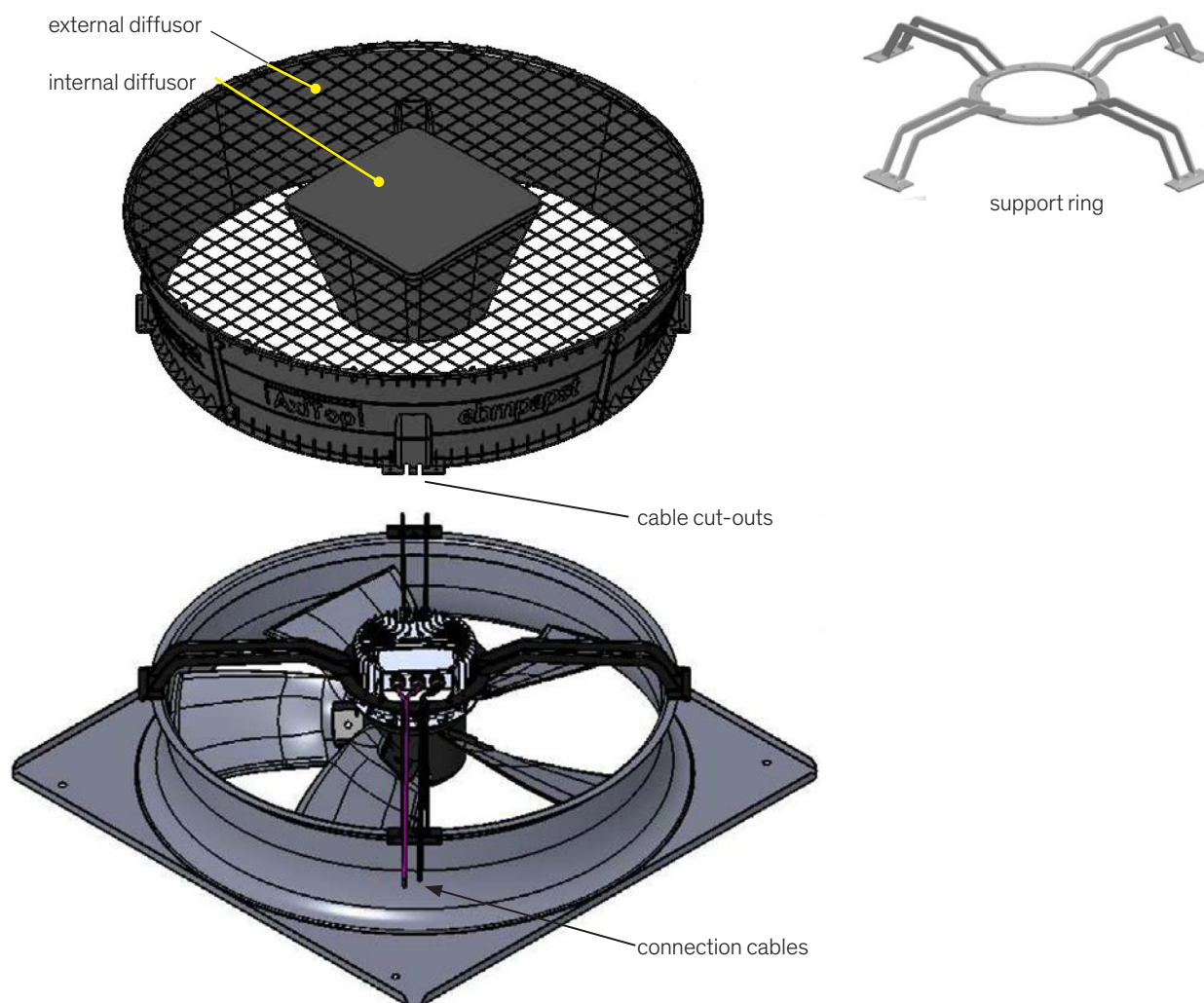
The unit height increases to 2500 mm in case of size 3/4 and to 2680 mm for the construction sizes 5 - 7.

