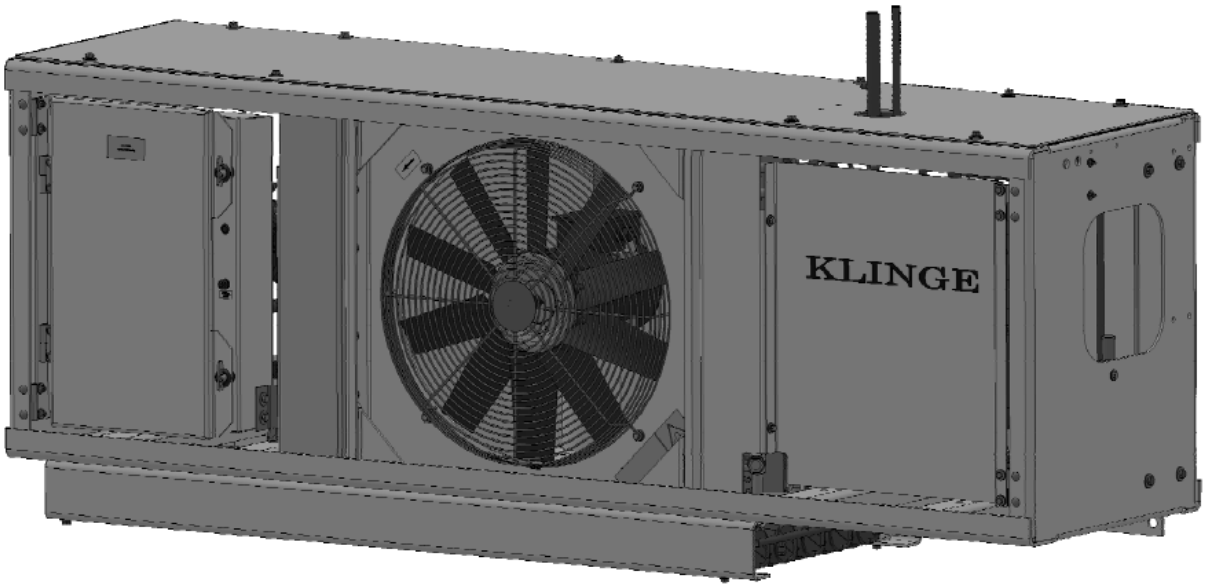
MODEL NMF-371-S

OPERATION, SERVICE AND PARTS MANUAL



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REVISION RECORD

Rev	Description	Date	Approved
B	Added Serial Numbers Registration (page 3) and Servicing Schedule (page 34)	2016/08/24	BES
C	8 Amp circuit breaker was 5 Amp (page 11), updated electrical schematic (page 13)	2017/03/13	BES
D	Updated information at "Compressor Lubrication" (page 27), defrost interval was 4 to 99 hours (page 9)	2017/09/26	BES
E	Updated piping diagram (page 8), added relief valve to R23 system (page 29), re-numbered Section 7.13 through 7.16	2017/10/18	BES
F	Updated cover, revised manual part number (was K35-06555-10), added Service and Spare Parts information (pg 4)	2018/03/05	BES
G	Updated Piping Diagram and Electrical Diagram	2023/07/14	BES

Service Request

Requests for Service should be directed to the Klinge Service Team. The below link should be used to place all requests for service and will afford the quickest response time.

https://klingecorp.com/request-service/

This form will help us determine model and age of the equipment, location, basic details about the issue, who to contact and how to best handle the issues with the equipment. A service ticket number will be provided in a response email once the form is received and processed. If the equipment is out of warranty, charges may apply for extensive technical support.

Additionally, our Service Department can be reached via email at technical@klingecorp.com.

Spare Parts Request

Requests for Spare Parts should be directed to our Parts Department via email at spares@klingecorp.com. Please have available at the time of the request the Serial Number of the equipment to ensure that the proper part is provided.

Use of this Manual

The use of this manual is intended for the safe operation of the equipment described. It is therefore reasoned that persons who have the occasion to use this manual have a knowledge of mechanical and electrical systems and components addressed by its' contents. However, efforts have been made to enable persons less familiar with these systems to use this manual.

The equipment may be installed in a number of configurations. Each may have optional items and differing external details provided by third parties. The specific electrical circuit and pipe diagram are posted on the unit as decals.

Most external and internal pipework parts are standard commercially available pipe fittings and not covered here. For external pipe fitting, replace like for like, taking care to replace stainless steel with stainless steel.

Suggestions as to improvement in content and format are welcome and should be addressed to engineering@klingecorp.com. Corrections and improvements will be included on dated revisions – the latest of which will be available upon request.

Table of Contents

SECTION 1. GENERAL DESCRIPTION

The **NMF-371-S** Unit (**N**ose **M**ounted **F**reezer) is designed especially for mounting in customer built-in rooms or on standard insulated containers. The unit can provide cargo temperature in the range from 0°C to -65°C.

The unit operates in ambient temperatures up to +50°C.

The unit is designed to maintain temperatures in the container by automatically heating, cooling, and defrosting during operation. Power for the unit is 400/460 volt 3-phase, 50/60 Hz. Control circuit power is reduced to 24/28volt AC.

The NMR-371-S can best be described as a “cascade” system with one high temperature system (compressors 1 & 2, running on R134a), and one low temperature system (compressor 3, running on R23) (See Section 2.). These two systems share a common heat exchanger.

The control box consists of all necessary components, fuses, and relays for operation of the unit.
A phase sequence sensor and reverse relay are installed to reverse two of the phases in order to ensure the correct rotation of the compressors, regardless of incoming phase sequence.

An electronic microprocessor controller controls the temperature in the box/container.

The Defrost function can be initiated in a number of ways using the controller:

- A timer can be set for recurring defrosts.
- An “on-demand” defrost will be initiated by the controller as noted later in this manual.
- A manual (operator-initiated) defrost can also be run from the display panel.

The termination of defrost occurs automatically when the temperature of the defrost sensor rises to the pre-set limit (can be set from +5° to +30°C). The unit will then automatically restart.

The defrost operates on hot gas in the Evaporator coils.

The unit can be delivered as a complete assembled unit, complete with full charge of refrigerant, compressor oil, factory tested and ready for operation after installation on a container or cold room. Or the unit can be delivered as a split system, the refrigerant charge and final system testing would take place upon installation on a container or cold room.

OPTION.
For operating on 200/230 volt, 50/60Hz, a dual voltage transformer can be supplied.

SECTION 2. REFRIGERATION SYSTEM

2.1 REFRIGERANT R134a

High temperature system, compressors 1 & 2

R134a has an ozone depletion potential (ODP) at zero.
Systems using R134a require ester synthetic compressor oil.

A moisture indicator is installed in the liquid line immediately after the filter-drier to indicate if there is moisture in the refrigerant charge.

The element, located in the center of the indicator, will change color on contact with moisture in the refrigerant passing over it.

A dry system will be indicated by a dark green color; a wet system will show from a yellowish green to bright yellow, depending on the amount of moisture in the system. A colored leak-detecting agent, added to the refrigerant, will permanently discolor the indicator, and should therefore not be used. The moisture indicator element will also become discolored if a compressor motor burn-out occurs, and should be replaced after the system has been cleaned out.

The following is a brief explanation of a few of the components in the system and their functions.

The condenser fans move air across the condenser coil surface for the purpose of removing heat.

The primary side of the heat exchange (R134a/R23) is the evaporator coil on the high temperature system (comp.1 & 2).
The purpose of the heat exchange (R134a/R23) is to remove heat from the low temperature system.

The purpose of the compressor is to provide a high temperature, high-pressure vapor to the condenser coil so that heat can be removed with the ambient temperature air. At the same time this causes a pressure differential between parts of the system and creates a flow pattern.

The expansion valve is a device, which provides liquid to the heat exchanger as required. It is important to remember the parts of the system that are subject to high-pressure and low-pressure refrigerant. The high pressures will be accompanied by high temperatures, and the low pressures will be accompanied by low temperatures.

The common terminology used for these parts of the system is "the high side" and "the low side". The area from the discharge side of the compressor to the inlet side of the expansion valve is referred to as the high side. The area from the outlet side of the expansion valve to the suction side of the compressors is referred to as the low side.

2.2 REFRIGERANT R23

Low temperature system, compressor 3

R23 has ozone depletion potential (ODP) at zero.
Systems using R23 require ester synthetic compressor oil.

A moisture indicator is installed in the liquid line immediately after the heat exchanger to indicate if there is moisture in the refrigerant charge.

The element, located in the center of the indicator, will change color on contact with moisture in the refrigerant passing over it.

A dry system will be indicated by a dark green color; a wet system will show from a yellowish green to bright yellow, depending on the amount of moisture in the system. A colored leak-detecting agent, added to the refrigerant, will permanently discolor the indicator, and should therefore not be used. The moisture indicator element will also become discolored if a compressor motor burn-out occurs, and should be replaced after the system has been cleaned out.

The following is a brief explanation of a few of the components in the system and their functions.

The secondary side of the heat exchange (R134a/R23) is the condenser for the low temperature system (comp.3).
The purpose is to move heat from the low temperature system to the refrigerant in the "high temperature system" which then will dispel the heat via the external condenser coil.

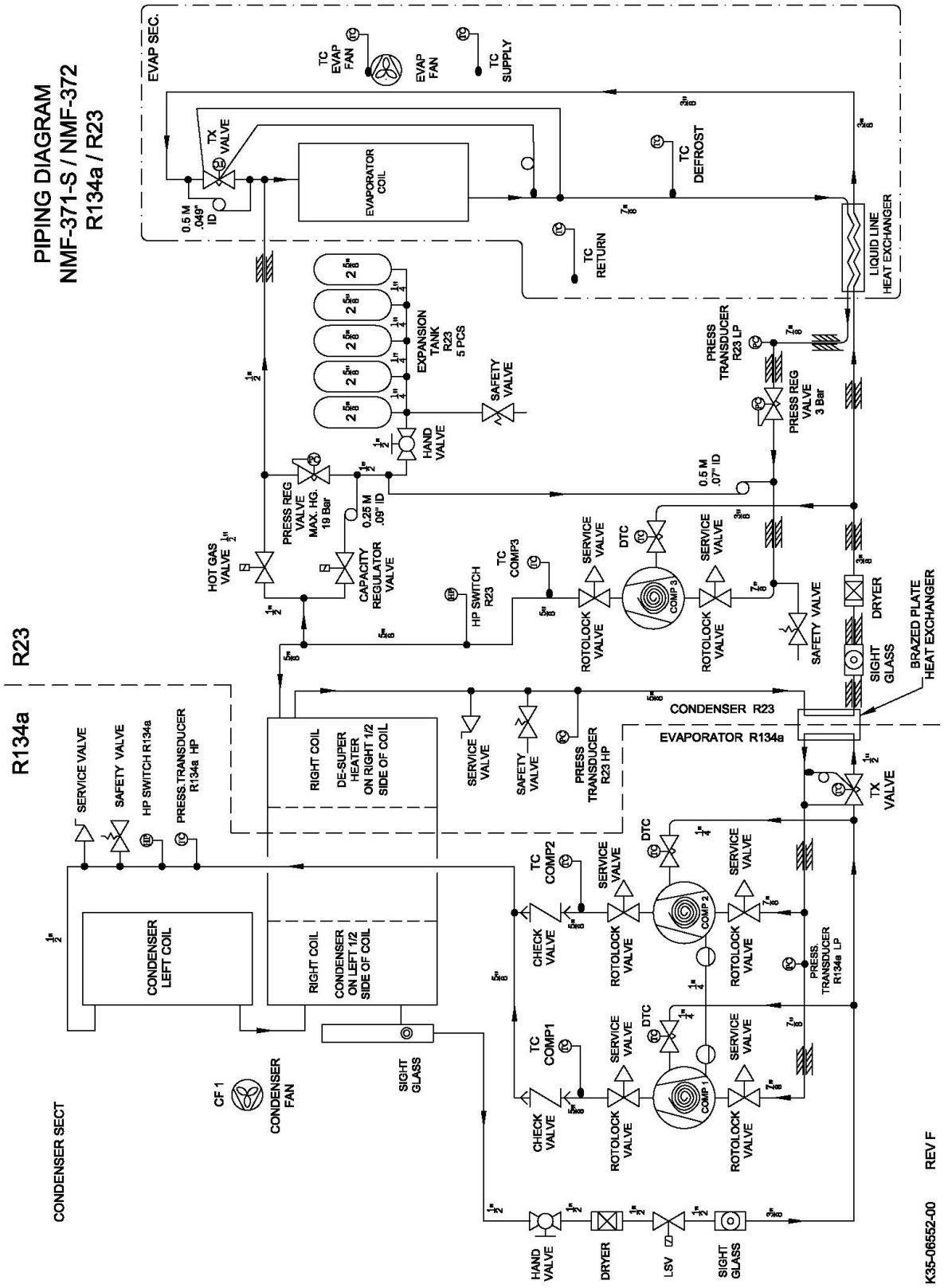
The evaporator fans move air across the evaporator coil for the purpose of removing heat from cargo area.

The purpose of the compressor is to provide a high temperature, high-pressure vapor to the condenser coil so that heat can be removed with the heat exchanger surface (evaporator comp.1 & 2-condenser comp.3). At the same time this causes a pressure differential between parts of the system and creates a flow pattern.

The expansion valve is a device, which provides liquid to the evaporator coil as required. It is important to remember the parts of the system that are subject to high-pressure and low-pressure refrigerant. The high pressures will be accompanied by high temperatures, and the low pressures will be accompanied by low temperatures.

The common terminology used for these parts of the system is "the high side" and "the low side". The area from the discharge side of the compressor to the inlet side of the expansion valve is referred to as the high side. The area from the outlet side of the expansion valve to the suction side of the compressor is referred to as the low side.

2.3 UNIT PIPING DIAGRAM



3.1 GENERAL INFORMATION

DO NOT REMOVE ANY COVER PLATES TO ROTATING PARTS BEFORE TURNING OFF POWER AND DISCONNECTING THE POWER PLUG.

To understand the operation of the electrical and refrigeration systems on the NMF-371-S unit, there are several things which must be noted:

1. The main electrical operating power is 400/460 volt +/-10%, 3-phase, 50/60Hz +/-2.5%
2. The NMF-371-S can best be described as a “cascade” system with one high temperature system (compressors 1 & 2, running on R134a.) and one low temperature system (compressor 3, running on R23.) (See Section 2) These two systems share a common heat exchanger.
3. When the power is switched "ON", the unit will start up with specific delay timer functions from the microprocessor controller. (See Section 5)
4. There are two circuit breakers protecting the electric system. One protects the main line 400/460 volt, 3-phase power, and the other protects the 24/28volt control circuit.
5. The high-pressure switches are located in the port / pipe of each compressor respectively, and are reset automatically.
6. All compressors are protected with overheat sensor controls monitored by the microprocessor controller.

3.2 PRE-STARTING

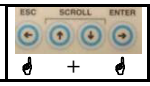
The following inspections should be made as part of a pre-trip inspection before the container is loaded.

1. Check the unit visually for physical damage.
2. Visually check all major hold-down and mounting bolts to ensure proper function.
3. Check that the control boxes are properly secured in their locked positions.
4. Open the control box cover and check that all electrical components are secured and that the terminal connections are tight.
5. Check the gasket on the control box cover and that the control box latches will hold the cover tightly closed.
6. Check the cleanliness of the condenser coils and clean if necessary.
7. Check all the refrigerant joints and connections thoroughly for traces of oil, which could be caused by a small refrigerant leak.

