Refrigeration Division

Grasso

Ammonia - Liquid Chillers
Type FX GC
Refrigerating Capacity 125 ... 2200 kW

Productinformation

Grasso

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GEA Grasso

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DESCRIPTION OF MAIN COMPONENTS

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General description

Description of main components

FX GC - APPLICATIONS AND ADVANTAGES

The FX GC type series of liquid chillers have been designed as an alternative to R22 liquid chillers and can perform in many applications conventionally reserved for coolers using R22 refrigerant. These include

- the supply of cold water to AC systems,
- process cooling,
- heat pumps,
- refrigeration over a range of normal temperatures using coolant temperatures down to -10°C.

Ammonia (R717) has the following advantages over R134a refrigerant:

- It is a natural substance (in the nitrogen cycle).
- It has a low TEWI (Total Equivalent Warming Impact - the refrigerant's direct greenhouse effect and the indirect effect from plant energy consumption) which makes it ecologically desirable.
- Its GWP (Global Warming Potential) is zero.
- Its ODP (Ozone Depletion Potential) is zero.
- It has a low odor threshold which serves as an effective warning in the event of leaks.
- It has served as a refrigerant for decades and caused no long-term damage.
- It gives better refrigerating capacity for the same investment expenditure.
- It has a better coefficient of performance.

The installation must comply with the following directives for ammonia refrigeration systems in Germany, e.g., UVV BGV D4 (former VBG 20), DIN 8975 and EN 378, respectively.

The FKA range gives safe and dependable operation with the following features:

- Fully welded plate evaporators which require no seals.
- Fully welded plate condensers which require no seals (GCW)
- Cylindrical heat exchangers which are easy to insulate.
- Simple refrigerant circuit with few joints.
- All refrigerant-carrying lines are safely mounted.
- Automatic oil return system for globally available mineral oil.
  This makes an oil separator expendable.
- By-pass line from the pressure line to the suction line with by-pass line for the compressor.
- Low refrigerant volume charge per kW of chill output due to intelligent design of the flooded system.
- Stored-program control and monitoring.
- High COP at full load and part load conditions due to very low overheating
- Improved part-load output index

TECHNICAL DESCRIPTION FX GC

FX GC are factory-assembled and tested compact units for indoor installation in machine houses or similar buildings, or with similar casing for outdoor installation.
The units are automatic single-step chillers with reciprocating piston compressors and flooded plate evaporators for cooling the refrigerating media water or brine.
The complete FX GC range comprises 3 series, which can be supplied or complemented with different condensers:

GCW liquid chiller with water-cooled condenser and closed refrigerant circuit
GCA evaporator unit for connection to one air-cooled condenser each (not part of the scope)
GCE evaporator unit for connection to one evaporation condenser each (not part of the scope)

Equipped with the Grasso reciprocating piston series, the FX GC range covers the refrigeration range of 125 to 2200 kW for cold water.
Capacity is automatically adjusted by internal control facilities which shut down compressors/cylinders in steps to suit refrigerating loads.
The manufacture of these chillers which can be transported as compact units conforms to applicable German regulations (DIN, UVV, VDE) or relevant rules and standards in the country of destination. All units bear the CE mark.

LIQUID CHILLER DESIGNATION FX GC

Example: **FX GC W 250 -2 K 30/30**

Flooded evaporation series

Evaporator type
Grasso chiller with shell & plate

Condenser type
W with water-cooled condenser
A for air-cooled condenser (not part of scope)
E for evaporation condenser (not part of scope)

Rated output of liquid chiller in kW related to cold water service 12°C / 6°C

No. of compressors
without standard design with 1 compressor
-2 standard design with 2 compressors

Design of liquid chiller
N normal chill range
K climate range
S special design
HP high performance (optional)

Rated output of drive motors

COMPRESSOR/DRIVE

The FX GC chillers use open, single-action, multi-cylinder reciprocating piston compressors for the refrigerant ammonia (R717) in the rated volume flow range of 87 to 1194 m^3/h each compressor. The most sophisticated versions have the following features:

- unloaded start
- capacity control by cylinder shutdown
- differential oil pressure monitoring
- oil heating
- end pressure monitoring
- suction pressure monitoring
- motor current limitation
- electric motor thermal monitoring

The serially fitted safety equipment of the pressure generators complies with the requirements of DIN 8975 and EN 378, resp. as well as UVV BGV D4 and comprises by-pass valves in combination with TÜV-certified DBK type safety pressure limiters. To prevent overheating, the compressed gas temperature is monitored for each compressor. 4-pole standard electric motors IP23 (optionally IP55) with 400V; 50Hz operating voltage/frequency drive the compressors via a coupling. Other operating voltages can be delivered on request.

CONDENSER

Type GCW
This incorporates circular plates for heat transfer made of WS 1.4401 special steel (designs with other materials available on request) and welded into a hermetic cylindrical casing made of St 35.8. The refrigerant condenses in the shell. Design, manufacture and acceptance comply with the requirements of the pressure appliances directive.

Type GCA
Client-provided air-cooled condenser (not part of the scope)

Type GCE
Client-provided evaporation condenser (not part of the scope)

EVAPORATOR + SEPARATOR

Circular heat exchange plates of stainless steel WS 1.4401 (other materials available on request) are hermetically welded in low-pressure vessels of St 35.8. The refrigerant condenses in the shell. Liquid drops are effectively separated in the separation space.
Design, manufacture and acceptance comply with the requirements of the pressure appliances directive.

INJECTION CONTROL

Expansion of the liquid refrigerant from condensation pressure to evaporation pressure and the optimal utilization of the evaporator capacity are ensured by the ECD (electronic condenser control) system in units of the GCW series. The action of the ECD system is based on the variables suction pressure, end pressure, output rating and the speed of the compressors.

The opening time of the AKVA injection valve is calculated by the PLC on the basis of continuous measurements; the cycle time of the pulse/pause control is 3 seconds.
Level measurements in the ECD tank add stability to the system.
In case of FX GCW, the level is measured at the high pressure side, whereas FX GCA/GCE has the level measurement on the low pressure side. A solenoid valve and a fluid filter are mounted upstream the injection valve.

OIL RETURN SYSTEM

The oil entrained by the compressor in the refrigerant circuit is returned to the compressor by a Grasso-developed automatic and maintenance-free oil return system at the low pressure side of FX GC.
In FX GCA / GCE it is important that one condenser is assigned to each evaporator unit, otherwise additional oil collection and distribution equipment is required.
Besides, the pressure and liquid lines to be provided by the client must be dimensioned and installed correctly without any "oil traps".

VALVES AND FITTINGS

To facilitate service and maintenance work, manual shutoff valves are mounted in the pressure gas line between compressor and condenser, in the injection line between injection valve and evaporator, in GCA and GCE evaporator units in the liquid line between condenser and liquid filter and in the suction line between evaporator and compressor.
A suction filter in the compressor motor keeps out dirt. The filter cartridge can be cleaned.

SWITCHING CABINET

This is a standard feature in the FX GC series and consists of a control and power section.
(enclosure IP 54)
For transporting the chiller, the switching cabinet is mounted on square beams. These must be removed on site and the switching cabinet placed on a level surface.

Standard version control section

- stored-program control (SPC)
- digital outputs (potential-free contacts) for
  internal
  · compressor motor and solenoid valve capacity control
  external
  · coolant/heat carrier pump control
  · group alarms
  · ready status
- digital inputs (potential-free contacts) for
  internal
  · safety device evaluation
  external
  · coolant/heat carrier pump acknowledgement
  · remote control
  · flow control, can be looped in
- analog inputs for
  internal
  · temperature and pressure recording
- operating panel with
  · function keys for manual/automatic operation, etc.
  · keys for calling fault reports/messages, altering control parameters, updating dates/times, programming time-switch clocks, acknowledging faults when repaired, input/output status indication
  · four-line display for 20 characters/line
- display for ON/OFF, alarm, menu selection

SPC functions:

- control of coolant outlet (or inlet) temperature in automatic mode
- restart following power failure (but not faults)
- monitoring of
  · compressor motor switching frequency
  · compressed gas/motor winding temperature
  · overpressure, low pressure, differential oil pressure
  · coolant outlet temperature
- indication of operating conditions such as
  · high/suction/oil pressure
  · running time (hours)

- · coolant outlet (or inlet) temperature
- · operating mode
- · group alarms for entire unit, individual faults callable via keyboard
- · unit capacity utilization
- · deficient starting conditions

- Control and monitoring of electronic injection valves

Standard version power section

Major components:
- main switch, emergency stop switch
- fuses, full motor protection, overcurrent relay
- contactor combination for star-delta starting of compressor drive motor

Optional version control section (on request)

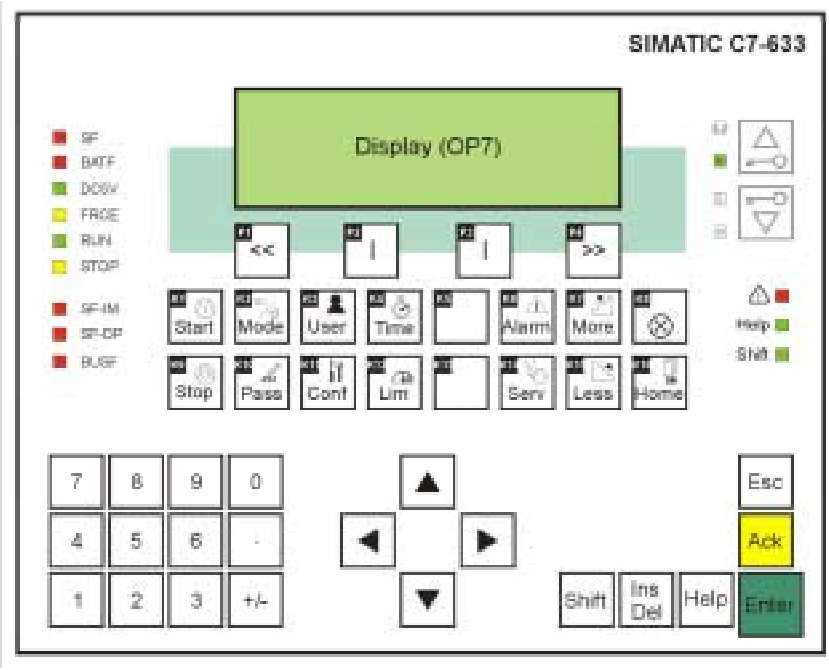
- remote adjustment of setpoint
  - · switchover to 2nd operating point (digital input, potentialfree)
  - · sliding adjustment of setpoint (analog input, 4 - 20mA or 0-10V)
- load limitation and load shedding by motor current monitoring
- recording of heat carrier temperatures
- recording of other operating conditions (on request)
- serial interface
  - · for linking control systems of equal type
  - · for linking with external systems, Profibus
- Siemens C7 control unit;
  - · with OP7: LC display, 4 lines with 20 characters (5 mm high) and 16 function keys;

Optional version power section

- power switch acts as main switch
- external emergency stop, can be looped in
- direct starting
- modem for remote diagnosis;

SPS SIEMENS C7-633/P

Front View of the C7-633



Definition of the C7 Standard Functions

Standard Functions of the Buttons

Button	Description	Function
F1…F4	Function Button	Function is dependent on the text shown on the display
K1…K16	K Button	See functional description of the chiller operation
Esc	Escape Button	Cancel new / Show previous screen
Ack	Acknowledge Button	Acknowledge alarm on OP
Enter	Enter Button	Accept new input
Help	Help Button	Show help text
Shift	Shift Button	Lock the Shift function
<, ∨, ∧, >		Used for the selection of items and screens

Siemens Functions for the F1…F4 Buttons

<<	Return to previous menu screen
>>	Next menu screen
|	Go to the next menu level

Standard functions of the Shift Button

Shift + ∧ or ∨	Change the selection
Shift + "+/–"	Adjust the display contrast

Special functions of the Shift Button

Shift + K16	Return to the Startup screen (see Introduction)

Special PLC buttons (on the right side of the display)

key up button	Selection of PLC run modus, S (stop), R (run), R-P (run-program mode)
key down button	Selection of PLC run modus, R (run), S (stop), M (memory reset)

Normally, the PLC buttons are locked and the LEDs are off. In this way it is not possible to change the PLC mode accedentilly. Please contact Grasso when the PLC mode has to be changed or a memory reset must be carried out.

DESCRIPTION OF THE GRASSO SYSTEM CONTROL (GSC) FOR RECIPROCATING-PISTON COMPRESSORS

Essential features of GSC		
Safety monitoring	Minimum suction pressure	
	Maximum suction pressure	
	Maximum compressor end pressure	
	Minimum oil differential pressure	
	Maximum oil differential pressure	
	Maximum compressor end temperature	
	Minimum oil temperature	
	Maximum oil temperature	
	Maximum motor current	
	Overpressure protection switch	
	Motor overload protection	
	Maximum cylinder head temperature	optional
	Maximum liquid separator level	with GCA / GCE
Start-up control	Floating output: compressor in reserve	
	Floating input: external starting	
	Motor running feedback signal from star-delta switch	
Output control	Control mode selection - Off (control completely disabled) - Manual mode - Automatic mode - Remote mode	
	Selection of detecting element - Suction pressure - External pressure - External temperature - Refrigerant inlet temp. - Refrigerant outlet tem	optional optional optional
	Start/Stop and output increase/reduction by setpoint value	
	Use of remote control variables (4..20 mA input signal)	
	Frequency control	optional

Essential features of GSC		
Output limitation	Output reduction when motor current is high	
	Output reduction when compressor end pressure is high	
	Output increase when compressor end temperature is high Compressor switched off when measuring value below setpoint value	
Display of important values	Compressor state	
	Setpoint value, measuring value, output, pressures, temperatures, motor current	
	Value for timers in operation	
	Parameter setting for sequencing control	
	Alarm messages (up to 256 stored messages)	
	Freeze values for the last 5 alarm messages Saving of compressor operating values before alarm shutdown	
	Date, time	
Signaling	Floating contacts - external starting (input signal) - output increase (input signal) - output reduction (input signal) - alarm is set (output signal) - compressor at reserve (output signal) - compressor running (output signal) - auxiliary output signal: reserve/operation/ minimum output/ maximum output/100% obtained/setpoint reached	
	MPI protocol - Master-slave configurations (not yet available)	optional
	Profibus DP	optional

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PRINCIPAL DATA

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Principal data

P & I diagram

Leading dimensions

Capacity selection

Deviating / other operating points can require changes of the technical specifications.

