MODEL CBU-30-04

CONTAINER BLAST FREEZER UNIT
WITH ADJUSTABLE CEILING

OPERATION, SERVICE AND PARTS MANUAL

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MANUFACTURED BY KLINGE CORPORATION

REVISION RECORD

Rev	Description	Date	Approved
B	Updated information at "Compressor Lubrication" (page 25, included serial number and manual usage topics (page 5) added "Uncontrolled if Printed" to footer	2017/11/28	BES
C	Updated cover, revised manual part number (was K35-05850-49-04), added Service and Spare Parts information (pg 5)	2018/03/13	BES
D	Added deflection plate (Sect. 10.2), added 20' adjustable ceiling (Sect. 10.4), added vacuum valve information	2019/05/21	BES
E	Revised descriptions of Items 7 & 15, Section 9.2	2019/07/31	BES
F	Updated Electrical Schematic as changed on ECR 20-057	2020/06/03	BES
G	Updated Section 9 & 10	2021/12/02	DG/BS
H	Added A18 to Sect 8.2 Alarm Chart	2022/10/26	BES

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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.

SECTION 1. GENERAL DESCRIPTION

The **CBU-30** (**C**ontainer **B**last freezer **U**nit) 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 -60°C.

The unit operates in ambient temperatures up to +50°C however, cooling capacity may be reduced.

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 24/28 volt AC.

The CBU-30-04 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 for operation of the unit.
A phase sequence sensor and reversing relay are installed to reverse two of the phases, if necessary, in order to ensure correct rotation of 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 return to normal operation.

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. 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) of 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, which is 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 exchanger (R134a/R23) is to remove heat from the low temperature system.

The compressors 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 an ozone depletion potential (ODP) of 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, which is 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.

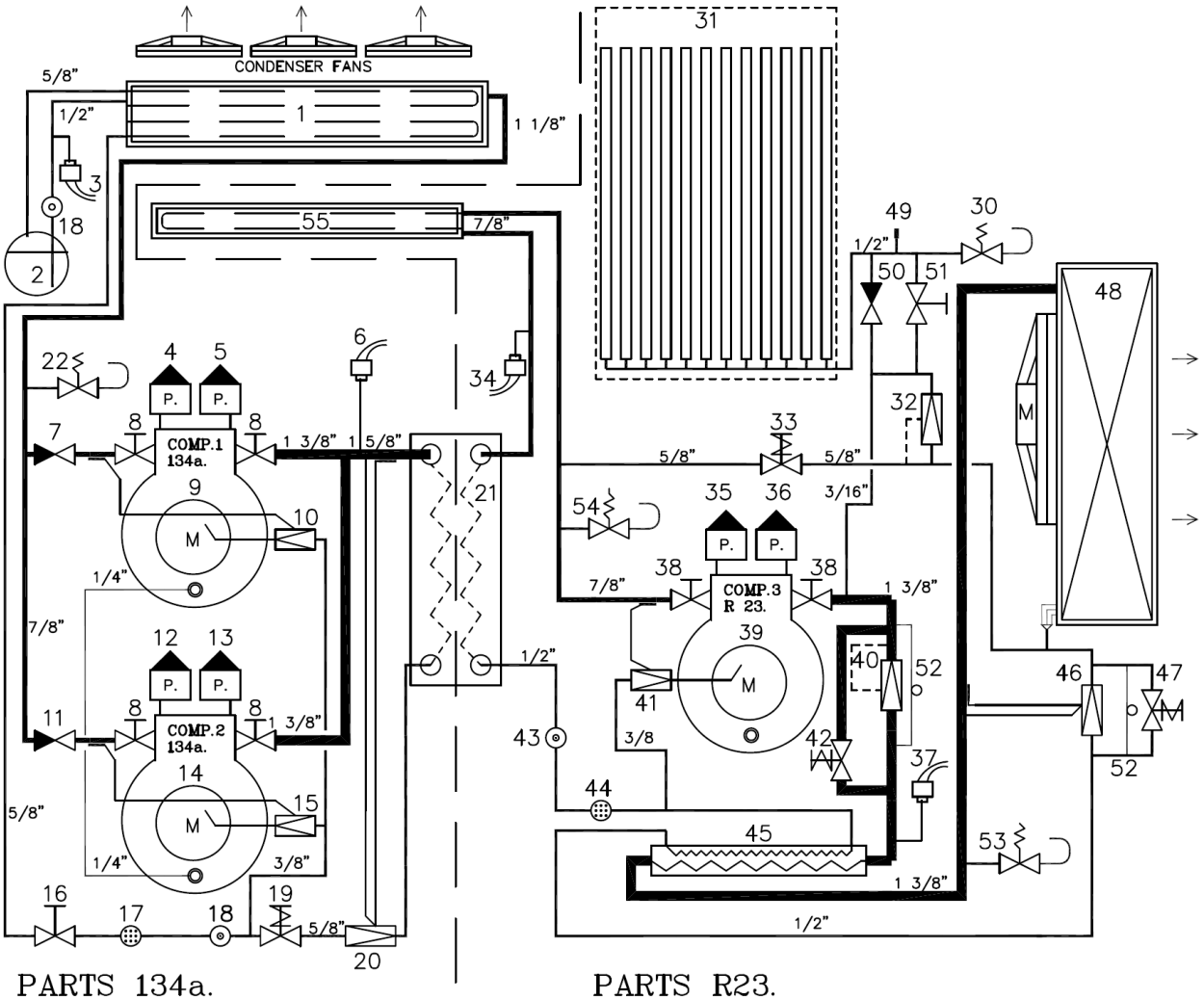
The evaporator fans move air across the evaporator coil for the purpose of removing heat from the cargo area.

The compressor provides a high temperature, high-pressure vapor to the condenser coil so that heat can be removed with the heat exchange 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



PARTS 134a.

1. CONDENSER COIL
2. RECEIVER
3. HIGH PRESSURE TRANSDUCER
4. HIGH PRESSURE SWITCH COMP.1
5. LOW PRESSURE SWITCH COMP.1
6. EVAP. PRESSURE TRANSDUCER
7. CHECK VALVE COMP.1
8. SHUT OFF VALVE COMP.
9. COMPRESSOR 1.
10. INJECTION VALVE COMP.1
11. CHECK VALVE COMP.2
12. HIGH PRESSURE SWITCH COMP.2
13. LOW PRESSURE SWITCH COMP.2
14. COMPRESSOR 2.
15. INJECTION VALVE COMP.2
16. BALL VALVE LIQUID
17. DRIER
18. SIGHT GLASS
19. LIQUID SOLENOID VALVE
20. EXPANSION VALVE
21. HEAT EXCHANGER (134a/R23)
22. SAFETY RELIEF VALVE, HIGH PRESSURE

PARTS R23.

