Cooling Unit

Q-Cooler

Operation and Maintenance Instructions

Object: .....

IV PRODUKT

Air handling with the focus on LCC

Contents

1. Air Cooling and Heat Pump Systems

1.1 General

All air cooling and heat pump systems operate according to the same principle. The system conveys the heat content in the medium such as air, water, gas, etc. from one place where the heat isn't wanted or needed, to a place where it is possible to utilise the heat, or get rid of it.

Your system is designed and has been installed to comply with explicit requirements. Special components have been selected and combined to meet these requirements for optimum safety and at lowest possible overall costs.

The system has been designed according to specific fundamental prerequisites which must exist in order for it to operate. These prerequisites must not be changed without first determining whether the system will be able to cope and operate as expected after the change.

1.2 The Phases of a Cooling Circuit

See the relevant Flow Chart.

The refrigerant in the cooling circuit absorbs the heat in the object to be chilled. The refrigerant then passes through the evaporator where it evaporates and, as its pressure drops, is transformed from a liquid to a gaseous state.

The cold suction gas that has now absorbed heat from the chilled space/medium is sucked back to the compressor where it is compressed, causing it to increase in temperature.

The suction gas in all totally hermetic compressors is also used for cooling the compressor's electric motor. In such applications, the refrigerant contains heat from the item to be chilled, heat generated by the compressor motor and the heat of compression.

The refrigerant, in a hot gaseous state, is then thrust from the compressor to the condenser where it gives off its heat.

As the refrigerant cools, it condenses from gas to liquid. This sequence repeats itself in a completely closed system, until the temperature in the chilled/heated medium drops/rises to the temperature that has been preset.

1.3 Control Operations

1.3.1 Q-Cooler EQU

1.3.1.1 Interlocking

The compressors are interlocked across the supply air fan and the extract air fan. If the fans stop, the compressors will also stop.

1.3.1.2 Heating Operation

On an increasing control signal for heating, the compressors are switched in across stepping switch SK1. On a decreasing control signal for heating the compressors are switched out.

1.3.1.3 Cooling Operation

On an increasing control signal for cooling, the reversing valves and compressors are switched in across stepping switch SK1. On an increasing control signal for cooling, the compressors are switched in across stepping switch SK1. On a decreasing control signal for cooling the compressors are switched out.

1.3.1.4 Temperature Limiting

If the ambient temperature by the temperature limiting thermostat drops below the preset value, the compressors are switched out step-by step. If the step-by-step switch-out sequence lasts longer than 10 hours, the group alarm on the SK1 will be energized.

1.3.1.5 Compressor protection

If the protective motor switch trips or if a safety circuit alarm is initiated, the compressors are switched out and the group alarm relay is energized. The alarm indication can be viewed on the SK1.
In the event of an alarm, take remedial action to correct the malfunction and press the reset button on the SK1 (arrow pointing downward).

IMPORTANT!
Each high pressure switch has its own manual reset button.

The safety circuit alarm will trip in the event of two different malfunctions:

- Excessively high pressure in the system. HP
- Excessively low pressure in the system. LP

If the safety circuit alarm is initiated repeatedly, call an authorized refrigeration service technician.

1.3.1.6 Technical Description

The electric equipment panel of the EQU cooling unit is fitted with the following:

- Main switch
- Protective motor switch
- Contactors
- Stepping switch

The electric equipment panel is mounted inside the EQU cooling unit and its internal electric connections have been fully wired and tested at the factory.