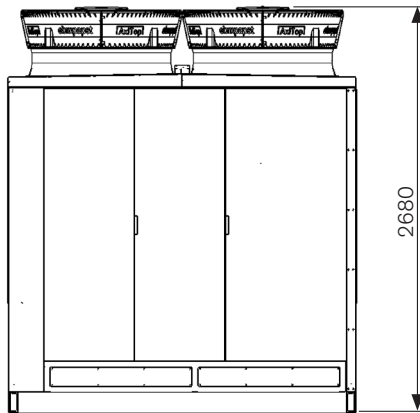
Unit size 3 and 4



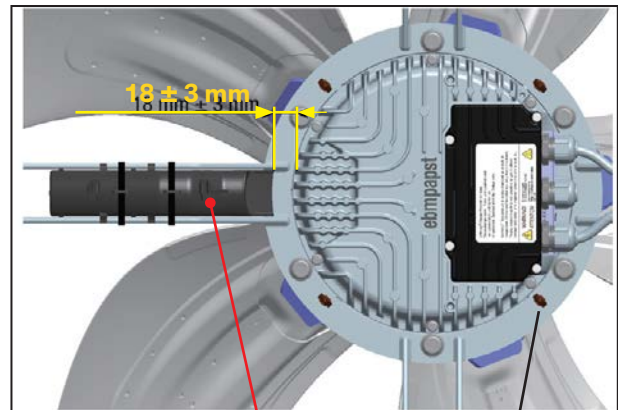
The external diffuser of the AxiTop is attached by two M6×12 lens head screws at four points on the fan housing. The internal diffuser is attached by four plastic clips at the support ring.

If the fan is exchanged, the AxiTop must be removed. When reassembling, make sure that the cable cut-outs are located, where the cables are routed. The eight screws may be tightened with a torque of $9 \text{ Nm} \pm 1,4 \text{ Nm}$.

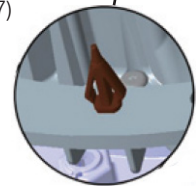


Unit size 5-7**for sizes 5-7 only:**

A cooling tube is fixed by two cable ties at the support bracket opposite to the cable connection. Warm air is aspirated from the motor housing by the cooling tube. If the fan is entirely exchanged (not only the motor) it is appropriate to reuse the support ring at which the cooling tube is attached.



cooling tube
(for unit sizes 5-7)



plastic clip

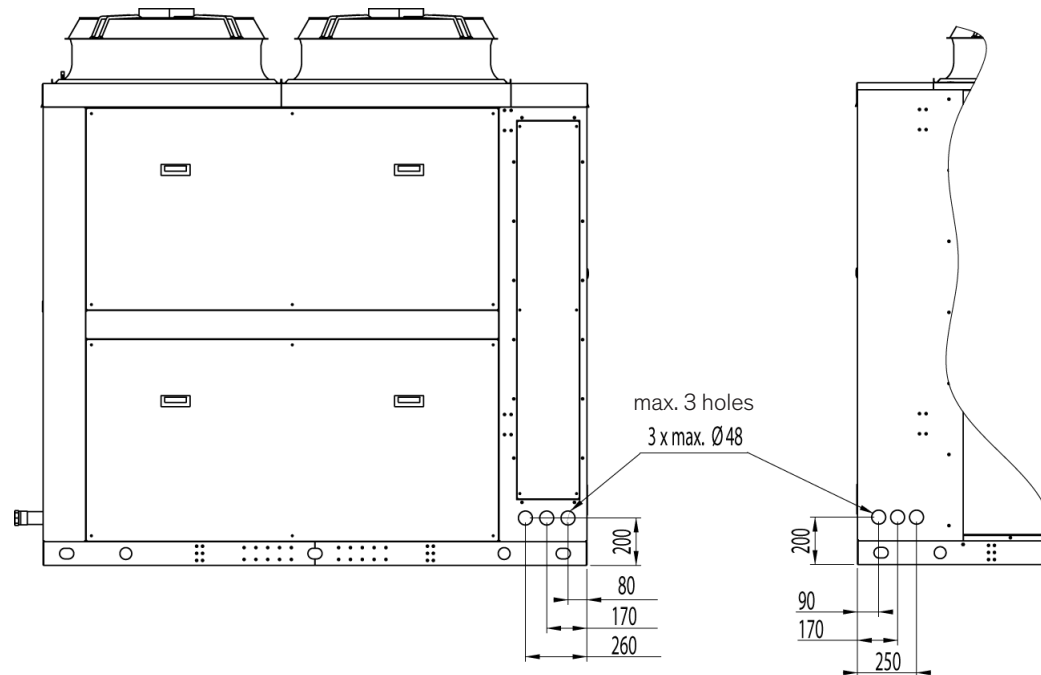
11.3 Option lateral power supply

With this option you can feed in the power supply cables from the right or left side.

