SCM REF

Instruction manual

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CCU 5-P

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Introduction

Reducing the climate impact of refrigerants used in cooling and heat pump systems is a major challenge these days. One way of achieving this objective is to phase out synthetic refrigerants that affect the climate and make a transition to natural refrigerants.

Hydrocarbons (e.g. Propane R-290) are suitable for use as refrigerants in completely indirect systems, where the amount of refrigerant can be reduced in hermetically sealed equipment. This means it is easier technically to handle flammable refrigerants in these types of system solutions.

The CCU unit is a compact liquid cooled, liquid cooling unit, designed for a broad temperature range. The unit is based on the complete indirect system principle, where both the evaporator and condenser are affected by liquid. This reduces the size of the refrigerant circuit and thus refrigerant filling.

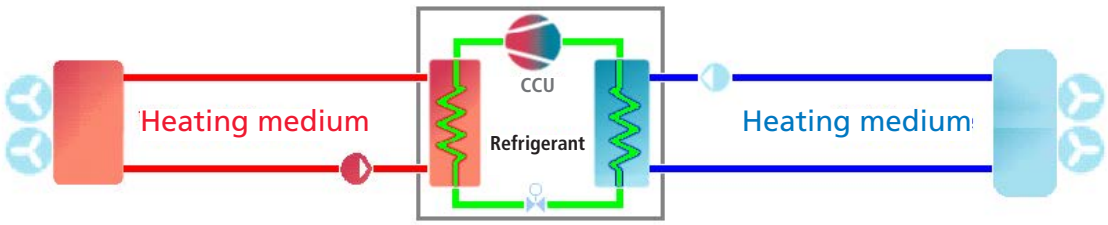
Personnel working with CCU units must have the necessary knowledge and skill to work with systems filled with flammable refrigerants.

Propane R-290 is a hydrocarbon and this means that the working medium is combustible. This places higher demands on installation and maintenance work to prevent incidents and accidents.

CCU units must be installed and maintained so that they meet applicable regulations and national legislation. CCU units must not be used if they do not meet these requirements.

The leakage risk and refrigerant filling in CCU units is minimised by using the latest heat exchange technology.

Each CCU unit is supplied complete and factory tested, ready to be connected to the system's brine/heating circuit.



Complete indirect system

Design / Construction

CCU units are designed for minimal leakage risk, the entire refrigerant circuit has soldered joints. Each CCU unit is pressure and leak tested prior to being filled and is test run according to documented procedures.

The EC59 heat exchanger is spherically mounted in cellular plastic insulation, which minimises the occurrence of cold bridges and vibrations. The CCU unit is filled with Propane R-290 and classed as hermetically sealed equipment.

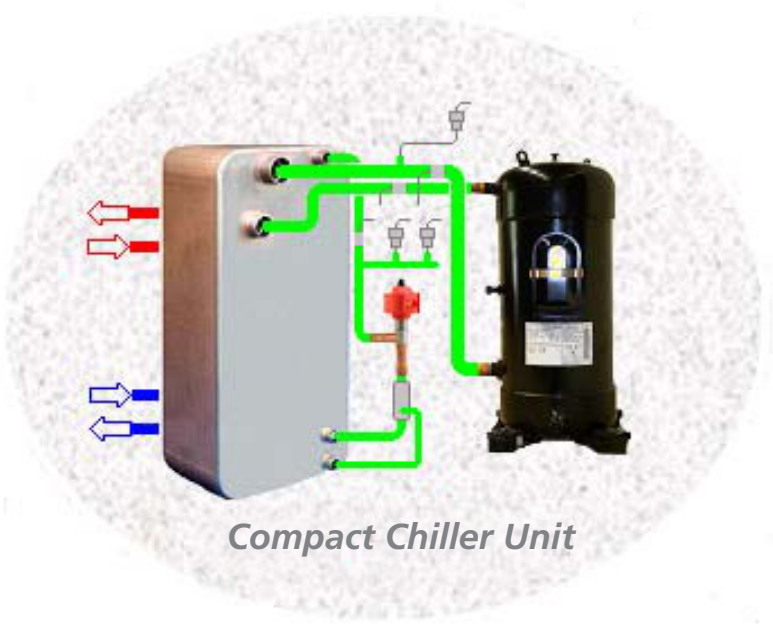
Pipe lines for suction and liquid are insulated with Armaflex insulation. The compressor is mounted with vibration damping. Brine and heating medium are connected to the rear of the unit via flexible connections.

The compact heat exchanger, EC59, has three functions in the same exchanger, evaporator-condenser and subcooler. Electronic expansion valves prevent overheating. Scroll compressor with fully soldered connections minimises the volume. The refrigerant system is protected against excessive low and high pressure via pressure switches. The high pressure side has two pressure switches that are independent of each other, and the HP2 protection switch has manual reset.

The entire refrigerant circuit is mounted in a vacuum-ventilated housing. The control box for internal electrical equipment is mounted externally on the front panel on the CCU housing for easy access. The CCU housing is designed to slide easily into CCU Rack stands when multiple units are to be connected in parallel. Flexible connections for both electricity and liquid also facilitates unit replacement.

WARNING!

CCU 4 is filled with refrigerant and is pressurised. Risk of serious injury/damage if work is performed on a pressurised unit. Only authorised personnel may handle the unit. High and low temperatures can be generated during operation. Always cut the operating and supply voltage before working on the unit. Always read the entire Instruction manual before working on the unit.