3.3 STARTING CHECK

1. Connect the main power plug with the receptacle to supply power to unit.
2. Be sure that the CB circuit breakers in electrical box are in the “ON” position.
3. Switch ON/OFF switch to "ON". (Note: There will be a timer delay for start.)
4. As soon as the unit starts, scroll down in the Display menu to see the high and low-pressure in the refrigerant system. Check the pressure in the R23 system, if the pressure is 200 to 230 psi the unit is operating at the correct pressure. Some quick functions to see pressures and temperatures in the system are noted below:

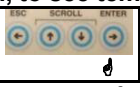
Quick function, to see Pressure:

ⓘ PRESSURE		R23 X.XX XX.XB R134a X.XX XX.XB

(Display shows low – and high-pressure for R23/R134a.)

▼

Quick function, to see temperature:

ⓘ PRESSURE		R23 XX.X XX.X °C/F R134a XX.X XX.X °C/F

(Display shows temperature for refrigerant R23/R134a.)

5. Adjust the set-point to be lower than the box temperature. The set-point can be set from 0° to -65°C.
6. Check the defrost interval (set under "config" in the display menu). The defrost interval can be set between 3 to 99 hours. The factory setting is 24 hours.
7. Check the defrost termination temperature (set under "config" in the display menu). The defrost termination temperature can be set from 5° to 30°C. The factory setting is 14°C.
8. Check log (data logger) interval (set under "config" in the display menu). The interval can be set from 6 to 60 minutes. The factory setting is 15 minutes.
9. Start “Run auto test” (start in "commands" in the display menu). The unit will run the auto test and check amperage on all motors. The unit will go into normal operation after test.
   See Section 5.2 Controller for info about auto test
   (If there is a motor failure indicated, see event log.)
10. Check the difference between "Return Air" RT and "Supply Air" SU temperature sensors in display. The difference should be between 3° to 7°C.
11. Check refrigerant level on "high temperature system" (R134a) in the sight glass after approx. 15 minutes of continuous running.
12. Check defrost.
    Check defrosting termination function. (See defrost sensor temperature in display.) See Section 5.3 for more info about defrost.
13. After the satisfactory completion of the above checks, adjust the set-point to the desired cargo temperature.

3.4 RUNNING UNIT

Having been started, and with the temperature set to the desired setting, the unit will now be controlled by the controller to reach the set-point temperature.
When the cargo temperature requires cooling, the compressors will run, and the condenser fan will operate to draw air over the air-cooled condenser coil. The cargo temperature will continue to pull down until it reaches set-point, at which point the compressors and the condenser fan motor will stop. The controller regulates cargo temperature via the “RETURN AIR SENSOR” mounted in the return air from the container.
The defrost cycle can be activated manually, or automatically by the controller.

The defrost cycle can be activated in 3 different ways:

1. Manual defrost.
This is operator-initiated from the display panel.

2. Recurring timer. (can be set from 3- to 99 hours)
This is set under "config" menu in the display. The factory setting is 24 hours.

3. On-Demand defrost.
When the unit is started, the first timer defrosting will begin after ¼ of the timer setting (timer set = 24 hour, first defrost = 6 hour), or the first time the return air temperature goes below –29° C (whichever comes first).

If the unit has been disconnected from power for more than 30 minutes, the timer setting will be reset.
The unit will also start a defrost if the supply air sensor registers a temperature more than 10°C lower than the return air sensor or if the defrost sensor registers a temperature more than 15°C lower than the return air sensor.

The defrosting of the coil and drain pan operates on hot gas from Compressor 3. The condenser fan and the evaporator fans stop during defrosting.

Defrost is automatically terminated when the temperature of the defrost sensor (Evap.temp.) rises to the preset limit (which can be set under the "config" menu in the display between +5° to +30°C). The factory setting is 14°C.

The controller will restart the unit if the defrost is not completed within the maximum defrost operating time selected by the user. The maximum time can be set under the "config" menu in the display at anywhere between 15 to 99 minutes. The factory setting is 45 minutes.

SECTION 4 - ELECTRICAL AND ELECTRONIC FUNCTION

4.1 GENERAL INFORMATION

When high voltage is being fed to the unit and CB 1 is in the ON position, the power will pass along L1, L2 and L3 to the line of the: Compressor relay (CMR1-CMR2-CMR3), Condenser fan relay (CFR), Evaporator fan relays (EFR) and the transformer.

Note:
Beware of high voltage (400/460volt) in various parts of the unit, it is recommended that a thorough study of the wiring diagram be made to determine where high voltage may be encountered when power is fed to the unit.

When the unit ON/OFF switch is placed in the ON position, the POWER ON light is lit.
The 28volt AC power from the transformer will pass along wires no. 01 and X2 through the circuit breaker CB 2, and continue in wires no. 02 and X2 to the control power. The 24volt power from the transformer will pass along wires no. 03 and 04 through the controller logic.

All wires are numbered on both ends.

4.2 ELECTRIC BOX

A. Circuit Breaker. (CB1).
The 32 amp circuit breaker incorporates three breakers, one for each line. It is reset manually and protects the entire unit against overload.
The circuit breaker is adjusted to 32 amps and must be manually reset when tripped.

B. Circuit Breaker. (CB2).
The 8 amp circuit breaker protects the 28volt control power in case of possible overload. The circuit breaker must be manually reset when tripped.

A. Compressor 1, motor relay. (CMR1)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the motor of compressor 1, and is energized by the controller.

B. Compressor 2, motor relay. (CMR2)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the motor of compressor 2 and is energized by the controller.

C. Compressor 3 motor relay. (CMR3)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the motor of compressor 3 and is energized by the controller.

D. Condenser fan motor relay. (CFR)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the condenser fan 1 motor (bottom fan), and is energized by the controller.

E. Evaporator fan motor relay. (EFR)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the evaporator fan motors and is energized by the controller.

F. Phase sensor relay. (PCR1 / PCR2)
3 poles, 460volt, and direct-in-line contactor with 28volt AC operating coil. It operates the change in rotation of motors in the unit, and is energized by the controller. Between the two relays a safety mechanical lock device is mounted to prevent both relays from being energized at the same time.

The primary windings are tied into the line from circuit breaker CB1. The secondary windings supply 28volts for the main control power, and 24volts for the controller logic.
The NMF-371-S includes a 3-phase current transformer which corrects the rotation of the fans/compressors in the unit (phase direction) and shows the actual current of the unit load in the display (see the "unit data" menu in the display).
To supply power to the controller in the case that the unit is disconnected from the main power, a 6volt rechargeable (Ni-MH) battery pack is installed in the system.
The microprocessor controller has a software program that can be used for multiple units. To indicate that the controller is used for the NMF-371-S unit, the controller has a resistor code installed (pin 6-8, 10-pole plug).
The resistor code for NMF-371-S is 1800 Ω.
If the resistor code fails, disconnect the resistor, and manually set the program code in the display, under the menu option "Control setting - System no." to system No. 22.

Note: Without a resistor code installed, the MPC3 controller will not automatically select the right program if you restore a new controller on the unit.

The microprocessor controller is based on the newest technology and not only controls the operation of the unit, but also collects temperature data for the data logger and data for event logging.

A. The controller includes 16 relay outputs and 16 analog input, a battery back-up for setting of set-point without starting the unit, and 7 sensors for measuring of unit data information.

B. Data logging. The data log interval can be set from 6 to 60 minutes. If the interval is set to 6 minutes, the data logger will store data for approximately 30 days before overwriting the oldest data. If set to 60 minute intervals, the data logger will store date for approximately 300 days before overwriting the oldest data.

C. Event logging. The event log contains all information related to the most recent 2000 events. (Main power on/off --defrost start/end--set-point change—alarm, etc.). This information can be referenced under the “data logger” menu in the display.

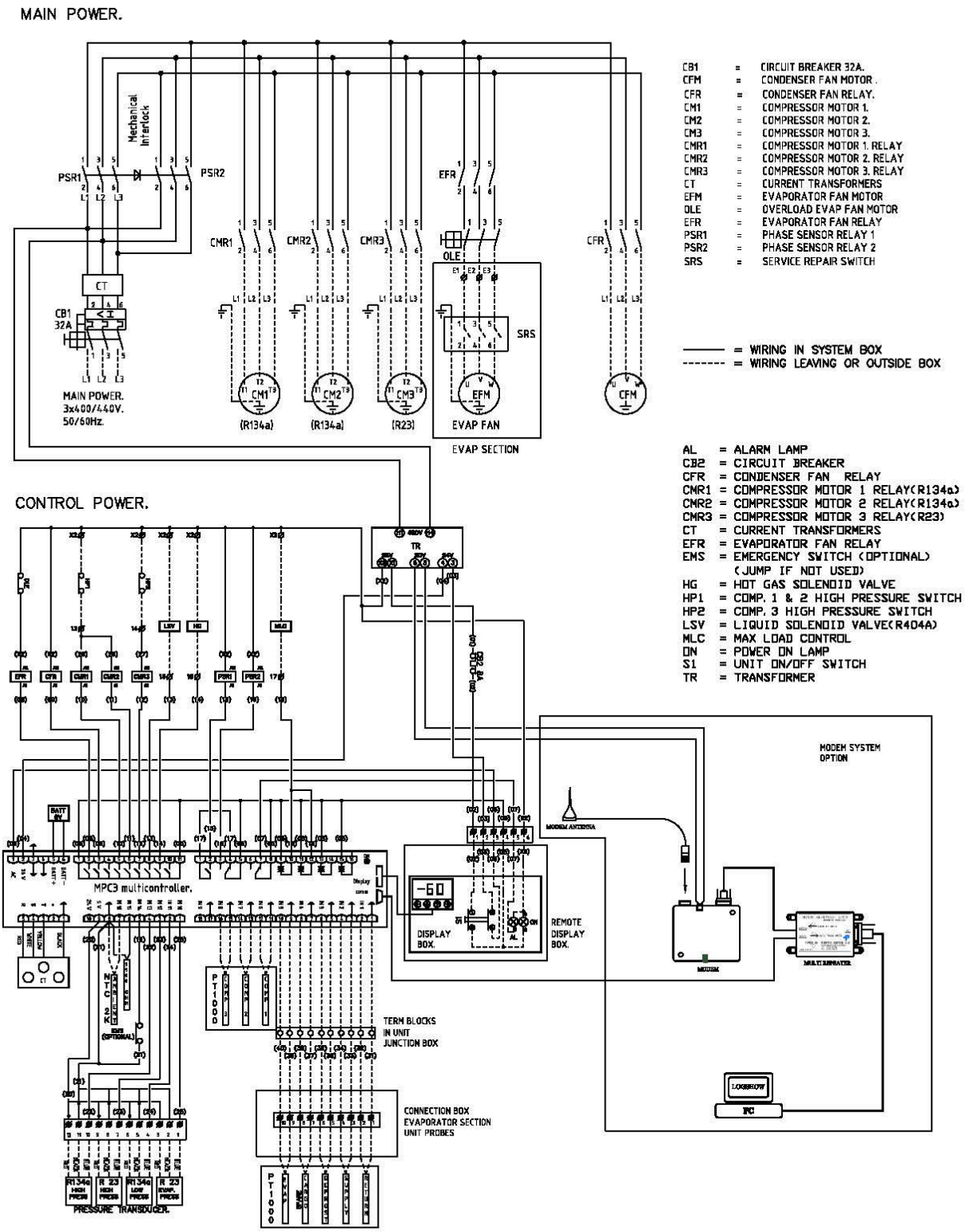
4.3 DISPLAY.

A. Power on. (Green)
An L.E.D. light indicates that power is on.

B. Alarm on. (Red)
An L.E.D. light indicates if there is any alarm coming from the controller. (See alarm information in display and troubleshooting Section 8.)

The display shows all information regarding temperature for all unit sensors, all data logged in data logger and all information for unit operating conditions.
The four keypad buttons are for setting temperatures and scrolling through unit data information.

4.4 ELECTRICAL DIAGRAM



SECTION 5. CONTROLLER INSTRUCTIONS AND SEQUENCE

5.1 GENERAL INFORMATION

The microprocessor controller system is based on the newest technology and consists of different parts:

1. The microprocessor controller.
2. The display/keypad.
3. Temperature sensors.

The controller is mounted in the electrical box, the display/keypad is mounted in the display panel box and all sensors are mounted in the unit.

It is recommended that a voltmeter or an ohmmeter be used for troubleshooting the system. Be careful as a short can cause damage to the electronic circuits. As control is related to resistance, an ohmmeter is required to check components.

The following will help you to understand the controller and troubleshooting this component.
PLEASE READ IT ALL CAREFULLY.

Several time delays are incorporated in the controller and are not adjustable. Details of the time delays are explained later in this section under, CONTROLLER.

The accuracy of the temperature probes is +/- 0.5°C maximum. Checking of temperature should be done with an instrument with equal or better accuracy.

5.2 CONTROLLER

(MPC3. software version min. #042)

This device contains all circuits necessary to select the required functions to maintain an accurate temperature. The selection is based on signals received from the sensors and the analog input from the operator. When the unit ON/OFF switch is put in “ON” position, the controller will go into “Start up” mode and the display will show, BOOTING–KLINGECORP, NMF-371–DATE and TIME, for a few seconds, then it checks for the correct phase direction of the unit.
Display shows “Phase direction test, 0” while under test, and after the phase sensor relay determines which should be activated (PC, R1 or PC, R2) the display shows “Phase direction test 1.” or “Phase direction test 2.”

When the controller has determined the correct phase direction for the unit, the display shows the set-point temperature (SP) and return air temperature. (RT)
These two temperatures are always shown in the display when the unit is switched “ON”. The controller controls the temperature using the “return air” sensor temperature (RT), and regulates the start/stop of the compressors. When the unit has reached set point, the evaporator fans will operate to maintain air circulation in the container.

The “set-point menu” in the display is designed for setting of temperature:

Start:
If the return air temperature (RT) rises to 1°C above the set-point (SP), the controller will call for cooling. The unit will start and will continue to run until the return air temperature reaches the set-point, or for a minimum of 15 minutes, whichever is longer.

Stop:
If the return air temperature (RT) falls to 2°C below the set-point (SP), the unit will stop and will not restart for a minimum of 10 minutes.

The starting sequence table below shows the start-up sequence:

Unit “ON/OFF” switch in “ON” position.

UNIT POWER ON.	
System start, App. 60 sec.	Evaporator fan on. *Next step: Delay 5 sec.* Phase sensor relay 1on *Next step: Delay 10 sec.* If load is <0.5A then condenser fan relay on and alarm A30 is set *Next step: Delay 10 sec.* Evap. fan relay off Cond. Fan relay off If phase direction is wrong, then PCR1 off and PCR2 on *Next step: Delay 5 sec.* Evaporator fan on *Next step: Delay 5 sec.* Compressor 1 on *Next step: Delay 2 sec.* Condenser fan on *Next step: Delay 3 sec.* Compressor 2 on *Next step: Delay 27 sec.* Compressor 3 on

The auto test sequence table below shows the Auto test sequence:
Unit “ON/OFF” switch in “ON” position.