TECHNICAL DATA
FX GCW 125 - FX GCW 1100, SINGLE
APPLICATION: AIR CONDITIONING

Size FX GCW... single		125	200	260	400	525	750	1100
Refrigerating capacity [1] Q_0	KW	116	175	258	387	516	723	1085
Electrical power consumption [1] compressor P_{eff}	kW	21.3	31.9	46.8	69.5	91.7	131.7	195.9
Transport weight m_L	kg	2040	2540	3180	4300	5050	5690	7080
Operating weight m_B	kg	2090	2600	3270	4420	5200	5880	7360
refrigerant charge NH_3	kg	13	18	27	30	42	48	72
Oil charge $V_{ÖL}$	l	10.2	11	11	13	18	15.6	16.7
Coolant volume	l	9.9	14.7	24.3	32.7	43.3	60.6	90.3
Heat carrier charge	l	11.3	18	26.4	36.8	48.7	68.3	101.3
Flange connections coolant [2]	DN	50	50	50	100	100	100	100
Flange connections heat carrier [2]	DN	50	50	50	100	100	100	100
Grasso compressor	Typ	RC 46	RC66	Grasso 410	Grasso 610	Grasso 810	RC412E	RC612E
Capacity stages LS	%	50/100	33/67/100	25/50/100	33/50/67/ 83/100	25/37/50/ 62/75/87/ 100	50/75/100	33/50/67/ 83/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	30	45	55	90	110	160	250
Rated current at 400 V I_n	A	56	84	102	165	200	285	440
Relative starting current [5] I_a/I_n		6.7	6.7	6.5	6.7	6.5	7	7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	25	50	70	120	185	2 x 120	2 x 150
series fuse	A	80	125	160	250	315	400	500

1) $t_{K1/K2}$ = 12 / 6 °C; $t_{W1/W2}$ = 27 / 32 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCW 250-2 - FX GCW 800-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCW... duo		250-2	300-2	360-2	420-2	520-2	650-2	800-2
Refrigerating capacity [1] Q_0	KW	232	291	350	408	516	645	774
Electrical power consumption [1] compressor P_{eff}	kW	42.6	53.2	63.8	74.6	93.6	116.3	139
Transport weight m_L	kg	3290	3990	4360	4680	5640	6110	6640
Operating weight m_B	kg	3380	4090	4480	4780	5790	6300	6860
refrigerant charge NH_3	kg	24	25	30	34	38	49	58
Oil charge $V_{ÖL}$	l	20.4	21.5	23	23.5	25	25.5	27
Coolant volume	l	22.1	24.9	29.7	34.4	43.3	54	64.7
Heat carrier charge	l	22.6	27.9	33.3	39.2	49.3	61.2	73
Flange connections coolant [2]	DN	50	100	100	100	100	100	100
Flange connections heat carrier [2]	DN	100	100	100	100	100	100	100
Grasso compressor	Typ	RC 46 + RC 46	RC66 + RC 46	RC66 + RC66	RC 86+ RC66	Grasso 410 + 410	Grasso 610 + 410	Grasso 610 + 610
Capacity stages LS	%	25/50/75/ 100	20/30/40/ 60/80/100	16/33/50/ 66/83/100	14/28/42/ 57/71/86/ 100	25/38/50/ 63/75/87/ 100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	30+30	45+30	45+45	55+45	55+55	90+55	90+90
Rated current at 400 V I_n	A	56+56	84+56	84+84	102+84	102+102	165+102	165+165
Relative starting current [5] I_a/I_n		6.7/6.7	6.7/6.7	6.7/6.7	6.5/6.7	6.5/6.5	6.7/6.5	6.7/6.7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	50	70	95	95	120	185	2 x 120
series fuse	A	125	160	200	200	250	315	400

1) $t_{K1/K2}$ = 12 / 6 °C; $t_{W1/W2}$ = 27 / 32 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCW 900-2 - FX GCW 2200-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCW... duo		900-2	1050-2	1300-2	1500-2	1700-2	1850-2	2200-2
Refrigerating capacity [1] Q_0	KW	903	1032	1255	1446	1617	1808	2170
Electrical power consumption [1] compressor P_{eff}	kW	161.2	183.4	231.1	263.4	295.3	327.6	391.8
Transport weight m_L	kg	7310	8180	8770	10170	10760	12160	13560
Operating weight m_B	kg	7570	8500	9130	10580	11250	12670	14170
refrigerant charge NH_3	kg	72	95	110	125	140	155	195
Oil charge $V_{ÖL}$	l	31.5	37	26	32	28	33	35
Coolant volume	l	74.8	85.5	105.1	120	169.6	150.8	180.6
Heat carrier charge	l	84.9	96.8	119.4	136.6	153.2	171	204.2
Flange connections coolant [2]	DN	100	100	100	100	100	2x100	2x100
Flange connections heat carrier [2]	DN	100	100	100	2x100	2x100	2x100	2x100
Grasso compressor	Typ	Grasso 810 + 610	Grasso 810 + 810	RC412E RC312E	RC412E RC412E	RC612E RC312E	RC612E RC412E	RC612E RC612E
Capacity stages LS	%	14/28/43/50 /57/71/78/8 6/92/100	18/25/43/50 /56/68/75/ 81/93/100	14/29/43/ 57/71/86/ 100	23/38/50/ 75/87/100	11/22/33/ 44/56/67/ 78/89/100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	110+90	110+110	160+132	160+160	250+132	250+160	250+250
Rated current at 400 V I_n	A	200+165	200+200	285+235	285+285	440+235	440+285	440+440
Relative starting current [5] I_a/I_n		6.5/6.7	6.5/6.5	7.0/6.8	7.0/7.0	7.0/6.8	7.0/7.0	7.0/7.0
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	2 x 120	2 x 150	2 x 150	3 x 120	3 x 150	3 x 185	4 x 150
series fuse	A	400	500	630	630	800	800	1000

1) $t_{K1/K2}$ = 12 / 6 °C; $t_{W1/W2}$ = 27 / 32 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCW 125 - FX GCW 1100, SINGLE
APPLICATION: NORMAL COOLING

Size FX GCW... single		125	200	260	400	525	750	1100
Refrigerating capacity [1] Q_0	KW	58	87	133	200	267	386	579
Electrical power consumption [1] compressor P_{eff}	kW	17.9	26.7	38.6	57.1	75.3	108.7	161.4
Transport weight m_L	kg	1950	2290	2780	3950	4160	4600	5610
Operating weight m_B	kg	1990	2340	2900	4100	4270	4730	5800
refrigerant charge NH_3	kg	12	17	25	28	34	42	65
Oil charge $V_{ÖL}$	l	10.2	11	11	13	18	15.6	16.7
Coolant volume	l	5.8	9.2	13.7	21.4	27.9	40.4	60
Heat carrier charge	l	6.2	8.6	12.7	19.6	25.5	36.8	54.6
Flange connections coolant [2]	DN	50	50	50	100	100	100	100
Flange connections heat carrier [2]	DN	50	50	50	100	100	100	100
Grasso compressor	Typ	RC 46	RC66	Grasso 410	Grasso 610	Grasso 810	RC412E	RC612E
Capacity stages LS	%	50/100	33/67/100	25/50/100	33/50/67/ 83/100	25/37/50/ 62/75/87/ 100	50/75/100	33/50/67/ 83/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	22	37	45	75	90	132	200
Rated current at 400 V I_n	A	42	71	84	138	165	235	355
Relative starting current [5] I_a/I_n		6.7	6.5	6.7	6.7	6.7	6.8	7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	16	35	50	95	120	185	2 x 120
series fuse	A	63	100	125	200	250	315	500

1) $t_{K1/K2}$ = -3 / -8 °C; $t_{W1/W2}$ = 25 / 30 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCW 250-2 - FX GCW 800-2, DUO
APPLICATION: NORMAL COOLING

Size FX GCW... duo		250-2	300-2	360-2	420-2	520-2	650-2	800-2
Refrigerating capacity [1] Q_0	KW	116	145	174	202	266	333	400
Electrical power consumption [1] compressor P_{eff}	kW	35.8	44.6	53.4	62.5	77.2	95.7	114.2
Transport weight m_L	kg	2830	3070	3450	3740	4620	5490	5980
Operating weight m_B	kg	2900	3150	3540	3850	4750	5640	6150
refrigerant charge NH_3	kg	24	28	34	38	44	48	59
Oil charge $V_{ÖL}$	l	20.4	21.5	23	23.5	25	25.5	27
Coolant volume	l	12	14.7	17.8	20.5	27	35	41.6
Heat carrier charge	l	11.6	14.4	17.8	20.8	26.7	32.7	39.2
Flange connections coolant [2]	DN	50	50	50	50	50	100	100
Flange connections heat carrier [2]	DN	50	50	100	100	100	100	100
Grasso compressor	Typ	RC 46 + RC 46	RC66 + RC 46	RC66 + RC66	RC 86+ RC66	Grasso 410 + 410	Grasso 610 + 410	Grasso 610 + 610
Capacity stages LS	%	25/50/75/ 100	20/30/40/ 60/80/100	16/33/50/ 66/83/100	14/28/42/ 57/71/86/ 100	25/38/50/ 63/75/87/ 100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	22+22	30+22	30+30	45+30	45+45	75+45	75+75
Rated current at 400 V I_n	A	42+42	56+42	56+56	84+56	84+84	138+84	138+138
Relative starting current [5] I_a/I_n		6.7/6.7	6.7/6.7	6.7/6.7	6.7/6.7	6.7/6.7	6.7/6.7	6.7/6.7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	35	50	50	70	95	150	185
series fuse	A	100	125	125	160	200	250	315

1) $t_{K1/K2}$ = -3 / -8 °C; $t_{W1/W2}$ = 25 / 30 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCW 900-2 - FX GCW 2200-2, DUO
APPLICATION: NORMAL COOLING

Size FX GCW... duo		900-2	1050-2	1300-2	1500-2	1700-2	1850-2	2200-2
Refrigerating capacity 1) Q_0	KW	467	534	670	772	863	965	1158
Electrical power consumption 1) compressor P_{eff}	kW	132.4	150.6	190.9	217.4	243.6	270.1	322.8
Transport weight m_L	kg	6630	7170	7620	8550	9410	9950	11230
Operating weight m_B	kg	6820	7390	7870	8840	9730	10320	11680
refrigerant charge NH_3	kg	70	85	95	110	125	140	170
Oil charge $V_{ÖL}$	l	31.5	37	26	32	28	33	35
Coolant volume	l	48.1	55.2	69.5	79.6	89.1	98.6	120
Heat carrier charge	l	45.7	52.3	65.3	74.8	83.7	118.2	130
Flange connections coolant 2)	DN	100	100	100	100	100	100	100
Flange connections heat carrier 2)	DN	100	100	100	100	100	100	100
Grasso compressor	Typ	Grasso 810 + 610	Grasso 810 + 810	RC412E RC312E	RC412E RC412E	RC612E RC312E	RC612E RC412E	RC612E RC612E
Capacity stages LS	%	14/28/43/50 /57/71/78/ 86/92/100	18/25/43/50 /56/68/75/ 81/93/100	14/29/43/ 57/71/86/ 100	23/38/50/ 75/87/100	11/22/33/ 44/56/67/ 78/89/100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz 3), IP 23, air cooled						
Rating 4) P_n	KW	90+75	90+90	132+110	132+132	200+110	200+132	200+200
Rated current at 400 V I_n	A	165+138	165+165	235+200	235+235	355+200	355+235	355+355
Relative starting current 5) I_a/I_n		6.7/6.7	6.7/6.7	6.8/6.5	6.8/6.8	7.0/6.5	7.0/6.8	7.0/7.0
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	2 x 95	2 x 120	2 x 150	2 x 150	3 x 120	3 x 150	3 x 185
series fuse	A	400	400	630	500	630	630	800

1) $t_{K1/K2}$ = -3 / -8 °C; $t_{W1/W2}$ = 25 / 30 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCE 125 - FX GCE 1100, SINGLE
APPLICATION: AIR CONDITIONING

Size FX GCE... single		125	200	260	400	525	750	1100
Refrigerating capacity [1] Q_0	KW	116	175	258	387	516	723	1085
Electrical power consumption [1] compressor P_{eff}	kW	21.3	31.9	46.8	69.5	91.7	131.7	195.9
Condenser capacity Q_c	kW	137.3	206.9	304.8	456.5	607.7	854.7	1280.9
Transport weight m_L	kg	1860	2320	2900	3780	4450	4920	6120
Operating weight m_B	kg	1890	2370	2960	3850	4550	5040	6290
refrigerant charge NH_3	kg	13	18	27	30	42	48	72
Oil charge $V_{ÖL}$	l	10.2	11	11	13	18	15.6	16.7
Coolant volume	l	9.9	14.7	24.3	32.7	43.3	60.6	90.3
Flange connections coolant [2]	DN	50	50	50	100	100	100	100
Grasso compressor	Typ	RC 46	RC66	Grasso 410	Grasso 610	Grasso 810	RC412E	RC612E
Capacity stages LS	%	50/100	33/67/100	25/50/100	33/50/67/ 83/100	25/37/50/ 62/75/87/ 100	50/75/100	33/50/67/ 83/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	30	45	55	90	110	160	250
Rated current at 400 V I_n	A	56	84	102	165	200	285	440
Relative starting current [5] I_a/I_n		6.7	6.7	6.5	6.7	6.5	7	7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	25	50	70	120	185	2 x 120	2 x 150
series fuse	A	80	125	160	250	315	400	500

1) $t_{K1/K2}$ = 12 / 6 °C; t_c = 35 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCE 250-2 - FX GCE 800-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCE... duo		250-2	300-2	360-2	420-2	520-2	650-2	800-2
Refrigerating capacity [1] Q_0	KW	232	291	350	408	516	645	774
Electrical power consumption [1] compressor P_{eff}	kW	42.6	53.2	63.8	74.6	93.6	116.3	139
Condenser capacity Q_c	kW	274.6	344.2	413.8	482.6	609.6	761.3	913
Transport weight m_L	kg	2870	3550	3880	4140	5010	5440	5900
Operating weight m_B	kg	2940	3620	3960	4200	5120	5570	6050
refrigerant charge NH_3	kg	24	25	30	34	38	49	58
Oil charge $V_{ÖL}$	l	20.4	21.5	23	23.5	25	25.5	27
Coolant volume	l	22.1	24.9	29.7	34.4	43.3	54	64.7
Flange connections coolant [2]	DN	50	100	100	100	100	100	100
Grasso compressor	Typ	RC 46 + RC 46	RC66 + RC 46	RC66 + RC66	RC 86+ RC66	Grasso 410 + 410	Grasso 610 + 410	Grasso 610 + 610
Capacity stages LS	%	25/50/75/ 100	20/30/40/ 60/80/100	16/33/50/ 66/83/100	14/28/42/ 57/71/86/ 100	25/38/50/ 63/75/87/ 100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz[3], IP 23, air cooled						
Rating [4] P_n	KW	30+30	45+30	45+45	55+45	55+55	90+55	90+90
Rated current at 400 V I_n	A	56+56	84+56	84+84	102+84	102+102	165+102	165+165
Relative starting current [5] I_a/I_n		6.7/6.7	6.7/6.7	6.7/6.7	6.5/6.7	6.5/6.5	6.7/6.5	6.7/6.7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	50	70	95	95	120	185	2 x 120
series fuse	A	125	160	200	200	250	315	400

1) $t_{K1/K2}$ = 12 / 6 °C; t_c = 35 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCE 900-2 - FX GCE 2200-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCE... duo		900-2	1050-2	1300-2	1500-2	1700-2	1850-2	2200-2
Refrigerating capacity [1] Q_0	KW	903	1032	1255	1446	1617	1808	2170
Electrical power consumption [1] compressor P_{eff}	kW	161.2	183.4	231.1	263.4	295.3	327.6	391.8
Condenser capacity Q_c	kW	1064.2	1215.4	1486.1	1709.4	1912.3	2135.6	2561.8
Transport weight m_L	kg	6480	7280	7710	8640	9130	10520	11660
Operating weight m_B	kg	6660	7500	7950	8910	9460	10850	12070
refrigerant charge NH_3	kg	72	95	110	125	140	155	195
Oil charge $V_{ÖL}$	l	31.5	37	26	32	28	33	35
Coolant volume	l	74.8	85.5	105.1	120	169.6	150.8	180.6
Flange connections coolant [2]	DN	100	100	100	100	100	2x100	2x100
Grasso compressor	Typ	Grasso 810 + 610	Grasso 810 + 810	RC412E RC312E	RC412E RC412E	RC612E RC312E	RC612E RC412E	RC612E RC612E
Capacity stages LS	%	14/28/43/50 /57/71/78/ 86/92/100	18/25/43/50 /56/68/75/ 81/93/100	14/29/43/ 57/71/86/ 100	23/38/50/ 75/87/100	11/22/33/ 44/56/67/ 78/89/100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz [3], IP 23, air cooled						
Rating [4] P_n	KW	110+90	110+110	160+132	160+160	250+132	250+160	250+250
Rated current at 400 V I_n	A	200+165	200+200	285+235	285+285	440+235	440+285	440+440
Relative starting current [5] I_a/I_n		6.5/6.7	6.5/6.5	7.0/6.8	7.0/7.0	7.0/6.8	7.0/7.0	7.0/7.0
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	2 x 120	2 x 150	2 x 150	3 x 120	3 x 150	3 x 185	4 x 150
series fuse	A	400	500	630	630	800	800	1000