Compact Chiller Unit

Flammable gases and liquids

CCU unit with refrigerant Propane R-290 is classed as hermetically sealed equipment. The entire refrigerant circuit is mounted in a vacuum-ventilated housing that is served by a separate EX classified fan. The CCU unit with Propane R-290 has an internal Gas alarm.

For increased cooling effect, multiple CCU units are connected in parallel on the liquid side. For parallel connected CCU units with Propane R-290, a maximum limit of 30 kg within the same area applies, before special permission is required.

For example, 20 CCU units can be installed within the same area without special permission. (20 x 1.45 = 29.0 kg) [MSBFS 2013:3]

Safety

The CCU units are filled with Propane R-290 which is under pressure. Risk of serious injury/damage if work is performed on a pressurised CCU unit.

High and low temperatures can be generated during operation of the CCU unit. Always cut the operating and supply voltage before starting work.

Only personnel with sufficient knowledge and skills may handle the refrigerant circuit or the electrical installation. The refrigerant must always be dealt with by personnel with sufficient knowledge and skills before CCU units are scrapped.

Service work in the refrigerant circuit

For CCU units with Propane R-290, extra caution is required as this refrigerant is classed as flammable. Propane R-290 = class 3 [EN 378]

SCM Ref always recommends returning defective CCU units to an authorised service workshop for repair or exchange.

Climate impact

The CCU units are supplied with Natural refrigerant Propane R-290, which helps reduces climate impact. Propane R-290 has a GWP factor of 3.

The amount of CO equivalents from the refrigerant in a CCU unit is only 4.35 kg. CCU units are not subject to a statutory leakage check according to the F-Gas Regulation [EU/517/2014

Environmental information

The CCU product consists of approx. 96 weight % of mixed metals. The product contains Propane R-290 as well as a small amount of mineral oil. The remainder is plastic and elastomers. Propane R-290 and the oil must be removed and destroyed (environmentally hazardous waste) before the product is disassembled and scrapped.

Only those with the appropriate knowledge and skills may disassemble and scrap the product. NOTE! The oil may contain Propane R-290 and must therefore be degassed.

Working range

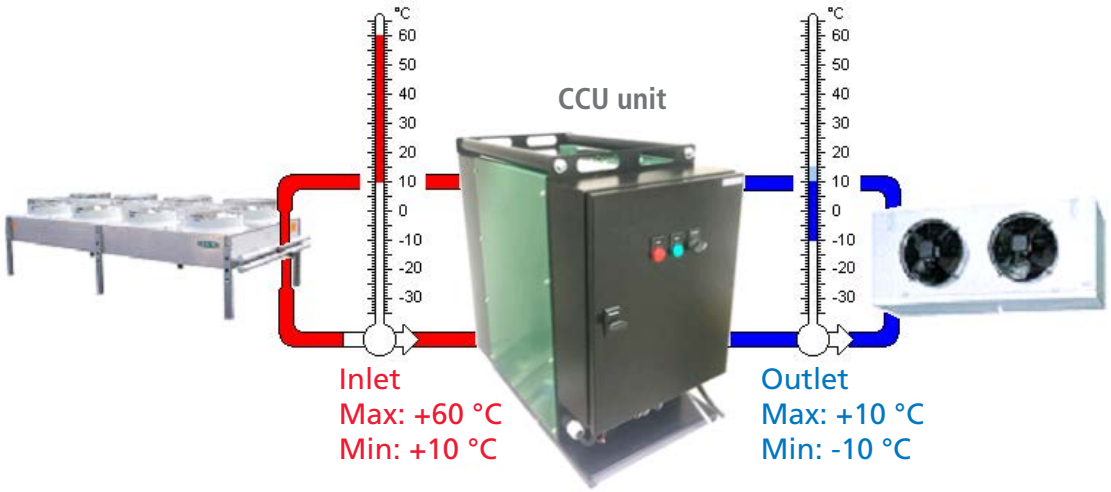
The CCU units are designed to work within broad temperature ranges for both refrigerant and heating medium. Component parts and safety are adjusted and tested to work based on these levels.

High temperature	**Medium temperature**	**Low temperature**
B out. 10° / 5°C	B out. 5° / -5°C	B out. -5° / -10°C
HM in. 15° / 60°C	HM in. 10° / 60°C	HM in. 10° / 55°C

The CCU units work with liquid condensation/subcooling that contributes to increased energy efficiency. The flow rate of liquid across the evaporator and condenser in the compact heat exchanger EC59 is fixed. B brine flow = 1.5 l/s, HM heating medium flow = 1.6 l/s.

The difference between incoming and outgoing liquid temperatures across the evaporator and condenser thus becomes liquid depending on the taken up/supplied power. Dimensioning of CCU units occurs according to outgoing B and incoming HM temperatures.

B = Brine
HM = Heating medium



Maintenance

The CCU concept is based on no work on the refrigerant circuit being carried out in the field. The CCU units can be easily replaced with an exchange unit via flexible connections. Defective units must be sent to an authorised workshop for repair or exchange.

The concept results in quick and easy servicing and CCU units are always guaranteed to run optimally and with a high levels of tightness, as well as energy efficiency.