Unit Auto test **Start in menu Commands - Auto test**		
System auto test.	AUTO TEST RUNNING 0.0 0.0 0.0 A.	
	Next step: Delay 5 sec. Evap. fan run 1.0 1.0 1.0 A	Relay EFR on If fault, then text will be shown in display for 10 sec.
	Next step: Delay 10 sec. Cond. fan 1 run 1.0 1.0 1.0 A	Relay CFR on If fault, then text will be shown in display for 10 sec.
	Next step: Delay 10 sec. Comp. 1 R134 run 7.0 7.0 7.0 A	Relay CMR1 on Relay CFR on LSV valve on If fault, then text will be shown in display for 10 sec.
	Next step: Delay 10 sec. Comp. 2 R134 run 7.0 7.0 7.0 A	Relay CMR2 on Relay CFR on LSV valve on
	Next step: Delay 4 sec. Comp. 3 R23 run 8.0 8.0 8.0 A	Relay CMR3 on If fault, then text will be shown in display for 10 sec.
	Next step: Delay 10 sec. Defrost test 7.0 7.0 7.0 A	Relay CMR3 on HG valve on If fault, then text will be shown in display for 10 sec.
	Next step: Delay 10 sec. PUMP DOWN COMP.1 R23 6.11 17.3 B 134a 0.11 12.3 B	Relay CMR1 on Relay CFR on Acceptable pressure range for R23 system shown in bars Acceptable pressure range for R134a system shown in bars
	Next step: Delay 10-60 sec. Test status TEST PASS OK Or TEST FAILED	Alarm code is displayed, see event log for info

An example of an event log from unit is below:

```
MPC3 temperature report
NMF 371
YY MM DD HH:MM
11 10 27 11:04 Operation press: 13.5 B -0.6 B 17.7 B  4.8 B  15.9°C 17.0°C  9.7°C  4.9°C
11 10 27 11:03 Auto test nr. 8  HOTGASS DEF.   9.4A 10.0A 10.5A Limit:  3.5A to 10.5A
11 10 27 11:03 Operation press: 13.5 B -0.2 B 18.6 B  4.6 B  15.9°C 16.8°C  9.3°C  4.8°C
11 10 27 11:03 Auto test nr. 6  COMP.3 (R23)  10.3A 11.3A 11.3A Limit:  4.0A to 12.0A
11 10 27 11:03 Auto test nr. 5  COMP.2 (134)   6.6A  6.7A  6.4A Limit:  3.9A to 10.1A
11 10 27 11:03 Auto test nr. 4  COMP.1 (134)   6.5A  6.8A  6.5A Limit:  3.9A to 10.1A
11 10 27 11:03 Auto test nr. 2  COND.FAN 1     2.2A  2.1A  2.0A Limit:  1.0A to  3.0A
11 10 27 11:03 Auto test nr. 1  EVAP. FAN      0.7A  0.6A  0.7A Limit:  0.5A to  1.5A
```

5.3 DISPLAY

The LED display shows all information regarding all temperatures for unit sensors, all data recorded in data logger and all information for unit operating conditions.

DISPLAY, MAIN MENU ▼	(The display will always show the set-point and the return air temperature in the display, except if a text message comes up.)							
Set-point. "SP" Return "RT" Supply "SU" Defrost "DF" Cargo "CS" E FAN L "EL" Comp. 1 "C1" Comp. 2 "C2" Comp. 3 "C3" E FAN R "ER" R23 LOW "LO" 134 LOW "LO" R23 HIGH "HI" 134 HIGH "HI"	SET-POINT, shows the actual setting temperature RETURN, shows the temperature for return air sensor, mounted in return air from container cargo. SUPPLY, shows the temperature for supply air sensor, mounted in supply air to container cargo. DEFROST, shows the temperature for evaporator coil, mounted on suction pipe from evaporator at the TX valve sensor. CARGO, shows the temperature of the product core/surface temperature sensor. (Option.) Evap. Fan motor left, shows the temperature of the Evap. Left Fan motor sensor, mounted on motor housing. COMP 1, shows the temperature for compressor 1 sensor, mounted on discharge pipe comp 1 COMP 2, shows the temperature for compressor 2 sensor, mounted on discharge pipe comp 2 COMP 3, shows the temperature for compressor 3 sensor, mounted on discharge pipe comp 3 Evap. Fan motor right, shows the temperature of the Evap. Right Fan motor sensor, mounted on motor housing. R23 low, shows the low-pressure on R23 system, mounted on suction pipe from evaporator to crankcase pressure regulator. R134 low, shows the low-pressure on R134a system, mounted on suction pipe to compressors 1 & 2. R23 high, shows the high-pressure on R23 system, mounted on condenser pipe to heat exchanger. R134 high, shows the high-pressure on R134a system, mounted on condenser pipe.							
Config ▶	→					Container ID. KLIUXXXXXX Log Interval Set:6-60 Min. DATE / TIME 01.03.23 16:00 DEF.INTERVAL SET:3-99HOUR DEF.OFF.TEMP SET:5-30° C. DEF.MAX.TIME SET:15-99 MIN. Unit series no. xxxx.xxxxx		
Datalogger ▶	→		Event Log. ▶	date/time, 01.03.23 16:00 all event Log.				
			Temp. Log. ▶	date/time, YY.MM.DD 16:00 temperat. sensor/ data: "RT"- "SU"- "DF"- "CS"- "EL"- "C1"- "C2"- "C3"- "ER"- "R23LO"- "134LO"- "R23HI"- "134HI"- "Relay-status"- "Volt"- "Hz"- "Amps"				
Unit Data ▶	→	Input ▶	Return, RT. Supply, SU. Defrost, DF Cargo, CS. E Fan L. EL. Comp. 1,C1 Comp. 2,C2 Comp. 3,C3 E Fan R. ER. Pres.R23 LO Pres.134 LO Pres.R23 HI Pres.134 HI Mains volt Mains amp. Mains Hz. Amp. Ph 1. Amp. Ph 2. Amp. Ph 3. 6volt battery C.int. temp. Counter.					
Commands ▶	→	Manual defrost Manual test Run Auto Test Test SMS Alarm.						
Alarms (*) (*) number of alarms. ▶	Shows all alarm							
Mode ▶	Standby. Delay. Airflow. Freezing Defrost. Defr.end					Control setting ▶	→	Not used. (Only for technical setting of different controller model.) Network no: Each controller can be coded with no. from 1 to 4.
(Set-point SP.)			Output ▶	All relay on / off status. 12 relays + 4 PVM. %load		Switch setting ▶	Temp. unit In °F. "ON" Password Protection "ON" Alarm cargo sensor "ON" Send SMS alarm. ON Send SMS status. ON Send SMS -E-mail,Off. 7-14 Spare Not used	
			Run hour: ▶	Total. Hour. E Fan. Cond.fan Not used Comp.1 Comp.2 Comp.3 Lsv,valve Hotgas val. No alarm.			Not used.	
			Software ▶	Newest data		GMS. pin code ▶ SMS alarm1/2/3 Telephone number to mobile phone for SMS alarm. (Option.) ▶	SMS, person 1. SMS, person 2. SMS, person 3.	

5.4 KEYPAD

The four button Keypad gives access to all operations, for setting of temperature and scrolling through unit data information.

Keypad function.

Set-point. Press (→) for change Scroll, press (↓) or (↑)	Use (↓) or (↑) for scroll in setting of freezing temperature. Press (→) for change set-point – XX.X°C. "Arrows flash". Enter new set-point, press (→) 2 sec. Note. The value to be changed must be on the top line in the display.		Display show, save change.
Unit sensor temperature. Scroll, press (↓) or (↑)	Display shows temperature for all unit sensors and pressure transducers.		
Config. >> Press (→) for enter Scroll, press (↓) or (↑) Esc. press (←)	**Unit type. NMF-371.** Scroll, press (↓) Esc. press (←)		
	Container ID. >> "KLIU1234567" Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	KLIU1234567 ↑. . . . . "Arrow flash" Change the first characters, 1. Use (↓) or (↑) for scroll 2. Use (→) to move to next character, and repeat no.1 Press (→) 2 sec. to enter new ID. no.	Display show, save change.
	Log interval. >> Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	"Arrows flash". Use (↓) or (↑) for changing log interval. Press (→) 2 sec. to enter new interval.	Display show, save change.
	Date and time. >> Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	Year 00-month 01-date 20. Time 12-min 30 ↑↓ (Arrows flash) . . . . Change the first value, 1.Use (↓) or (↑) for chance. 2.Use (→) to move to next item, and repeat 1 Press (→) 2 sec. to enter new date/time.	Display show, save change.
	Defrost interval. >> Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	"Arrows flash". (factory set. 24 hour.) Use (↓) or (↑) for changing defrost interval. Press (→) 2 sec. to enter new interval.	Display show, save change.
	Defrost termination >> Temperature. Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	"Arrows flash". (factory set. 18°C.) Use (↓) or (↑) for changing termination temperature. Press (→) 2 sec. to enter new temperature.	Display show, save change.
	Defrost max. time. >> Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	"Arrows flash". (factory set. 45 min.) Use (↓) or (↑) for changing max. defrost time. Press (→) 2 sec. to enter new defrost time.	Display show, save change.
	Unit serial no. >> "69XXXXXXX" Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	"69XXXXXXX" ↑. . . . . "Arrow flash" Change the first characters, 1.Use (↓) or (↑) for scroll 2.Use (→) to move to next character, and repeat no.1 Press (→) 2 sec. to enter new no.	Display show, save change.
	Control setting. >> Press (→) for enter Scroll, press (↓) or (↑) Esc. press (←)	Not used. (Only for technical setting of different controller model.) Network No: Each controller can be coded with a no. from 1 to 4, if there is more than one controller in the Norfrig downloading system and if all controllers are linked to the same PC Network.	
	Switch setting. >> Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	Unit temperature in °F.-Password- Alarm cargo sensor-PT1000 (set to ON) ext. (All values are ON/OFF functions, and not all are used for each unit model. Use (↓) or (↑) to scroll in menu of settings. Press (→) for change in function. Use (↓) or (↑) to change ON/OFF. Press (→)2 sec. to enter new interval.	Display show, save change.

Keypad function (cont'd)

Config. >> Press (→) for enter Scroll, press (↓) or (↑) Esc. press (←)	**GMS. pin code >>** Scroll, press (↓) or (↑) Esc. press (←)	If the unit is equipped with telephone modem, the pin code must be set to 4080 or de-activated.	
	SMS alarm 1 / 2 / 3. >> "XXXXXXXXXX" "SMS alarm is Option" Press (→) for change. Scroll, press (↑) Esc. press (←)	In "SMS alarm 1/2/3" you can select the telephone no. for max. 3 persons, to which the modem shall send the SMS alarm. ("Send SMS alarm" must be set to "ON" in Switch setting.) SMS alarm 1: Person no. 1. SMS alarm 2: Person no. 2. SMS alarm 3: Person no. 3. Insert selected telephone no.: "123456789----" ↑. . . . . "Arrow flash" Change the first characters, 1. Use (↓) or (↑) to scroll 2. Use (→) to move to next character, and repeat no.1 Press (→) 2 sec. to enter new telephone no.1 If person no. 1 does not respond to the SMS (Max.30 min. = 2 SMS calls) the SMS alarm will be sent to person no.2 or 3. (Only 1 call each.)	Display show, save change.
Data logger. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	**Temperature log. >>** Press (→) for information Scroll, press (↓) Esc. press (←)	Use (↓) or (↑) to scroll in time, and (←) or (→) to scroll in temperature. Esc. press (←)	
	Event log. >> Press (→) for information Scroll, press (↑) Esc. press (←)	Use (↓) or (↑) to scroll in time and event log. Press (→) for more information. Press (←) for Esc.	Event log information Scroll, press (↓) or (↑) Esc. press (←)
Unit data. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	**Input. >>** Press (→) for enter. Scroll, press (↓) Esc. press (←)	All input data from system. Use (↑) or (↓) to scroll in menu. Esc. press (←)	
	Output. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	All output data to system. Use (↑) or (↓) to scroll in menu. Esc. press (←)	
	Run hour. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	All running hour for system. Use (↑) or (↓) to scroll in menu. Esc. press (←)	
	Time to defrost. >> Scroll, press (↓) or (↑) Esc. press (←)	Display shows time to next defrost.	
	Software ID. >> Scroll, press (↑) Esc. press (←)	Display shows software ID.	
Commands. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	**Manual defrost. >>** Press (→) for enter. Scroll, press (↓) Esc. press (←)	Display shows defrost.	
	Manual test. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	Relay, energized = 1, de-energized = 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ↑ Use (↓) or (↑) for scroll, and (→) for ON/OFF (1/0) between relays. Esc. press (←)	
	Run auto test. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	The display shows the actual parts which are tested, and the load current of that part. (Motor-compressor e.g.) Esc. press (←)	(The test result is also shown in the Event log)
	Test SMS alarm >> Press (→) for enter. Scroll, press (↑) Esc. press (←)	The controller will set up the Modem and send a SMS alarm status to telephone no. for person 1, in the controller alarm list.	

Keypad function (cont'd)

Alarm. **>>** Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	Display shows current alarm, or no alarm, press (→) to cancel alarm.	
Mode. **>>** Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	Display shows current operating mode. (Delay- Airflow- Freezing- Defrost)	

5.5 TEMPERATURE SENSOR NTC. (ONLY AMBIENT SENSOR)

The temperature sensor is a NTC thermistor element, placed in a sealed metal tube, which is connected to a two-conductor cable. The temperature signal from the sensor is relayed to the controller through this cable. The accuracy of this will not change, except for an internal malfunction of the sensor itself. If the sensor has an open/short circuit, the current alarm will be shown in display as "----sensor out of range"

Use an ohmmeter only to check Ohm "**Ω".** Readings should agree with the following chart:

Sensor NTC.									
°C	**Ω**	**°C**	**Ω**	**°C**	**Ω**	**°C**	**Ω**	**°C**	**Ω**
120	109.84	**88**	251.41	**56**	662.22	**24**	2073.18	**-8**	8131.44
119	112.51	**87**	258.55	**55**	684.36	**23**	2155.36	**-9**	8524.23
118	115.26	**86**	265.92	**54**	707.36	**22**	2241.30	**-10**	8938.65
117	118.09	**85**	273.54	**53**	731.27	**21**	2331.21	**-11**	9376.03
116	121.00	**84**	281.42	**52**	756.11	**20**	2425.28	**-12**	9837.80
115	124.00	**83**	289.57	**51**	781.93	**19**	2523.74	**-13**	10325.47
114	127.09	**82**	297.99	**50**	808.77	**18**	2626.82	**-14**	10840.65
113	130.27	**81**	306.70	**49**	836.69	**17**	2734.74	**-15**	11385.08
112	133.55	**80**	315.72	**48**	865.73	**16**	2847.79	**-16**	11960.60
111	136.92	**79**	325.04	**47**	895.93	**15**	2966.22	**-17**	12569.21
110	140.39	**78**	334.69	**46**	927.36	**14**	3090.32	**-18**	13213.00
109	143.93	**77**	344.68	**45**	960.07	**13**	3220.41	**-19**	13849.25
108	147.66	**76**	355.01	**44**	994.11	**12**	3356.80	**-20**	14615.38
107	151.47	**75**	365.71	**43**	102.55	**11**	3499.83	**-21**	15378.98
106	155.38	**74**	376.79	**42**	106.46	**10**	3649.88	**-22**	16187.84
105	159.42	**73**	388.26	**41**	110.90	**9**	3807.32	**-23**	17044.94
104	163.59	**72**	400.14	**40**	1144.94	**8**	3972.57	**-24**	17953.48
103	167.88	**71**	412.45	**39**	1186.66	**7**	4146.05	**-25**	18916.88
102	172.31	**70**	425.21	**38**	1230.14	**6**	4328.24	**-26**	19938.83
101	176.87	**69**	438.42	**37**	1275.46	**5**	4519.61	**-27**	21023.28
100	181.58	**68**	452.12	**36**	1322.70	**4**	4720.69	**-28**	22174.47
99	186.44	**67**	466.31	**35**	1371.97	**3**	4932.03	**-29**	23396.95
98	191.45	**66**	481.03	**34**	1423.36	**2**	5154.22	**-30**	24695.63
97	196.62	**65**	496.29	**33**	1476.96	**1**	5387.87	**-31**	26075.77
96	201.96	**64**	512.12	**32**	1532.90	**+/-0**	5633.65	**-32**	27543.04
95	207.47	**63**	528.54	**31**	1591.28	**-1**	5892.27	**-33**	29103.54
94	213.16	**62**	545.57	**30**	1652.21	**-2**	6164.47	**-34**	30763.82
93	219.03	**61**	563.24	**29**	1715.84	**-3**	6451.05	**-35**	32530.96
92	225.10	**60**	581.58	**28**	1782.24	**-4**	6752.87	**-36**	34412.57
91	231.36	**59**	600.62	**27**	1851.70	**-5**	7070.82	**-37**	36416.87
90	237.83	**58**	620.39	**26**	1924.22	**-6**	7405.87	**-38**	38552.70
89	244.51	**57**	640.91	**25**	2000.00	**-7**	7759.04	**-39**	40829.62