Electrical Connections

Terminals L1, L2, L3, N, PE	Power supply: 400 V+N and earth
Terminals 211-212	Group alarm, compressors
Terminals 213-214	Interlock from potential-free SF and EF contacts
Terminals 215-216	Voltage feed 24 VAC
Terminal 217	Control signal 0-10 VDC heating signal
Terminal 218	Control signal 0-10 VDC cooling signal

Size	**Recommended fuse**	
	3 x 400 V	**3 x 230 V**
EQU-190-1	25 AT	50 AT
EQU-190-2	25 AT	50 AT
EQU-240-1	35 AT	63 AT
EQU-240-2	35 AT	63 AT
EQU-300-1	35 AT	63 AT
EQU-300-2	50 AT	63 AT
EQU-360-1	50 AT	100 AT
EQU-360-2	50 AT	100 AT
EQU-480-1	63 AT	100 AT
EQU-480-2	63 AT	100 AT
EQU-600-1	63 AT	125 AT
EQU-600-2	80 AT	125 AT
EQU-600-3	80 AT	160 AT

2. Summary of specific provisions in the Swedish Proclamation Regulating the Use of Refrigerants

2.1 One-piece unit containing less than 3 kg of refrigerant

The maintenance and care of these cooling units shall be carried out based on sound judgement and in a responsible manner. This means that the person servicing the system must not charge the refrigerant circuits with new refrigerant until, e.g. that person has taken action to seal off any possible leak in the cooling unit.

Furthermore, one must always take charge of the refrigerant that has been emptied from the cooling unit and see to that it is either recycled or transported to a facility for destruction.

When it comes to service and maintenance, no authorisation by authorities is required for the person servicing the unit. However, that person must exercise common sense and sound judgement in the care of the cooling unit.

If the need arises to modify the refrigerant circuit in any way, this work must only be carried out by a certified refrigeration technician.

No report need be submitted to responsible authorities regarding these cooling units.

One-piece cooling units that contain 3 kg or less refrigerant shall be regarded as units that do not contain any refrigerant whatsoever. This makes it possible to add or have any number of one-piece cooling units according to the above in an installation without having to account for increases in the total weight of the refrigerant contained in all the refrigeration circuits.

2.2 One-piece unit containing more than 3 kg of refrigerant

In addition to the rules stated above, these cooling units and components shall be inspected at least once a year, according to the provisions of Swedish Standards that apply to refrigeration systems. The responsibility for such inspection rests on the owner of the ventilation system. In this case, a permit/authorization is required for all fixed installations.

2.3 One-piece units that together contain more than 10 kg of refrigerant

In addition to the rules stated above, these cooling units require that their performance and maintenance history be recorded in a journal. The owner will be held responsible for maintaining said journal. The journal shall be submitted to an inspectorate once a year for evaluation. If the cooling unit is charged with more than 10 kg of refrigerant per circuit, special requirements pertain to the equipment in such systems.

3. Operating Instructions for the System

3.1 Commissioning Regulations

The cooling unit requires special commissioning by a person certified to carry out work on refrigeration systems. The fitter shall attend to the following before the equipment is commissioned:

3.1.1 DX Refrigeration Machines:

1. Power supply cable to the main switch and control signal wiring for cooling operation and heating operation.
2. Connection of condensate piping across a water trap to the sewer.
3. Adjustment of design supply air and extract air flows.
4. Cold water supply and drainage from the condenser if the system includes Climate Adaptation.
5. Connection of a discharge pipe. See the Technical Specification.

3.1.2 Rotary Heat Exchangers:

1. Power supply cable and control signal wiring to the control unit.

The wiring of all electrical connections shall be completed prior to commissioning.

The supply air and extract air flows shall be adjusted and recorded in the relevant journal.

Commissioning must only be carried out by skilled personnel and according to the accompanying Check List with pertinent Commissioning Record.

After the person, who has commissioned the cooling unit, has signed the Commissioning Record, a copy of the signed Commissioning report shall be signed by the seller and then be sent to IV Produkt.

The validity of the product warrantee presupposes that the cooling system has been correctly commissioned.

No modifications in the refrigeration machine shall be allowed during the warrantee period without approval by IV Produkt.

To avoid unnecessary service calls, follow the fault-tracing instructions in the fault-tracing schedules before placing an order for guarantee service.