In order to determine that the CCU units meet the required operating requirements and operating economy, it is recommended that annual checks/logging of the incoming/outgoing liquid temperatures, as well as the low and high refrigerant pressures and power consumption are carried out. Temperatures and pressures are easily read off from the display on regulator (pCO) in the unit. No work in the refrigerant circuit is necessary for this check. Gas alarm (GLD) is checked at the annual check.

Checked/logged values are compared with the unit's testing protocol to evaluate the CCU unit's operating condition

Set-up/Connection

The CCU units must always be mounted horizontally on a flat surface or in special CCU Rack stands. The units must be damped from vibration against the floor as there is a risk of noise or damaging vibration. Brine and heating medium must always be connected with flexible connections to the external pipe system.

The CCU units must be properly protected in the workplace before they are correctly connected and with a vacuum fan in operation. Welding work, naked flames or anything that may cause sparking must always be taken into consideration when the CCU units are filled with R-290 Propane

Lifting/Transportation

When lifting CCU units, use the oval lifting holes on the CCU housing or the unit's bottom plate. Do NOT lift by refrigerant pipes or liquid connection points on the reverse of the unit.

During transport CCU units are secured on transportation pallets. Protect the refrigeration circuit against impact during transportation by leaving the housing intact.

Transportation directive ADR (transportation of dangerous goods) transportation of machinery are excluded. [MSBFS 2015:1]

Do NOT lift by connection pipes

Lifting CCU units

Components

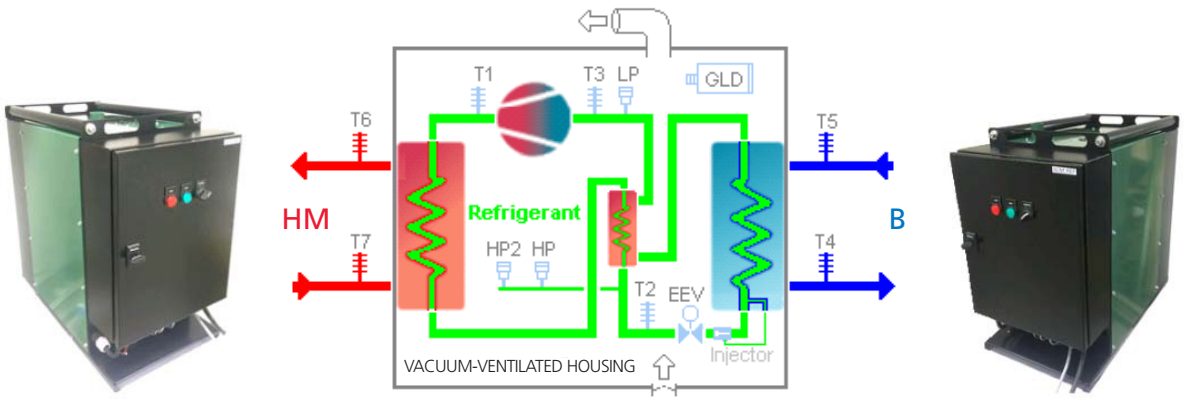
Component parts of CCU units are tested and approved for use in CCU units which are assembled and tested by the manufacturer, SCM Ref, and are used according to the manufacturer's instructions and directives.

The CCU units' operating conditions mean that both high pressure and low pressure can vary slightly during normal operation. Levels on protection switches for both high and low pressure therefore only protect the component parts of the CCU units. This means that both high and low pressure switches are not adapted to protect the external system against variations in flow or temperature.

The high pressure side of the CCU unit has two independent high pressure switches and the HP2 protection switch has a separate manual reset.

MAIN COMPONENT PARTS

- CCU #5P - Housing (powder coated)
- Heat exchanger evaporator - condenser - subcooler (cellular plastic insulated)
- Scroll compressor
- Control box (complete with start and electronic control system)
- Electronic Expansion valve EEV
- High pressure sensor HP
- Low pressure sensor LP
- High pressure sensor HP2 (manual) (protection switch)
- Temperature sensor T1 (suction gas)
- Temperature sensor T3 (hot gas)
- Temperature sensor T2 (refrigerant)
- Injector (refrigerant circuit)
- Crankcase heater
- Refrigerant alarm GLD
- Refrigerant Propane R-290
- Temperature sensor T4 (Out. B) Antifreeze
- Temperature sensor T5 (In. B)
- Temperature sensor T6 (Out. HM)
- Temperature sensor T7 (In. HM) Max in. HM temp.



B = Brine
HM= Heating medium

Function/Control

The CCU units have internal protection and control equipment fully tested and mounted in a control box on the front panel of the unit. Regulator Carel pCO with customised control program for CCU units control and monitor operation of the unit.

Function control program:
When a start impulse is given (closure between terminal 1 and 2) the compressor starts if the time in the start delay has been reached, the start delay prevents compressor start-up six minutes after stop. If the compressor has been stopped for longer than six minutes, it starts immediately when the start impulse is given. The HP2 high pressure switch cuts the compressor immediately and has a separate manual reset. Gas alarm stops the compressor and gives an impulse to the external EX fan to increase to full speed. Accessories: motor valves in the brine and heating medium lines receive impulses to open 30 seconds before compressor start.

NOTE! Antifreeze must be adjusted according to the brine temperature and freezing point of the antifreeze agent.