5.6 TEMPERATURE SENSOR PT1000.

The temperature sensor is a PT1000 thermistor element, placed in a sealed metal tube, which is connected to a two-conductor cable. The temperature signal from the sensor is relayed to the controller through this cable. The accuracy of this will not change, except for an internal malfunction of the sensor itself, If one of the sensors has an open/short circuit, the current alarm will be shown in display as "----sensor out of range"

Use an ohmmeter only to check Ohm "**Ω".** Readings should agree with the following chart:

SENSOR PT1000											
°C	**Ω**	**°C**	**Ω**	**°C**	**Ω**	**°C**	**Ω**	**°C**	**Ω**	**°C**	**Ω**
120	1460.6	**88**	1339.4	**56**	1217.0	**24**	1093.5	**-8**	968.7	**-40**	842.7
119	1456.8	**87**	1335.6	**55**	1213.2	**23**	1089.6	**-9**	964.8	**-41**	838.8
118	1451.1	**86**	1331.8	**54**	1209.3	**22**	1085.7	**-10**	960.9	**-42**	834.8
117	1449.3	**85**	1328.0	**53**	1205.5	**21**	1081.8	**-11**	956.9	**-43**	830.8
116	1445.5	**84**	1324.2	**52**	1201.6	**20**	1077.9	**-12**	953.0	**-44**	826.9
115	1441.7	**83**	1320.4	**51**	1197.8	**19**	1074.0	**-13**	949.1	**-45**	822.9
114	1438.0	**82**	1316.6	**50**	1194.0	**18**	1070.2	**-14**	945.2	**-46**	818.9
113	1434.2	**81**	1312.7	**49**	1190.1	**17**	1066.3	**-15**	941.2	**-47**	815.0
112	1430.4	**80**	1308.9	**48**	1186.2	**16**	1062.4	**-16**	937.3	**-48**	811.0
111	1426.6	**79**	1305.1	**47**	1182.4	**15**	1058.5	**-17**	933.4	**-49**	807.0
110	1422.9	**78**	1301.3	**46**	1178.5	**14**	1054.6	**-18**	929.5	**-50**	803.1
109	1419.1	**77**	1297.5	**45**	1174.7	**13**	1050.7	**-19**	925.5	**-51**	799.1
108	1415.3	**76**	1293.7	**44**	1170.8	**12**	1046.9	**-20**	921.5	**-52**	795.1
107	1411.5	**75**	1289.8	**43**	1167.0	**11**	1042.9	**-21**	917.7	**-53**	791.1
106	1407.7	**74**	1286.0	**42**	1163.1	**10**	1039.0	**-22**	913.7	**-54**	787.2
105	1403.9	**73**	1282.2	**41**	1159.3	**9**	1035.1	**-23**	909.3	**-55**	783.2
104	1400.2	**72**	1278.4	**40**	1155.4	**8**	1031.2	**-24**	905.9	**-56**	779.2
103	1396.4	**71**	1274.5	**39**	1151.5	**7**	1027.3	**-25**	901.9	**-57**	775.2
102	1392.6	**70**	1270.7	**38**	1147.7	**6**	1023.4	**-26**	898.0	**-58**	771.3
101	1388.8	**69**	1266.9	**37**	1143.8	**5**	1019.5	**-27**	894.0	**-59**	767.3
100	1385.0	**68**	1263.1	**36**	1139.9	**4**	1015.6	**-28**	890.1	**-60**	763.3
99	1381.2	**67**	1259.2	**35**	1136.1	**3**	1011.7	**-29**	886.2	**-61**	759.3
98	1377.4	**66**	1255.4	**34**	1132.2	**2**	1007.8	**-30**	882.2	**-62**	755.3
97	1373.6	**65**	1251.6	**33**	1128.3	**1**	1003.9	**-31**	878.3	**-63**	751.3
96	1369.8	**64**	1247.7	**32**	1124.5	**+/- 0**	1000	**-32**	874.3	**-64**	747.3
95	1366.0	**63**	1243.9	**31**	1120.6	**-1**	996.1	**-33**	870.4	**-65**	743.3
94	1362.2	**62**	1240.1	**30**	1116.7	**-2**	992.2	**-34**	866.4	**-66**	739.3
93	1358.4	**61**	1236.2	**29**	1112.8	**-3**	988.3	**-35**	862.5	**-67**	735.3
92	1354.6	**60**	1232.4	**28**	1109.0	**-4**	984.4	**-36**	858.5	**-68**	731.3
91	1350.8	**59**	1228.6	**27**	1105.1	**-5**	980.4	**-37**	854.8	**-69**	727.3
90	1347.0	**58**	1224.7	**26**	1101.2	**-6**	976.5	**-38**	850.6	**-70**	723.3
89	1343.2	**57**	1220.9	**25**	1097.3	**-7**	972.6	**-39**	846.7	NF. Temp. Chart.	

5.7 TEMPERATURE CONVERSION TABLES.

The numbers in bold-face type in the center column refer to the temperature, either in Centigrade or in Fahrenheit, which is to be converted to the other scale. Converting Fahrenheit to Centigrade, the equivalent temperature will be found in the left column.

TEMPERATURE			TEMPERATURE			TEMPERATURE			TEMPERATURE		
°C	**°C - °F**	°F	°C	**°C - °F**	°F	°C	**°C - °F**	°F	°C	**°C - °F**	°F
-40.0	**-40**	-40.0	-6.7	**+20**	+68.0	+26.7	**+80**	+176.0	+60.0	**+140**	+284.0
-39.4	**-39**	-38.2	-6.1	**+21**	+69.8	+27.2	**+81**	+177.8	+60.6	**+141**	+285.8
-38.9	**-38**	-36.4	-5.5	**+22**	+71.6	+27.8	**+82**	+179.6	+61.1	**+142**	+287.6
-38.3	**-37**	-34.6	-5.0	**+23**	+73.4	+28.3	**+83**	+181.4	+61.7	**+143**	+289.4
-37.8	**-36**	-32.8	-4.4	**+24**	+75.2	+28.9	**+84**	+183.2	+62.2	**+144**	+291.2
-37.2	**-35**	-31.0	-3.9	**+25**	+77.0	+29.4	**+85**	+185.0	+62.8	**+145**	+293.0
-36.7	**-34**	-29.2	-3.3	**+26**	+78.8	+30.0	**+86**	+186.8	+63.3	**+146**	+294.8
-36.1	**-33**	-27.4	-2.8	**+27**	+80.6	+30.6	**+87**	+188.6	+63.9	**+147**	+296.6
-35.6	**-32**	-25.6	-2.2	**+28**	+82.4	+31.1	**+88**	+190.4	+64.4	**+148**	+298.4
-35.0	**-31**	-23.8	-1.7	**+29**	+84.2	+31.7	**+89**	+192.2	+65.0	**+149**	+300.2
-34.4	**-30**	-22.0	-1.1	**+30**	+86.0	+32.2	**+90**	+194.0	+65.6	**+150**	+302.0
-33.9	**-29**	-20.2	-0.6	**+31**	+87.8	+32.8	**+91**	+195.8	+66.1	**+151**	+303.8
-33.3	**-28**	-18.4	0.0	**+32**	+89.6	+33.3	**+92**	+197.6	+66.7	**+152**	+305.6
-32.8	**-27**	-16.6	+0.6	**+33**	+91.4	+33.9	**+93**	+199.4	+67.2	**+153**	+307.4
-32.2	**-26**	-14.8	+1.1	**+34**	+93.2	+34.4	**+94**	+201.2	+67.8	**+154**	+309.2
-31.7	**-25**	-13.0	+1.7	**+35**	+95.0	+35.0	**+95**	+203.0	+68.3	**+155**	+311.0
-31.1	**-24**	-11.2	+2.2	**+36**	+96.8	+35.6	**+96**	+204.8	+68.9	**+156**	+312.8
-30.6	**-23**	-9.4	+2.8	**+37**	+98.6	+36.1	**+97**	+206.6	+69.4	**+157**	+314.6
-30.0	**-22**	-7.6	+3.3	**+38**	+100.4	+36.7	**+98**	+208.4	+70.0	**+158**	+316.4
-29.4	**-21**	-5.8	+3.9	**+39**	+102.2	+37.2	**+99**	+210.2	+70.6	**+159**	+318.2
-28.9	**-20**	-4.0	+4.4	**+40**	+104.0	+37.8	**+100**	+212.0	+71.1	**+160**	+320.0
-28.3	**-19**	-2.2	+5.0	**+41**	+105.8	+38.3	**+101**	+213.8	+71.7	**+161**	+321.8
-27.8	**-18**	-0.4	+5.5	**+42**	+107.6	+38.9	**+102**	+215.6	+72.2	**+162**	+323.6
-27.2	**-17**	+1.4	+6.1	**+43**	+109.4	+39.4	**+103**	+217.4	+72.8	**+163**	+325.4
-26.7	**-16**	+3.2	+6.7	**+44**	+111.2	+40.0	**+104**	+219.2	+73.3	**+164**	+327.2
-26.1	**-15**	+5.0	+7.2	**+45**	+113.0	+40.6	**+105**	+221.0	+73.9	**+165**	+329.0
-25.6	**-14**	+6.8	+7.8	**+46**	+114.8	+41.1	**+106**	+222.8	+74.4	**+166**	+330.8
-25.0	**-13**	+8.6	+8.3	**+47**	+116.6	+41.7	**+107**	+224.6	+75.0	**+167**	+332.6
-24.4	**-12**	+10.4	+8.9	**+48**	+118.4	+42.2	**+108**	+226.4	+75.6	**+168**	+334.4
-23.9	**-11**	+12.2	+9.4	**+49**	+120.2	+42.8	**+109**	+228.2	+76.1	**+169**	+336.2
-23.3	**-10**	+14.0	+10.0	**+50**	+122.0	-43.3	**+110**	+230.0	+76.7	**+170**	+338.0
-22.8	**-9**	+15.8	+10.6	**+51**	+123.8	+43.9	**+111**	+231.8	+77.2	**+171**	+339.8
-22.2	**-8**	+17.6	+11.1	**+52**	+125.6	+44.4	**+112**	+233.6	+77.8	**+172**	+341.6
-21.7	**-7**	+19.4	+11.7	**+53**	+127.4	+45.0	**+113**	+235.4	+78.3	**+173**	+343.4
-21.1	**-6**	+21.2	+12.2	**+54**	+129.2	+45.6	**+114**	+237.2	+78.9	**+174**	+345.2
-20.6	**-5**	+23.0	+12.8	**+55**	+131.0	+46.1	**+115**	+239.0	+79.4	**+175**	+347.0
-20.0	**-4**	+24.8	+13.3	**+56**	+132.8	+46.7	**+116**	+240.8	+80.0	**+176**	+348.8
-19.4	**-3**	+26.6	+13.9	**+57**	+134.6	+47.2	**+117**	+242.6	+80.6	**+177**	+350.6
-18.9	**-2**	+28.4	+14.4	**+58**	+136.4	+47.8	**+118**	+244.4	+81.1	**+178**	+352.4
-18.3	**-1**	+30.2	+15.0	**+59**	+138.2	+48.3	**+119**	+246.2	+81.7	**+179**	+354.2
-17.8	**0**	+32.0	+15.6	**+60**	+140.0	+48.9	**+120**	+248.0	+82.2	**+180**	+356.0
-17.2	**+1**	+33.8	+16.1	**+61**	+141.8	+49.4	**+121**	+249.8	+82.8	**+181**	+357.8
-16.7	**+2**	+35.6	+16.7	**+62**	+143.6	+50.0	**+122**	+251.6	+83.3	**+182**	+359.6
-16.1	**+3**	+37.4	+17.2	**+63**	+145.4	+50.6	**+123**	+253.4	+83.9	**+183**	+361.4
-15.6	**+4**	+39.2	+17.8	**+64**	+147.2	+51.1	**+124**	+255.2	+84.4	**+184**	+363.2
-15.0	**+5**	+41.0	+18.3	**+65**	+149.0	+51.7	**+125**	+257.0	+85.0	**+185**	+365.0
-14.4	**+6**	+42.8	+18.9	**+66**	+150.8	+52.2	**+126**	+258.8	+85.6	**+186**	+366.8
-13.9	**+7**	+44.6	+19.4	**+67**	+152.6	+52.8	**+127**	+260.6	+86.1	**+187**	+368.6
-13.3	**+8**	+46.4	+20.0	**+68**	+154.4	+53.3	**+128**	+262.4	+86.7	**+188**	+370.4
-12.8	**+9**	+48.2	+20.6	**+69**	+156.2	+53.9	**+129**	+264.2	+87.2	**+189**	+372.2
-12.2	**+10**	+50.0	+21.1	**+70**	+158.0	+54.4	**+130**	+266.0	+87.8	**+190**	+374.0
-11.7	**+11**	+51.8	+21.7	**+71**	+159.8	+55.0	**+131**	+267.8	+88.3	**+191**	+375.8
-11.1	**+12**	+53.6	+22.2	**+72**	+161.6	+55.6	**+132**	+269.6	+88.9	**+192**	+377.6
-10.6	**+13**	+55.4	+22.8	**+73**	+163.4	+56.1	**+133**	+271.4	+89.4	**+193**	+379.4
-10.0	**+14**	+57.2	+23.3	**+74**	+165.2	+56.7	**+134**	+273.2	+90.0	**+194**	+381.2
-9.4	**+15**	+59.0	+23.9	**+75**	+167.0	+57.2	**+135**	+275.0	+90.6	**+195**	+383.0
-8.9	**+16**	+60.8	+24.4	**+76**	+168.8	+57.8	**+136**	+276.8	+91.1	**+196**	+384.8
-8.3	**+17**	+62.6	+25.0	**+77**	+170.6	+58.3	**+137**	+278.6	+91.7	**+197**	+386.6
-7.8	**+18**	+64.4	+25.6	**+78**	+172.4	+58.9	**+138**	+280.4	+92.2	**+198**	+388.4
-7.2	**+19**	+66.2	+26.1	**+79**	+174.2	+59.4	**+139**	+282.2	+92.8	**+199**	+390.2

SECTION 6. MAINTENANCE AND SERVICE INSTRUCTION.

This section provides procedures for establishing preventive maintenance and systematic servicing schedules, which are the keys to successful operation.