1) $t_{K1/K2}$ = 12 / 6 °C; t_c = 35 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCA 125 BIS FX GCA 1100, SINGLE
APPLICATION: AIR CONDITIONING

Size FX GCA... single		125	200	260	400	525	750	1100
Refrigerating capacity [1] Q_0	KW	104	155	234	351	468	665	998
Electrical power consumption [1] compressor P_{eff}	kW	26.2	39.1	55.9	83	109.8	157.9	235.2
Condenser capacity Q_c	kW	130.2	194.1	289.9	434	577.8	822.9	1233.2
Transport weight m_L	kg	2050	2550	3190	4310	5050	5690	7090
Operating weight m_B	kg	2095	2610	3280	4420	5210	5890	7370
refrigerant charge NH_3	kg	13	18	27	30	42	48	72
Oil charge $V_{ÖL}$	l	10.2	11	11	13	18	15.6	16.7
Coolant volume	l	9.9	14.7	24.3	32.7	43.3	60.6	90.3
Flange connections coolant [2]	DN	50	50	50	100	100	100	100
Grasso compressor	Typ	RC 46	RC66	Grasso 410	Grasso 610	Grasso 810	RC412E	RC612E
Capacity stages LS	%	50/100	33/67/100	25/50/100	33/50/67/ 83/100	25/37/50/ 62/75/87/ 100	50/75/100	33/50/67/ 83/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz[3], IP 23, air cooled						
Rating [4] P_n	KW	37	45	75	110	132	200	315
Rated current at 400 V I_n	A	71	84	138	200	235	355	560
Relative starting current [5] I_a/I_n		6.5	6.7	6.7	6.5	6.8	7	6.7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	35	50	95	185	185	2 x 120	3 x 120
series fuse	A	100	125	200	315	315	500	800

1) $t_{K1/K2}$ = 12 / 6 °C t_c = 45 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCA 250-2 BIS FX GCA 800-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCA... duo		250-2	300-2	360-2	420-2	520-2	650-2	800-2
Refrigerating capacity [1] Q_0	KW	208	259	310	362	468	585	702
Electrical power consumption [1] compressor P_{eff}	kW	52.4	65.3	78.2	91.5	111.8	138.9	166
Condenser capacity Q_c	kW	260.4	324.3	388.2	362	579.8	723.9	868
Transport weight m_L	kg	3300	4010	4360	4680	5640	6120	6650
Operating weight m_B	kg	3390	4100	4480	4790	5800	6310	6870
refrigerant charge NH_3	kg	24	25	30	34	38	49	58
Oil charge $V_{ÖL}$	l	20.4	21.5	23	23.5	25	25.5	27
Coolant volume	l	22.1	24.9	29.7	34.4	43.3	54	64.7
Flange connections coolant [2]	DN	50	100	100	100	100	100	100
Grasso compressor	Typ	RC 46 + RC 46	RC66 + RC 46	RC66 + RC66	RC 86+ RC66	Grasso 410 + 410	Grasso 610 + 410	Grasso 610 + 610
Capacity stages LS	%	25/50/75/ 100	20/30/40/ 60/80/100	16/33/50/ 66/83/100	14/28/42/ 57/71/86/ 100	25/38/50/ 63/75/87/ 100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz[3], IP 23, air cooled						
Rating [4] P_n	KW	37+37	45+37	45+45	75+45	75+75	110+75	110+110
Rated current at 400 V I_n	A	71+71	84+71	84+84	38+84	138+138	200+138	200+200
Relative starting current [5] I_a/I_n		6.5/6.5	6.7/6.5	6.7/6.7	6.7/6.7	6.7/6.7	6.5/6.7	6.5/6.5
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	70	95	95	150	185	2 x 120	2 x 150
series fuse	A	160	200	200	250	315	400	500

1) $t_{K1/K2}$ = 12 / 6 °C t_c = 45 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

TECHNICAL DATA
FX GCA 900-2 BIS FX GCA 2200-2, DUO
APPLICATION: AIR CONDITIONING

Size FX GCA... duo		900-2	1050-2	1300-2	1500-2	1700-2	1850-2	2200-2
Refrigerating capacity [1] Q_0	KW	1170	936	1152	1330	1485	1663	1996
Electrical power consumption [1] compressor P_{eff}	kW	192.8	219.6	277	315.8	354.3	393.1	470.4
Condenser capacity Q_c	kW	1362.8	1155.6	1429	1645.8	1839.3	2056.1	2466.4
Transport weight m_L	kg	7310	8190	8770	10180	10780	12160	13560
Operating weight m_B	kg	7580	8500	9140	10590	11260	12680	14180
refrigerant charge NH_3	kg	72	95	110	125	140	155	195
Oil charge $V_{ÖL}$	l	31.5	37	26	32	27	33	35
Coolant volume	l	74.8	85.5	105.1	120	169.6	150.8	180.6
Flange connections coolant [2]	DN	100	100	100	100	100	2x100	2x100
Grasso compressor	Typ	Grasso 810 + 610	Grasso 810 + 810	RC412E RC312E	RC412E RC412E	RC612E RC312E	RC612E RC412E	RC612E RC612E
Capacity stages LS	%	14/28/43/50 /57/71/78/ 86/92/100	18/25/43/50 /56/68/75/ 81/93/100	14/29/43/ 57/71/86/ 100	23/38/50/ 75/87/100	11/22/33/ 44/56/67/ 78/89/100	20/30/40/ 50/60/80/ 100	16/25/33/42 /50/66/75/ 83/92/100
Electr. Data compressor motor		1500 min $^{-1}$, 400 V / 3 Ph / 50 Hz[3], IP 23, air cooled						
Rating [4] P_n	KW	132+110	132+132	200+132	200+200	315+132	315+200	315+315
Rated current at 400 V I_n	A	235+200	235+235	355+235	355+355	560+235	560+355	560+560
Relative starting current [5] I_a/I_n		6.8/6.5	6.8/6.8	7.0/6.8	7.0/7.0	6.7/6.8	6.7/7.0	6.7/6.7
Switching cabinet power supply		3 PEN / 400 V, internal control voltage: 230 V / 50 Hz / 24 VDC						
feedcross section	mm^2	2 x 150	2 x 150	3 x 150	3 x 185	3 x 185	4 x 150	4 x 185
series fuse	A	500	500	630	800	1000	1000	1250

1) $t_{K1/K2}$ = 12 / 6 °C t_c = 45 °C
2) connection flanges for coolant/heat carrier to DIN 2633 (equivalent to ISO PN 16)
3) Euro voltage range ±10%, other voltages/frequencies please inquire
4) for water inlet, outlet 12/6°C, different motor rating if conditions are different
5) reduced to 30% for Y - Δ starting

PART LOAD CHARACTERISTICS AT CONSTANT COOLING WATER INLET TEMPERATURES / CONDENSATION TEMPERATURES

FX GCW 125 - 420-2

t_{K2} = 6°C and t_{W1} = 27°C; $V_{K,W}$ = const.; LS = capacity stage %

Stage	Percentage	FX GCW (in %)										
		125	200	260	400	525	750	1100	250-2	300-2	360-2	420-2
1	LS	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Q_0	100	100	100	100	100	100	100	100	100	100	100
	P_{KI}	100	100	100	100	100	100	100	100	100	100	100
2	LS	**50**	**67**	**50**	**83**	**87**	**75**	**83**	**75**	**80**	**83**	**86**
	Q_0	53	70	53	85	89	77	85	77	82	85	87
	P_{KI}	51	67	51	83	87	75	83	74	79	82	85
3	LS		**33**	**25**	**67**	**75**	**50**	**67**	**63**	**60**	**66**	**71**
	Q_0		36	27	70	77	53	70	66	63	69	74
	P_{KI}		36	30	67	75	51	67	62	59	65	70
4	LS				**50**	**62**		**50**	**50**	**40**	**50**	**57**
	Q_0				53	65		53	53	43	53	60
	P_{KI}				51	63		51	49	40	49	56
5	LS				**33**	**50**		**33**	**25**	**30**	**33**	**42**
	Q_0				36	53		36	27	32	36	45
	P_{KI}				36	51		36	25	28	32	40
6	LS					**37**				**20**	**16**	**28**
	Q_0					40				22	18	30
	P_{KI}					40				20	17	28
7	LS					**25**						**14**
	Q_0					28						15
	P_{KI}					27						16
8	LS											
	Q_0											
	P_{KI}											
9	LS											
	Q_0											
	P_{KI}											
10	LS											
	Q_0											
	P_{KI}											
11	LS											
	Q_0											
	P_{KI}											
12	LS											
	Q_0											
	P_{KI}											
13	LS											
	Q_0											
	P_{KI}											
14	LS											
	Q_0											
	P_{KI}											
15	LS											
	Q_0											
	P_{KI}											

PART LOAD CHARACTERISTICS AT CONSTANT COOLING WATER INLET TEMPERATURES / CONDENSATION TEMPERATURES

FX GCW 520-2 BIS 2200-2

bei t_{K2} = 6°C und t_{W1} = 27°C; $V_{K,W}$ = const.; LS = Leistungsstufe %

Stage	Percentage	FX GCW (in %)										
		520-2	650-2	800-2	900-2	1050-2	1300-2	1500-2	1700-2	1850-2	2200-2	
1	LS	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	
	Q_0	100	100	100	100	100	100	100	100	100	100	
	P_{KI}	100	100	100	100	100	100	100	100	100	100	
2	LS	**87**	**80**	**92**	**92**	**93**	**86**	**87**	**89**	**90**	**92**	
	Q_0	89	82	93	93	94	87	88	90	91	93	
	P_{KI}	87	79	92	91	92	85	86	88	89	91	
3	LS	**75**	**70**	**83**	**86**	**87**	**71**	**75**	**78**	**80**	**83**	
	Q_0	77	73	85	87	88	73	77	80	82	85	
	P_{KI}	74	69	82	85	86	70	74	77	79	82	
4	LS	**63**	**60**	**75**	**78**	**81**	**57**	**50**	**67**	**70**	**75**	
	Q_0	66	63	77	80	82	60	53	70	73	77	
	P_{KI}	62	54	74	77	80	56	49	66	69	74	
5	LS	**50**	**50**	**66**	**71**	**75**	**43**	**38**	**56**	**60**	**66**	
	Q_0	53	53	68	73	77	46	41	59	63	69	
	P_{KI}	49	49	65	70	74	41	36	54	59	65	
6	LS	**38**	**40**	**50**	**64**	**68**	**29**	**23**	**44**	**50**	**50**	
	Q_0	40	43	53	66	70	31	27	47	53	53	
	P_{KI}	26	40	50	63	66	30	25	43	48	49	
7	LS	**25**	**30**	**42**	**57**	**62**	**14**		**33**	**40**	**42**	
	Q_0	27	33	45	59	64	15		36	43	45	
	P_{KI}	25	18	40	56	61	16		33	39	40	
8	LS		**20**	**33**	**50**	**56**			**22**	**30**	**33**	
	Q_0		12	36	53	58			24	33	36	
	P_{KI}		20	32	49	55			24	30	32	
9	LS			**25**	**43**	**50**			**11**	**20**	**25**	
	Q_0			27	46	53			12	22	27	
	P_{KI}			25	41	49			14	21	25	
10	LS			**16**	**35**	**43**					**16**	
	Q_0			17	38	46					18	
	P_{KI}			17	33	41					17	
11	LS				**28**	**37**						
	Q_0				31	40						
	P_{KI}				25	35						
12	LS				**21**	**32**						
	Q_0				24	35						
	P_{KI}				19	30						
13	LS				**14**	**25**						
	Q_0				17	29						
	P_{KI}				11	23						
14	LS					**18**						
	Q_0					22						
	P_{KI}					16						
15	LS					**12**						
	Q_0					13						
	P_{KI}					14						

LIMITS OF APPLICATION

The Ammonia chillers can be operated under the most varied operation conditions within the given limits of application according to the requirements involved. The limits of application listed below are based on the operational principle of the Reciprocating Compressor, thermodynamic relations, used vessels and safety devices and practical operating conditions.

suction pressure	p_0	bar (a)	min max	0,7 6,2
water leaving temperature as sec. refrigerant	t_{KA}	°C	min max	+3 +15
brine leaving temperature as sec. refrigerants	t_{WA}	°C	min max	-10 +15
condensing pressur	p_c	bar (a)	min max	10 23
heat carrier inlet temperature	t_{WE}	°C	min max	+20 +45

Comments:

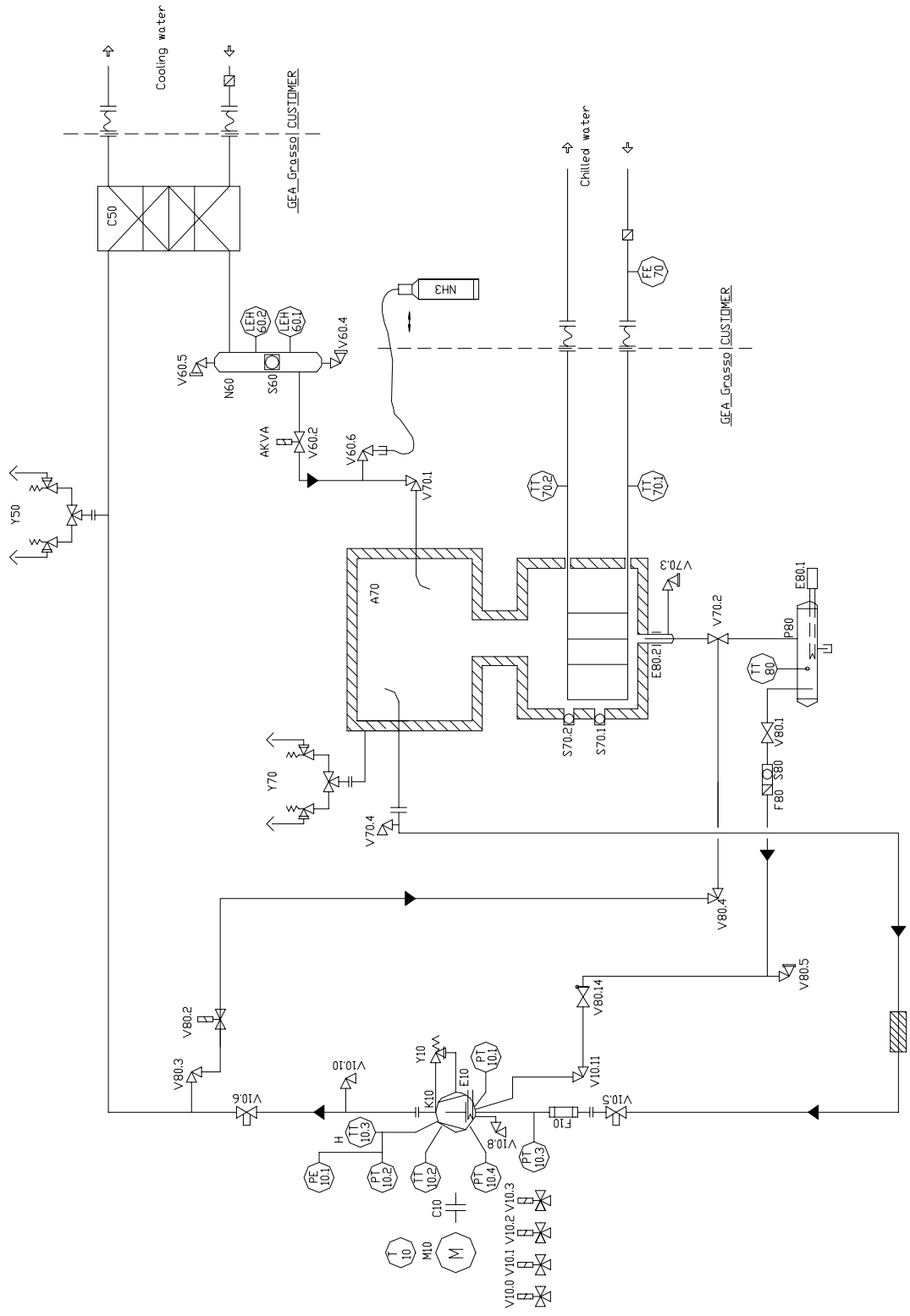
1. When considering a particular case, all conditions given in the tables should be taken into consideration and adhered to.
2. Should the given limit values be exceeded in any particular case, the manufacturer must be consulted.
3. In addition to the application limits given in the tables, consider the operating conditions which must be observed for the corresponding type of compressor (e.g. start-up regime, oil pressure, oil quantity etc.).
4. The given data refer to the operation conditions in a refrigeration or air conditioning installation. While start-up of the unit it is only for a short time permitted to leave these conditions.