30. SAFETY RELIEF VALVE, BUFFER TANK
31. BUFFER TANKS
32. MAX. HOT GAS PRESSURE VALVE
33. HOT GAS SOLENOID VALVE
34. HIGH PRESSURE TRANSDUCER
35. HIGH PRESSURE SWITCH
36. LOW PRESSURE SWITCH
37. EVAP. PRESSURE TRANSDUCER
38. SHUT OFF VALVE COMP.
39. COMPRESSOR 3.
40. CRANKCASE PRESSURE REG.
41. INJECTION VALVE COMP.3
42. BYPASS VALVE
43. SIGHT GLASS
44. DRIER
45. HEAT EXCHANGER
46. EXPANSION VALVE
47. FULL FLOW VALVE
48. EVAPORATOR COIL
49. SERVICE SCHRADER VALVE
50. CHECK VALVE
51. SHUT OFF VALVE
52. 500x3.5 MM CAPILLARY TUBE
53. SAFETY RELIEF VALVE,LOW PRESSURE
54. SAFETY RELIEF VALVE,HIGH PRESSURE
55. SUPERHEAT REDUCER COIL

KLINGE CORPORATION
York, Pennsylvania USA
Marine Container Refrigeration Equipment

PIPING DIAGRAM CBU–30–04

(REVISION B 4/9/2014)

K35–06466–00

SECTION 3. OPERATION

3.1 GENERAL INFORMATION

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

To understand the operation of the electrical and refrigeration systems on the CBU-30 unit, there are several things, which must be noted:

1. The main electrical operating power is 400/460 volt+/-10%, 3-phase, 50/60 Hz+/-2.5%.
2. The CBU-30 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 determined by the microprocessor controller. (See Section 5)
4. There are three circuit breakers protecting the electrical system. One protects the main line 400/460 volt, 3-phase power, one protects the main line 400/460 volt power to transformer and one other protects the 28 volt 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 the circuit breakers in the electrical box are closed in the “ON” position.
3. Switch the ON/OFF switch to "ON".
   (Note: There will be a timer delay during start-up.)
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:

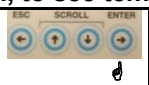
Quick function, to see pressure:

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

(Display shows low - and high-pressure for R23/134a.)

▼

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 R23/134a.)

5. Adjust the set-point to be lower than the box temperature. The set-point can be set from -20° to -65°C.
6. Check the defrost interval (set under "config" in the display menu). The defrost interval can be set from 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 the test.
   See Section 5.2 Controller for more 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 the 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.

COOLING CYCLES

When the cargo temperature requires cooling, the compressors will run, and the condenser fans will operate to draw air over the air-cooled condenser coil. The cargo temperature will continue to pull down until it reaches set-point; then the compressors and the condenser fan motors will stop. The controller regulates cargo temperature via the “RETURN AIR SENSOR” mounted in the return air from the container.

DEFROST CYCLES

The defrost 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 the "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 fans and the evaporator fan are stopped 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, from +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. This 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.

3.5 VACUUM VALVE

The vacuum valve draws outside air into the container to prevent the container from developing negative atmospheric pressure as the cargo temperature decreases toward -60°C. This is activated during pulldown as well as when there is a quick temperature change within the container for example during a Door Opening or Defrost Operation.

It is extremely important to check the vacuum pipe opening, to make sure that the pipe is not blocked by ice or snow. The frequency of this check is dependent on the operation conditions of the unit. We suggest that this check should be performed on a weekly basis and possibly more frequently if there are a number of Door Openings.

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 relay (EFR) and the transformer.

Note:
Beware of high voltage (400/460 volt) 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 the power is fed to the unit.

When the unit ON/OFF switch is placed in the ON position, the POWER ON light is lit.

PHASE SELECTION

The 28 volt AC power from the transformer will pass along wires no. X1 and X2 through the circuit breaker CB 3, and continue in wires no. 01 and X2 to the control power. The 24 volt power from the transformer will pass along wires no. X3 and 04 as per the controller logic.

All wires are numbered on both ends.

4.2 ELECTRIC BOX

CIRCUIT BREAKER

A. Circuit Breaker. (CB1)
The 100-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 100 amperes and must be manually reset when tripped.

B. Circuit Breaker. (CB2)
The 10-amp circuit breaker incorporates two breakers, one for each line. It is reset manually and protects the transformer against overload. The circuit breaker is adjusted to 10 amperes and must be manually reset when tripped.

C. Circuit Breaker. (CB3)
The 6-amp circuit breaker protects the 28 volt control power, in case of possible overload. The circuit breaker is adjusted to 6 amperes and must be manually reset when tripped.

RELAYS

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

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

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

D. Condenser fan 1 motor relay. (CFR1)
3 poles, 460 volt, and direct-in-line contactor with 28 volt AC operating coil. It operates condenser fan 1 motor and is energized by the controller.

E. Condenser fan 2 motor relay. (CFR2)
3 poles, 460 volt, and direct-in-line contactor with 28 volt AC operating coil. It operates condenser fan 2 motor and is energized by the controller.

F. Condenser fan 3 motor relay. (CFR3)
3 poles, 460 volt, and direct-in-line contactor with 28 volt AC operating coil. It operates condenser fan 3 motor and is energized by the controller.

G. Evaporator fan motor relay. (EFR)
3 poles, 230 volt, and direct-in-line contactor with 28 volt AC operating coil. It operates the evaporator fan motor and is energized by the controller.

OVERLOAD RELAY

A. Motor protection, compressor motors.
(OL, COM1- OL, COM2- OL, COM3)
3 pole, 460 volt, direct-in-line overload relay, to protect motors against phase missing, overload etc. The thermal protection is adjusted to 30 amperes and must be manually reset when tripped.

B. Motor protection, condenser fan motors.
(OL, CFM1- OL, CFM2- OL, CFM3)
3 pole, 460 volt, direct-in-line overload relay, to protect motors against phase missing, overload etc. The thermal protection is adjusted to 1.7 amperes and must be manually reset when tripped.

C. Motor protection, evaporator fan motors (OL, EFM)
3 poles, 460 volt, direct-in-line overload relay, to protect motors against phase missing, overload etc. The thermal protection is adjusted to 7 amperes and must be manually reset when tripped.

TRANSFORMER (TR)

The primary windings are tied into the line from circuit breaker CB1. The secondary windings supply 28 volts to

the main control power, and 24 volts for the controller logic.

CURRENT TRANSFORMER (CT)

The CBU-30 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).

COMPRESSOR MOTOR PROTECTION

(INT1-INT2-INT3.)
The scroll compressor motors are equipped with an internal overload/overheat thermistor relay and thermistor sensors in the compressor motor winding. This device will break, and stop the compressor, if any problem causes the motor to overheat. When the motor cools sufficiently the overload will reset automatically.

BATTERY PACK. (BAT)

To supply power to the controller in the case that the unit is disconnected from the main power, a 6 volt rechargeable (Ni-MH) battery pack, is installed in the system.

DELAY TIMER (TI)

The delay timer operates the 28 volt power to the control system with a delay setting of 2 seconds. The delay gives the controller time to “start up” and reset all output relays, before supplying 28 volt power to all main relays.

PROGRAM CODE RESISTOR (PCR)

The microprocessor controller has a software program that can be used for multiple units. To indicate the controller is used for the CBU-30 unit, the controller has a resistor code installed (pin 6-8, 10-pole plug).
The resistor code for CBU-30 is 1500 Ω.
If the resistor code fails, disconnect the resistor code and manually set the program code in the display, under the menu option "Control setting - System no." to system No. 19.

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

CONTROLLER

(MPC3. software version min. #036)

The microprocessor controller is based on the newest technology, and not only controls 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 inputs, 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 data for approximately 300 days before overwriting the oldest data.

C. Event logging. The event log contains all information of the most recent 2000 events. (Main power ON/OFF --defrost start/end--set-point change--alarm etc.) See under data logger in display.

MODEM/REPEATER BOX (OPTION)

If a Modem and Repeater box are installed in the unit, it’s possible to communicate with the system over the telephone net.
(See special Manual for Modem operating.)

4.3 DISPLAY

LIGHTS/L.E.D.s

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.)