3.2 Check List

1. Check how the power supply leads are wired to the unit. Make sure that the phases are connected to the correct terminal and that the earth cable is connected. The zero wire must be connected for the auxiliary relay. ☐
2. Make sure that the incoming cables from the external control cubicle are wired to the correct terminal and in the correct manner according to the wiring diagram, for example: – shielded cable – correct wiring in the motors – the terminal screws have been tightened ☐
3. Switch off **ALL** the protective motor switches. ☐
4. Switch on the power supply across the fuses. ☐
5. Feel the compressors to determine whether the crankcase heater is working. ☐
6. Check that the protective motor switches have been preset according to the settings specified in the commissioning record. ☐
7. It is important that the oil in the compressor crankcase is warm before the compressor starts up. The crankcase heating shall be switched in during a sufficient period before it is commissioned to allow the oil to maintain a temperature of at least 30°C for approx. 2–3 hours. The temperature can be measured externally on the underside of the compressor. ☐
8. Start (TFA). ☐
9. Check whether there is supply air and extract air flow and that they are have been adjusted and recorded. ☐
10. Operate all the control functions according to their descriptions in the wiring diagram **WITHOUT STARTING THE COMPRESSORS**. ☐
11. Connect the manometer mount on the service tapping. Vent the hoses. **OBS: Type of refrigerant** ☐
12. Test the compressors each separately and review the commissioning record. Allow the compressors to run for a while before taking readings; about 10 minutes. Test the safety functions. ☐
13. After testing the compressors, each separately, test them all at the same time. Review the commissioning record. ☐
14. Let the cooling unit operate until it stops in response to the control function selected. ☐
15. One copy of the commissioning record shall be sent to: IV Produkt. ☐

4. Maintenance Instructions and Procedures

4.1 General

This section of the instructions is comprehensive. It is formulated to enable you to carry out a simple periodic inspection of the cooling system and to inform you of simple checks you can make in the event of a breakdown before you call for qualified service help. If more advanced work on the cooling system is required, the enclosed wiring diagrams and special instructions for the components of the system will provide all the necessary information you need.

4.2 Regulatory Requirements in the Swedish Proclamation Regulating the Use of Refrigerants

A one-piece cooling unit containing more than 3 kg of refrigerant must be inspected by an accredited company as stipulated in the Swedish Standard for Refrigerating Systems. All service and modifications in the cooling system as well as the charging and emptying of refrigerant circuits shall be recorded in a journal.

If the total weight of the refrigerant is more than 10 kg (Important! This weight refers to all the cooling units in the building), a report and annual detailed account must be submitted to the local Environment and Health Authorities.

4.3 Requirements according to Directive 97/23/EC (PED)

Type Designation	EQU	
PS (design pressure)	(-1) – 23.3	bar (e)
PT (max. test pressure)	33.3	bar (e)
TS (max. temperature)	(-50) – (+55)	°C
Fuse - low pressure side	0.3	bar (e)
Fuse - high pressure side	23.3	bar (e)
Opening pressure - safety valve	27.6	bar (e)
Fluid group	II	
Type of refrigerant	R 407C	
Code (O=Other)	O	
CE with identification 0409 Body notified: Det Norske Veritas Inspection AB		

This cooling unit has been produced according to Directive 97/23/EC (PED).

The pressure bearing components of the system must not be tampered with or modified since they contain medium under pressure above atmospheric. Only a person with certified skills shall be allowed to carry out such work.

Do not touch the piping. While the cooling unit is operating, certain components can reach temperatures higher than +50 °C.

Extremely important!
All the transport safety devices must be removed before the cooling unit is commissioned. The compressors are fixed in their positions by locking devices during transport to prevent them from applying a load on the pipework.

4.4 Periodic Inspection

1. Appoint one or several competent persons to assume responsibility for the continuous inspection of the refrigeration system. Make sure that these persons are familiar with how the system operates and where the components of the system are located.

2. The cooling system is designed to operate automatically. The settings made at the time that the cooling system is commissioned are recorded in the Commissioning Record of the system. Make sure that the settings made for the thermostats, control units, pressure switches and other adjustable components are not altered by anyone who lacks sufficient knowledge of how the system operates.