6.1 SAFETY

a. When any work is to be done on the components of the refrigeration system, always make sure that the equipment cannot be started automatically or accidentally. If valves are closed and/or circuits interrupted during service procedures, the control switches should be suitably tagged with such notations.

b. Use proper tools and correct size of wrenches.

c. Do not exert excessive pressure when tightening flare nuts, as it may result in a rupture of the flare or stripped threads.

d. Always wear approved goggles or eye shields when working with the refrigerant to prevent eye injury if the refrigerant is accidentally discharged into the face of the service engineer.

e. Never under any circumstances apply heat to a refrigerant cylinder by using a naked flame. Should it be considered necessary to apply heat to a cylinder to create a refrigerant flow when recharging a system, place the cylinder in a container of hot or warm water to a point about 3/4 of the height of the cylinder.

   Even this method requires that a pressure gauge is in use in the charging line to indicate the pressure in the cylinder at all times.

   Also, never close the shut off valve on the cylinder while the cylinder is being heated.

   The use of a manifold gauge set will permit compliance with having a gauge in the line and a shut off valve on the manifold to stop the flow of refrigerant into the system and allow the gauge to read cylinder pressure.

f. Always replace refrigerant cylinder valve and connection caps after using the cylinder, and do not permit a cylinder to be dropped or hit severely by another object.

g. Due to the height at which the refrigeration unit is placed in the container always use safe and secure means to service the unit and to allow a platform for tools and a refrigerant cylinder.

h. Never loosen a refrigerant line rapidly if there is positive pressure in the line:

   1. Because liquid refrigerant may give you a severe cold burn, or other injury.
   2. Because gas refrigerant may also cause oil to discharge, leaving the compressor short of oil, and creating an oily mess.

6.2 CHECK REFRIGERANT R134a CHARGE

Checking with the unit operating.

It should be noted and remembered that the only requirement of liquid level is that a seal be maintained at the outlet of the receiver. At low refrigerant flow rate the liquid refrigerant may not accumulate in the receiver to a point where a liquid level will show on the sight glass. Many times, the liquid will collect in the condenser; therefore, caution should be taken before adding refrigerant. Air in the receiver may also prevent the level from being properly indicated in the sight glass. If the refrigerant is not visible in the sight glass, it is recommended that the pressures be checked according to the suction and the discharge pressures noted on the graphs provided before determining that the charge is low. It is just as possible to do harm to the system by overcharging, as it is to run it undercharged.

It is important to have the correct amount of refrigerant in the system. If there is too little, the expansion valve will pass vapor and reduce the capacity of the evaporator. Too much refrigerant will result in higher head pressures and oil dilution.

The liquid level should be visible in the sight glass.

Caution:
It should be understood that an air-cooled system will operate at many different ambient temperatures and the performance of the system will vary accordingly. Therefore, before adding any refrigerant (or making any other adjustments), it should be taken into consideration whether the unit is running with a low temperature load or a high temperature load, running in a cold ambient or a hot ambient load and most important whether the suction and the discharge pressures are in line given existing conditions.

Note:
Unit capacity will be greatly reduced when high ambient temperature is experienced; therefore, a careful check should be made of unit performance before making any adjustments or adding refrigerant to the system. Before adding refrigerant, always determine the reason for the low charge and remedy the cause. Leak test thoroughly with an electronic leak detector and check also for traces of oil.

Caution:
When the refrigerant charge is added, it is important initially to purge the air from the transfer tubes of the manifold gauge set.
For instruction charging of for the system; see Section 8.

6.3 CHECK REFRIGERANT R23 CHARGE

Note:
Check only with unit in STANDBY.

R23 refrigerant is best controlled at standby on an empty container (before power connection).
When no parts of the cooling system are cold (below –5°C.) the entire R23 charge will be gas, and pressure will show the total pressure of the gas charge.

It is important that the R134a compressor has not been operating and that the heat exchanger has cooled.
(There must not be frost or ice on the heat exchanger pipe stubs.)

Factory filling = 200 psi at 20°C.
220 psi at 30°C.
230 psi at 40°C.

If the standby pressure is between 200 and 250 psi the unit is fully functional, and there should be no correction made to the charge.
When the standby pressure is above 250 psi there is a risk of a high-pressure cut out at start up with warm container/cargo area, and it may be necessary to reduce the pressure to 250 psi.
Overcharging can easily happen if the system is being charged during unit operation.
If the standby pressure is between 160 and 190 psi the unit is working at reduced capacity but may maintain temperature between –45 to –50 deg. C.
Note: During standby both high and low-pressure transducers must show the same pressure.

CORRECT R23 CHARGE "RUNNING"
Since there is great risk to overcharge the unit while in operation, there should be no recharging if the container can maintain the required set-point or during cool down maintain a temperature difference between return and supply at app. 4°C.
If there is a leak of R23 refrigerant, the R23 high-pressure will be lower than normal.
A sight glass is mounted on the R23 return liquid pipe from the heat exchanger, in order to control the R23 charging while operating. (Must be clear when return air temperature is below -40°C) In order to see the sight glass, the insulation material must be removed.

6.4 PROCEDURE FOR ADDING REFRIGERANT R134a

Checking when the unit is operating.

a. Remove the compressor suction service valve cap. Connect the charging line to the refrigerant cylinder and tighten the connection.

b. Crack open the cylinder valve and the manifold suction gauge valve and allow the entire line to purge the air, and then tighten the connections at the compressor.

c. With the system still operating and the suction pressure being 60 psi or below, and the cylinder pressure at 145 psi (dependent upon room temperature), open the refrigerant cylinder liquid valve completely and the manifold suction valve.

d. Allow refrigerant into the system and observe the receiver sight glass (20-30 second bursts with a 5 minute interval) until desired level is reached.

e. When it is determined that the system has an adequate refrigerant charge, close the refrigerant cylinder valve (if not already closed) and then close the manifold suction gauge valve (in that order). Remove the manifold lines and replace the caps securely.

6.5 PROCEDURE FOR ADDING REFRIGERANT R23

CHARGING R23
The pressure in the R23 cylinder is higher than the unit system pressure while operating. Therefore, it is more secure to fill directly to the buffer tank without use of manometer, in the following way:

Mount the ¼ inch standard flare hose on the Schrader adapter without opening the Schrader valve (use the end of the hose without the "Schrader activator"). Mount the "Schrader activator end" of the hose to the R23 bottle. This order will avoid leakage between the system and the bottle pressure. The pressure from the bottle easily opens the Schrader valve during charging.

NOTE: It is important initially to purge the air from the transfer hose, by loosening the hose adapter nut, on the Schrader adapter.

Now slowly open the bottle, until a flow can be heard.

At standby,
R23 is charged, until both transducers show 200 psi at 20° C. ambient.

When the unit is working,
R23 charging is slowly performed until the sight glass is fully covered by liquid.

6.7 OPENING R134a SYSTEM

Whenever it is necessary to open a charged or functioning system to make repairs or replacements, it is necessary to discharge the refrigerant from that part of the refrigerant circuit before the system is opened. If the final pressure is reduced to less than atmospheric, sufficient refrigerant should be bled into the evacuated part of the system to raise the pressure to approximately 0 psi. Connections may then be broken and the necessary repairs made.

Extreme care must always be taken to prevent the entrance of moisture and dirt into the system.

The use of "EASY-FLOW" silver solder and flux, or equivalent, is recommended in the refrigerant system piping. Do not use soft solder.

Prior to disturbing any connections, the type of solder originally used should first be verified, then continue.

By taking this precaution, contamination of the joint will be avoided.

6.8 OPENING R23 SYSTEM

Whenever it is necessary to open a charged or functioning system to make repairs or replacements, it is necessary to discharge the R23 from the refrigerant circuit to the lowest positive pressure before the system is opened. To do that follow instructions below:

1. Connect a recycle pump with service hose between the ¼ inch service adapter on the R23 system suction side and the ¼ inch valve on an approved tank for R23 gas.
   CAUTION. The volume of the tank must be at least 40 liters to take the whole charge from the unit. The pressure in the tank must not at any time exceed the pressure that the tank is approved for.
2. Connect a vacuum pump to both hoses on the recycle pump and take the system down to full vacuum.
3. Close the connection to the vacuum pump.
4. Open valves on the service hose “shut of valve”, as well as the suction service valve and start the recycle pump. Operate the pump until the R23 gas is pumped over to the approved tank for R23 gas.
5. After the system is repaired or part has been replaced, the system must be leak tested. (See Section 6.9)
6. Draw a vacuum on R23 system. (See Section 6.10)
7. By reversing the hoses on the recycle pump all the R23 gas can be pumped back to the R23 piping system at the unit.

6.9 TESTING FOR LEAKS

The preferred method for finding leaks is by use of an electronic leak detector. There are several different makes available and they all use the same method of detecting a leak through an exploring tube, which will detect from large to extremely small leaks depending on the setting used on the detector.

Leak testing with soapsuds will reveal only the large leaks, and is therefore ineffective in determining the tightness of a system.

To provide the best possible condition for leak checking the system, it is recommended that the pressure in the refrigerant system be increased by adding dry nitrogen to create a pressure suitable for checking.

6.10 VACUUM THE SYSTEM

Caution:
Do not use the compressor as a vacuum pump or as an air compressor. It is not designed to handle air and will not pull down to as low a vacuum as a pump designed for that purpose. Similarly, if used to compress air, serious overheating and consequent damage may result.

Connect a pump capable of drawing a vacuum of 0.15 mm HG or better to that part of the system which has been opened. Continue until all air and moisture have been removed.

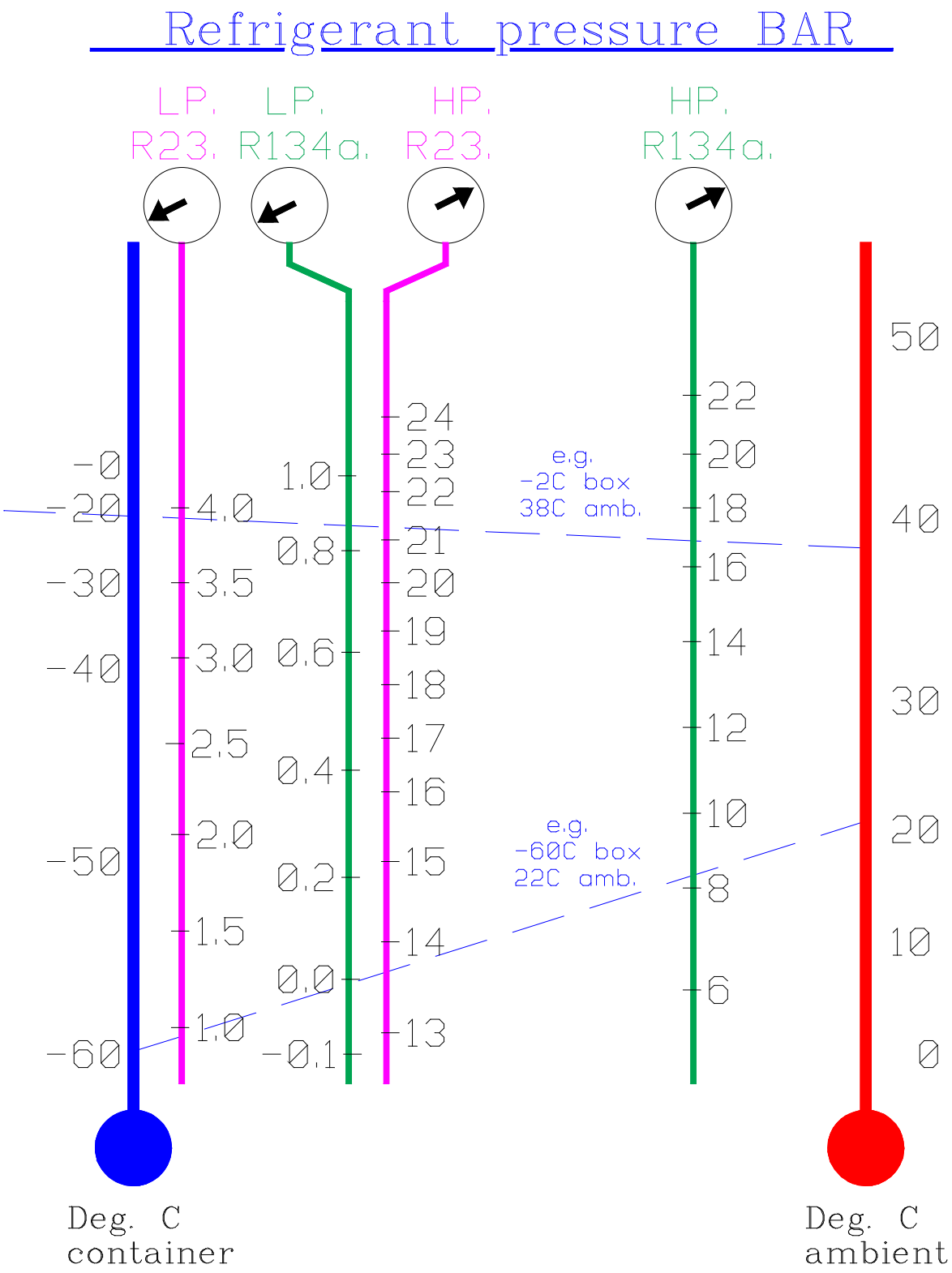
The final evacuation may be accelerated, however, by manifolding the connections to the vacuum pump and evacuating simultaneously the high and the low sides of the system, the vacuum should be broken by introducing refrigerant.

Too much emphasis cannot be placed on the importance of keeping the system free of moisture during the evacuation process. Slight amounts of water in the system will inevitably lead to trouble in the following forms:

a. Corrosion of the steel parts.
b. Copper plating of the shaft and the bearing.
c. Slugging or gumming of the oil.
d. Plugging of the strainers and the driers.
e. Freezing and plugging of the expansion valve.

6.11 REFRIGERANT R134a /R23, TEMPERATURE / PRESSURE TABLE

The table shows the pressure and temperature between the two refrigerant systems, with a ΔT at 5° to 10°C on the heat exchange between high-pressure in the R23 system, and low-pressure in the R134a system.



SECTION 7. SERVICING COMPONENTS

7.1 COMPRESSOR (R134a / R23)

The scroll compressor motors in the R134a/R23 systems are equipped with an internal overload / overheat device. This device will break the circuit and stop the compressor, if any problem causes the motor to overheat. When the motor cools sufficiently the over-load will reset automatically.

CAUTION:
The Scroll compressor will only compress in one rotational direction, it is important to include notices to ensure the proper rotation direction when the compressor is started. Reverse rotation results in a sound level above what is normal in correct rotation, and there will be no reaction in suction – and discharge pressure. Operating the compressor in reverse rotation may cause damage to the compressor.
To check the oil level in the compressor, a sight glass is provided in the front of the shell, allowing the oil inside to be visible at all times.

Before the system is started, each compressor sight glass should be approximately ¼ full of oil. Because the oil level will vary with operating conditions, it should be checked again after the compressor has been running long enough for the crankcase to warm up to operating conditions. The level in the sight glass shall be visible when the compressor is running. If the level is low, oil should be added, to maximum 50% level sight glass.
(Note, oil level in compressor 1 will always be lower than in compressor 2, because oil from compressor 1 will be sucked to compressor 2 in the equalizing pipe.)

As there is no means of pouring oil into the compressor as there is on hermetic compressors, oil has to be sucked into the crankcase by way of the suction service valve.
To do this, the compressor has to be separated from the system by closing the liquid valve to empty the compressor of refrigerant.

Although this procedure is relatively simple, some preparations and care must be taken as follows:

Use a standard oil filling hand pump.