ACOUSTIC DATA

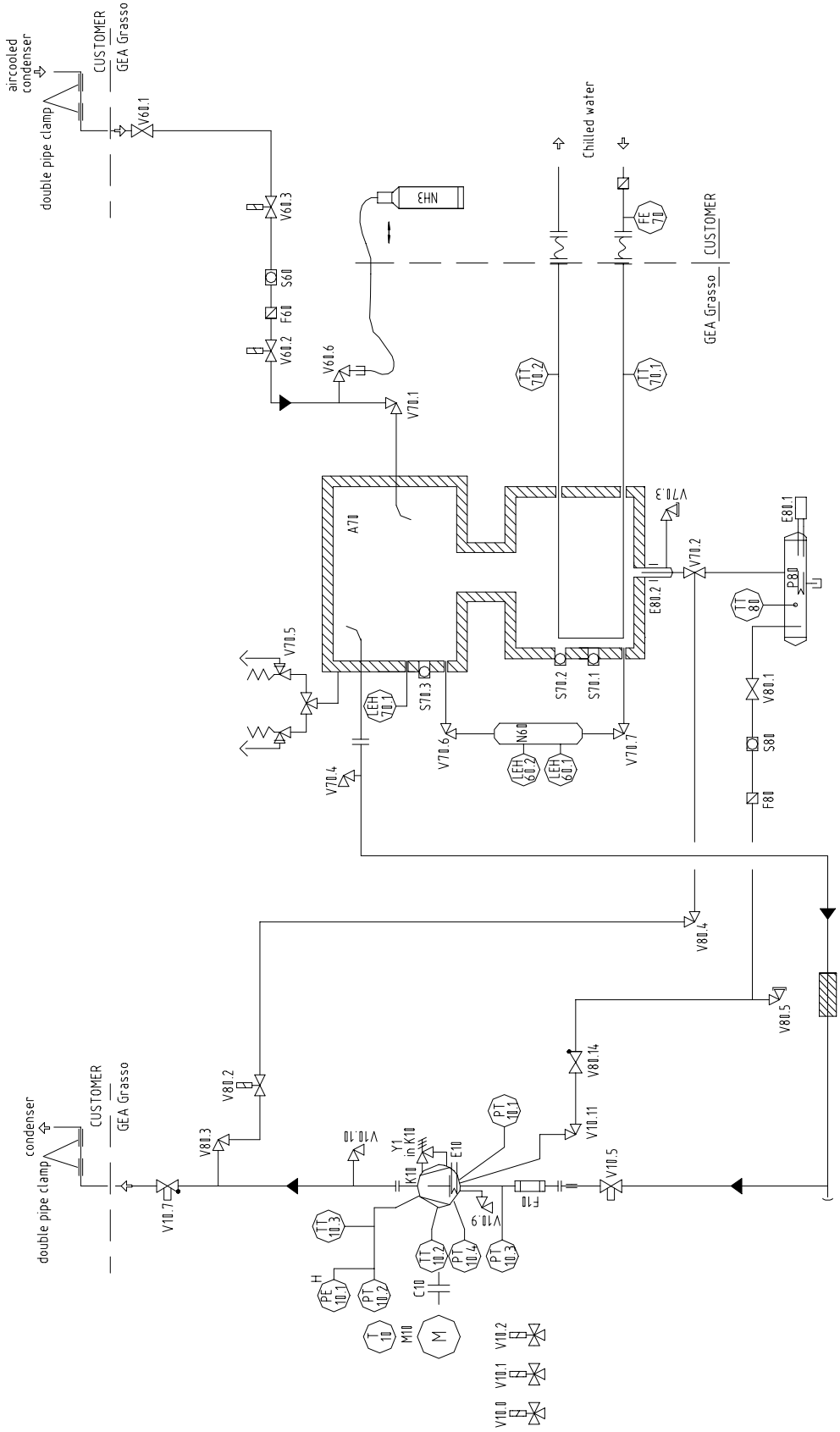
Size GC	Total sound pressure level[1] L_P [dB(A)]	Sound power L_{WA}[dB(A)]	Octave sound pressure level L_{POkt} [dB]							
			medium sound frequency f_m [Hz]							
			63	125	250	500	1000	2000	4000	8000
125	65	81	66	78	79	81	76	70	65	59
200	68	84	73	78	80	83	79	75	68	63
260	75	90	81	89	92	90	87	85	83	77
400	78	92	91	89	85	92	91	87	85	79
525	80	96	83	95	94	97	93	84	83	82
750	83	101	87	98	101	97	98	93	88	86
1100	83	101	88	99	101	99	98	94	88	86
250-2	68	84	69	81	82	84	79	73	68	60
300-2	69	86	74	81	82	85	80	76	69	64
360-2	71	86	76	81	83	86	82	78	71	66
420-2	73	88	79	80	84	87	84	80	73	68
520-2	79	93	84	92	95	93	90	88	86	80
650-2	81	94	84	92	93	94	92	89	87	81
800-2	81	95	84	92	88	95	94	90	88	82
900-2	84	97	85	96	95	98	95	89	87	84
1050-2	86	99	86	98	97	100	96	87	86	85
1300-2	87	103	90	100	102	100	101	95	100	88
1500-2	88	104	90	101	104	100	101	96	91	89
1700-2	88	103	90	101	102	101	101	96	91	89
1850-2	88	104	91	102	104	101	101	97	91	89
2200-2	88	104	91	102	104	102	101	97	91	89

[1] Measuring distance 1 m; AC and heat pumps
tolerance up to +3 dB

CIRCUIT DIAGRAM FX GCW



CIRCUIT DIAGRAM FX GCA / GCE



PRINCIPAL PARTS AND FITTINGS OF FX GC

K10 Reciprocating-piston compressor
M10 Motor
T10 Winding temperature
C10 Coupling
E10 Crank pan heater
F10 Suction filter
PT10.1 Pressure transmitter (P-oil)
PT10.2 Pressure transmitter (P-end)
PT10.3 Pressure transmitter (P-suction)
PT10.4 Pressure transmitter (P-crankcase)
PE10.1 Safety pressure limiter
PE10.2 Pressure limiter
TT10.2 Temperature sensor (T-Öl)
TT10.3 Temperature sensor (T-End)

V10.0 Reduced-load starting
V10.1 Output control
V10.2 Output control
V10.3 Output control
V10.4 Output control
V10.5 Suction shutoff valve
V10.6 Pressure shutoff valve
V10.7 Non-return valve *(only GCA and GCE)*
V10.8 Crankcase oil drain valve
V10.10 Compressor pressure side service valve
V10.11 Oil return line connection valve

Y10 Compressor overflow valve

C50 Condenser *(only GCW)*
Y50 Blow-off safety valve *(only GCW)*
N60 Level tank
V60.1 Liquid line shutoff valve *(only GCA and GCE)*
V60.2 Electronic injection valve
V60.3 Solenoid valve *(only GCA and GCE)*
V60.4 Level control drain valve *(only GCW)*
V60.5 Level control venting valve *(only GCW)*
V60.6 Refrigerant filling valve

LEH60.1 Low level gauge sensor
LEH60.2 High level gauge sensor
F60 Filter *(only GCA and GCE)*

S60 Level gauge sight glass *(only GCW)*

A70 Plate heat exchanger / separator
V70.1 Injection line shutoff valve
V70.2 GPV
V70.3 Oil sump service valve
V70.4 Suction line service valve
V70.6 Level gauge shutoff valve *(only GCA and GCE)*
V70.7 Level gauge shutoff valve *(only GCA and GCE)*
Y70 Blow-off safety valve

LEH70.1 Separator max. level sensor *(only GCA and GCE)*
FE70 Refrigerant flow monitoring device optional (loose delivery)

S70.1-2 Evaporator/ separator sight glass

TT70.1 Refrigerant inlet resistance thermometer
TT70.2 Refrigerant outlet resistance thermometer

P80 Oil pulse pump

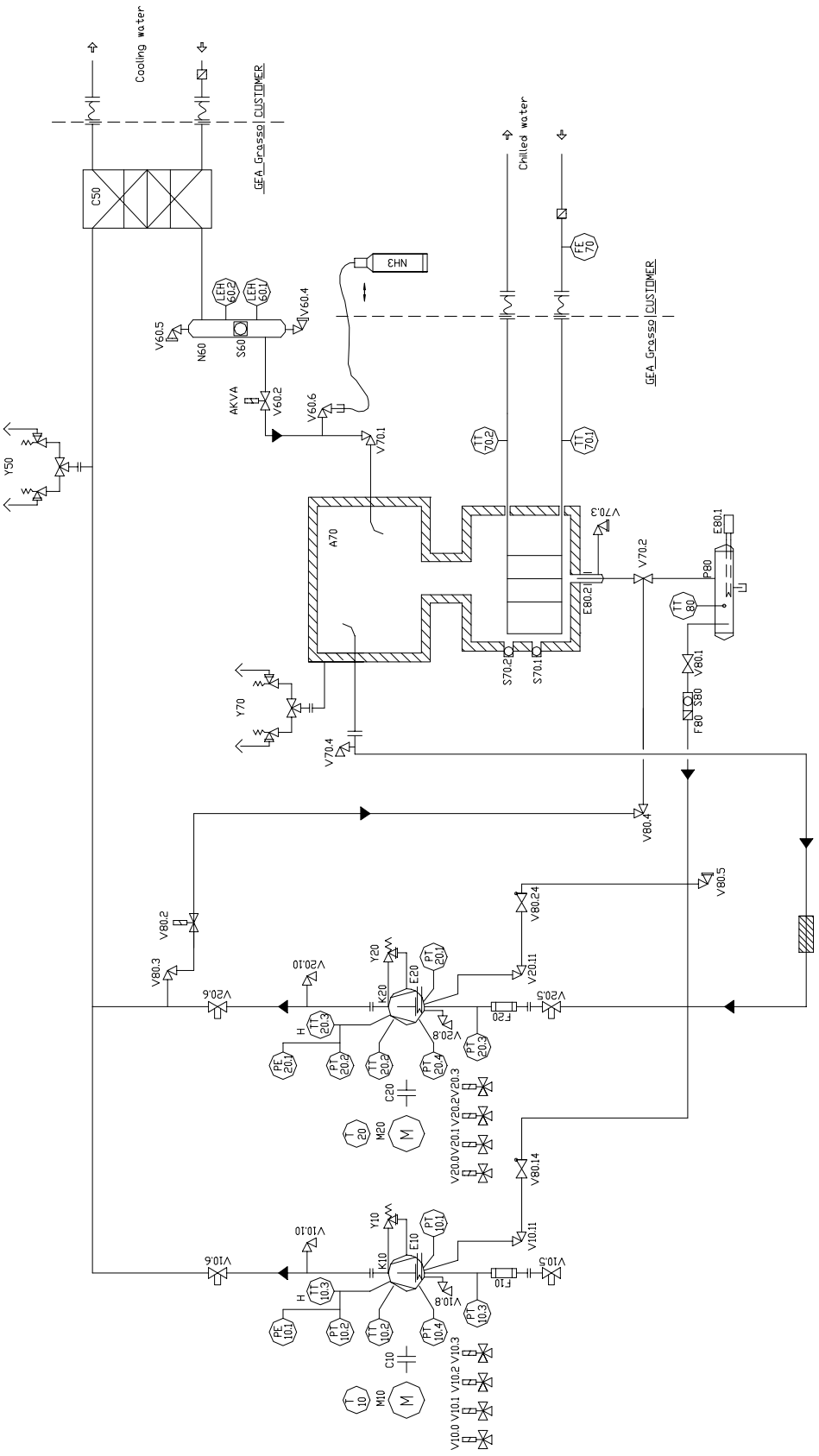
E80.1 Oil pulse pump heater
E80.2 Oil hood heater

F80 Filter
V80.1 Oil pump shutoff valve
V80.2 2-directional solenoid valve
V80.3 Oil return line pressure connection
V80.4 Shutoff valve for GPV pressure connection
V80.5 Oil return line service valve
V80.14 Oil return line non-return valve