3. See to it that the machine room or other location where system components are installed is kept clean.

4. Certain components in the cooling system can require open air paths in order to operate properly. Make sure that such air paths do not become temporarily or permanently blocked. If any one or several of these components are fitted with an air filter or other type of filter, check these filters every three months. Replace filters if necessary.

5. Under normal conditions, no lubrication, oil change or the like are necessary. If any special rules apply to any given component of the system, they will be specified in the instructions governing that particular component.

6. The cooling system and its components shall be inspected by a skilled service technician at least once a year. The following shall be inspected:

   – that the component refrigeration system is tight.
   – that there is no serious corrosion damage.
   – that the safety equipment is in good shape.

7. **Journalising.** Entries shall be made for every cooling system recording charging and emptying of refrigerant, the results of inspections to detect leakage and other measures implemented to inspect and maintain the refrigerant circuits and their operation.

8. If you are unsure about anything in or near your cooling system? Get in touch with your supplier! In some cases it can be better and cheaper to phone too often than too seldom.

5. Fault Tracing and Leakage Detection

5.1 Fault Tracing Schedule

SYMPTOM	POSSIBLE CAUSE	REMEDIAL MEASURE
Excessive temperature in the chilled item of equipment/medium	Power supply failure.	Check the control/safety switch and the fuses
	No flow or poor flow across the evaporator.	Check whether anything is obstructing the flow
	The thermostat/control equipment is not correctly set/faulty.	Adjust the setting or replace the equipment
	The compressor is not operating.	See ”Compressor”
The compressor is not operating	Power supply failure.	Check the control/safety switch and the fuses
	The compressor safety circuit is switched out.	Check and reset if needed
	Faulty compressor.	Determine the fault. Replace the compressor
The low pressure switch switches out the compressor	Insufficient refrigerant	A leak has occurred. Seal the leak and charge with refrigerant
	No flow or poor flow across the evaporator	Check the flow.
	Expansion valve is faulty	Check and replace the valve
	Faulty low pressure switch	Check and replace the switch
The high pressure switch switches out the compressor	No flow or poor flow across the evaporator.	Check the flow across condenser
	The high pressure switch is faulty	Check and replace the switch.
Substantial frost accumulates on the evaporator	The expansion valve is incorrectly set/ faulty	Check and replace the valve
	Insufficient refrigerant	Check the sight glass. Leakage in the system. Seal the leak. Charge with new refrigerant.

5.2 Leakage Detection

The system shall be inspected to detect leakage at least once per calendar year as a preventive measure. The inspection for leakage shall be documented and recorded in a journal.

A leak can arise in the refrigeration system. This can be readily seen mainly by impaired cooling performance or, if the leakage is instantaneous, that the system will not operate at all.

If you suspect refrigerant leakage, check the refrigerant level in the unit's sight glass which is located in the liquid piping on the refrigeration machine.

If bubbles continuously appear in the sight glass, while the performance of the system is appreciably worse, it is most likely that the system has sprung a leak. One or a few bubbles appearing when the machine starts up, operates at reduced capacity or operates normally does not necessarily mean that the system is lacking in refrigerant.