Or use a vacuum pump as follow:

a. Connect vacuum pump to the Schrader valve on the compressor suction side.
b. Connect a charging hose to the “oil level Schrader valve” (placed level with sight glass)
c. Now place the end of the charging hose into the can of oil and start the vacuum pump. Continue to take the pressure to vacuum, and pull the oil into the crankcase, and observe the oil level in the compressor sight glass.
d. As soon as enough oil has been transferred to the compressor, disconnect charging hose. For comp.1 (R134a), the vacuum pump must draw a vacuum of 0,15 mm HG. or better in the compressor, then open the liquid valve and start the unit.
e. Allow the unit to run 30 minutes before re-checking the oil level in the compressor sight glass, immediately after the compressor has been shut off.

Note:
Always keep commercial oil stored in sealed containers. Oil exposed to the atmosphere will absorb moisture, which can cause damage when introduced into the system. Use only the grades of oil which are suitable and recommended for compressor lubrication and have been specially processed so as to have the necessary low moisture content. The following oils are suitable:

Mobil Ester oil EAL 22CC
Ici Emkarate RL32CF
(Both oils are miscible)

P/N K11 00416 00
When a hermetic motor burn-out occurs, the stator winding insulation decomposes forming carbon, water and acid. To prevent contamination of the refrigerant system and repeated motor failures, steps must be taken to ensure that the refrigerant circuit is kept clean from contamination.

Important:
Damage to a compressor caused by failure to clean the system properly after burn-out constitutes abuse and is not covered by the terms of the warranty.
Note:
After it has been observed that a hermetic motor has failed either by observing an obvious electrical fault or by a strong burnt odor to the refrigerant gas released at the discharge valve port, the following procedure must be followed to clean the system and thus prevent failure of a replacement compressor.
Caution:
Acids are formed during a motor burn-out. Use rubber gloves and eye protection, when working on the system or handling contaminated parts.

Moisture is a normal product of decomposition and is very harmful in a refrigeration system. However, it is one of the easiest products to remove. Acids, both hydrochloric and hydrofluoric, are generated. Both are highly corrosive and hydrofluoric acid will also attack glass.

Note: The etching of various sight glasses around the system will give an indication of the extent of con-tamination. The acid, most of which concentrates in the compressor oil, must be removed to prevent failure of the replacement compressor.

a. To recover the refrigerant from the system, use a recover or reclaim system, so that the refrigerant can be disposed of according to local regulations.
b. Replace the oil in the compressor.
c. Replace the drier (replace the moisture indicator, if necessary).
d. Evacuate the system.

Note:
It is vital to use a high stage vacuum pump to eliminate any moisture in the refrigerant system. The most effective method is to use a two-stage vacuum pump. A high stage vacuum pump will remove all the moisture in the refrigerant system because it lowers the pressure in the system to a level at which the water will boil.

e. Charge the system with the refrigerant.

f. Run the system for approximately 6 hours.

g. Make an acid test.
If the oil sample indicates acid, pump down the system and close the compressor service valve, drain the compressor of the oil and refill with new oil. Replace the drier.

h. Run the refrigeration unit for an additional 6 hours and then carryout a new acid test. Repeat the above procedure until the system is free of acid.

7.2 COND. AND EVAP. FANS MOTOR.

The condenser fan motor is a totally enclosed motor and is equipped with shielded ball bearings, which require no lubrication under normal service conditions.

The evaporator fan motors are totally enclosed motors and are equipped with shielded ball bearings, which require no lubrication under normal service conditions.

It is recommended to check the condenser and evaporator fan motor bearings for noise and defects every ½ year, or before a long period of use.

7.3 COND. AND EVAP. FANS.

If a motor or fan has to be removed / dismounted from the unit for any reason, be sure that the motor or fan is relocated, to the same position.

7.4 FILTER-DRIER ASSEMBLY.

A replaceable filter-drier is installed in the liquid line. It removes moisture and dust from the refrigerant while it is circulated.

TO REPLACE FILTER-DRIER IN THE R134a SYSTEM:
If the moisture indicator shows a yellow color, or if the outlet side of the filter-drier feels cooler than the piping side, the drier should be changed.

1. Close the liquid line shutoff valve, and pump down the system until the suction pressure stabilizes at 0 psi. Remove all power to unit.

2. Remove drier from clamp, and un-solder the drier.

3. Remove caps from new filter-drier and install immediately. (If the change of the driers is accomplished fast enough, there will be no need to purge air out of the lines.)

4. Install the new filter-drier correctly into the liquid line using the arrow sign.

5. Open liquid valve and the unit is ready to run again.

TO REPLACE FILTER-DRIER IN THE R23 SYSTEM:
If the moisture indicator shows a yellow color, or if the outlet side of the filter-drier feels cooler than the piping side, the filter-drier should be changed.
The total refrigerant charge has to be pumped into a tank that is approved for the R23 gas. (See instruction, Section 6.8.)

NOTE. Install the new filter-drier correctly into the liquid line using the arrow sign.

7.5 HIGH-PRESSURE SWITCH, COMPRESSOR.

The pressure switches function automatically to open or close the compressor contactor coil circuit upon increase or decrease in discharge pressure.

All pressure switches are mounted on the "Schrader valve" adapter.
To replace the pressure switches, located on the discharge side of the compressors:

1. Switch off the unit.

2. Disconnect/cut wire to switch, loosen the pressure switch and quickly unscrew the pressure switch. The unit will not lose refrigerant, because the "Schrader valve" will close when the switch is disconnected.

3. Replace defective switch.

4. Connect electrical wires.

7.6 PRESSURE TRANSDUCERS.

Both refrigerant systems in the unit are designed with transducers on the high and low-pressure sides.

All four transducers are equipped with "Schrader valve" adapters.
To replace transducer:

1. Switch off the unit.
2. Disconnect/cut wire to the transducer, loosen and quickly unscrew the transducer. The unit will not lose refrigerant, because the "Schrader valve" will be closed when the transducer is disconnected.
3. Replace defective transducer.
4. Connect electrical wires.

7.7 THERMAL EXPANSION VALVE.

There are two expansion valves on the unit:

1 pc. for R134a/R23 heat exchanger,
1 pc. for R23 evaporator coil.

Both are technically the same and consist of three parts:

1. The body, to which the inlet and outlet tubing is brazed.

2. The cage/filter.
3. The power element which is part of the body. The thermal sensing bulb, which is attached to the top of the power assembly by a capillary tube, allows the power element to be controlled by temperature changes in the bulb. In addition to this, a 1/4 in. copper tube connects the valve to the suction line, which serves as equalizer.

The thermal bulb is secured to a pre-selected point on the suction line and is positioned at 4 or 8 o'clock, by the perforated metal straps. If, for any reason, these bulbs are removed from the suction line, care must be taken to ensure the bulbs are replaced correctly and at the correct orientation.

It is seldom that an expansion valve fails and even less often that it needs adjustment. Superheat is pre-set and should not need attention after installation.
The expansion valve is pre-set by the manufacturer to operate at 9°C superheat on maximum capacity. No attempt should be made to adjust this setting. Non-compliance to this could cause a reduction in system capacity and may damage the compressor and void the warranty.

If, at initial start-up of the system, a particle of dirt become lodged in the valve, it will be necessary to pump down the system and dismantle the valve cage/filter to remove the particle.
The expansion valve is pre-set by the manufacturer to operate at 6°C superheat on maximum capacity.
No attempt should be made to adjust this setting. Non-compliance to this could cause a reduction in system capacity and may damage the compressor and void the warranty.

If valve fails, the total refrigerant charging has to be pumped into an approved tank for R23 gas.
(See instruction, Section 6.8).

7.8 SAFETY RELIEF VALVE.

There are four "safety relief valves" in the unit refrigerant system:
One in the system's discharge line, to relieve the pressure in the high-pressure side, if the unit gets overcharged. (425 psi activation)
One in the system's suction line, to relieve the pressure in the low-pressure side if the unit gets overcharged. (300 psi activation)

One in the system's discharge line, to relieve the pressure in the high-pressure side, if the unit gets overcharged. (425 psi activation)

One on the buffer tank/-high-pressure side, to relieve the pressure if the unit is overcharged. (425 psi activation)

The valves cannot be adjusted and if one of the valves fails, the total refrigerant charge must be removed from the system.

7.9 NON RETURN VALVE.

There are two "non-return valves" in the unit refrigerant system:
Two (2) are mounted in the discharge piping to compressors 1 & 2, to prevent the refrigerant from going back in to the compressor, when it stops.

If one of valves fails, the total refrigerant charge has to be removed from the system.

7.10 CRANKCASE PRESSURE REGULATOR, R23.

For operation with high air temperature in the container room a crankcase pressure regulator is mounted in the R23 system suction line in order to protect compressor 3 motor against overload.

TO ADJUST REGULATOR:
1. Connect service pressure gauge to the compressor suction valve "Schrader valve" adapter.
2. Start unit, (**NOTE.** Normally the regulator is adjusted with unit operating on defrost.)
3. Remove protection cap on crankcase pressure regulator.
4. With an Allan wrench turn the adjustment stem clockwise to raise or counter-clockwise to lower the valve setting. Correct setting is maximum suction pressure 50 psi.
5. Replace protection cap on crankcase pressure regulator.

If valve fails, the total refrigerant charge has to be pumped into an approved tank for R23 gas.
(See instruction, Section 6.8).

7.11 LIQUID INJECTION VALVE, R134a COMPRESSORS.

The two liquid injection valves for compressors 1 and 2 are pre-set by the manufacturer (Copeland) to control that temperature on the compressor does not rise above approximately 90°C. Non-compliance with this could cause a reduction in system capacity and may damage the compressor and void the warranty.

TO REPLACE THE VALVE:
1. Close the shut off valve in the liquid line and pump down the system, until the suction pressure stabilizes between 0 and 1.5 psi. Remove all power to unit.
2. Slowly loosen bolts on the valve body to release any R134a that may by left in the system.
3. Replace defective valve.
4. Re-install new valve.
5. If the repair/exchange is completed within 5 minutes, purging the system for air will not be necessary because the refrigerant mixed in the compressor/evaporator coil will continue to boil off and create positive pressure in the system, which will prevent air from entering.
6. Open the liquid line shut off valve and the unit is ready to start again.
7. Check for leaks.

7.12 LIQUID INJECTION VALVE, R23 COMPRESSOR.

The liquid injection valve for compressor 3, is pre-set by the manufacturer (Copeland) to control that

temperature on the compressor does not rise above approximately 90°C. Non-compliance to this could cause a reduction in system capacity and may damage the compressor and void the warranty.
If valve fails, the total refrigerant charge has to be pumped into an approved tank for R23 gas.
(See instruction, Section 6.8).

7.13 MAX. HOT GAS PRESSURE REGULATOR.

To prevent operating the system with too high of pressure during defrosts a “maximum hot gas pressure regulator” is mounted in the R23 hot gas piping. The valve opens for leading the pressure to the buffer tank.

TO ADJUST REGULATOR.

1. Connect service pressure gauge to the compressor suction service valve.
2. Start unit, (**NOTE.** Can only be adjusted when system is in defrost.)
3. Remove protection cap on the pressure regulator.
4. With an Allen wrench turn the adjustment stem clockwise to raise or counter-clockwise to lower the valve setting. Correct setting is max. pressure at 275 psi.
5. Replace protection cap on pressure regulator.

If valve fails, the total refrigerant charge has to be pumped into an approved tank for R23 gas.
(See instruction, Section 6.8)

7.14 LIQUID SOLENOID VALVE, R134a.

The solenoid valve (NC) in the R134a system is mounted in the liquid line; the valve operates on a signal from the controller. When the solenoid coil is energized, it diverts refrigerant to the expansion valve.

TO REPLACE OR REPAIR VALVE:

1. Close the liquid line shut off valve and pump down the system until the suction pressure stabilizes between 0 and 1.5 psi. (The valve must be open.) Remove all power to unit.
2. Remove cap and coil.
3. Slowly loosen bolts on the solenoid valve body to release any refrigerant that may by left in the lines.
4. Remove enclosing tube slowly, check for foreign material in the valve.
5. Replace defective parts.
6. Re-install all valve parts.
7. If the repair/exchange is completed within 5 minutes, purging the system for air will not be necessary because the refrigerant mixed in the compressor/evaporator coil will continue to boil off and create positive pressure in the system, which will prevent air from entering.
8. Open the liquid line shut off valve and the unit is ready to start again.
9. Check for leaks.

7.15 HOT GAS SOLENOID VALVE.

The solenoid valve (NC) in the R23 hot gas system is mounted in the hot gas piping to the evaporator coil and the drain piping.

The valve operates from a signal from the controller. When the solenoid coil is energized, it diverts hot gas to the evaporator coil.

If the valve fails, the total refrigerant charge has to be pumped into an approved tank for R23 gas.
(See instruction, Section 6.8).

7.16 SERVICING SCHEDULE.

	Daily or Weekly	Initial 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Every 2000 Hours
REFRIGERATION SYSTEM (NMF SERIES)						
Check Compressor Oil Level / add if needed		X	X			
Check and clean Condenser Coils		X	X			
Check Moisture Indicators				X		
Check Refrigerant Levels				X		
Check Reefer for unusual noises	X		X			
Inspect Reefer Unit for damaged, loose or broken parts, missing bolts			X			
Check condition of mounting bolts		X	X			

In addition to the above checklist, the normal Pre-Trip Inspection Form should also be completed every 2 months.

SECTION 8. TROUBLE SHOOTING.

8.1 GENERAL INFORMATION.

Several components are incorporated in the unit to assist the service engineer to find the cause of problems, concerning the operation and efficiency of the unit.
L.E.D. lights on the display panel indicate which cycle the micro-processor controller is calling for and should be used in conjunction with the pressure gauges to determine whether certain cycles are operating.
NOTE: It is recommended to initiate the test after all repairs. The alarm light on the display panel will be lit until the failure is repaired. **(If the fault causing an alarm corrects itself, the alarm light will shut off after one hour delay.)**

8.2 ALARM CHART.

"ALARM" LAMP LIGHT ON.
GO TO "ALARM" IN MAIN MENU, PRESS (→) FOR ENTER. THE DISPLAY SHOWS ACTIVE ALARM CODE.
SCROLL, PRESS (↓) OR (↑). PRESS (→) FOR CANCEL. ESC. PRESS (←)

Display text		Description	Corrective Action
Return air sensor, Out of range.	A01	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Supply air sensor, Out of range.	A02	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Defrost sensor, Out of range.	A03	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Cargo sensor, Out of range.	A04	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Evap motor left sensor, Out of range.	A05	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Compr 1 sensor. Out of range.	A06	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Compr 2 sensor. Out of range.	A07	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Compr 3 sensor. Out of range.	A08	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Evap motor right sensor, Out of range.	A09	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
R23 low press. Out of range.	A10	Pressure Transducer, R23 low-pressure, has an open (210 psi) or short circuit (-42 psi).	Replace defective transducer.
R134a low press. Out of range.	A11	Pressure transducer, R134a low-pressure has an open (210 psi) or short circuit (-42 psi).	Replace defective transducer.
R23 high press. Out of range.	A12	Pressure transducer, R23 high-pressure, has an open (580 psi) or short circuit (-70 psi).	Replace defective transducer.
R134a high press. Out of range.	A13	Pressure transducer, R134a high-pressure has an open (580 psi) or short circuit (-70 psi).	Replace defective transducer.
Ambient temp sensor. Out of range.	A16	The sensor has an open (999.9°C) or short circuit (-99.9°C).	Replace defective sensor.
Reference error. Shutdown.	A17	Internal controller error	Replace defective MPC3 Controller.
Comp #1 temp too high.	A22	Compressor 1, discharge line temp above 120°C.	Repair or replace defective sensor.
		Defective refrigerant system.	Check R134a refrigerant charge. (Sight glass)
		Too high condensing temperature. (Max. 30°C above ambient.)	Clean condenser, check condenser fan motor and fan.
		Defect liquid injection valve.	Repair or replace defective part.
Comp #2 temp too high.	A23	Compressor 2, discharge line temp above 120°C.	Repair or replace defective sensor.
		Defective refrigerant system.	Check R134a refrigerant charge. (Sight glass)
		Too high condensing temperature. (Max. 30°C above ambient.)	Clean condenser, check condenser fan motor and fan.
		Defective liquid injection valve.	Repair or replace defective part.