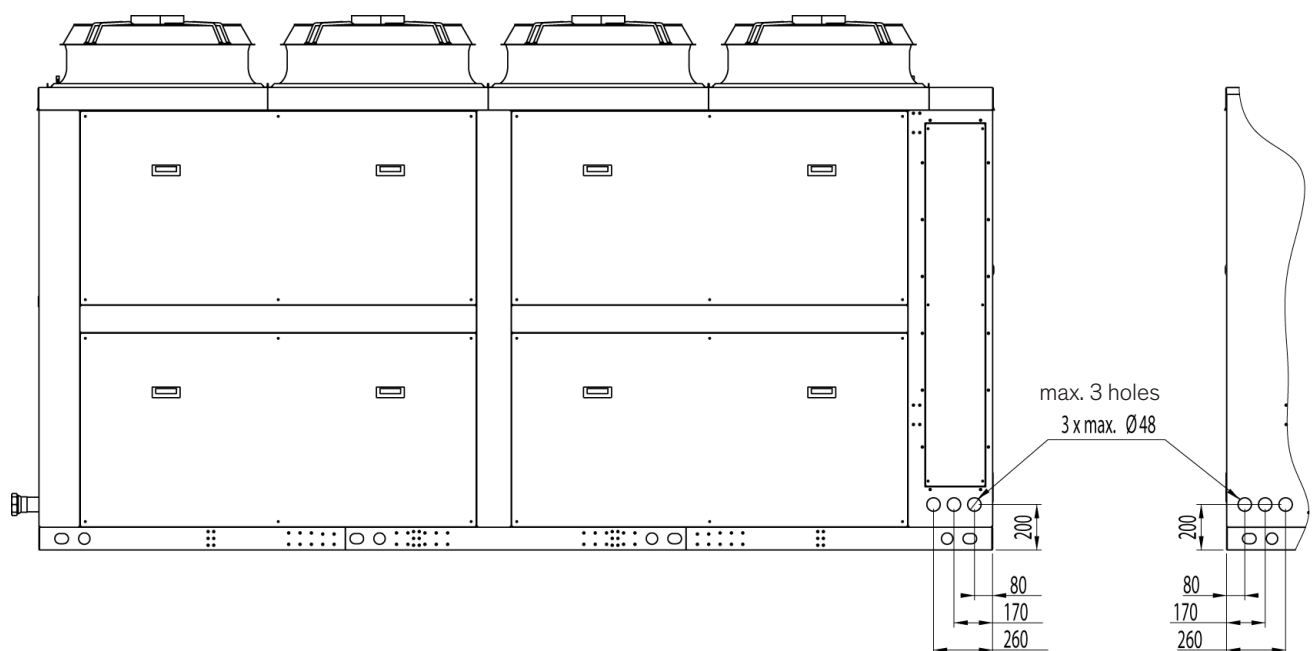
Size 3

Feed in from left

Feed in from right

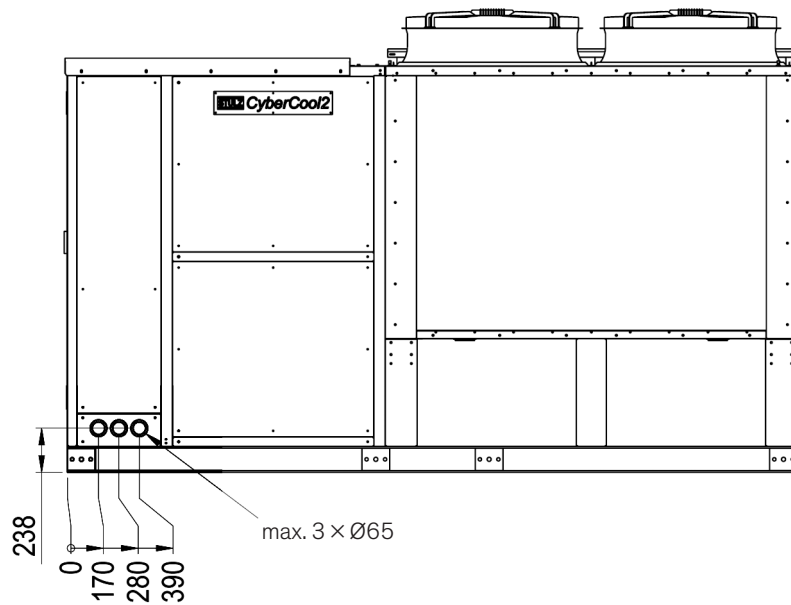


Size 4

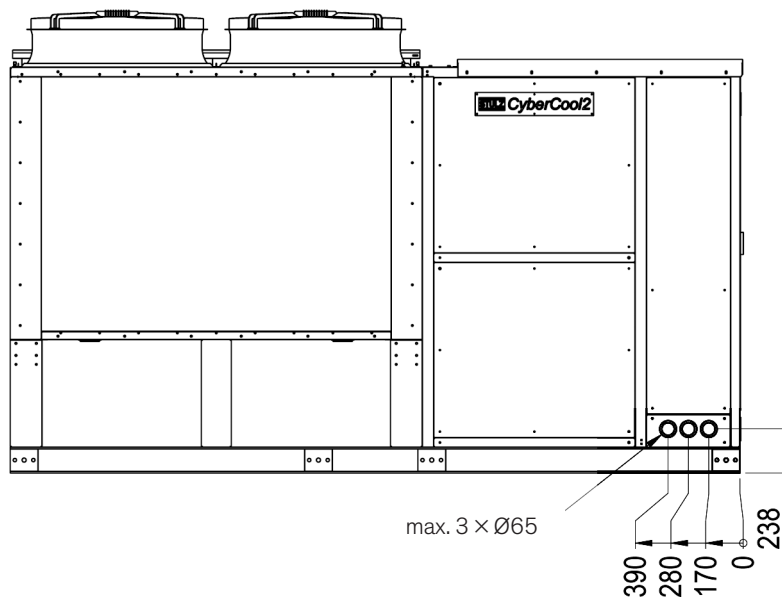


Size 5 - 7

Feed in from right



Feed in from left



11.4 Option anti-corrosion coating

The aluminium fins of the air side heat exchanger coils are coated with polyurethane.

We recommend this option for an improved protection against corrosion for an installation:

- in an industrial environment
- located near waste incinerators or waste water treatment plants
- near the sea (site within 20 km from the coast).

As the corrosion protection depends largely on the concentration and corrosiveness of industrial exhaust gas no warranty for a general corrosion resistance can be derived from this.

When using the anti-corrosion coating the cooling capacity specified in the technical data is reduced by 5-10%.

The airside pressure loss increases by 0 - 5%.



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Implementation



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Technical Management Facility



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For general inquiries about our products and services, our hotline is available at +49 40 5585-5000. Our service hours are weekdays from 7 am – 4 pm.

Or directly contact our representative in your area:

STULZ COMPANY HEADQUARTERS

STULZ GmbH
Holsteiner Chaussee 283
22457 Hamburg
Tel. +49 40 5585-0
Fax +49 40 5585-352
products@stulz.de

STULZ SUBSIDIARIES

AUSTRALIA
STULZ Australia Pty. Ltd.
Tel. +61 (2) 96 74 47 00
Fax +61 (2) 96 74 67 22