DISPLAY

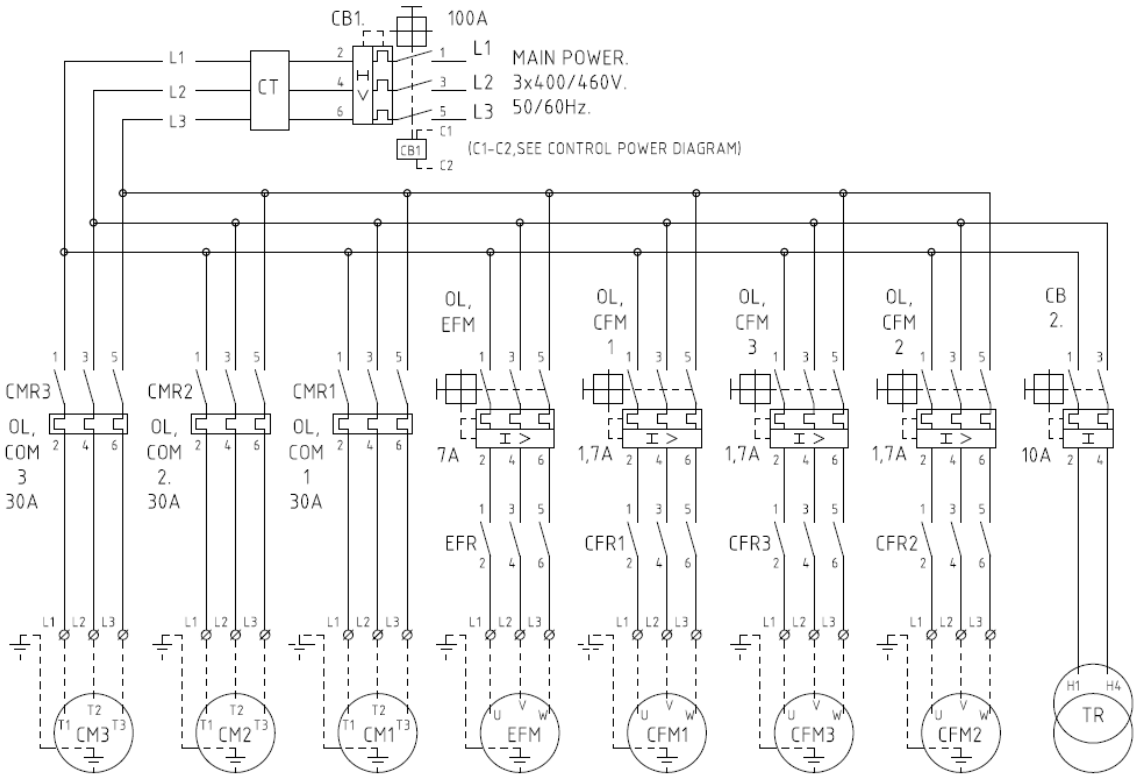
The display shows all information regarding temperatures on all unit sensors, all data logged in the data logger and all information for unit operating conditions.

KEYPAD

The four keypad buttons are for setting temperatures and scrolling through unit data information.

4.4 ELECTRICAL DIAGRAMS

MAIN POWER



SUBPANEL COMPONENT LAYOUT

BAT	=	BATTERY 6 V.	CT	=	CURRENT TRANSFORMER
CB1	=	CIRCUIT BREAKER 100A.	EFM	=	EVAPORATOR FAN MOTOR
CB2	=	CIRCUIT BREAKER 10A.	EFR	=	EVAPORATOR FAN RELAY
CB3	=	CIRCUIT BREAKER 6A.	MPC-3	=	CONTROLLER
CFM1	=	CONDENSER FAN MOTOR 1.	OL,CFM1	=	OVERLOAD, COND FAN1 MOTOR
CFM2	=	CONDENSER FAN MOTOR 2.	OL,CFM2	=	OVERLOAD, COND FAN2 MOTOR
CFM3	=	CONDENSER FAN MOTOR 3.	OL,CFM3	=	OVERLOAD, COND FAN3 MOTOR
CFR1	=	CONDENSER FAN RELAY 1.	OL,COM1	=	OVERLOAD, COMP 1 MOTOR
CFR2	=	CONDENSER FAN RELAY 2.	OL,COM2	=	OVERLOAD, COMP 2 MOTOR
CFR3	=	CONDENSER FAN RELAY 3.	OL,COM3	=	OVERLOAD, COMP 3 MOTOR
CM1	=	COMPRESSOR MOTOR 1.	OL,EFM	=	OVERLOAD, EVAP FAN MOTOR
CM2	=	COMPRESSOR MOTOR 2.	SRS	=	SAFETY REPAIR SWITCH
CM3	=	COMPRESSOR MOTOR 3.	TB	=	TERMINAL BOARD
CMR1	=	COMPRESSOR MOTOR 1. RELAY	TI	=	TIMER, DELAY POWER
CMR2	=	COMPRESSOR MOTOR 2. RELAY	TR	=	TRANSFORMER
CMR3	=	COMPRESSOR MOTOR 3. RELAY			

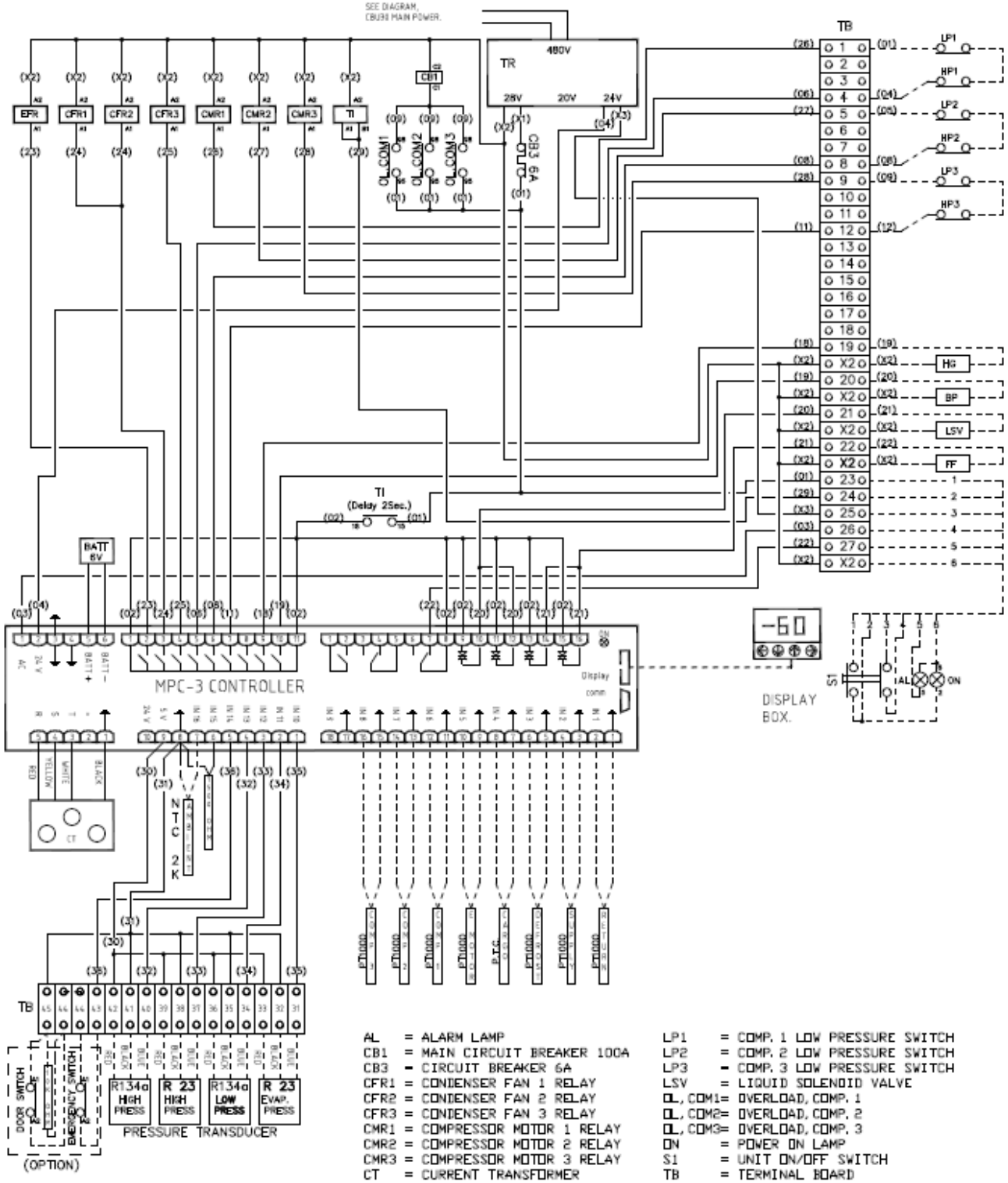
KLINGE CORPORATION
York, Pennsylvania USA
Marine Container Refrigeration Equipment