ALARM CHART.

No alarm:		Description	Corrective Action
Comp #3 temp. too high.	A24	Compressor 3, discharge line temp above 130°C.	Repair or replace defective sensor.
		Defective refrigerant system.	Check R23 refrigerant charge. (Sight glass)
		Too high condensing temperature. (Heat ex-changer R134a/R23 not operating optimal.)	Check R134a refrigerant charge. (Sight glass)
Drop of temperature is slow.	A26	This alarm is activated when the return air sensor is within 5°C of the set point AND there is a decrease in the average drop in temperature measured at the return air over a period of ten minutes.	Check container door is closed. Check refrigerant system. Reset evap fan motors
"Phase direction problem" (Controller not able to "set" phase direction)	A31.	Missing phase from main power.	Check power in all 3 phases.
		Defective phase sensor relay.	Repair or replace defective relay.
R23 High-pressure cut-out.	A33	Defective refrigerant R134a system.	
		Defective compressor R134a system.	Check R134a compressors.
		Condenser fan is not running	Check condenser motor.
		Defective refrigerant system.	Check R23 refrigerant system.
R134a High-pressure cut-out.	A34	Too high condensing temperature. (Max. 30°C above ambient.)	Clean condenser, check condenser fan motor and fan.
		Condenser fan is not running	Check condenser motor.
		Defective refrigerant system.	Check 134a refrigerant system.
R23 Low-pressure cut out	A35	Suction pressure R23 too low <0 psi.	Check R23 charge Check R23 TX valve Check evap fan motor Check air circulation in container
R134a Low-pressure cut out	A36	Suction pressure R134a too low < -7.25 [so.	Check R134a charge Check R134a TX valve Check R23 system for fault. Check air circulation in container
Evap fan motor temp too high.	A37	Evaporator motor temp above 65°C. (If the motor operated too long with high box temperature (+°C), the motor will be overheated)	Check motor condition (run free) and try to restart.
Evap fan motor starts fail.	A38	Evaporator motor has failed to start, motor may be frozen/stuck in fan blade.	Check motor condition (run free) and try to restart.
Auto test error, amps too low.	A40	Current of one of the tested parts is too low.	Check amps on the faulty part with an amp meter. Repair or replace defective part.
Auto test error, amps too high.	A41	Current of one of the tested parts is too high.	Check amps on the faulty part with an amp meter. Repair or replace defective part.
Auto test error, delta amps too high.	A42	The difference in current of one of the tested parts is too high.	Check amps on the faulty part with an amp meter. Repair or replace defective part.
Emergency stop activated.	A46	Emergency switch in container is activated.	Check for person in container. Reset Emergency switch. Defective Emergency switch.

MESSAGE INFORMATION IN DISPLAY.
(To see message in display, “Remove message” has to be set to “OFF” in Controller “Switch setting” menu.)

DISPLAY SHOWS:		**Description**	**Action**
Comp #1 temp too high	M04	Compressor #1 discharge line temp above 120°C	Info only
Comp #2 temp too high	M05	Compressor #2 discharge line temp above 120°C	Info only
Comp #3 temp too high	M06	Compressor #3 discharge line temp above 120°C	Info only
Evap fan motor temp too high	M08	Evaporator motor temp above 65°C.	Unit shutdown
R23 High-pressure	M10	R23 high-pressure higher than 390 psi.	After 5 times, the Unit stops.
R23 Low-pressure	M12	R23 low-pressure lower than 3 psi.	Info only
R134a Low-pressure	M13	R134a low-pressure lower than -6 psi.	Info only
Door open. (Option.)	M18	Container door open.	Unit shutdown
Emergency stop activated.	M19	Emergency switch in container is activated.	See Alarm code A46
Phase direction test	M20	Phase direction test run (Max. 25 sec. after main power ON.)	Direction, 0 = test. Run direction, 1= PC, R1. Run direction, 2= PC, R2.
Phase direction test missing	M21	Phase direction test errors	Unit shutdown

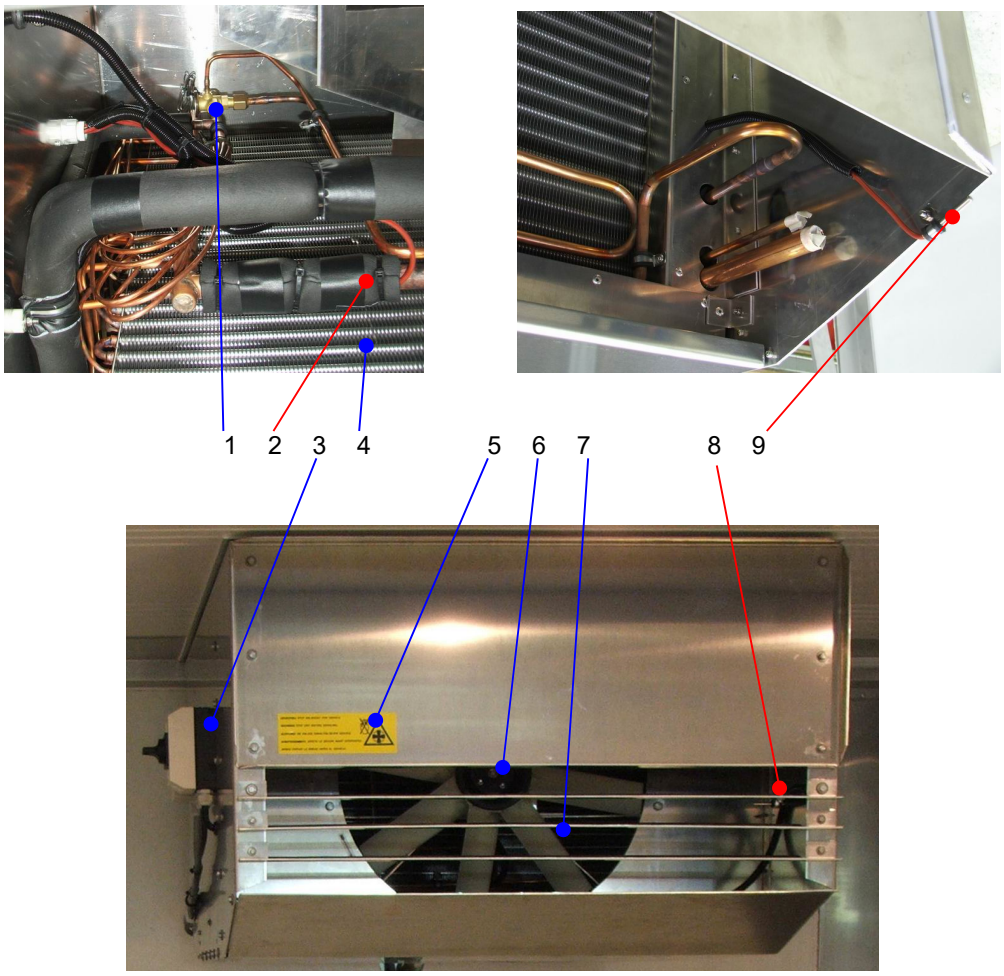
8.3 UNIT INFORMATION.

Electrical All data are approx. and based on 460volt/60 Hz	
Input power	400/460 volts +/-10% 3 phase 50/60 Hz+/-5%
Compressor 1 motor	3400 Rpm - full load – 12Amps.
Compressor 2 motor	3400 Rpm - full load – 12 Amps.
Compressor 3 motor	3400 Rpm - full load – 12 Amps.
Condenser fan motor	1120 Rpm - full load – 1.2 Amps.
Evaporator fan motors.(each)	1730 Rpm - full load – 0.6 Amps.

Refrigerant System	
System charging R134a	3.8 kg
System charging R23	2.3 kg
Compressor 1. Oil charge.	1.9 Liter.
Compressor 2. Oil charge.	1.9 Liter.
Compressor3. Oil charge.	1.9 Liter.
High-pressure switch, R134a system. (cannot be adjusted)	Cut-out approx. 24 bar +/-10 psi. Cut-in approx. 17 bar +/-4 psi.
High-pressure switch, R23 system. (Cannot be adjusted)	Cut-out approx. 28 bar +/-10 psi. Cut-in approx. 20 bar +/-4 psi.
Hotgas Max. pressure regulator R23 system	Set to max. Pressure at 275 psi.
Crankcase pressure regulator R23 system	Set to suction pressure at max. 50 psi.
Safety relief valve, R134a High-pressure (Cannot be adjusted)	425 psi.
Safety relief valve, R134a Low-pressure (Cannot be adjusted)	250 psi.
Safety relief valve, R23 High-pressure/ buffer tank. (Cannot be adjusted)	425 psi.
Safety relief valve, R23 Low-pressure (Cannot be adjusted)	250 psi.
Max. Leak Test pressure, high-pressure side	400 psi.
Max. Leak Test pressure, low-pressure side	250 psi.

SECTION 9. SERVICE PARTS.

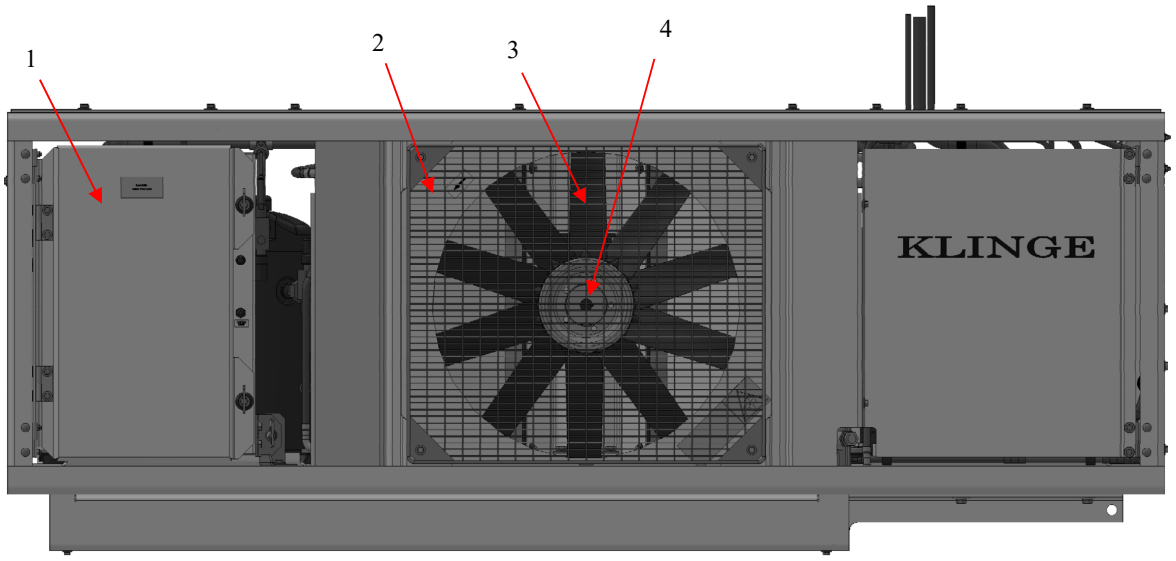
EVAPORATOR SECTION (360-16615-10)



EVAPORATOR SECTION – Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
1	K25-25728-00	EXPANSION VALVE R23	1
2	K25-26808-00	SENSOR, DEFROST	1
3	K24-22498-00	REPAIR SWITCH	1
4	K26-25229-00	COIL EVAPORATOR	1
5	K35-04602 00	LABEL, WARNING	1
6	K24-22499-00	MOTOR, EVAP. FAN	1
7	K26-25230-00	FAN, EVAP. MOTOR	1
8	K25-26808-00	SENSOR, SUPPLY AIR	1
9	K25-26808-00	SENSOR, RETURN AIR (BACK SIDE OF UNIT.)	1

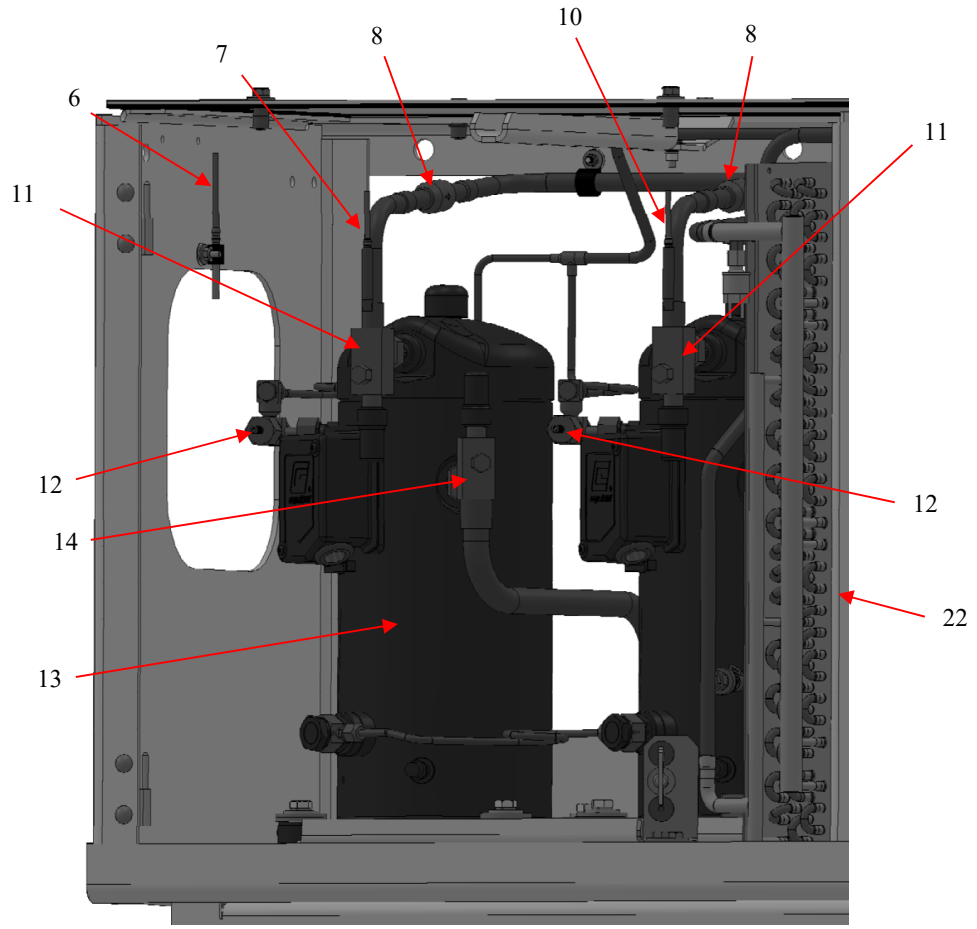
CONDENSER SECTION (360-16616-10)