Parameter list

Parameters	*No.*	*Factory setting*	*Min/max values*
Overheating EEV	B009	15 °K	Min= 0 °K / Max=25 °K
EEV Forced open at start	B004	60%	Min= 20% / Max= 60%
Time for forced opening of EEV at start	B003	10 sec.	Min= 1 sec. / Max= 10 sec.
Valve relay KE3 opens before comp. start	A005	30 sec.	Min= 10 sec. / Max= 180 sec.
Start delay comp.	A003	360 sec.	Min= 180 sec. / Max= 600 sec.
Out. B (Brine) / Antifreeze (T4)	A013	4 °C	Min= -15 °C / Max= 5 °C (*)
In. Heating medium / High temp HM (T7)	A014	60 °C	Min= 40 °C / Max= 70 °C
Hot gas temp. (T1)	A012	120 °C	Min= 50 °C / Max= 130 °C
High pressure off (HP)	A009	27.0 barg	Min= 18.0 barg / Max= 27.0 barg
Restart on	A010	18.0 barg	Min= 10.0 barg / Max= 27.0 barg
Time for restart	A011	300 sec.	Min= 0 sec. / Max= 360 sec.
Low pressure off (LP)	A006	0.2 barg	Min= 0.0 barg / Max= 3.0 barg
Restart on	A007	3.0 barg	Min= 0.2 barg / Max= 3.0 barg
Time for restart	A008	60 sec.	Min= 0 sec. / Max= 360 sec.
Gas detector installed	C012	Yes	Yes= installed No= Not installed
Gas alarm level	C017	500 ppm	Min= 100 ppm / Max= 1000 ppm
(*) Adjust antifreeze according to B temp.			
<u>Separate protection switch</u>			
Motor protection/Phase sequence (QM1/FK1)	QM1	21 Amp.	Min= 17 Amp. / Max= 22 Amp.
High pressure protection (HP2) Man. Restart	IR33	28.0 bar.	Min= 13.0 barg / Max= 28.0 barg

Parameter setting

CCU units are supplied with factory set control program parameters. Factory set parameters can be changed via a [Service code] that allows entry to the program. (Obtained from SCM Ref)

Alarm can be reset and antifreeze setting can be changed without a code.

Changing antifreeze

The antifreeze temperature can be changed via Carel pCO. In the window showing B and HM temperatures (image 1), scroll using the arrow buttons so that SET is highlighted and then press ENTER.

An antifreeze window appears (image 2), press ENTER to highlight the value, the value can be changed between -15°C and +5°C using the arrow buttons, then press ENTER to confirm the new value. Check concentration and freezing point of the brine so that it corresponds with the given value for antifreeze.

image 1

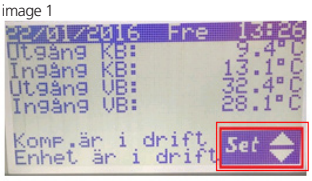
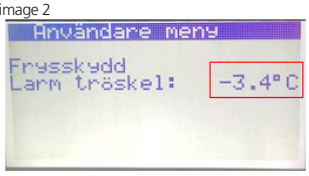


image 2



Resetting the alarm

Reset the alarm by pressing the alarm button, scroll with the arrow button to the alarm to be acknowledged and press the alarm button again. If the alarm is not reset, the fault has not been rectified or the alarm has automatic reset.

Controller pCO EEV Driver IR33 (HP2)

Alarm list

Alarm (manual reset)	
Low pressure	AL013
High pressure	AL014
Phase sequence / Phase failure / Motor protection	AL015
Hot gas	AL016
Antifreeze	AL017
High incoming HM temp	AL018
Restart Low pressure several attempts	AL019
Restart High pressure several attempts	AL020
Gas alarm	AL022
High pressure HP2	AL041
HP2 appears in IR33 as	E03
HP2 resets in both pCO and IR33	
EVD (EEV alarm) motor alarm	AL037
EVD off	AL040

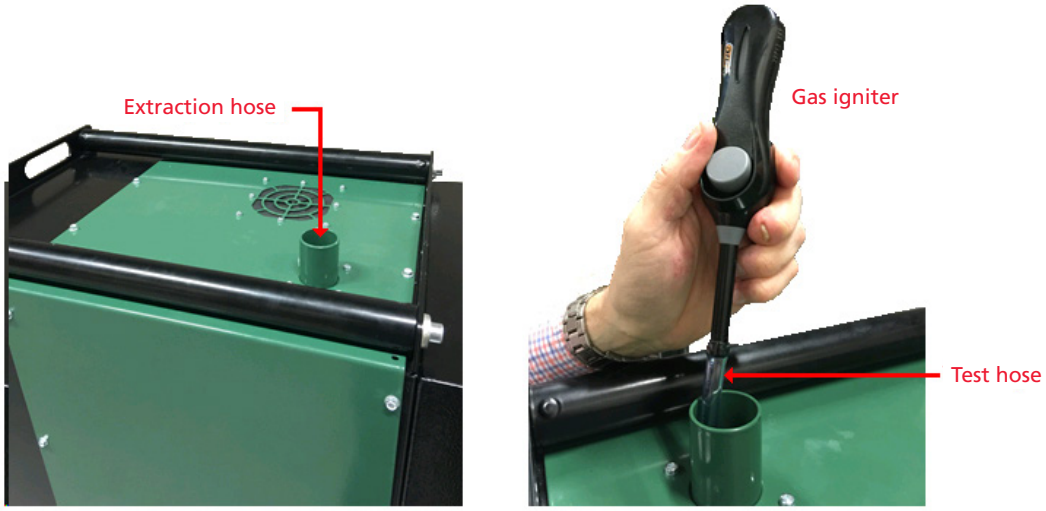
Alarm (automatic reset)	
Sensor Low pressure	S1
Sensor High pressure	S3
Sensor Suction gas temp.	S2
Sensor Hot gas temp.	S4
Sensor Outgoing B	B2
Sensor Incoming B	B3
Sensor Refrigerant	B1
Sensor Outgoing HM	B4
Sensor Incoming HM	B5
Sensor HP2 appears in IR33 as	E01+E03