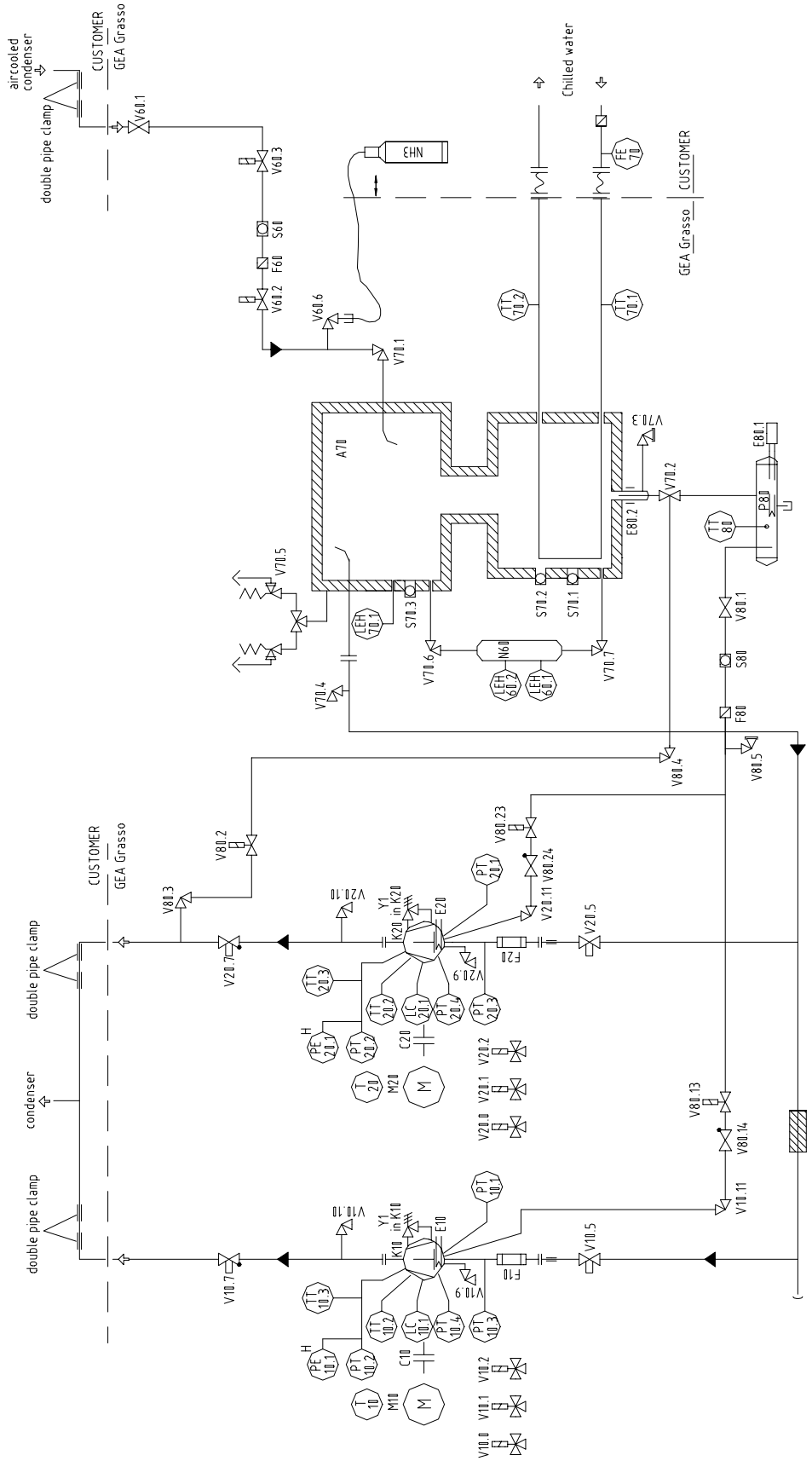
S80 Oil return line sight glass

TT80 Oil pulse pump resistance heater

CIRCUIT DIAGRAM FX GCW - 2



CIRCUIT DIAGRAM FX GCA - 2 / GCE - 2

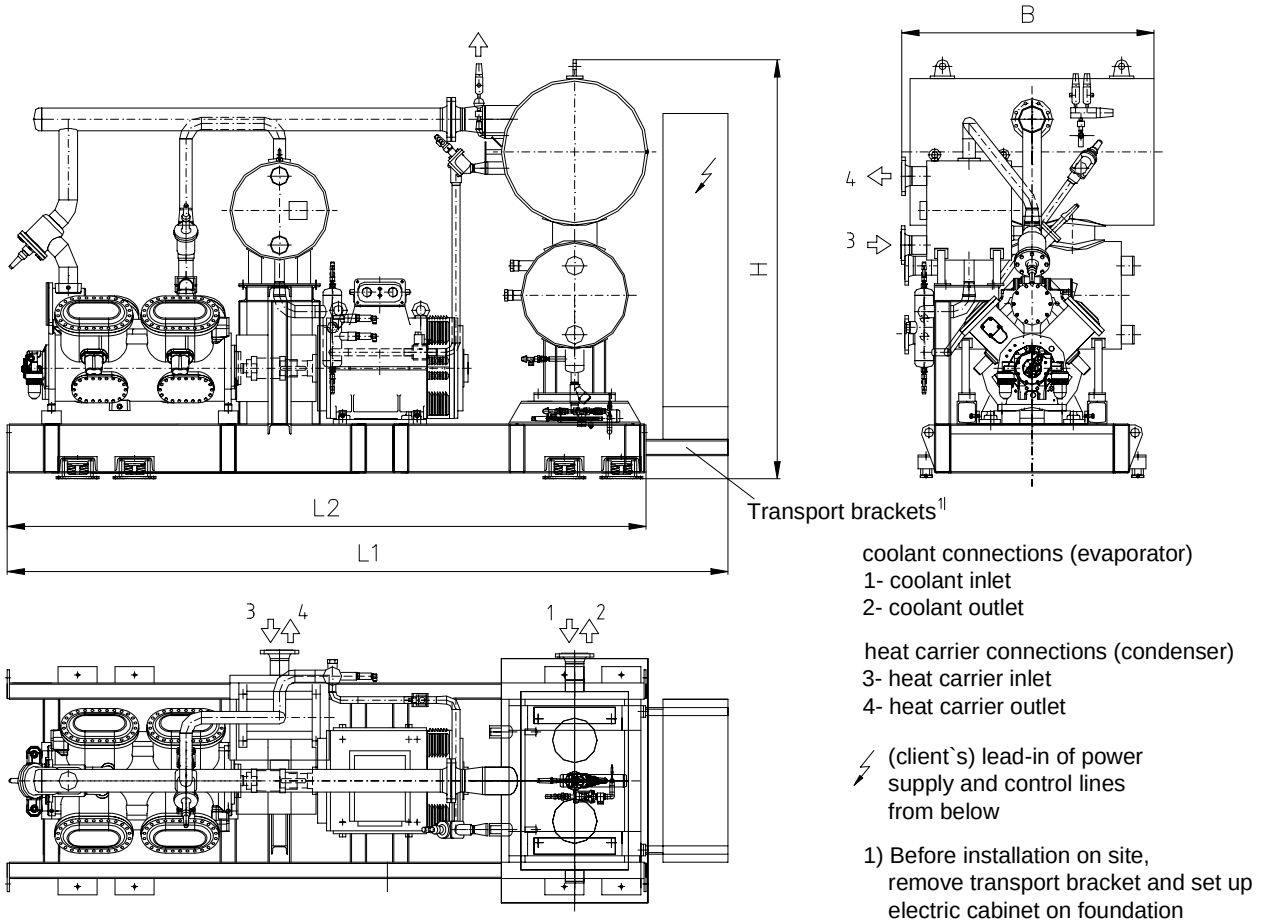


PRINCIPAL PARTS AND FITTINGS FX GC -2

K10 Reciprocating-piston compressor
M10 Motor
T10 Winding temperature
C10 Coupling
E10 Crank pan heater
F10 Suction filter
PT10.1 Pressure transmitter (P-oil)
PT10.2 Pressure transmitter (P-end)
PT10.3 Pressure transmitter (P-suction)
PT10.4 Pressure transmitter (P-crankcase)
PE10.1 Safety pressure limiter
PE10.2 Pressure limiter
TT10.2 Temperature sensor (T-oil)
TT10.3 Temperature sensor (T-end)
LC10.1 Compressor crankcase oil level
V10.0 Reduced-load starting
V10.1 Output control
V10.2 Output control
V10.3 Output control
V10.4 Output control
V10.5 Suction shutoff valve
V10.6 Pressure shutoff valve
V10.7 Non-return valve *(only GCA and GCE)*
V10.8 Crankcase oil drain valve
V10.10 Compressor pressure side service valve
V10.11 Oil return line connection valve
Y10 Compressor overflow valve

K20 Reciprocating-piston compressor
M20 Motor
T20 Winding temperature
C20 Coupling
E20 Crank pan heater
F20 Suction filter
PT20.1 Pressure transmitter (P-oil)
PT20.2 Pressure transmitter (P-end)
PT20.3 Pressure transmitter (P-suction)
PT20.4 Pressure transmitter (P-crankcase)
PE20.1 Safety pressure limiter
PE20.2 Pressure limiter
LC20.1 Compressor 2 crankcase oil level
TT20.2 Temperature sensor (T-oil)
TT20.3 Temperature sensor (T-end)
V20.0 Reduced-load starting
V20.1 Output control
V20.2 Output control
V20.3 Output control
V20.4 Output control
V20.5 Suction shutoff valve
V20.6 Pressure shutoff valve
V20.7 Non-return valve *(only GCA and GCE)*
V20.8 Crankcase oil drain valve
V20.10 Compressor pressure side service valve
V20.11 Oil return line connection valve
Y20 Compressor overflow valve
TT80 Oil pulse pump resistance thermometer
C50 Condenser *(only GCW)*
Y50 Blow-off safety valve *(only GCW)*
N60 Level tank
V60.1 Liquid line shutoff valve *(only GCA and GCE)*
V60.2 Electronic injection valve
V60.3 Solenoid valve *(only GCA and GCE)*
V60.4 Level control drain valve *(only GCW)*
V60.5 Level control venting valve *(only GCW)*
V60.6 Refrigerant filling valve
LEH60.1 Low level gauge sensor
LEH60.2 High level gauge sensor
F60 Filter *(only GCA and GCE)*
S60 Level gauge sight glass *(only GCW)*
A70 Plate heat exchanger / separator
V70.1 Injection line shutoff valve
V70.2 GPV
V70.3 Oil sump service valve
V70.4 Suction line service valve
V70.6 Level gauge shutoff valve *(only GCA and GCE)*
V70.7 Level gauge shutoff valve *(only GCA and GCE)*
Y70 Blow-off safety valve
LEH70.1 Separator max. level sensor *(only GCA and GCE)*
FE70 Refrigerant flow monitoring device optional (loose delivery)
S70.1-2 Evaporator/ separator sight glass
TT70.1 Refrigerant inlet resistance thermometer
TT70.2 Refrigerant outlet resistance thermometer
P80 Oil pulse pump
E80.1 Oil pulse pump heater
E80.2 Oil hood heater
F80 Filter
V80.1 Oil pump shutoff valve
V80.2 2-directional solenoid valve
V80.3 Oil return line pressure connection
V80.4 Shutoff valve for GPV pressure connection
V80.5 Oil return line service valve
V80.13 Compressor 1 oil return line solenoid valve
V80.14 Compressor 1 oil return line non-return valve
V80.23 Compressor 2 oil return line solenoid valve
V80.24 Compressor 2 oil return line non-return valve
S80 Oil return line sight glass
TT80 Oil pulse pump resistance heater

LEADING DIMENSIONS FX GCW



coolant connections (evaporator)
1- coolant inlet
2- coolant outlet

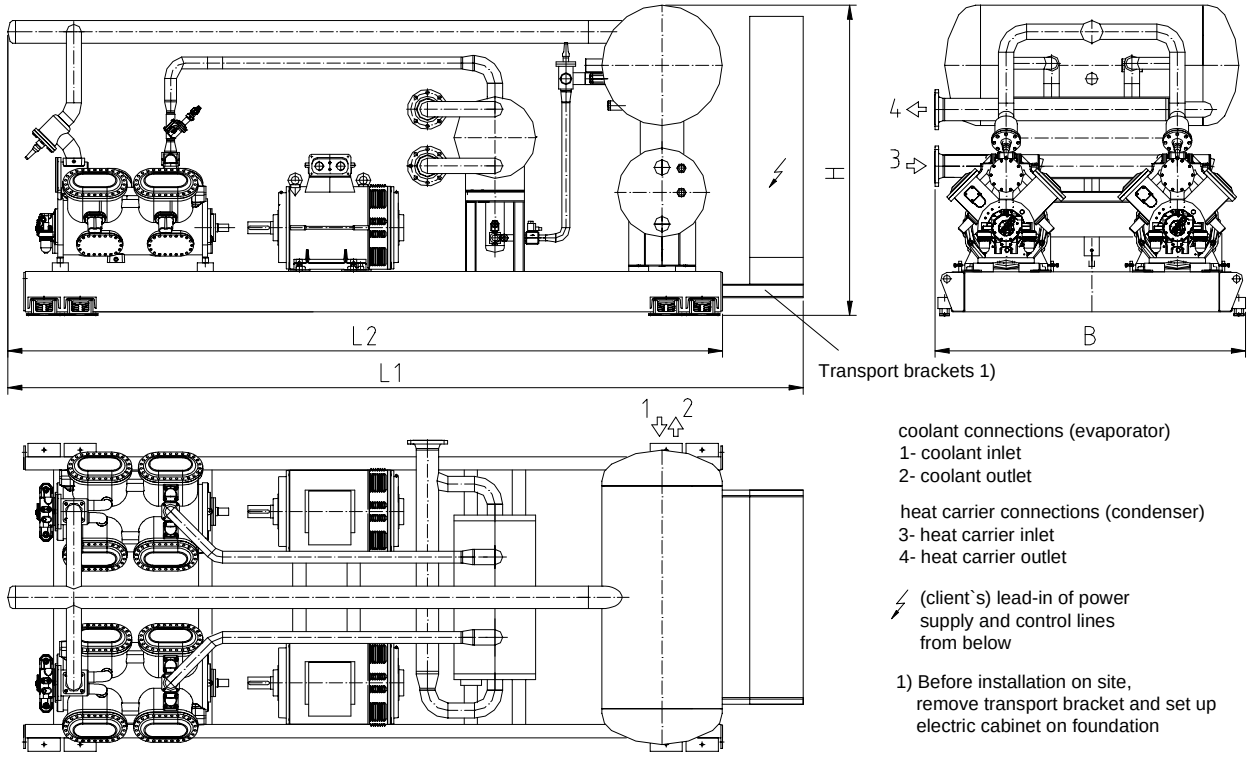
heat carrier connections (condenser)
3- heat carrier inlet
4- heat carrier outlet

(client`s) lead-in of power supply and control lines from below

1) Before installation on site, remove transport bracket and set up electric cabinet on foundation

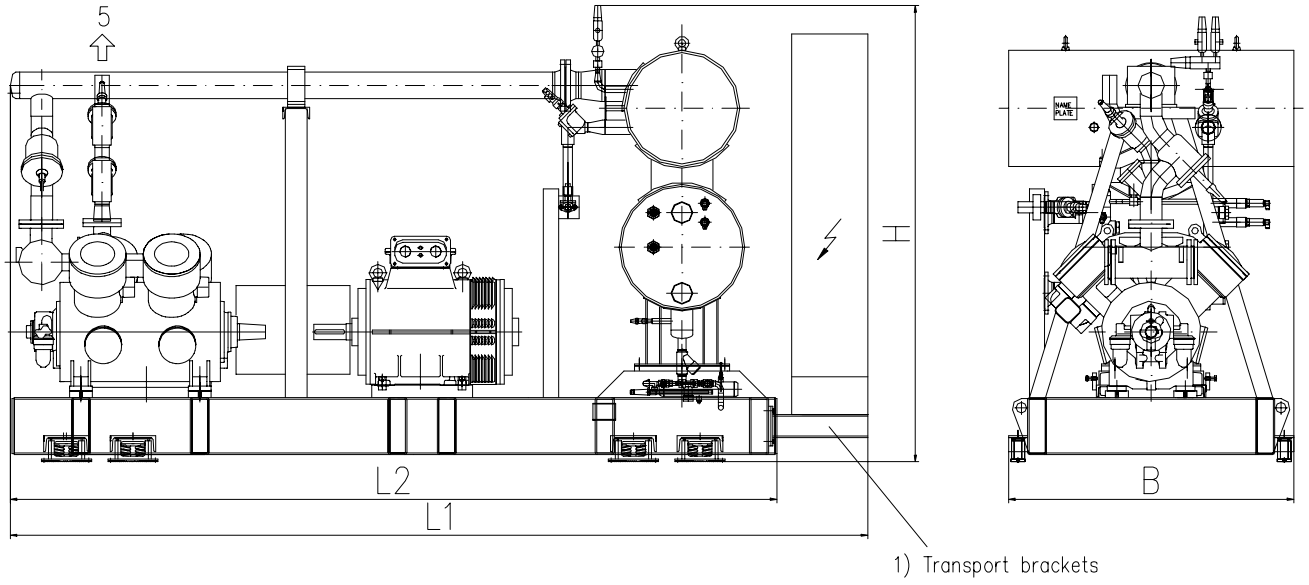
Size	Leading dimensions			
FX GCW	L1	L2	B	H
	mm			
125	2700	2200	1000	1850
200	2950	2450	1200	1950
260	3150	2650	1400	2000
400	3880	3350	1500	2100
525	4230	3700	1500	2280
750	5050	4500	1600	2300
1100	5350	4800	1600	2550