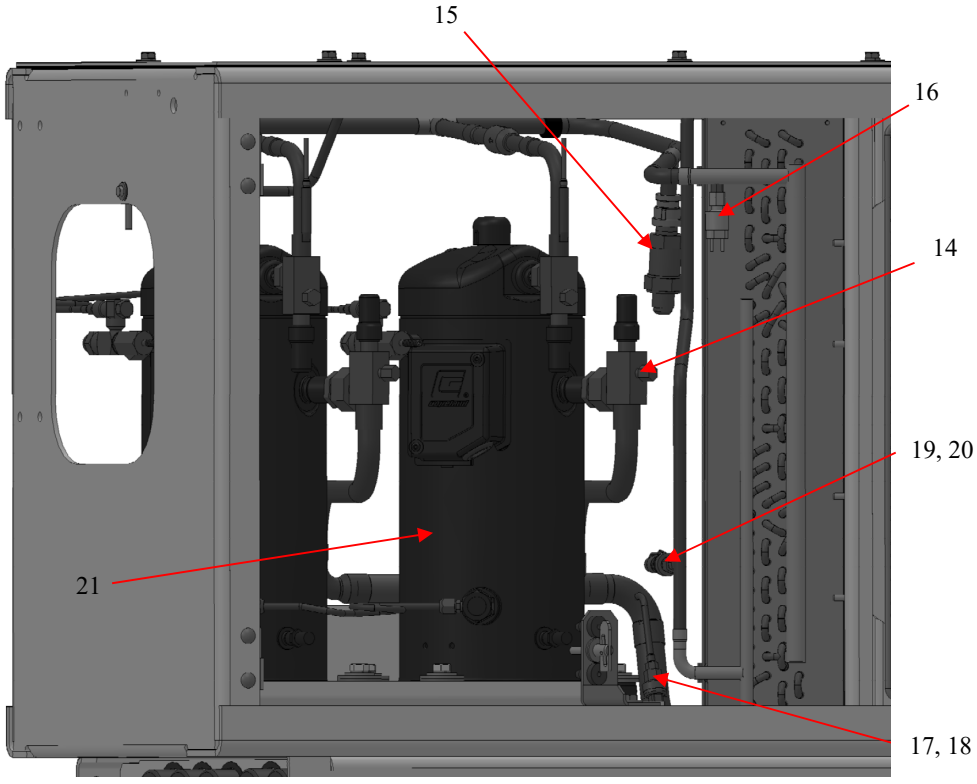


CONDENSER SECTION - Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16620-00	ELECTRICAL BOX COMPLETE	1
2	K26-25253-02	GUARD FAN	1
3	K26-25272-01	FAN 20.75 DIA 7/8 BORE 4 BLADE	1
4	360-16572-00	MOTOR ¾ HP MTR 1200 RPM	1

CONDENSER SECTION LH (R134a Compressor side)

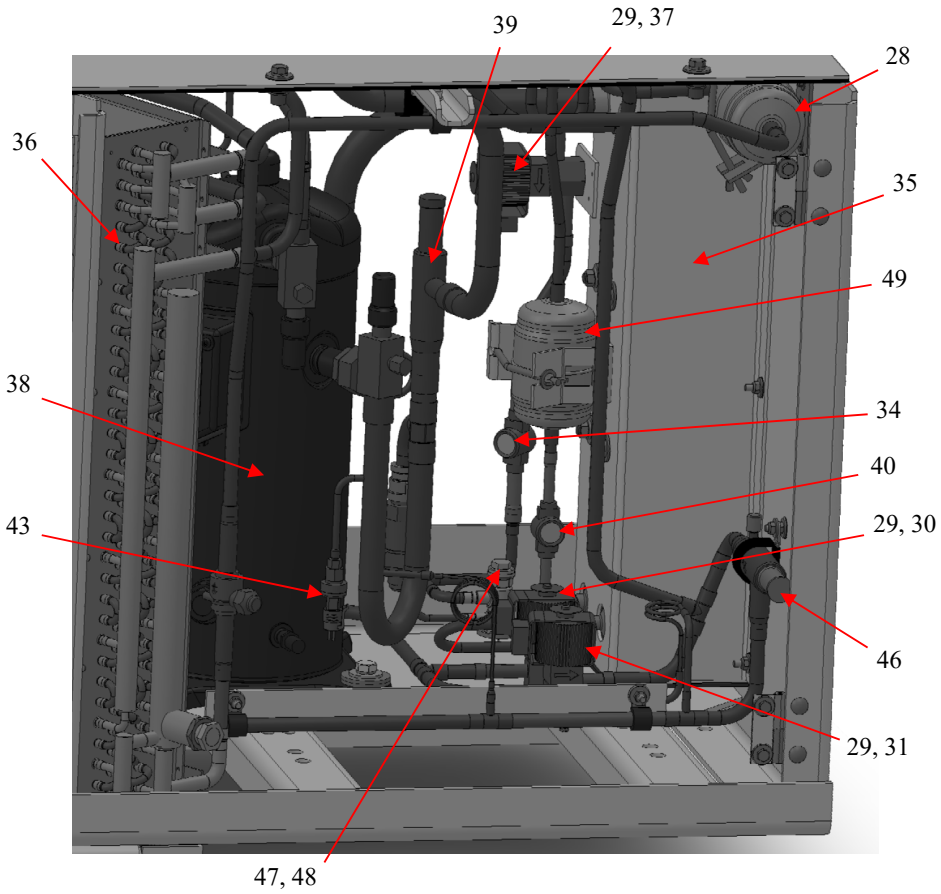


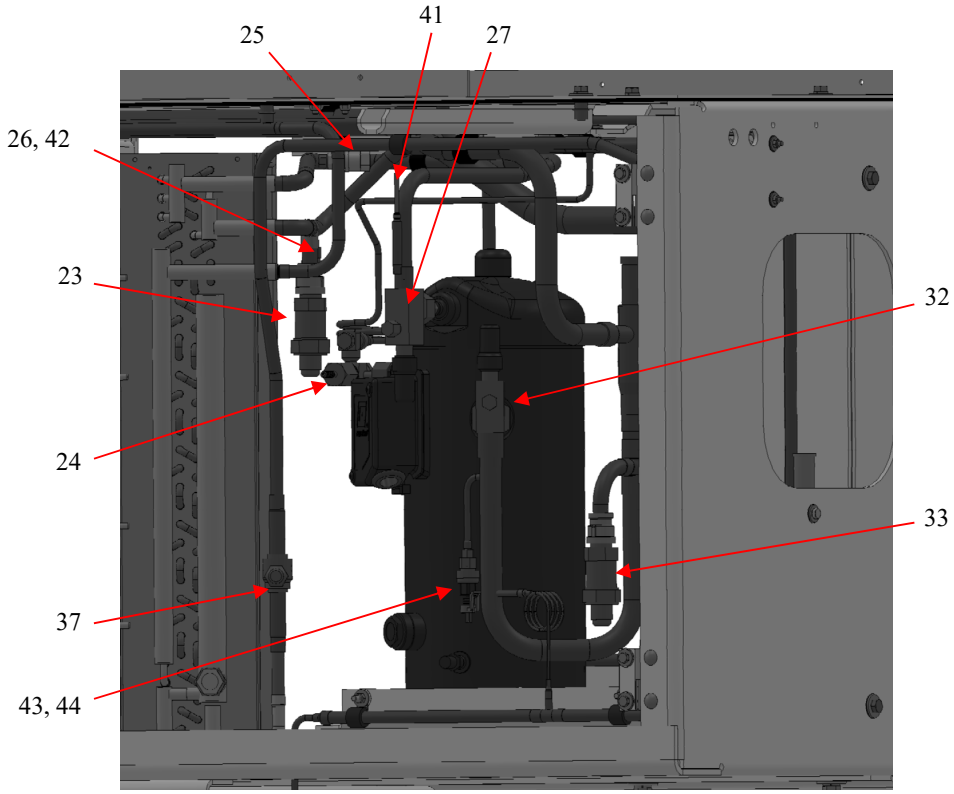


CONDENSER SECTION LH (R134a Compressor side) - Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
6	360-16509-20	PROBE AMBIENT 1	1
7	360-16509-25	PROBE COMPRESSOR 1	1
8	K26-58023-30	NON RETURN VALVE 5/8C X 5/8C	2
9	K22-07028-01	VALVE RELIEF (425 PSIG)	1
10	360-16509-26	PROBE COMPRESSOR 2	1
11	K22-06970-00	VALVE ROTA 1 1/4 X 5/8C BRASS	1
12	K15-00042-13	KIT VALVE DTC DISCH TEMP CONTL	2
13	360-16581-01	COMPRESSOR 1 R134A	1
14	K22-06910-00	VALVE ROTA 1 1/4-12 X 7/8C BRASS	2
15	K22-07028-00	VALVE RELIEF (300 PSIG)	1
16	360-16509-13	CABLE HIGH PRESS SW 1 R134A	1
17	360-16509-32	CABLE R134A LP PRESS TRANS	1
18	K25-26809-00	TRANSDUCER 0-200 PSI	1
19	360-16509-30	CABLE R134A HP PRESS TRANS	1
20	K25-26810-00	TRANSDUCER 0-500 PSI	1
21	360-16581-02	COMPRESSOR 2 R134A	1
22	K26-25217-00	COIL CONDENSER LH	1

CONDENSER SECTION RH (R23 Compressor side)

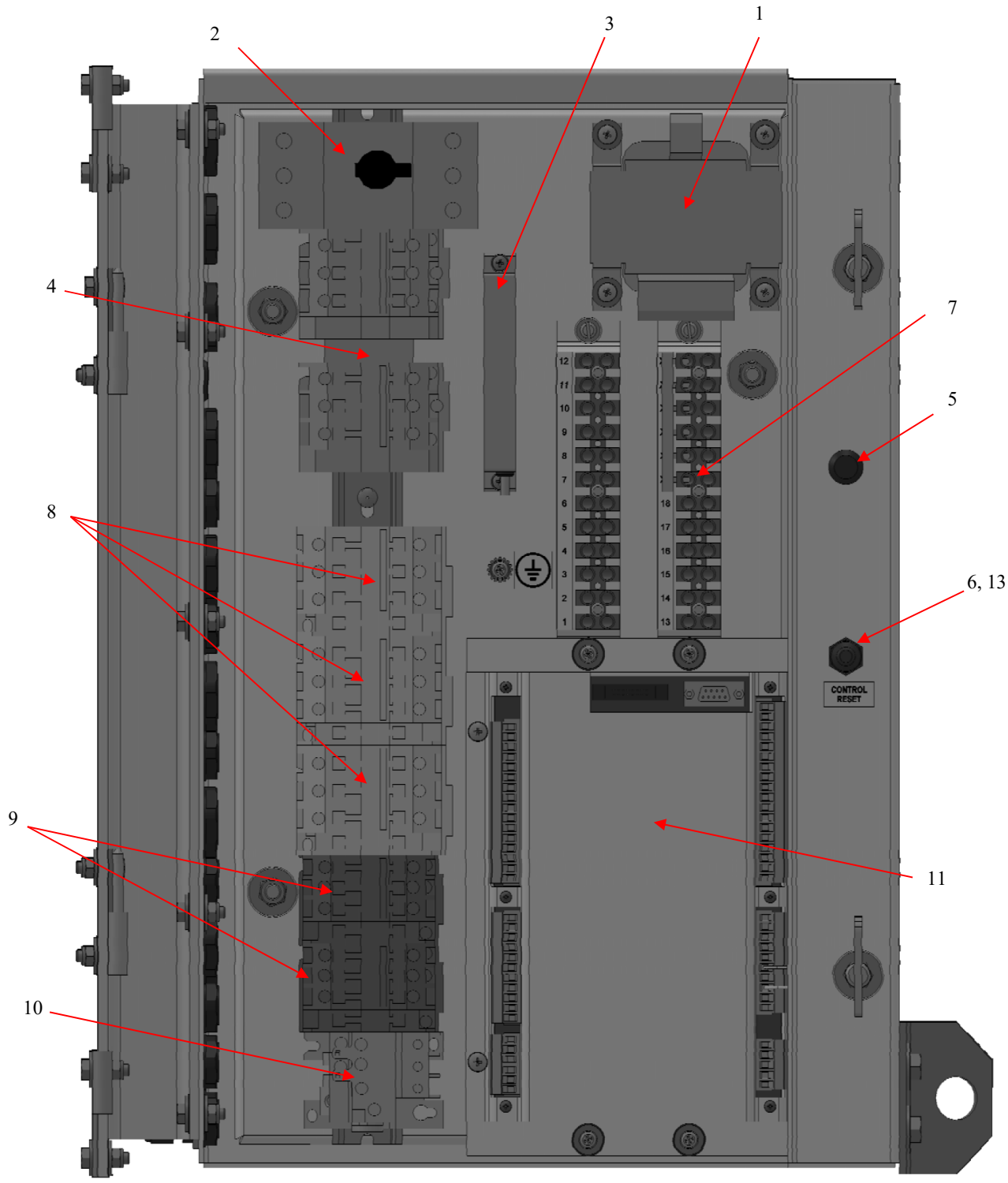




CONDENSER SECTION RH (R23 Compressor side) - Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
23	K22-07028-01	SAFETY RELIEVE VALVE HP	2
24	K15-00042-13	LIQUID INJECTION VALVE	1
25	360-16509-14	CABLE HIGH PRESS SW R23	1
26	K25-26810-00	PRESSURE TRANSDUCER HP	2
27	K22-06970-00	VALVE ROTA 1-14 X 5/8C BRASS	3
28	K26-10795-01	FILTER DRIER ½ " SOLDER	2
29	K25-26089-00	COIL SOLENOID VALVE	2
30	360-16509-02	CABLE HOT GAS SOLENOID	1
31	360-16509-04	CABLE MAX LOAD CONTROL SOLENOID	1
32	K22-06910-00	VALVE ROTA 1-1/4-12 X 7/8C BRASS	1
33	K22-07028-00	SAFETY RELIEVE VALVE LP	1
34	K26-25116-00	SIGHT GLASS R23	1
35	K26-25220-00	HEAT EXCHANGER R134a / R23	1
36	K26-25218-00	COIL CONDENSER RH	1
37	K22-07030-03	VALVE SHUT-OFF 1/2C X 1/2C	1
38	360-16581-03	COMPRESSOR 3 R23	1
39	K22-07026-00	PRESSURE REGULATOR	1
40	K26-25216-00	SIGHT GLASS R134a	1
41	360-16509-27	PROBE COMPRESSOR 3	1
42	360-16509-31	CABLE R23 HP PRESS TRANS	1
43	K25-26809-00	TRANSDUCER 0-200 PSI	1
44	360-16509-33	CABLE R23 EVAP PRESS TRANS	1
45	360-16509-01	CABLE LIQUID SOLENOID	1
46	K22-07027-00	PRESSURE REGULATOR CONDENSING	1
47	K25-26512-00	TX VALVE R134a	1
48	K25-25729-01	TX VALVE ORIFICE R134a	1
49	K26-25215-00	FILTER DRYER 3/8 SOLDER	1

CONTROL BOX



CONTROL BOX (LH side inside) – Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
1	K25-26741-00	TRANSFORMER	1
2	K24-22439-00	MAIN CIRCUIT BREAKER	1
3	K25-26743-20	CURRENT TRANSFORMER ASSEMBLY	1
4	K24-22315-01	PHASE REVERSING CONTACTORS	1
5	K28-10936-04	PLUG	1
6	K24-20565-00	CONTROL CIRCUIT BREAKER 8A	1
7	K25-26488-12	TERMINAL BLOCK	2
8	K24-58160-05	CONTACTOR RELAY	3
9	K24-58160-03	CONTACTOR RELAY	2
10	K24-22323-00	MOTOR OVERLOAD RELAY	1
11	K31-00927-01	CONTROLLER MPC3	1
12	K25-26756-00	BATTERY PACK FOR MPC3 (LOCATED UNDER MPC3)	1
13	K24-18164-00	CONTROL CIRCUIT BREAKER BOOT	1

REMOTE DISPLAY AND CONTROLS

REMOTE DISPLAY AND CONTROLS – Parts List

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16424-00	DISPLAY CONTROL	1