HM = Heating medium temperature
B = Brine temperature

Testing the Gas alarm

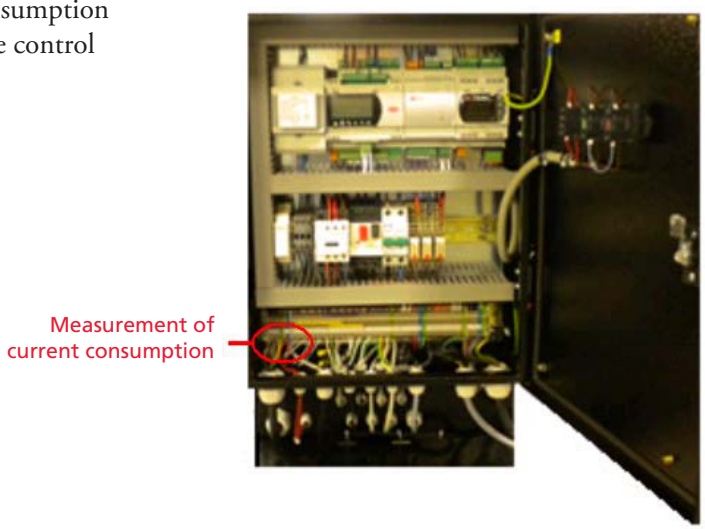
The recommended annual test of the gas alarm is made by disconnecting the extraction hose to the CCU unit and sealing during testing. Connect the test hose in the connector to a gas igniter and spray gas into the plastic hose to the Gas alarm, which is located at the bottom of the CCU unit (see image)

The gas alarm trips if the right amount of gas surrounds the gas sensor. Reset the gas alarm and restart the CCU unit. Reconnect the extraction hose to the CCU unit.

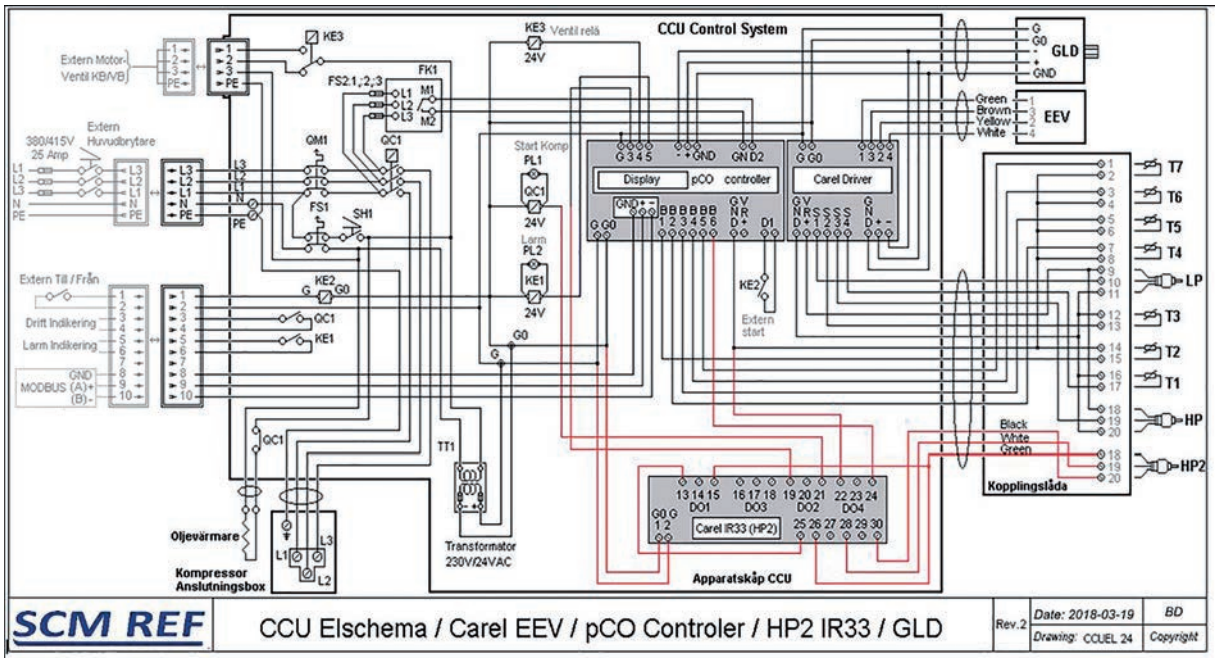


Measurement of current consumption

Recommended annual measurement of current consumption occurs via compressor connection to terminal in the control box for CCU unit



Wiring diagram



Electrical components

QM1 = Motor protection compressor
KE2 = Outer control relay (On/Off)
GLD = Gas alarm Detector (Alarm)
QC1 = Contactor compressor
KE3 = Valve relay (open/close)
EEV = Electronic Expansion valve
FS1 = Control fuse 10A
TT1 = Transformer 230 / 24V
LP = Low pressure switch
FS2 = Fuse FK1 3x10A
PL1 = Operation indication (comp. Operation)
HP = High pressure switch
SH1 = Control switch