ELECTRICAL SCHEMATIC MAIN POWER CBU-30-04

(REVISION B 8/07/2013)

K35-06465-00

CONTROL POWER



AL = ALARM LAMP
CB1 = MAIN CIRCUIT BREAKER 100A
CB3 = CIRCUIT BREAKER 6A
CFR1 = CONDENSER FAN 1 RELAY
CFR2 = CONDENSER FAN 2 RELAY
CFR3 = CONDENSER FAN 3 RELAY
CMR1 = COMPRESSOR MOTOR 1 RELAY
CMR2 = COMPRESSOR MOTOR 2 RELAY
CMR3 = COMPRESSOR MOTOR 3 RELAY
CT = CURRENT TRANSFORMER
EFR = EVAPORATOR FAN RELAY
FF = FULL FLOW SOLENOID VALVE
HG = HOT GAS SOLENOID VALVE
HP1 = COMP. 1 HIGH PRESSURE SWITCH
HP2 = COMP. 2 HIGH PRESSURE SWITCH
HP3 = COMP. 3 HIGH PRESSURE SWITCH

LP1 = COMP. 1 LOW PRESSURE SWITCH
LP2 = COMP. 2 LOW PRESSURE SWITCH
LP3 = COMP. 3 LOW PRESSURE SWITCH
LSV = LIQUID SOLENOID VALVE
OL, COM1= OVERLOAD, COMP. 1
OL, COM2= OVERLOAD, COMP. 2
OL, COM3= OVERLOAD, COMP. 3
ON = POWER ON LAMP
S1 = UNIT ON/OFF SWITCH
TB = TERMINAL BOARD
TI = TIMER, DELAY POWER
TR = TRANSFORMER
----- = WIRES LEAVING CONTROL BOX
- — - = OPTIONS

KLINGE CORPORATION
York, Pennsylvania USA
Marine Container Refrigeration Equipment

ELECTRICAL SCHEMATIC CONTROL POWER CBU-30

REVISION D

K35-06464-00

SECTION 5. CONTROLLER INSTRUCTIONS AND SEQUENCE

5.1 GENERAL INFORMATION

The microprocessor controller system is based on the newest technology and consists of 3 basic 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.

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. #036)

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, CBU-30–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."
After 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 fan will operate to maintain air circulation in container.

CONTROLLER REGULAR SEQUENCE

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 10 minutes, whichever is longer.

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

CONTROLLER STARTING SEQUENCE

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

Unit "ON/OFF" switch in "ON" position.

UNIT POWER ON.	
(System start, App. 20sec.)	Evaporator fan on. *Next step: Delay 5 sec.* Compressor 1.on. *Next step: Delay 2 sec.* Condenser fan 1/2.on. *Next step: Delay 1 sec.* Condenser fan 3.on. (Fan 3 did not start, if condenser temperature is below +30°C.) *Next step: Delay 3 sec.* Compressor 2.on. *Next step: Delay 27 sec.* Compressor 3.on.

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 condition.

DISPLAY, MAIN MENU. (The display will always show the set-point and the return air temperature in the display, except if a message text appears.)

Set-point. "SP"	SET-POINT, shows the actual setting temperature.
Return "RT"	RETURN, shows the temperature for return air sensor, mounted in return air from container cargo.
Supply "SU"	SUPPLY, shows the temperature for supply air sensor, mounted in supply air to container cargo.
Defrost "DF"	DEFROST, shows the temperature for evaporator coil, mounted on injection pipe to coil.
Option "Cargo"	CARGO sensor, shows the temperature of the product core/surface temperature. (Option.)
EF.motor "EF"	Evap. Fan motor, shows the temperature of the Evap. Fan motor sensor, mounted on motor housing.
Comp. 1 "C1"	COMP.1, shows the temperature for compressor 1 sensor, mounted on discharge pipe comp.1.
Comp. 2 "C2"	COMP.2, shows the temperature for compressor 2 sensor, mounted on discharge pipe comp.2.
Comp. 3 "C3"	COMP.3, shows the temperature for compressor 3 sensor, mounted on discharge pipe comp.3.
Press"R23LO"	R23 low, shows the low-pressure on R23 system, mounted on suction pipe to compressor 3.
Press "134LO"	R134 low, shows the low-pressure on R134a system, mounted on suction pipe to compressor 1/2.
Press"R23HI"	R23 high, shows the high-pressure on R23 system, mounted on condenser pipe to heat exchanger.
Press "134HI"	R134 high, shows the high-pressure on R134a system, mounted on condenser pipe to receiver.

- **Config** ▶ Container ID. NFRU1234567; 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. 6970xxxxx
- **Data logger** ▶
  - Event Log. ▶ date/time, 01.03.23 16:00 all event Log.
  - Temp. Log. ▶ date/time, 01.03.23 16:00 temperat. sensor/ data: "RT"- "SU"- "DF"- "CS"- "EF"- "C1"- "C2"- "C3"- "R23LO"- "134LO"- "R23HI"- "134HI"- "Relay-status"- "Volt"- "Hz"- "Amps"
- **Unit Data** ▶
  - Input ▶ Return, RT. Supply, SU. Defrost, DF Cargo, CS. Evap. F. EF. Comp. 1,C1 Comp. 2,C2 Comp. 3,C3 Pres.R23LO Pres.134LO Pres.R23HI Pres.134HI Mains volt Mains amp. Mains Hz. Amp. Ph 1. Amp. Ph 2. Amp. Ph 3. 6volt battery C.int. temp. Counter.
  - Output ▶ All relay on/off status. 12 relays + 4 PVM. %load
  - Run hour: ▶ Total. Hour.
- **Commands** ▶ Manual defrost; Manual test; Run Auto Test; Test SMS Alarm. (Only if "Send SMS alarm" is set to "ON")
- **Alarms (*)** (*) number of alarms. ▶ Shows all alarm
- **Mode** ▶ Standby. Delay. Airflow. Freezing Defrost. Defr.end
- (Set-point SP.)
- Control setting ▶ → Not used. (Only for technical setting of Different Controller model.)
- Switch setting ▶ Temp. unit In °F. "ON"; Password Protection "ON"; Alarm cargo sensor "Off"; Send SMS alarm."ON"; Send SMS status"ON"; Send SMS E-mail"Off"; 7-14 Spare Not used
- GMS. pin code ▶ Not used.