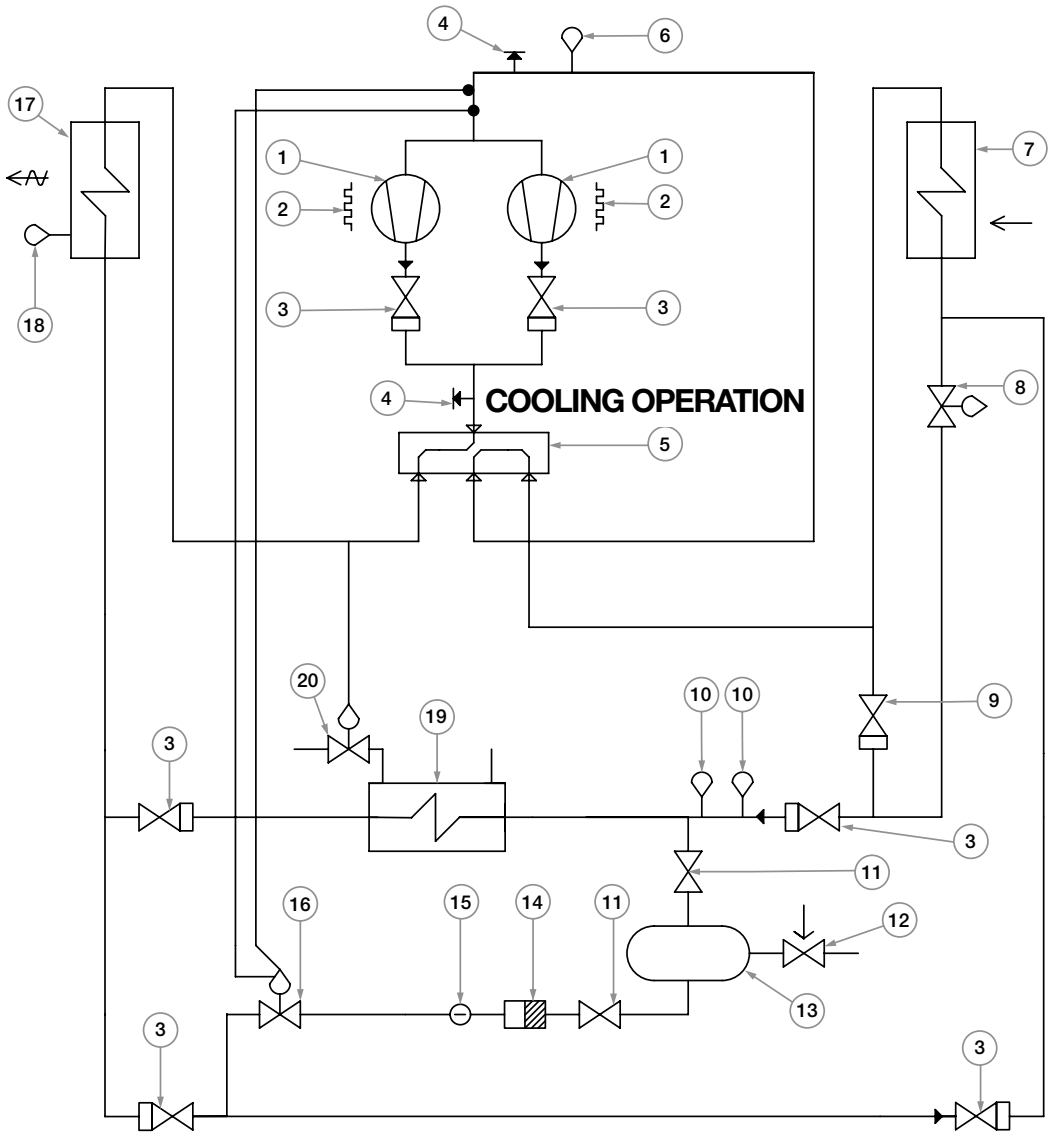
IF BUBBLES APPEAR IN THE SIGHT GLASS AND THE PERFORMANCE OF THE SYSTEM IS APPRECIABLY WORSE – CALL FOR AUTHORIZED SERVICE ASSISTANCE.

Keep in mind that the refrigerant must not be released in the atmosphere and that escaping refrigerant can cause burns if it comes in contact with skin. Always wear personal safety equipment whenever you work with refrigerant circuits.