PL2 = Alarm indication
HP2 = High pressure switch (safety switch)
FK1 = Phase sequence relay/Phase failure L1-L2-L3
pCO = Carel Controller
KE1 = Alarm relay (buzzer alarm)
CD = Carel EEV Driver
T1 = Sensor Hot gas temperature
T2 = Sensor Liquid temperature (Ref.)
T3 = Sensor Suction gas temperature
T4 = Sensor Out. B temperature (antifreeze)
T5 = Sensor In. B temperature
T6 = Sensor Out. HM temperature
T7 = Sensor In. HM temperature (max. temp

Technical data

Compressor	= Sanyo Scroll C-SCN903H8H
Displacement	= 205.4 cm3/rev. (2900 rpm)
Oil volume	= 2800 ml (mineral oil)
Voltage	= 380 - 415 Volt - 3 Phase - 50 Hz (fuses 25 AMP)
Output input	= 8.8 kW (12 Hp)
Heat exchanger	= Multichannel EC59 60 plates (evaporator, condenser, subcooler, Injector 6 mm
Flow B	= Nom. 1.5 l/s (evaporator)
Flow HM	= Nom. 1.6 l/s (condenser)
Pressure drop B	= 35-40 kPa (evaporator)
Pressure drop HM	= 55-60 kPa (condenser)
Expansion valve	= Carel E2V35BSMOI
Overheating	=15K
Subcooling	= 10 – 30K
Refrigerant	= R-290 Propane
Amount	= 1450 grams
Pressure sensor	= Carel SPK0019R1 / SPK0039R1
Temperature sensor	= Carel NTC015WF11 / NTC015HT41
Outgoing B temp	= +10° / -10°C
Incoming HM temp	= +60° / +10°C
Gas alarm GLD	= Carel DPWL P0700

Output Data

The cooling output and the supplied output vary with liquid temperatures of brine/heating medium. The CCU unit has a broad working area and works with fixed B respectively HM flows.

The units can therefore work with liquid condensation within the normal working range, which helps reduce the supplied output.

For outgoing brine <5°C, antifreeze agent must be added. The antifreeze temperature of the liquid is dimensioned 10 - 15K lower than outgoing brine temperature. If the heating medium is subjected to temperatures lower than 5°C, this must also be supplemented with antifreeze agent, outdoor use KMK is such an application.

Cooling output kW

Out. brine	**In. heating medium**					
	60°C	50°C	40°C	30°C	20°C	10°C
10°C	20,3	24,3	27,7	30,1	32,0	***
5°C	18,3	22,1	24,4	26,5	28,3	***
0°C	16,0	19,3	20,7	22,5	24,5	26,1
– 5°C	***	16,5	17,9	19,8	20,8	22,4
– 10°C	***	14,0	15,2	16,3	17,7	19,0

(xxx) = Outside working range

Supplied power kW

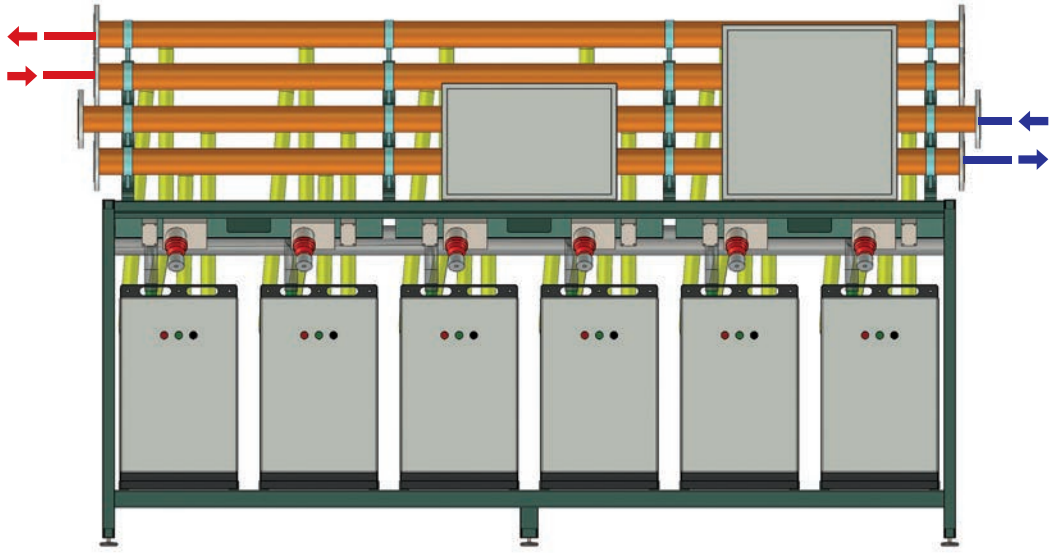
Out. brine	**In. heating medium**					
	60°C	50°C	40°C	30°C	20°C	10°C
10°C	12,16	10,34	8,68	7,24	6,07	***
5°C	12,10	10,20	8,70	7,22	5,99	***
0°C	12,06	10,15	8,56	7,15	5,97	4,92
– 5°C	***	9,87	8,38	6,96	5,88	4,86
– 10°C	***	9,60	8,07	6,76	5,68	4,80

(xxx) = Outside working range

CCU Rack stand

The CCU units can be supplied as single units or combined in a Rack stand where the CCU units are connected in parallel on the liquid side. Depending on the required output, up to six units can be connected in a Rack stand. Rack stands for two, four or six units are standard.