Network no: Each controller can be coded with no. from 1 to 4.

			Software ►	Evap. fan Cond.fan1 Cond.fan2 Comp.1 Comp.2 Comp.3 Lsv, valve Hotgas val. No alarm. Newest data		SMS alarm,1/2/3 ► (Only if "Send SMS alarm" is set to ON) Telephone NO. to mobile phone for SMS alarm. (Option.) Alarm filter. ►	SMS, person 1. SMS, person 2. SMS, person 3. Remove SMS alarm from list.	

5.4 KEYPAD

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

Keypad function.

Set-point. Press (→) for change Scroll, press (↓) or (↑)	Use (↓) or (↑) for scroll in setting of freezing temperature. Press (→) to 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. CBU-30.** Scroll, press (↓) Esc. press (←)		
	Container ID. >> "NFRU1234567" Press (→) for change. Scroll, press (↓) or (↑) Esc. press (←)	NFRU1234567 ↑. . . . . "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-mont.01-date20. time.12-min.30 ↑↓ (Arrows flash) . . . . Change the first value, 1. Use (↓) or (↑) for change. 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. 14°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 (↑) to change max. Defrost time. Press (→) 2 sec. to enter new temperature.	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 characters, 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.
	GMS. pin code >> Scroll, press (↓) or (↑) Esc. press (←)	If the unit is equipped with a telephone modem, the pin code must be set to 4080 or de-activated.	
Config. >> Press (→) for enter Scroll, press (↓) or (↑) Esc. press (←)	**SMS alarm 1/2/3.** >> "XXXXXXXXX" "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 to. ("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 (↑) for scroll 2. Use (→) to move to next character, and repeat no.1 3. Press (→) 2 sec. to enter new telephone no.1 If person no. 1does not respond on 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.
	Alarm Filter >> Scroll, press (↑) Esc. press (←)	If "Send SMS alarm" is set to "ON" in Switch setting and there are alarms you don't wish to send as a` SMS message, all "not important" alarms can be removed from the alarm list by a simple ON/OFF function. Press (→) for change in function. Use (↓) or (↑) to change ON/OFF. Press (→)2 sec. to enter new interval.	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 hours 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)
Commands. >> Press (→) for enter. Scroll, press (↓) or (↑) Esc. press (←)	**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. (Only if “Send SMS alarm” is set to ON)	
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- Defrost end)		

5.5 TEMPERATURE SENSOR NTC

(ONLY AMBIENT SENSOR)

The temperature sensor is an 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**	1029.55	**11**	3499.83	**-21**	15378.98
106	155.38	**74**	376.79	**42**	1066.46	**10**	3649.88	**-22**	16187.84
105	159.42	**73**	388.26	**41**	1104.90	**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 PT 1000 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 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 by ensuring power is completely disconnected. 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 sized wrenches.

c. Do not exert excessive torque 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.

   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 CHECKING REFRIGERANT R134a CHARGE

Checking during unit operation.

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:
Air-cooled systems 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.

6.3 CHECKING REFRIGERANT R23 CHARGE

Note:
Checking only with unit in STANDBY.

R23 refrigerant is best controlled at standby on an empty container (before power connection).
When no part of the cooling system is 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 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 should show the same pressure.

CORRECT R23 CHARGE "RUNNING"
Since there is a larger 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 approximately 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 to control the R23 charging while operating. (Must be clear when return air temperature is below -40°C.) To see the sight glass, the insulation material must be removed.

6.4 PROCEDURE FOR ADDING REFRIGERANT R134a

Checking when the unit is in operation.

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 (depending on 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 seconds 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 first time the sight glass is fully covered by liquid.

6.6 NON-CONDENSABLE GASES
(ONLY R134a SYSTEM)

Air and non-condensable gases in any system gather in the receiver above the liquid. These can be removed during operation by purging through the valve provided for this purpose at the receiver. To purge, depress the Schrader type valve core for a few seconds. Note any significant difference between the initial pressure and when the valve is again closed. Repeat the operation until the pressure is approximately equal to the

refrigerant vapor pressure corresponding to the temperature of the receiver.

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 solders 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, the 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 instruction 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 for which the tank is approved.
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-off valve", as well as the compressor 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. Drawing 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 of 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 be the result.

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

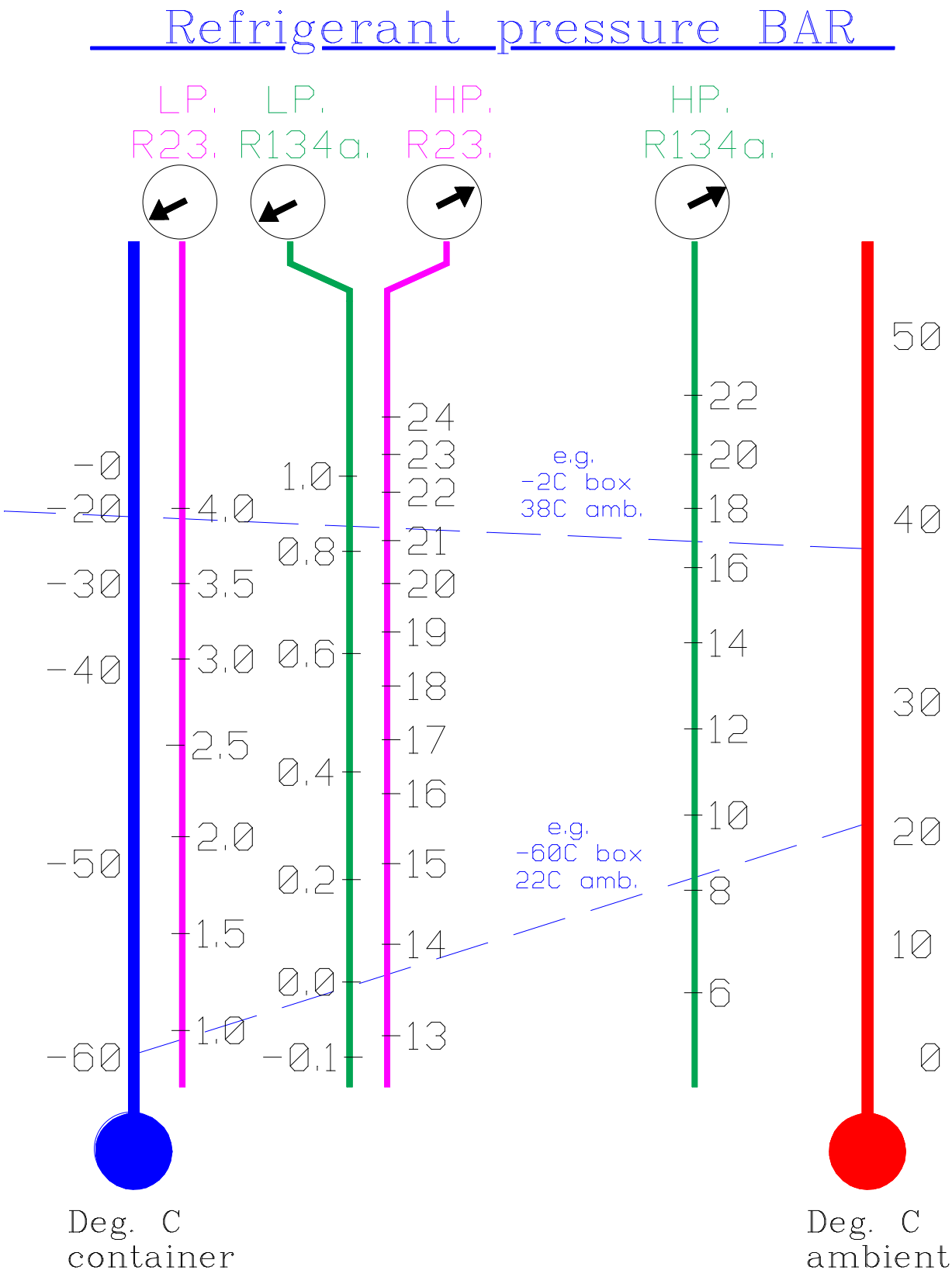
The final evacuation may be accelerated, however, by manifolding the connections to the vacuum pump and evacuating simultaneously the high and the low sides of the system, the vacuum should be broken by introducing refrigerant.