sales@stulz.com.au

BELGIUM
STULZ Belgium BVBA
Tel. +32 (470) 29 20 20
info@stulz.be

BRAZIL
STULZ Brasil
Ar Condicionado Ltda.
Tel. +55 11 4163 4989
Fax +55 11 2389 6620
comercial@stulzbrasil.com.br

CHINA
STULZ Air Technology and Services Shanghai Co., Ltd.
Tel. +86 (21) 3360 7133
Fax +86 (21) 3360 7138
info@stulz.cn

FRANCE
STULZ France S.A. R. L.
Tel. +33(1)34804770
Fax +33(1)34804779
info@stulz.fr

ITALY
STULZ S.p.A.
Tel. +39(045)633 1600
Fax +39(045) 633 1635
info@stulz.it

INDIA
STULZ-CHSPL (India) Pvt. Ltd.
Tel. +91 (22) 56 66 94 46
Fax +91 (22) 56 66 94 48
info@stulz.in

INDONESIA
PT STULZ AIR TECHNOLOGY INDONESIA
Tel. +62 21 2221 3982
Fax +62 21 2221 3984
info@stulz.id

MEXICO
STULZ México S.A. de C.V.
Tel. +52(55)52928596
Fax +52(55)52540257
ventas@stulz.com.mx

NETHERLANDS
STULZ GROEP B. V.
Tel. +31 (20) 54 51 111
Fax +31 (20) 64 58 764
stulz@stulz.nl

NEW ZEALAND
STULZ New Zealand Ltd.
Tel. +64 (9) 360 32 32
Fax +64 (9) 360 21 80
sales@stulz.co.nz

POLAND
STULZ Polska SP. Z O.O.
Tel. +48 (22) 883 30 80
Fax +48 (22) 824 26 78
info@stulz.pl

SINGAPORE
STULZ Singapore Pte Ltd.
Tel. +65 6749 2738
Fax +65 6749 2750
andrew.peh@stulz.sg

SPAIN
STULZ España S.A.
Tel. +34(91)5178320
Fax +34(91)5178321
info@stulz.es

SOUTH AFRICA
STULZ South Africa Pty. Ltd.
Tel. +27 (0) 11 397 2363
Fax +27 (0) 11 397 3945
aftersales@stulz.co.za

SWEDEN
STULZ SWERIGE AB
Tel. +46 8 12157550
info@stulzswerige.se

UK
STULZ U. K. Ltd.
Tel. +44 (1372) 74 96 66
Fax +44 (1372) 73 94 44
sales@stulz.co.uk

USA
STULZ AIR TECHNOLOGY SYSTEMS (SATS), INC.
Tel. +1 (301) 620 20 33
Fax +1 (301) 662 54 87
info@stulz-ats.com