ONLY ACCREDITED INSPECTORATES – COMPANIES WITH REQUIRED AUTHORIZATION SHALL BE ALLOWED TO WORK WITH OR MODIFY THE REFRIGERANT SYSTEM

6. Flow Charts for the Refrigerant Systems

6.1 Flow Chart for the EQU Refrigerant System



1. Compressor
2. Oil heater
3. Non-return valve
4. Measurement tapping
5. Four-way valve
6. Low pressure switch
7. Supply air coil
8. Condenser pressure valve
9. Differential pressure valve
10. High pressure switch
11. Shut-off valve
12. Safety valve
13. Refrigerant receptacle
14. Drying filter
15. Sight glass
16. Thermostatic expansion valve with ext. pressure balancing
17. Extract air coil
18. Limiting thermostat
19. Climate adaptation condenser
20. Water saving valve

7. Technical Specification

7.1 Technical Specification, EQU

7.1.1 Specification

Cooling Unit EQU-a -b -c -d -e -f -g

a -Size:	190, 240, 300, 360, 480, 600
b -Casing:	00 = Thermal insulation E3 = EI30
c -Capacity variant:	1, 2, 3
d -Climate adaptation:	0 = without 1 = with
e -Voltage:	23 = 230 V 40 = 400 V
f -Rotor:	No = normal Hy = hygroscopic
g -Supply air:	U = upper airflow path N = lower airflow path
h -Insp. side:	H = right-hand V = left-hand

7.1.2 Discharge Piping

The discharge pipe extending from the top of the unit shall be connected according to Swedish Refrigeration Standard. Section 13:10 Discharge Piping.

Exception: If the room is continuously ventilated (24 hours/day) and has an open room volume as tabulated below, no particular discharge piping will be required.

7.1.3 Open Room Volume and Discharge Connection

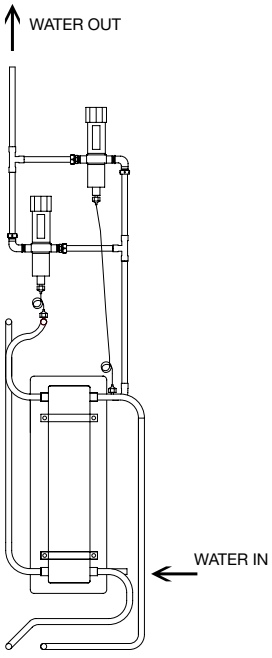
Size		**190**		**240**		**300**		**360**		**480**		**600**		
Capacity variant		1	2	1	2	1	2	1	2	1	2	1	2	3
Open room vol.	(m^3)	32	32	41	35	45	41	69	69	93	84	93	93	91
Connection, O.D.	(mm)	42	42	42	42	42	42	42	42	42	42	42	42	42