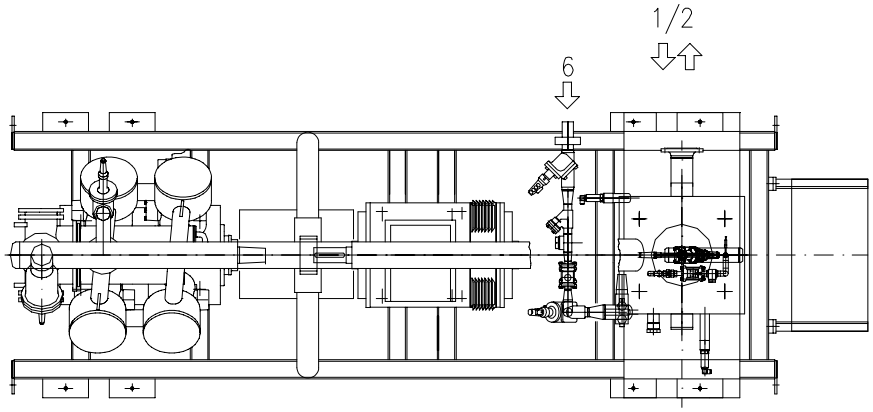
LEADING DIMENSIONS FX GCW-2



Size	Leading dimensions			
FX GCW-2	L1	L2	B	H
	mm			
250-2	2900	2400	1700	2000
300-2	3300	2750	1700	2100
360-2	3350	2800	1750	2200
420-2	3400	2850	1750	2250
520-2	3800	3250	2200	2300
650-2	4600	4050	2200	2400
800-2	4850	4300	2200	2500
900-2	5350	4800	2200	2500
1050-2	5550	5000	2200	2550
1300-2	5650	5100	2200	2550
1500-2	5650	5100	2200	2600
1700-2	6050	5500	2300	2650
1850-2	6250	5700	2300	2800
2200-2	6350	5800	2350	2800

LEADING DIMENSIONS FX GCA / FX GCE





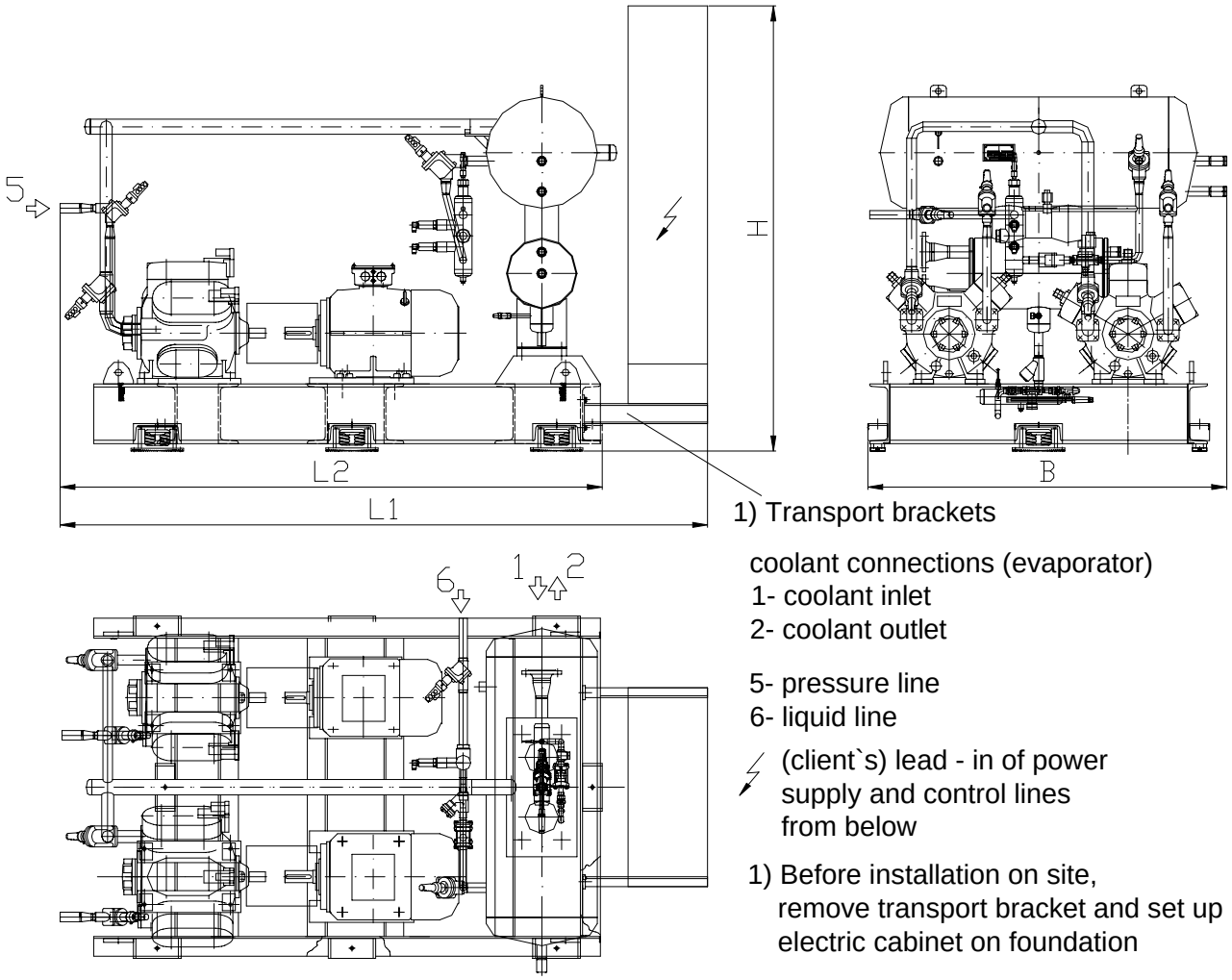
coolant connections (evaporator)
1– coolant inlet
2– coolant outlet
5– pressure line
6– liquid line

(client's) lead–in of power supply and control lines from below

1) Before installation on site, remove transport bracket and setup electric cabinet on foundation

Size	Leading dimensions			
FX GCA / FX GCE	L1	L2	B	H
	mm			
125	2700	2200	1000	1850
200	2950	2450	1200	1950
260	3150	2650	1400	2000
400	3880	3350	1500	2100
525	4230	3700	1500	2280
750	4450	3900	1600	2300
1100	4750	4200	1600	2550

LEADING DIMENSIONS FX GCA-2 / FX GCE-2



1) Transport brackets

coolant connections (evaporator)
1- coolant inlet
2- coolant outlet

5- pressure line
6- liquid line

(client`s) lead - in of power supply and control lines from below

1) Before installation on site, remove transport bracket and set up electric cabinet on foundation

Size	Leading dimensions			
FX GCA-2 / FX GCE-2	L1	L2	B	H
	mm			
250-2	2900	2400	1700	2000
300-2	3300	2750	1700	2100
360-2	3350	2800	1750	2200
420-2	3400	2850	1750	2250
520-2	3800	3250	2200	2300
650-2	4000	3450	2200	2400
800-2	4150	3600	2200	2500
900-2	4700	4150	2200	2500
1050-2	4900	4350	2200	2550
1300-2	4950	4400	2200	2550
1500-2	5050	4500	2200	2600
1700-2	5300	4750	2300	2650
1850-2	5450	4900	2300	2800
2200-2	5550	5000	2350	2800

GUIDELINES

1. The standard selection is made with reference to the capacity data for the air-conditioning and normal chill ranges in the „Technical data“ overview.
   The exact capacity specification for other operating points is defined in the offer.

2. Capacity ratings are based on a spread of coolant and heat carrier temperatures Δt_{KW} = 6K

3. Capacity ratings are based on a dirt factor of $s_f = 0.5 \times 10^{-4}\ m^2$ K/W . The capacity rating in the offer must be adjusted for other dirt factors.

4. For part load characteristics see Table. Observe operating limit for part load.

5. The condenser capacity Q_C can be estimated (checked) using the following formula:

$$Q_C\ [kW] = Q_O\ [kW] + P_{Kl}\ [kW]$$

6. Determine volume flow rates as follows:

   Coolant

$$V_K\ [m^3/h] = \frac{Q_O\ [kW] \times 3600\ [s/h]}{\vartheta_K\ [kg/m^3] \times c_{pK}\ [kJ/kgK] \times \Delta t_K\ [K]}$$

   Heat carrier

$$V_W\ [m^3/h] = \frac{Q_C\ [kW] \times 3600\ [s/h]}{\vartheta_W\ [kg/m^3] \times c_{pW}\ [kJ/kgK] \times \Delta t_W\ [K]}$$

MATERIAL DATA FOR VOLUME FLOW RATE CALCULATION

t_m (°C)	Material data rho_{KW} (kg/m³) x c_{pKW} (KJ/kgK)		
	Water	Ethylene glycol[1)] 34 Vol. % (FS= -20°C)	Propylene glycol[2)] 38 Vol. % (FS= -20°C)
-20		3809	3850
-15		3820	3857
-10		3827	3864
-5		3834	3871
0	4216	3838	3884
5	4199	3845	3887
10	4192	3848	3890
20	4175	3855	3903
30	4161	3868	3901
40	4146	3871	3909
50	4131	3873	3917

FS = frostproof down to
1) e.g. Antifrogen N
2) e.g. Antifrogen L

7. The coolants/heat carriers may be water or brine which should be compatible with the material combinations used for the heat exchanger in question and the connected piping.

3

INSTALLATION

Contents

DELIVERY

The liquid chillers are delivered with the protective gas charge (nitrogen) in the refrigerant circuit, the heat exchanger connections are closed. Check on arrival for possible transport damage and report damage in writing. Protect chillers from damage, dirt and moisture during longer periods of storage prior to setup/installation (check protective gas charge).
The compressors of the cold-water unit are not charged with oil, therefore the unit must not be started unless properly installed and commissioned.

SETUP

Set up on a level surface and allow sufficient space for maintenance. The unit will normally remain stationary due to its dead weight. The cold-water unit is delivered with vibration isolators, which must be attached with foundation bolts. For location of holes for the vibration isolator foundation bolts, see the cold-water unit drawing (supply documentation). Cold and heat carrier piping must be disconnected (flexible connections).
The electric control cabinet mounted to the liquid chiller for transport must be removed from the base frame of the FX GC together with the brackets and installed at the same place in front of the FX GC on a level concrete surface without brackets.
Make sure that substances escaping from leaks can not penetrate into the soil, groundwater or surface water (observe national legislation). Unless otherwise required by local conditions, the permissible ambient temperatures for operation are +5 to +40°C.

AIR-COOLED CONDENSER AND EVAPORATION CONDENSER FOR GCA AND GCE SERIES

If an air-cooled condenser or evaporation condenser is used, certain points must be observed:
The condenser is not integrated in the liquid chiller, but set up separately, mostly on the roof of the building.
The connection between the liquid chiller and condenser must be made and the fittings mounted on site.
Check the local operating conditions in Summer and Winter in regard of the refrigerant volume concentration in certain parts of the system. The liquid chiller from Grasso can be ordered without condenser or with separate condenser.

COOLANT SYSTEM

After the cold-water unit is aligned, it can be connected at the chill refrigerant side. The piping for the refrigerant connections must be installed by the system erector on site.
The unit is mounted on vibration isolators, therefore the connections of the water piping to the evaporator must be flexible. For size and position of the water connections to the evaporator, see the drawing in the supply documentation.

1. Install the evaporator on the discharge side of the pump.

2. Arrange a dirt trap immediately upstream of the evaporator (recommended mesh size 1.25 mm, upstream of solenoid/water valves 0.5 mm).

3. The coolant quantity should be constant.

HEAT CARRIER SYSTEM

After the cold-water unit is aligned, it can be connected at the heat carrier side. The piping for the heat carrier connections must be installed by the system erector on site.
The unit is mounted on vibration isolators, therefore the connections of the water piping to the condenser must be flexible. For size and position of the water connections to the condenser, see the drawing in the supply documentation.

1. Install the condenser on the discharge side of the pump.

2. Arrange a dirt trap immediately upstream of the condenser (recommended mesh size 1.25 mm, upstream of solenoid/water valves 0.5 mm).

3. Check the water quality.

WATER TREATMENT

Industrial water mostly contains dissolved or solid components which cause corrosion or deposit or encourage algal growth. The water for the condenser and evaporator circuits should be treated chemically to reduce undesired effects.
To avoid cost rises for the removal of layers of dirt or the replacement of corroded parts, a water treatment specialist should be consulted. He can help avoid extensive damage.

WATER PIPING

1. All pipes must be installed with flexible connection separate from the unit. Pipe connections on the unit must not be exposed to additional static/dynamic loads.
2. Make sure that vibration can not be transmitted.
3. Provide charging/discharging facilities.
4. Rinse pipes before connection to remove dirt and welding beads.

REFRIGERANT PIPING

FX GCW

1. Units of the FX GCW series are delivered with complete refrigerant piping, tested and with nitrogen charge.
2. The blow-off lines for the safety valve must be installed and connected by the client.

FX GCA/E

1. The refrigerant piping of the evaporator is factory-tested, sealed and charged with nitrogen.
2. The pressure line connection between compressor and condenser and the liquid line between condenser and evaporator injection must be installed, connected and tested by the client.
3. The blow-off line for the safety valve must be installed and connected by the client.

ELECTRICAL INSTALLATION

The cold-water unit has been designed for plug-in and reliable automatic operation.

1. All connections must be made as required by the current installation guudelines.
2. Connections on the unit should be flexible and must be free of loads.
3. Feed cross sections should be dimensioned to DIN VDE 100 part 520.

All connections and almost all external terminals are factory-wired.
Some external components, such as the second emergency stop switch, the ammonia sensor, the water pump flow monitor and the fans of the machine house, must be connected by the plant erector on site.

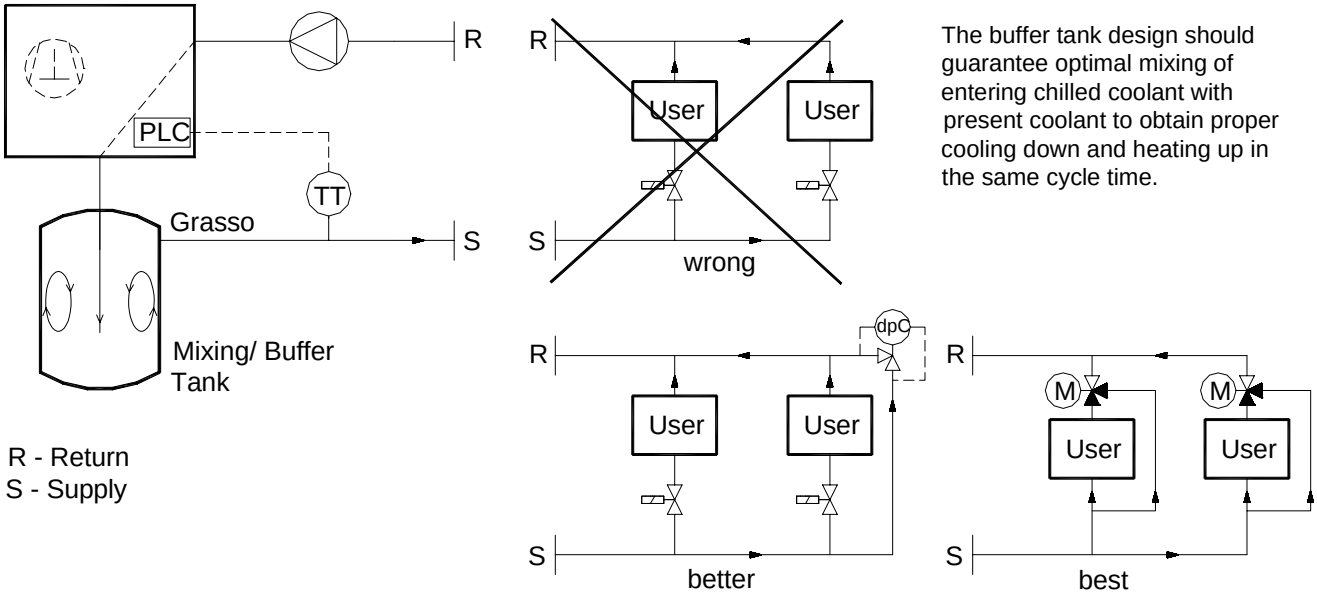
COOLANT SYSTEMS ON RECIPROCATING CHILLERS

Capacity control on reciprocating chillers is stepwise, thus the coolant temperature will react in the same manner.
When the system content is large enough, temperature control is usually done on the return flow.
The required coolant system content is a function of:

- cooling capacity per capacity step
- allowed restart time of compressor drive motor
- temperature control requirements

(see buffer size calculation.)
Close control of coolant supply temperature is only possible if a proper sized buffer is fitted in the chiller outlet.