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 R23 system, and low-pressure in R134a system.



SECTION 7. SERVICING COMPONENTS

7.1 COMPRESSOR (R134a/R23)

COMPRESSOR MOTOR PROTECTION

The scroll compressor motors in the R134a/R23 systems are equipped with an internal overload/overheat thermistor relay and thermistor sensors in the compressor motor winding. This device will break, and stop the compressor, if any problem causes the motor to overheat. When the motor cools sufficiently the overload 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.

COMPRESSOR LUBRICATION

A sight glass is provided in the front of the compressor shell to check the oil level, 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 via the equalising pipe.

ADDING OIL

Unlike on hermetic compressors, there is no means of pouring oil into the compressor, oil must be sucked into the crankcase by way of the suction service valve. To do this, the compressor must 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 in 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. 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 compressor.1 (R134a), the vacuum pump must draw a vacuum of 0.15 mm HG or greater 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 especially processed to have the necessary low moisture content. The following oils are suitable:

Mobil Esteroil EAL 22CC
ICI Emkarate RL32CF
(Both oils are miscible).

P/N K11 00416 00

COMPRESSOR MOTOR BURN-OUT

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 repeat the 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 burned 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 is the only acid that will attack glass.

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

CLEAN-OUT PROCEDURE

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 filter-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 filter-drier from clamp and unsolder the filter-drier.
3. Remove caps from new filter-drier and install immediately. (If the change of the filter-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 must 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 the unit OFF.
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 be closed 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 mounted on Schrader valve adapters.

To replace transducer:
1. Switch the unit OFF.
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 switch.
4. Connect electrical wires.

7.7 THERMAL EXPANSION VALVE

GENERAL INFORMATION

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.

THERMAL EXPANSION VALVE, R134a

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 becomes lodged in the valve, it will be necessary to pump down the system and dismantle the valve cage/filter to remove the particle.

THERMAL EXPANSION VALVE, R23

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 the valve fails, the total refrigerant charge must be pumped into an approved tank for R23 gas.

7.8 SAFETY RELIEF VALVE

There are five "safety relief valves" in the unit refrigerant system:

R134a 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 (285 psi activation).

R23 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 (285 psi activation).

One on the buffer tanks 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 three "non-return valves" in the unit refrigerant system:

R134a SYSTEM

Two (2) are mounted in the discharge piping to compressors 1 & 2, to prevent the refrigerant from going back into the compressor, when it stops.
If one of the valves fails, the total refrigerant charge must be removed from the system.

R23 SYSTEM

One (1) valve is mounted in the piping to the buffer tank, to prevent the R23 refrigerant from going back into the system when pumping over the R23 charge.

7.10 CRANKCASE PRESSURE REGULATOR, R23

For operation with high temperature in the container room, a crankcase pressure regulator is mounted in the R23

system suction line 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 Allen 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 must be pumped into an approved tank for R23 gas.

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 1.5psi. Remove all power to unit.
2. Slowly loosen bolts on the valve body to release any R134a that may be left in the system.
3. Replace defective valve.
4. 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 the valve fails, the total refrigerant charge must be pumped into an approved tank for R23 gas.

7.13 MAXIMUM 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:** adjust during system 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 19 bar.
5. Replace protection cap on pressure regulator.

If valve fails, the total refrigerant charge must be pumped over in the buffer tank.

7.14 FULL FLOW SOLENOID VALVE

The solenoid valve (NC) in the R23 system is mounted parallel over the R23 expansion valve. The valve is open when the container temperature is above –30° C, or if the system operates with more than 10°C superheat over the evaporator coil. The controller regulates the valve based on the temperature of the defrost sensor and the evaporator pressure. When the solenoid coil is energized, the valve opens and liquid by-passes the expansion valve, to ensure that the system operates with full flow, thru the evaporator coil.

TO REPLACE OR REPAIR VALVE

1. The total refrigerant charge must be removed from the system.
2. Remove cap and coil.
3. Loosen slowly the big nut on the solenoid valve body to release any refrigerant that may be 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. After the re-install, follow the normal evacuating and charging of the system.

7.15 LIQUID SOLENOID VALVE R134a

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

TO REPLACE OR REPAIR SOLENOID VALVE

1. Close the liquid line shut-off valve, and pump down the system until the suction pressure stabilizes between 0 and 0.1 bar. (The valve must be open.)

Remove all power to unit, then front seat the suction service valve on both compressors.

2. Remove cap and coil.
3. Slowly loosen bolts on the solenoid valve body to release any refrigerant that may be 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 suction service valve and the unit is ready to start again.
9. Check for leak.

7.16 BYPASS SOLENOID VALVE

The solenoid valve (NC) in the R23 system is mounted parallel over the R23 crankcase pressure regulator. The valve is open when the container temperature is below –33° C., and if the system operates with lower than 52°C condensing temperature, on the R404A side. This valve is regulated based on the temperature of the return air sensor and opened if the suction pressure is below 4 bar. When the solenoid coil is energized, the valve opens and liquid by-passes the crankcase pressure regulator valve, to ensure that the system operates with maximum capacity.

TO REPLACE OR REPAIR SOLENOID VALVE

1. The total charge must be removed from the system.
2. Remove cap and coil.
3. Loosen slowly the big nut on the solenoid valve body to release any refrigerant that may be 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. After the re-install, follow the normal evacuating and charging of the system.

7.17 HOTGAS SOLENOID VALVE

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

The valve is operating on signal from the controller. When the solenoid coil is energized, it diverts hotgas to the evaporator coil.

If valve fails, the total refrigerant charge must be pumped over in the buffer tank.

7.18 EMERGENCY SWITCH (Option.)

The emergency switch is mounted inside the container. When the switch is activated the unit stops and if the unit is equipped with an “alarm system”, the switch also activates the alarm horn, indicating that a person is inside the container.

7.19 DOOR SWITCH (Option.)

The door switch is mounted inside, near the top of the right container door. The switch stops the unit when the door is open, to ensure that a minimum of moist air enters the container when the door is open.

7.20 VACUUM VALVE

The vacuum valve draws outside air into the container to prevent the container from developing negative atmospheric pressure as the cargo temperature decreases toward –60°C.

It is extremely important to check the vacuum pipe opening, to make sure that the pipe is not blocked by ice or snow. The frequency of this check is dependent on the operation conditions of the unit. We suggest that this check should be performed on a weekly basis and possibly more frequently if there are a number of Door Openings.