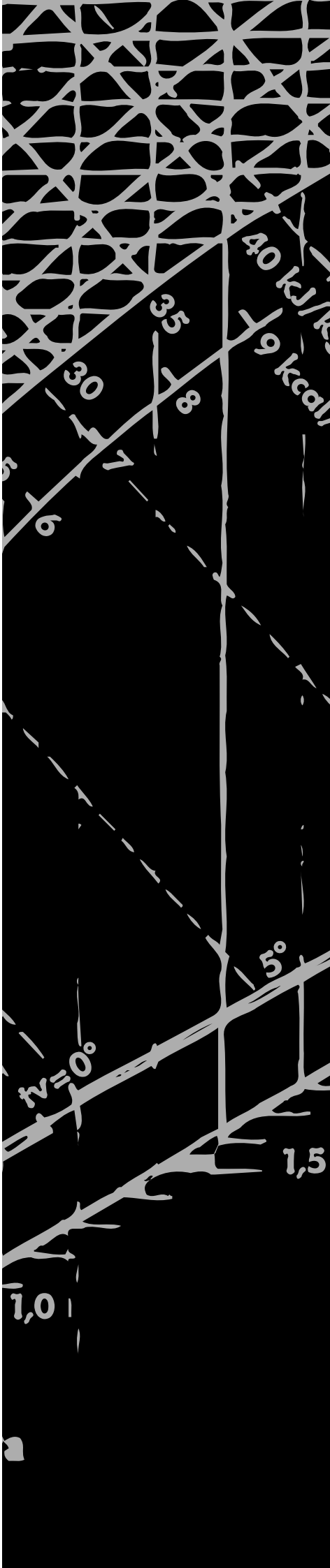
7.1.4 Capacity Survey

Size		190		240		300		360		480		600		
Capacity Variant		1	2	1	2	1	2	1	2	1	2	1	2	3
Air volumes: Nom. SA/EA	(m^3/s)	1.25	1.41	1.56	1.79	2.00	2.27	2.49	2.81	3.13	3.52	4.09	4.86	5.49
Air volumes: Min. SA/EA	(m^3/s)	1.10	1.24	1.37	1.58	1.76	1.96	2.19	2.47	2.75	3.10	3.60	4.12	5.11
Air volumes: Max. SA/EA	(m^3/s)	1.86	1.90	2.08	2.40	2.66	3.00	3.31	3.60	4.17	4.8	5.45	6.00	6.00
Nom. cooling capacity at:														
^{t} outdoor air: 26 °C. RH 50 %														
^{t} extract air: 22 °C														
Nom. cooling capacity	(kW)	26.0	29.4	32.6	37.5	41.8	46.6	52.0	58.7	65.4	73.7	85.6	98.0	114.9
Nom. cooling load. compr.	(kW)	8.2	9.3	10.3	11.9	13.2	14.7	16.4	18.2	20.6	23.5	27.0	30.4	33.1
Nom. coeff. of performance	(C.O.P)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.1	3.2	3.2	3.5
Nom. heating conditions														
^{t} outdoors: 0 °C														
^{t} extract air: 20 °C, RH 50 %														
Nom. heating capacity	(kW)	30.4	34.3	38.1	43.8	48.7	54.4	60.7	68.6	76.3	86.0	99.9	114.4	134.1
Nom. power required. compr.	(kW)	5.2	5.9	7.1	7.7	8.1	9.3	10.0	11.5	12.9	14.1	16.8	19.3	22.2
Nom. coeff. of performance	(C.O.P)	5.8	5.8	5.4	5.7	6.0	5.8	6.1	6.0	5.9	6.1	5.9	5.9	6.0
No. of compressors	(st)	2	2	2	3	3	3	4	4	4	4	4	4	4
No. of control steps	(st)	3	3	3	5	5	5	8	8	8	8	8	8	8
Max conn. power compr.	(kW)	8.7	9.8	10.9	12.6	14.0	15.5	17.4	19.3	21.9	24.9	28.6	32.3	35.1
Max drive current 3×400 V; 50 Hz	(A)	16.5	18.6	20.1	24.0	25.9	29.1	32.6	37	39.4	44.0	48.0	54.8	67.2
Rec. fuse 3×400 V; 50 Hz	(A)	25	25	35	35	35	50	50	50	63	63	63	80	80
Max drive current 3×230 V; 50 Hz	(A)	34.6	39.8	44.0	55.1	51.9	55.5	74.4	82.4	74.4	81.6	90.2	95.2	116.2
Rec. fuse 3×230 V; 50 Hz	(A)	50	50	63	63	63	63	100	100	100	100	125	125	160
Refrigerant: R407C, Circuit 1	(kg)	6.0	6.0	7.0	7.0	9.9	9.9	8.1	8.1	9.5	9.5	9.6	9.6	9.6
Refrigerant: R407C, Circuit 2	(kg)	9.9	9.9	12.0	12.0	14.0	14.0	21.4	21.4	26.0	26.0	29.9	29.9	29.9
Electric heater: EQUT-02-a	(kW)	3.0	3.0	3.0	3.0	3.0	3.0	5.0	5.0	5.0	5.0	10.0	10.0	10.0

7.1.5 Climate Adaptation

Cooling units equipped with Climate adaptation shall be connected to a mains cold water supply and be fitted with a run-off pipe extending to a floor gulley. Connected run-off pipe dia. = 15 mm.





Air handling with the focus on LCC

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