SINGLE CHILLER, SINGLE-PUMP SYSTEME

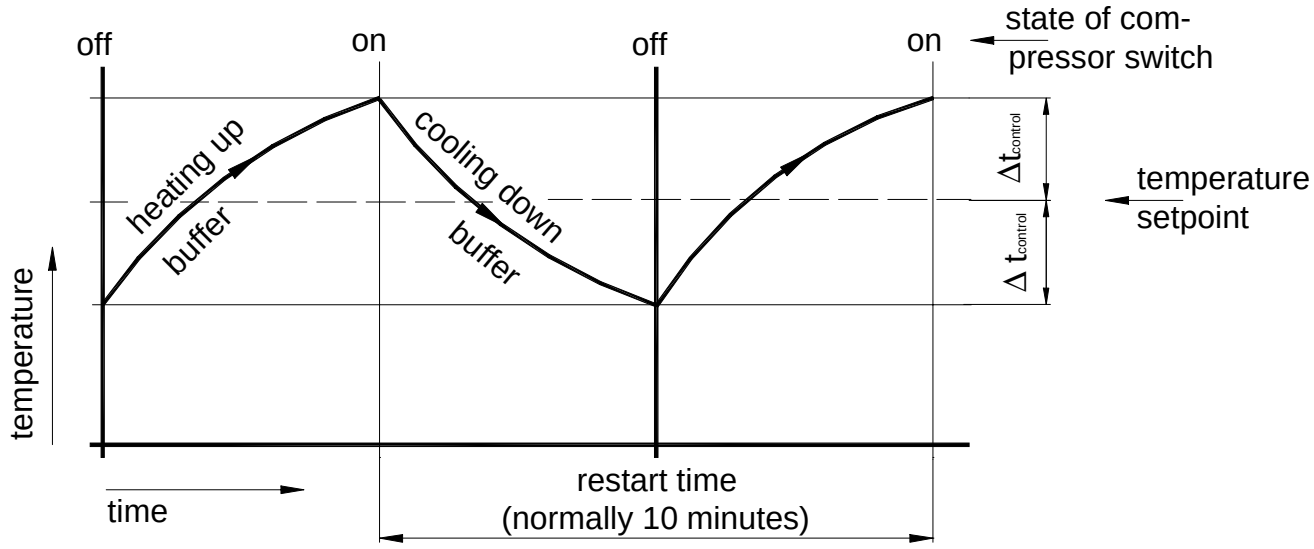


The buffer tank design should guarantee optimal mixing of entering chilled coolant with present coolant to obtain proper cooling down and heating up in the same cycle time.

Theory behind sizing mixing/buffer tanks

To prevent overheating of the compressor motor, starts should be limited to a maximum of 1 per 10 minutes. Installing a mixing/buffer tank guarantees accurate coolant outlet control.

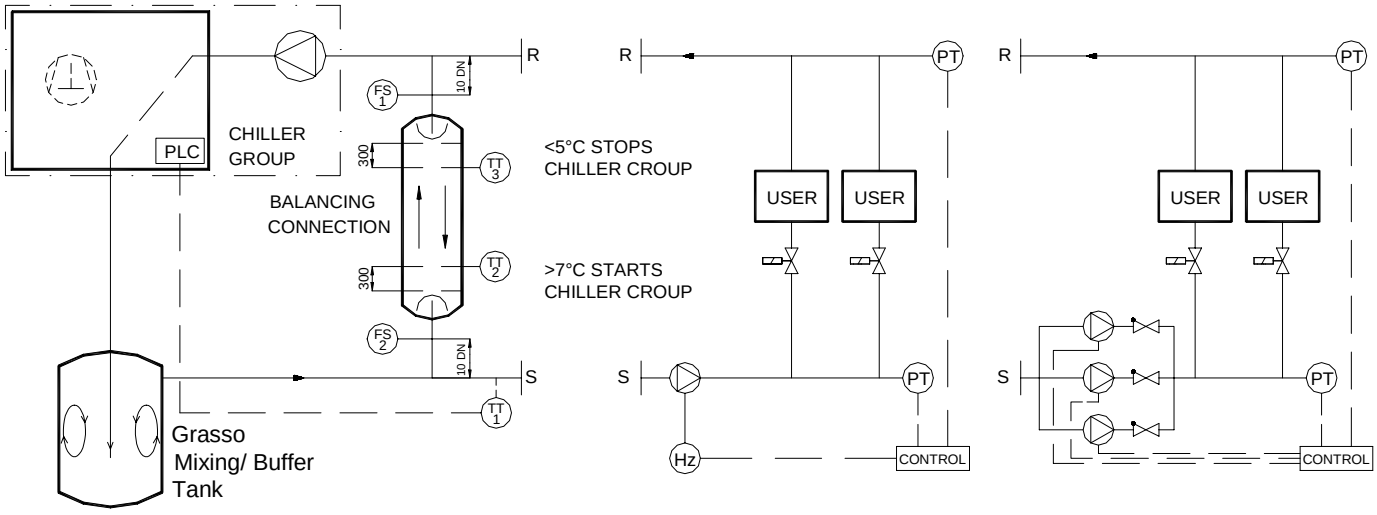
$\frac{M_{Buffer}(kg) \cdot Cp_{Coolant}(kJ/kgK) \cdot 2 \cdot \Delta t(K) = Oo_{min}(kW) \cdot (\text{restart time})(s)}{2}$		(kJ)
Qo_{min} is minimum cooling capacity before switching off		(kW)
M_{Buffer} =	$V_{Buffer}(m^3) \cdot p_{Coolant}(kg/m^3)$	(kg)
$V_{Buffer\_required}$ =	$\frac{Qo_{min} \cdot 150}{P_{Coolant} \cdot Cp_{Coolant} \cdot \Delta t}$	(m^3)



SINGLE CHILLER, DOUBLE-PUMP SYSTEMS

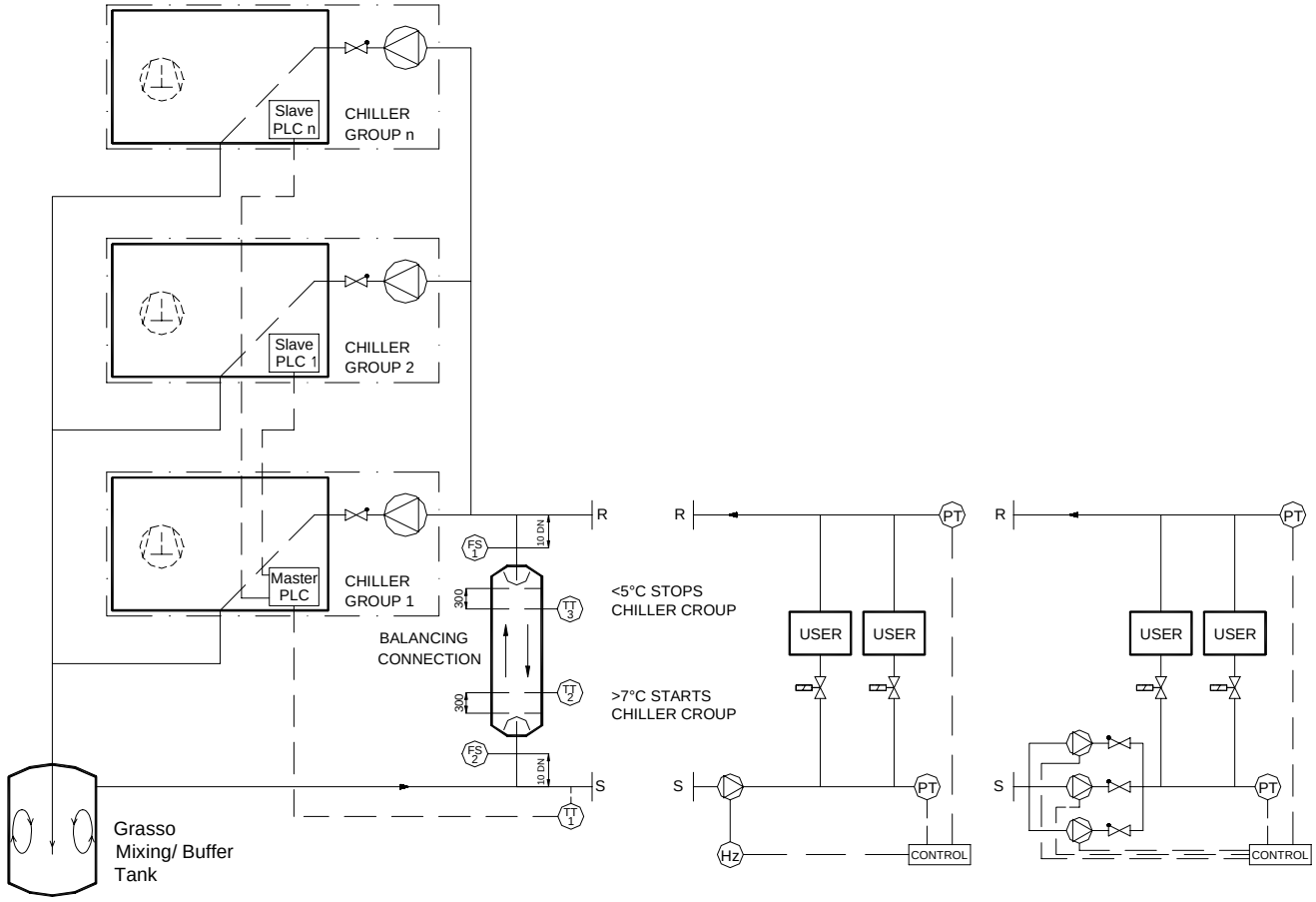
Chiller system independent of user system by balancing connection.
NOTE:
Take care that chiller pump flow is always larger than the total of the user pump flow (at least 20 %).

R - Return
S - Supply



MULTI CHILLER, DOUBLE-PUMP SYSTEMS

Chiller system independent of user system by balancing connection.



NOTE:

Take care that chiller pump flow is always larger than the total of the user pump flow (at least 20 %).

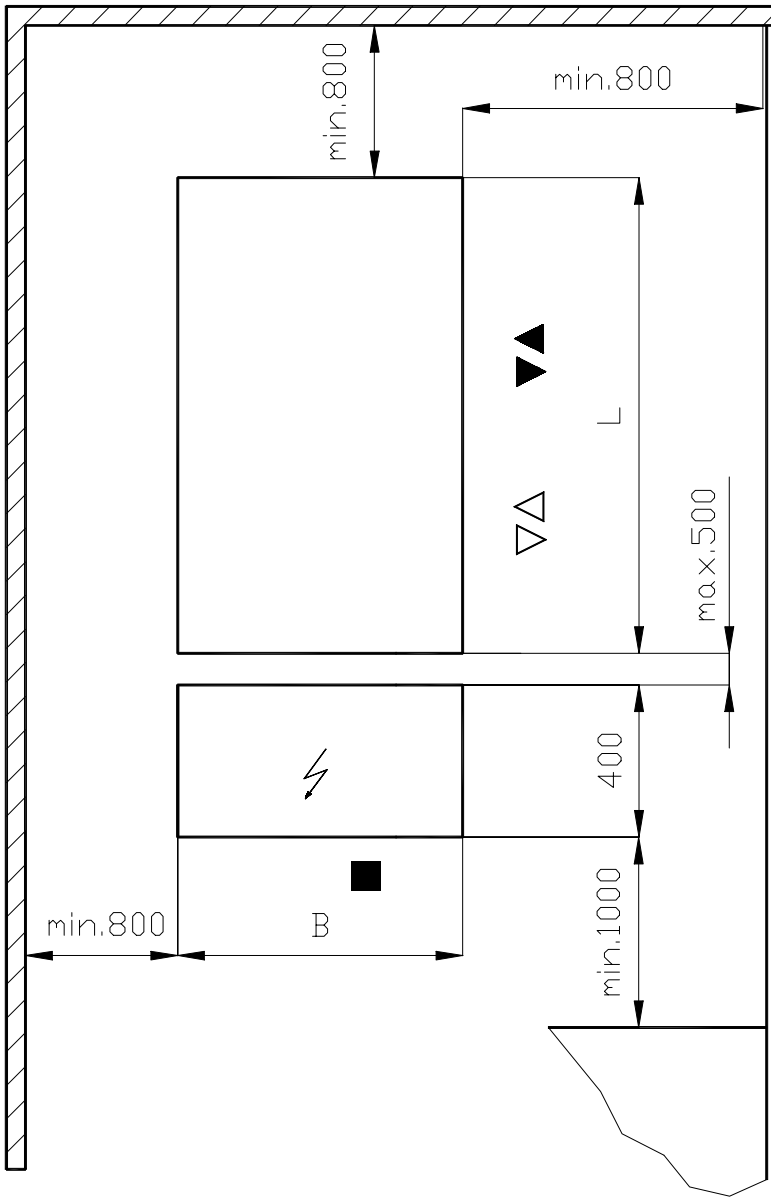
On the contrary to the mixing tank, the balancing connection should guarantee laminary flow to obtain stratification 0f the warm- and cold coolant. The inlets should be executed in such a manner that no impulse will be introduced and the coolant velocity in the tank should be less than:

$$V < \frac{2300 \times \vartheta\ (m^2/s)}{d_{Vessel}\ (m)} \quad (m/s)$$

ϑ is kinematics viscosity of coolant.

By measuring the chilled coolant temperature at TT1, chiller capacity is controlled. Due to less users the user flow will decrease, thus the dominant chilled coolant flow will create an upflow in the balancing connection. When at minimum capacity the setpoint minus Δt is reached TT3 will switch off one chiller group. When the user flow increases, due to is dominance it will create a downflow in the balancing connection. When the warm return coolant, at a temperature of setpoint plus Δt, reaches TT2 one chiller group will be switched on.
Summarising: TT1 takes care of chiller capacity control and TT2 & TT3 take care of switching on & off the chiller group.
There's a problem when both user and chiller flows are equal and supply temperature is to low. (This can occur f.e. when the user pump control is defective.) Temperature in balancing/connection stays constant, TT2 & TT3 do not react and chiller keeps running at lowest capacity. Only in this case TT1 can switch off the chiller group the permission given to do so comes from flowswitches 1 and 2, they must be in no-flow position!