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.
LEDs on the display panel indicate which cycle the micro-processor controller is calling for and should be used in conjunction with 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. **(Alarm not active, will be cancelled 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 (←)		
No alarm:	**Description**	**Corrective Action**
Return air sensor out of range. A01	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Supply air sensor out of range. A02	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Defrost sensor out of range. A03	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Cargo sensor out of range. A04	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Evap motor sensor out of range. A05	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Compr.1 sensor out of range. A06	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Compr.2 sensor out of range. A07	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Compr.3 sensor out of range. A08	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
R23 Low press out of range. A10	Pressure transducer, R23 low-pressure, has an open (14.5bar) or short (-2.91bar) circuit.	Replace defective transducer.
R134a Low press out of range. A11	Pressure transducer, R134a low-pressure has an open (14.5bar) or short (-2.91bar) circuit.	Replace defective transducer.
R23 High press out of range. A12	Pressure transducer, R23 high-pressure, has an open (40bar) or short (-4.82bar) circuit.	Replace defective transducer.
R134a High press out of range. A13	Pressure transducer, R134a high-pressure has an open (40bar) or short (-4.82bar) circuit.	Replace defective transducer.
Ambient temp.sensor out of range. A16	The sensor has an open (999.9°C) or short (-99.9°C) circuit.	Replace defective sensor.
Reference error. Shutdown. A17	Internal controller error	Replace defective MPC3 controller.
Evap temp too low A18	If the controller calls for a defrost less than 30 minutes after last defrost end. (the delta T between the return air and the defrost probe is too large)	Check evaproator airflow. Check if fins at evaporator coil are bent. Check door to container is closed. Check defrost and return sensors for correct reading.
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)

	To 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.
	Defect liquid injection valve.	Repair or replace defective part.
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 exchanger R134a/R23 not operated optimal.)	Check R134a refrigerant charge. (sight glass)
Drop of temperature is slow. A26	The return air sensor shall be 5°C in range of set-point. The average of drop in temperature on return air sensor in 10min. must be lower than the temperature was for 10min. ago.	Check container door is closed. Check refrigerant system. Reset overload relay, OL-EFM
R23 High-pressure cut-out. A33	Defective refrigerant R134a system.	
	Defective compressor R134a system.	Check R134a compressors.
	Overload relay “OL, CFM” has tripped to "OFF" position.	Reset overload relay OL, CFM
	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.
	Overload relay “OL, CFM” has tripped to "OFF" position.	Reset overload relay OL, CFM
	Defective refrigerant system.	Check 134a refrigerant system.
Evap fan motor temp too high. A37	Evaporator motor temp above 85°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 maybe frozen/object in fan blade.	Check motor condition (run free) and try to restart.
Auto test error, amperage too low. A40	Current of one of the tested parts is too low.	Check amperage on the failed part with an ammeter. Repair or replace defective part.
	Overload relay has tripped to "OFF" position.	Reset overload relays.
Auto test error, amperage too high. A41	Current of one of the tested parts is too high.	Check amperage on the failed part with an ammeter. Repair or replace defective part.
Auto test error, delta amperage too high. A42	The difference in current of one of the tested parts is too high.	Check amperage on the failed part with an ammeter. 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.

8.3 MESSAGE INFORMATION IN DISPLAY

(See message in display, “Remove message” must be set to “OFF” in controller “Switch setting” menu.)

DISPLAY SHOWS:	Description	Action
Comp. #1 temp too high M04	Compressor #1 discharge line temperature above 120°C.	Unit shutdown
Comp. #2 temp too high M05	Compressor #2 discharge line temperature above 120°C.	Unit shutdown
Comp. #3 temp too high M06	Compressor #3 discharge line temperature above 120°C.	Unit shutdown
Evap fan motor, temp too high M08	Evaporator motor temperature above 85°C.	Unit shutdown
R23 High-pressure M10	R23 high-pressure higher than 27bar.	After 5 times, the unit stops.
Wrong phase direction. M17	The 3 phase power to unit has wrong phase direction.	Change phase direction
Door open. (Option.) M18	Container door open.	Unit shutdown
Emergency stop activated. M19	Emergency switch in container is activated.	See Alarm code A46

8.4 UNIT INFORMATION

ELECTRICAL

Electrical All data are approximate 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 – 24 Amperes
Compressor 2 motor	3400 Rpm - full load – 24 Amperes
Compressor 3 motor	3400 Rpm - full load – 28 Amperes
Condenser fan motors (each)	1720 Rpm - full load – 1.7 Amperes
Evaporator fan motor.	1120 Rpm - full load – 6.8 Amperes