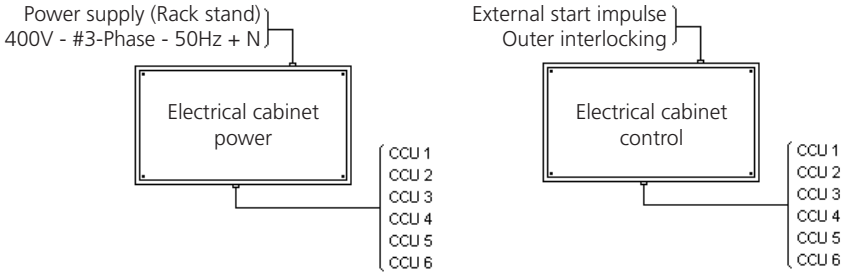
CCU Rack stands are supplied ready connected with connection pipes, connection hoses for both brine and heating medium. Internal electrical connection to electrical cabinet for power and control as well as extraction pipe for vacuum ventilation of the CCU housings.



Complete CCU Rack stand with six CCU units

Power supply

Power is supplied to electrical cabinet for power where each CCU unit is internally fused with a 25A automatic fuse. External start impulse and any outer interlocking are connected to the terminal in the electrical cabinet for control.



Parallel connected CCU unit

When several CCU units are connected together in parallel on the liquid side, the flow also circulates across the CCU units that are not operational. To prevent this, it is recommended that motor valves are mounted in the connection line to the CCU units which shut off the flow when the compressor stops.

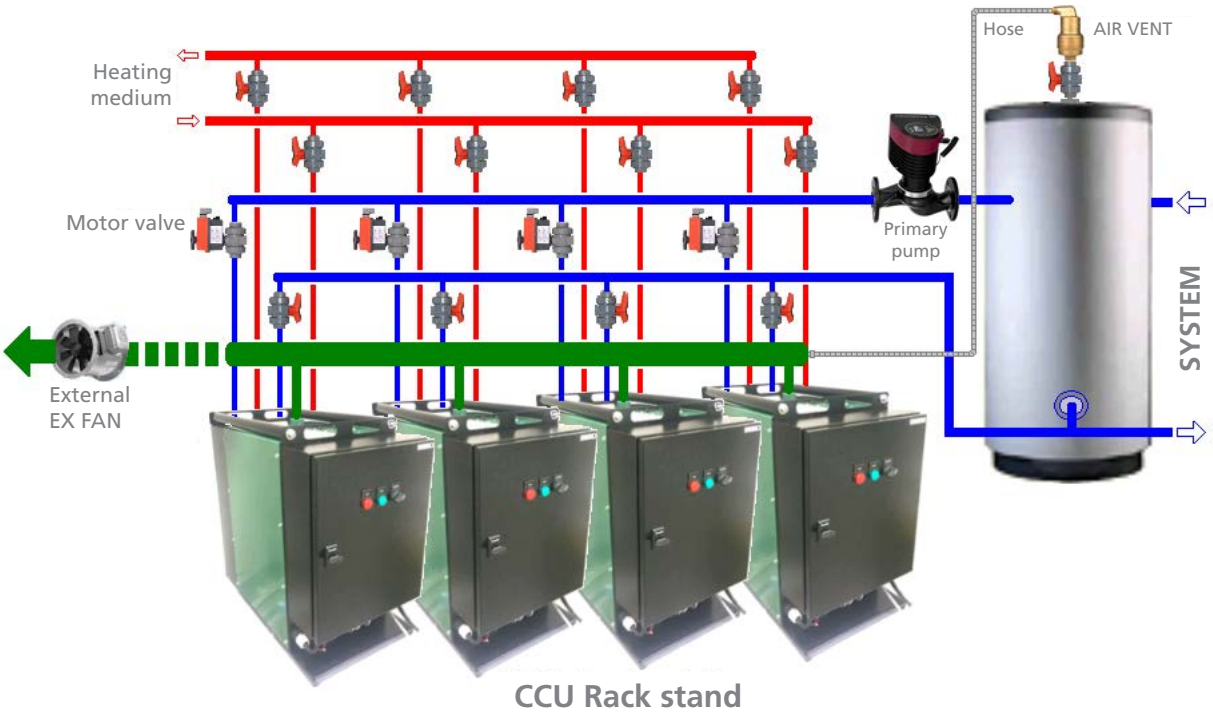
This function can be mounted for both brine and heating medium, it is initially recommended for brine. Without motor valves mounted, the mixing temperatures and disproportion of the refrigerant increase when the liquid passes across CCU units that are not operational.

CCU Rack stands can be obtained with motor valves ready installed and connected from the manufacturer, SCM Ref. Motor valves open 30 seconds before the compressor starts, controlled internally.

With motor valves mounted on the brine, the primary flow varies via internal pressure regulated pump depending on how many CCU units are operational.

The secondary system works via external pump and supplies the system with designed flow.