FOUNDATION PLAN FX GCW



■ Main operating (control cabinet) side

◁ Coolant connections for evaporator

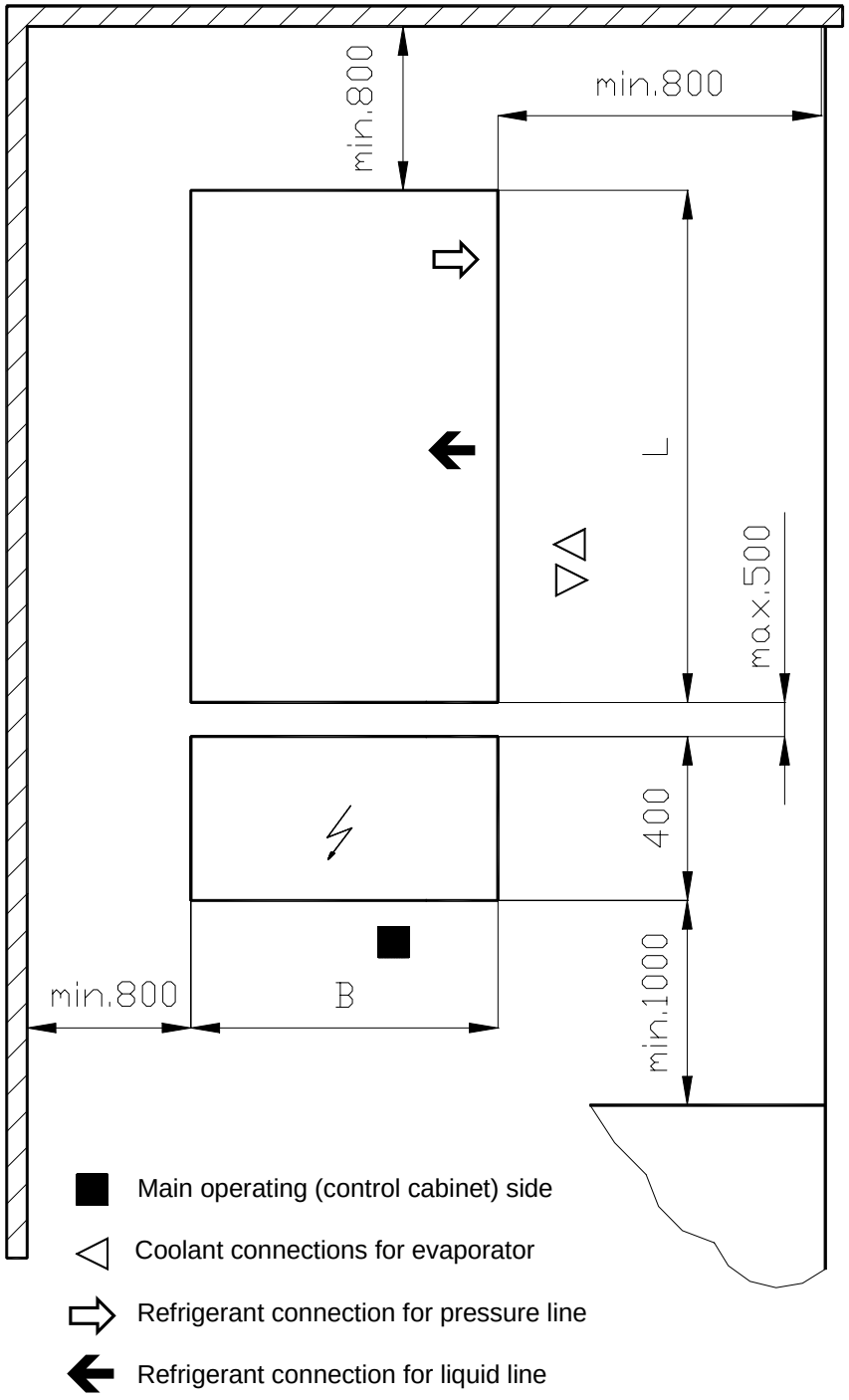
◀ Heat carrier connections for condenser

Dimensions for B and L, see chiller unit leading dimensions

Allow for maintenance space of 0.8 m above set.
(For unit height, see leading dimensions)

Allow for suitable clearance to operate lifting gear when dismantling components for repair.

FOUNDATION PLAN FX GCA / GCE

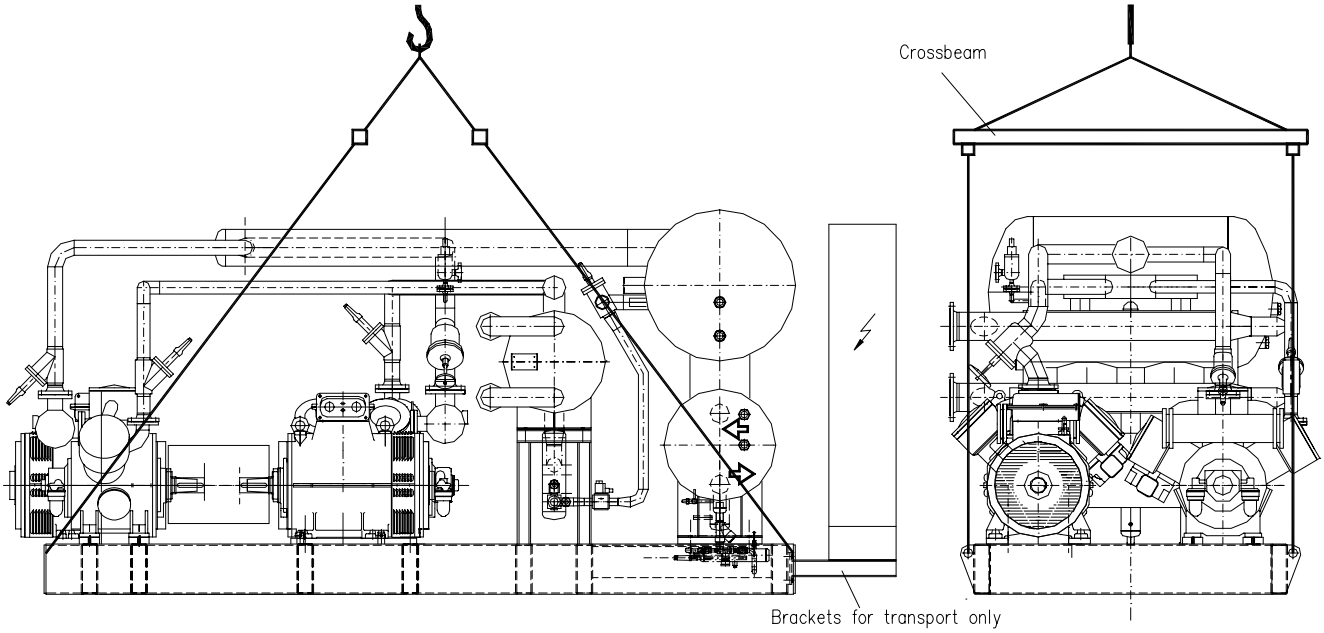


Dimensions for B and L, see chiller unit leading dimensions

Allow for maintenance space of 0.8 m above set.
(For unit height, see leading dimensions)

Allow for suitable clearance to operate lifting gear when dismantling components for repair.

TRANSPORT INSTRUCTIONS FX GC



Lifting tackle:
4 sling bands with shackles
Sling bands to suit DIN 61360 and unit weights
Loops should be so arranged as to avoid damage to components when lifting the unit
(use crossbeam if necessary)

COLD WATER UNIT MAINTENANCE PLAN

The following maintenance plan specifies the run hours after which maintenance work is required. The cold water unit must be switched off for most maintenance activities. To avoid switching off the cold water unit when its capacity is needed, maintenance should be undertaken preferably during regular downtime. The reduce maintenance cost, the maintenance plan provides for several activities being carried out at the same time.
It is recommended to maintain the cold water unit once every year irrespective of the run hours.
The system erector/client should carry out maintenance of the cold water unit as specified in the enclosed plan.

- After 50 hours:
  Change the lubricating oil and carry out 50-hour maintenance (see compressor manual)
- Replace the throw-away suction gas filter on the compressor with the supplied replacement filter after maximum 100 hours.
  Check the tightening torques of the coupling pins.
- Every 2,500 hours:
  Inspect and maintain the cold water unit
- Every 10,000 hours:
  Carry out general inspection and maintenance of the cold water unit

REGULAR MAINTENANCE

2,500-hour (or annual) maintenance:

a. Inspect and maintain the compressor (see compressor manual)
b. Inspect the level surface of the cold water unit (adjust vibration isolators if necessary)
c. Inspect water piping flanged connections for stress

10,000-hour maintenance:

a. Carry out the 2,500-hour maintenance
b. Carry our general inspection of the compressor and maintain compressor as described in the compressor manual.

INSTALLATION REQUIREMENTS

The selection of the suitable installation site of the chiller should consider the following aspects:

- There should be no danger that the equipment can be damaged by in-plant transport and handling operations.
- Sufficient space must be available for visual inspection and maintenance work on the equipment.
- The floor on which the equipment is set up must be such that ammonia and oil cannot seep in the ground.

Additional requirements for the setting-up and ensuring the safe operation of ammonia chillers are contained in the accident prevention directive "Refrigerating systems, heat pumps and chillers" BGVD4, (see §16).

For further information regarding the situation in the machine house, please consult our brochure "Machine house situation and charge volumes for NH_3 refrigeration systems complying with UVV ".

PERSONAL PROTECTION

The employer must provide personal protection equipment to protect from refrigerant. The personal protection equipment must be stored in ready-to-use condition at a place with easy access outside the danger area.

Protection equipment must be available at least for 2 persons.

Protection equipment for ammonia:

- gloves
- eye protection
- breather with filter

Safety systems:

To ensure a high level of safety against leaking ammonia

- ammonia warning systems and
- absorption systems

can be ordered.

4

SPECIFICATION

Contents

LIQUID CHILLERS WITH SEMI-HERMETIC RECIPROCATING COMPRESSORS AND NH_3 REFRIGERANT

Type : FX GC

1 **Basic version** (standard)

1.1 Scope of supplies

- self-contained factory-tested compact unit
- components, features, workmanship to Grasso standards
- connecting flanges without mating flanges
- suitable for installation indoors
- fully automatic operation, capacity control in several stages
- permissible indoor temperature +5°C to 40°C
- safety features to : UVV(BGVD4), EN378, pressure devices directive, VDE;
- without refrigerant, without oil charge
- control and power cabinet
- color code for unit: hammer-blue, control cabinet: RAL (pebble gray)
- documentation: one copy (English)

1.2 **Description of main components** (for 1 unit)

1.2.1 Compressor
- open, single-step piston compressor with:
  reduced starting load, oil heater, suction filter, overflow valve, safety pressure limiter;
- capacity control in steps by cylinder startup/shutdown
- air-cooled cylinders

1.2.2 Motor
Standard motor with winding shield;
- 4-pole, IP23, voltage/phases/frequency 400/3/50 Hz
- star-delta starting

1.2.3 Evaporator
- pressure vessel acc. to DruckbehV pressure vessel directive, with blow-off safety valve mounted in suction line or separator;
- with CE label, other certification on request;
- circular heat exchanger plates made of AISI 316L, special steel welded hermetically into cylindrical casing made of St 35.8
- operating pressure: 16 bar on refrigerant side, 10 bar on coolant side
- diffusion proof elastic thermal insulation

1.2.4 Condenser (only GCW)
- pressure vessel acc. to DruckbehV pressure vessel directive, with blow-off safety valve;
- with CE label;
- circular heat exchanger plates made of AISI 316L, special steel welded hermetically into cylindrical casing made of St 35.8
- operating pressure: 23 bar on refrigerant side, 10 bar on coolant side

1.2.5 Refrigerant circuit
- factory tested for pressure/tightness and dehydrated
- steel piping
- diffusion proof elastic thermal insulation for suction line
- fittings: shutoff valves in the pressure, liquid and suction lines, filter in the liquid line (GCA/GCE), safety valves, electronic injection valve, service valves;

1.2.6 Control/power cabinet
- fully wired, degree of protection IP 54, internal control voltage/frequency: 230V/50 Hz
- lead-in for power supply and client's control lines from below
- cubicle door with pocket for diagrams showing circuitry and terminals

1.2.6.1 Control section
- stored-program control (SPC)
- digital outputs (potential-free contacts) for:
  - coolant/heat carrier pump control
  - remote control
  - flow control, can be looped in
- operating panel with
  - function keys for manual/automatic operation, etc.
  - keys for calling fault reports/messages, altering control parameters, updating dates/times, programming time-switch clocks, acknowledging faults when repaired, input/output status indication
  - four-line display for 20 characters/line
- LED display for ON/OFF, alarm, menu selection

SPC functions:
- control of coolant outlet (or inlet) temperature in automatic mode
- restart following power failure (but not faults)
- monitoring of
  - compressor motor switching frequency
  - compressed gas/motor winding temperature
  - overpressure, low pressure, oil pressure
  - coolant outlet temperature
- indication of operating conditions such as
  - high/suction/oil pressure
  - running time (hours)
  - coolant outlet (or inlet) temperature
  - operating mode
  - unit fault as group fault signal to be displayed via keyboard
  - unit capacity utilization
  - deficient starting conditions

1.2.6.2 Power section

Major components:
- main switch, emergency stop switch
- fuses, full motor protection, overcurrent relay
- contactor combination for star-delta starting of compressor drive motor

1.2.7 Accessories
- vibration dampers (loose supply).

2. Technical data (for 1 unit)

2.1 Evaporator

No. of evaporators	pcs.	1	
Unit refrigerating capacity	Q_O	kW	
Coolant inlet	t_{K1}	°C	
Coolant outlet	t_{K2}	°C	
Coolant volume flow rate	V_K	m³/h	
Coolant pressure loss	dp_K	bar	
Coolant			
Coolant connection	DN_K	mm	**to be connected by client**

2.2 Condenser (GCW)

No. of condensers	pcs.	1	
Condenser capacity	Q_C	kW	
Heat carrier inlet	t_{W1}	°C	
Heat carrier outlet	t_{W2}	°C	
Heat carrier volume flow rate	V_W	m³/h	
Heat carrier pressure loss	dp_{W1}	bar	
Heat carrier			
Heat carrier connection	DN_W	mm	**to be connected by client**

2.3 Compressor (technical data per pc.)

No.	pcs.	1	
Type		Grasso	
Condensation temperature		°C	
Electrical power consumption	P_{KI}	kW	
Capacity control	LS	%	
Motor speed	n_{synch}	min^{-1}	
Voltage/phases/frequency	U/-/f	V/Ph/Hz	
Nominal current for circuit	I_n	A	
Starting/nominal current	I_a	A	

2.3 Unit

No. of circuits	pcs.	1	
Capacity control	LS	%	
Dimensions:			
- length	L	mm	
- width	B	mm	
- height	H	mm	
Weights:			
- transport weight	m_T	kg	
- refrigerant charge	m_{NH3}	kg	
- oil charge	$V_{Öl}$	l	

3 Options (additional price)

Replacement of standard components, if applicable also in the supply contract / extended scope of supplies.

3.1 Compressor

3.1.1 Compressor cooling: water-cooled for max. part-load step for a combination of lowevaporation temperature and high condenser temperature;

3.2 Motor

3.2.1 Special voltage: 500 V
3.2.2 Pole-reversing 3-phase motors ;
3.2.3 IP 55 drive motor;
3.2.4 Explosion-proof 3-phase motors;

3.3 Evaporator

3.3.1 Heat exchanger plate material: please inquire

3.4 Condenser

3.4.1 Heat exchanger plate material: please inquire

3.5 Refrigerant circuit

3.5.1 Gauge board for high/suction/oil pressure

3.6 Control section

3.6.1 Remote adjustment of setpoint
3.6.1.1 Sliding adjustment of setpoint (analog input, 4 – 20 mA or 0 – 10 V)
3.6.2 Serial interface
3.6.2.1 Linking control systems of equal type
3.6.2.2 Linking with external systems, Profibus
3.6.3 Modem for remote diagnosis

3.7 Power section

3.7.1 Power switch used as main switch
3.7.2 External emergency stop can be looped in
3.7.3 Direct startingSoftstarter;

3.8 Accessories

3.8.1 Flow rate monitor for heat carrier (supplied loose for connection by client)
3.8.2 Thermostat to prevent freezing