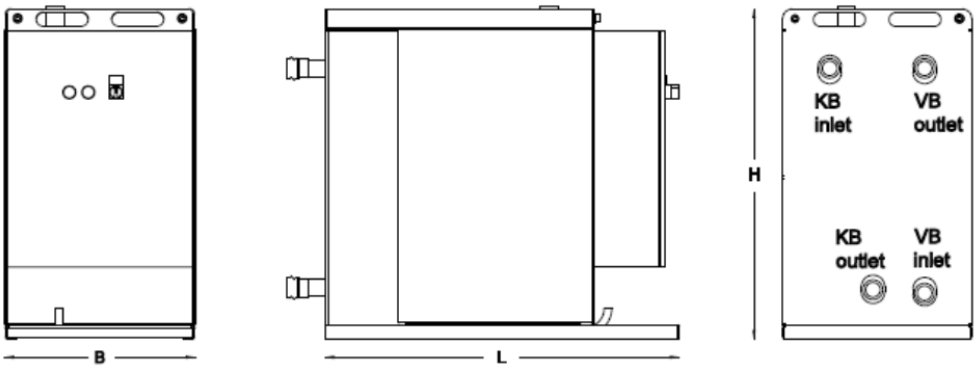
An automatic air vent sits on top of the tanks sits and is connected by flexible hose to extraction line for vacuum ventilation.



CCU unit with R-290 Propane has vacuum ventilated housing. Each CCU unit included in a Rack stand is connected to extraction line which creates a vacuum via external EX class fan. The EX fan is mounted as close to the outlet as possible to prevent overpressure in the outlet line.

Dimensions/Weight

Dimensions and weight of CCU units as well as CCU Rack stand for two, four and six CCU units

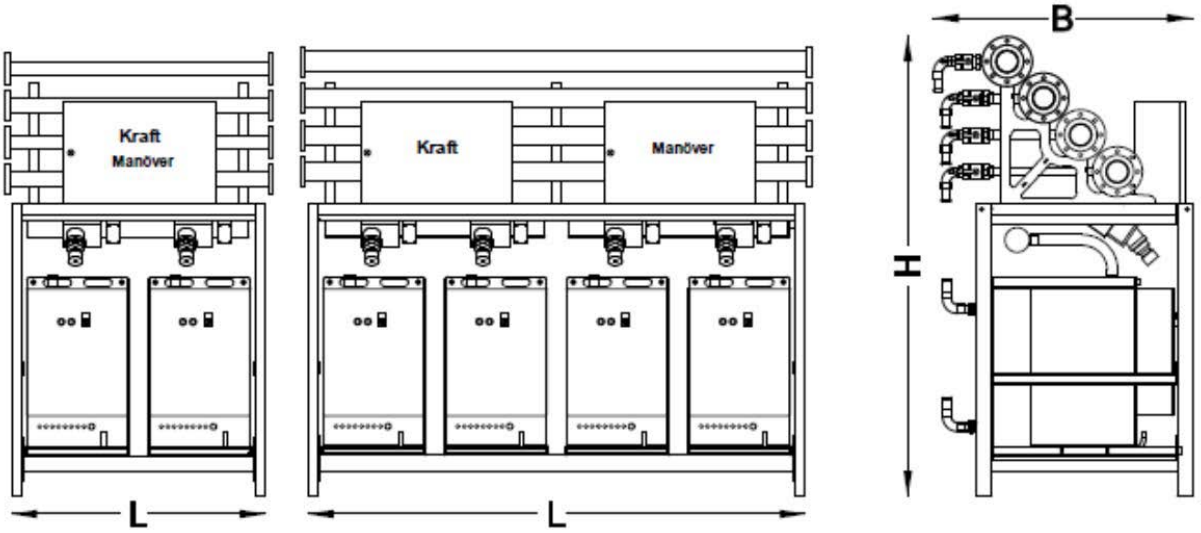


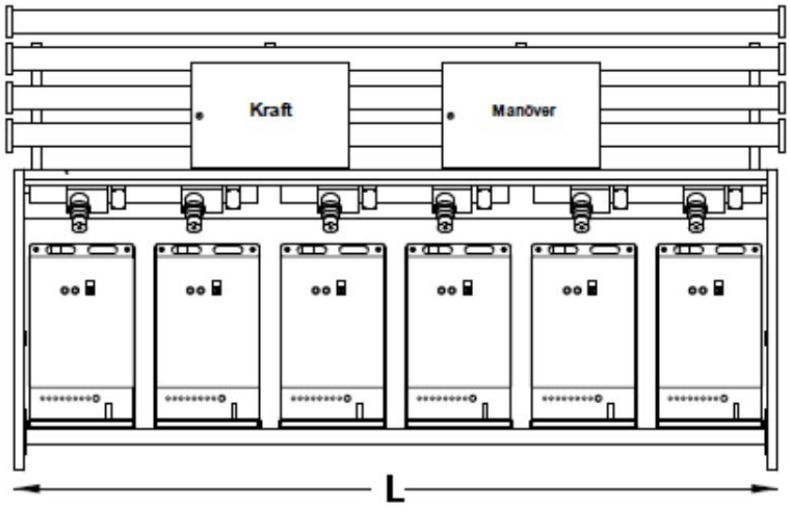
CCU 5-P

H x W x L

Height: **= 700 mm**
Width: **= 400 mm**

Weight kg: **= 155**
Length: **= 750 mm**





CCU Rack stand

H x W x L

Height: **= 1.850 mm**
Width: **= 1.025 mm**

Length:	2-CCU	4-CCU	6-CCU
mm	1.000	2.000	3.000
Weight kg:	410	820	1.230

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