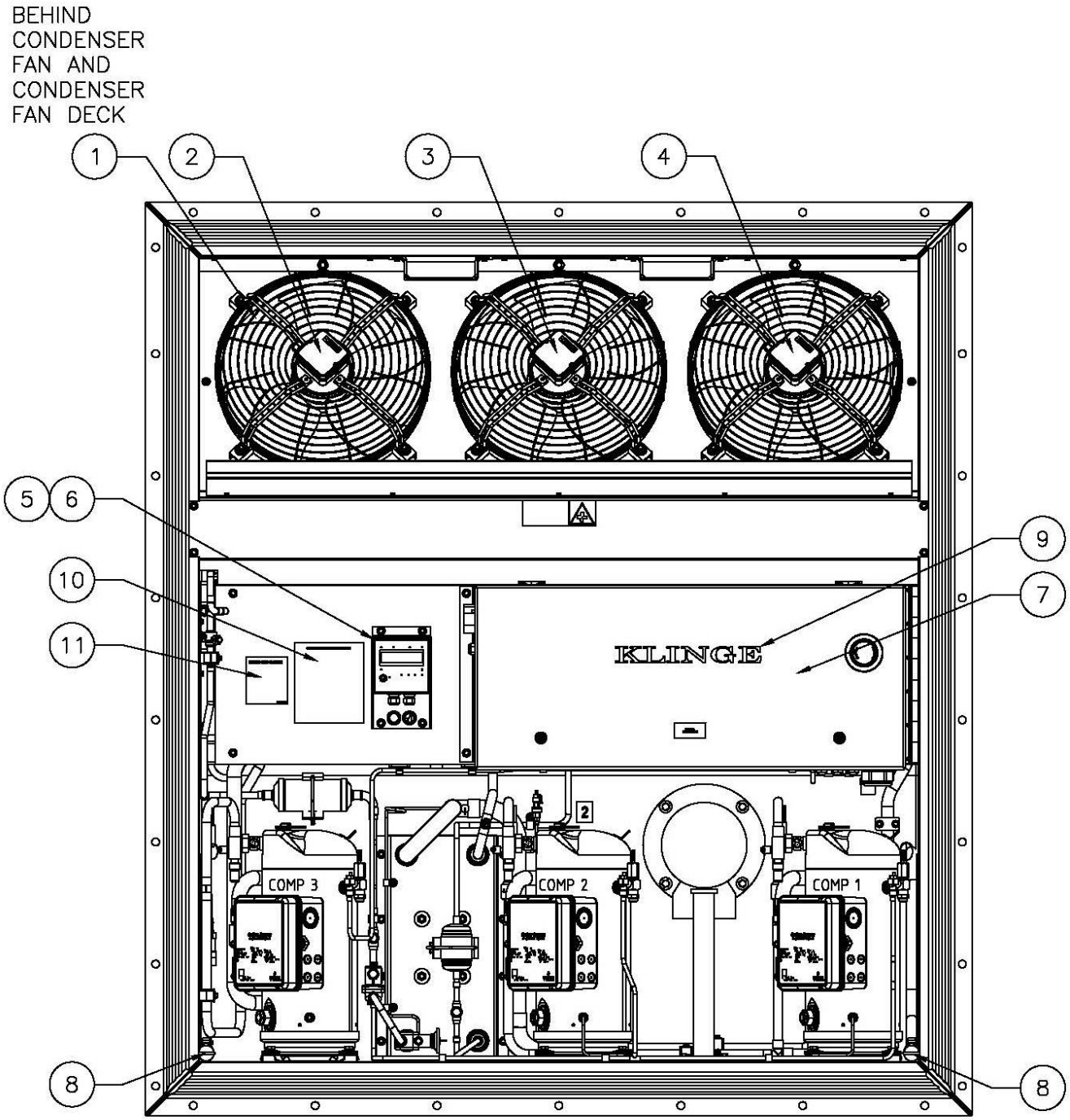
REFRIGERANT

Refrigerant System	
System charge R134a	10 kg
System charge R23	8 kg
Compressor 1 to 3. Oil charge.	4.1 Liter.
High-pressure switch, R134a system. (cannot be adjusted)	Cut-out approx. 28 bar +/-0.7 bar Cut-in approx. 20 bar +/-0.3 bar
Low-pressure switch, R134a system (cannot be adjusted)	Cut-out approx. -0.4 bar +/-0.2 bar Cut-in approx. 0.3 bar +/-0.3 bar
High-pressure switch, R23 system. (cannot be adjusted)	Cut-out approx. 28 bar +/-0.7 bar Cut-in approx. 20 bar +/-0.3 bar
Low-pressure switch, R23 system (cannot be adjusted)	Cut-out approx. -0.4 bar +/-0.2 bar Cut-in approx. 0.3 bar +/-0.3 bar
Hotgas max. pressure regulator R23 system	Set to max. Pressure at 19 bar
Crankcase pressure regulator R23 system	Set to suction pressure at max. 3 bar
Safety relief valve, R134a high-pressure	29.3 bar

(cannot be adjusted)	
Safety relief valve, R23 high-pressure (cannot be adjusted)	29.3 bar
Safety relief valve, R134a low-pressure (cannot be adjusted)	19.6 bar
Safety relief valve, R23 low-pressure (cannot be adjusted)	19.6 bar
Safety relief valve, R23 (buffer tank.) (cannot be adjusted)	29.3 bar
Max. leak test pressure, high-pressure side	28 bar
Max. leak test pressure, low-pressure side	18 bar

SECTION 9. SERVICE PARTS

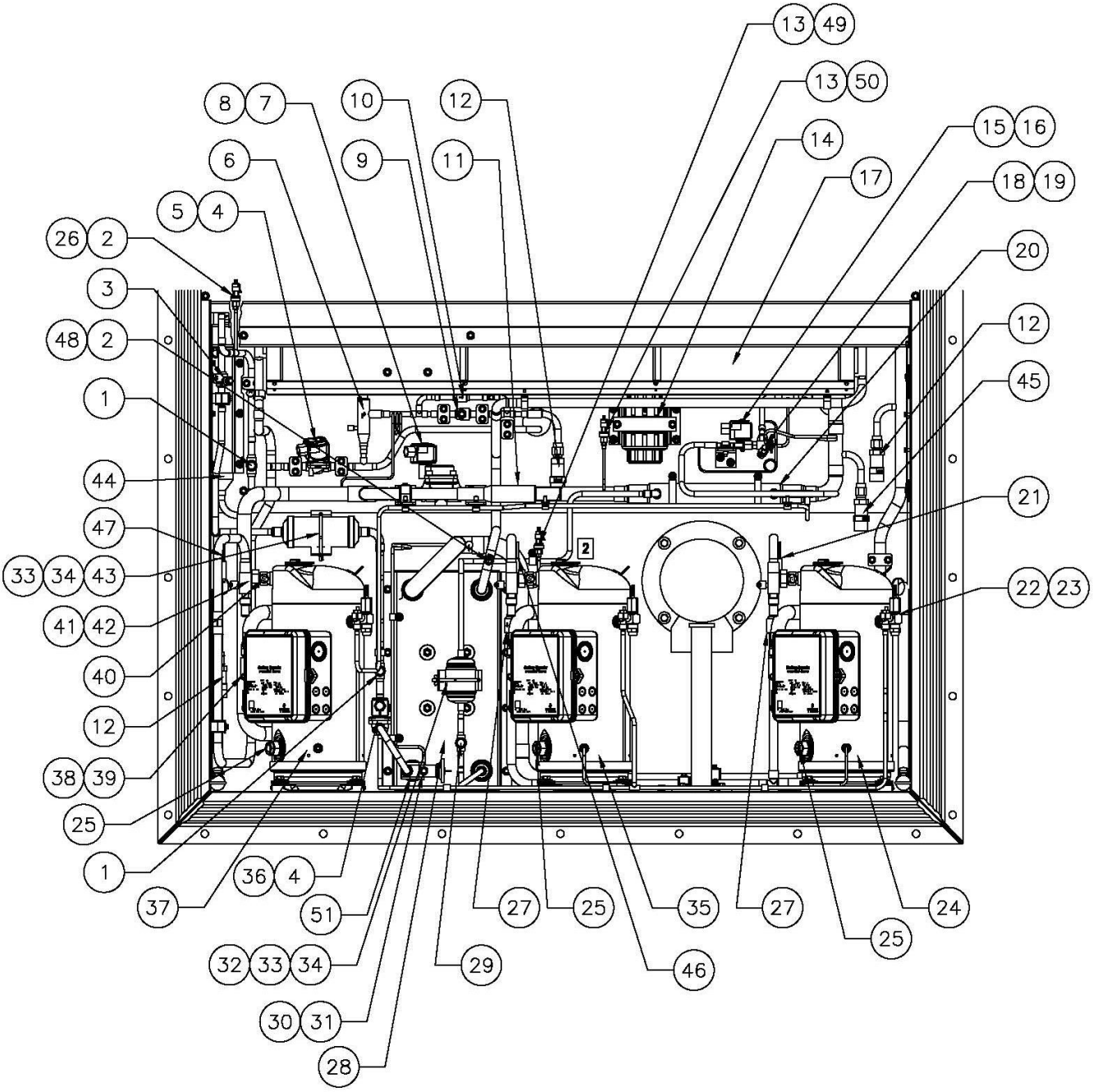
9.1 FRONT VIEW



9.1 FRONT VIEW

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16814-00	CONDENSER COIL ASSEMBLY	1
2	360-18650-01	FAN CONDENSER FULLY WIRED	1
3	360-18650-02	FAN CONDENSER FULLY WIRED	1
4	360-18650-03	FAN CONDENSER FULLY WIRED	1
5	360-16824-00	DISPLAY PANEL MPC3	1
6	360-16424-01	DISPLAY MPC3 (PART OF ITEM #5) (See manual Section 9.4C)	1
7	360-16402-00	ELECTRICAL BOX (See manual Sections 9.4A and 9.4B)	1
8	360-16483-00	DRAIN HOSE ASSEMBLY	2
9	K35-05743-01	LABEL KLINGE BLUE	1
10	K35-06467-00	LABEL OPERATING INSRTUCTIONS MPC3	1
11	K35-05803-10	LABEL DATA PLATE MODIDIED	1

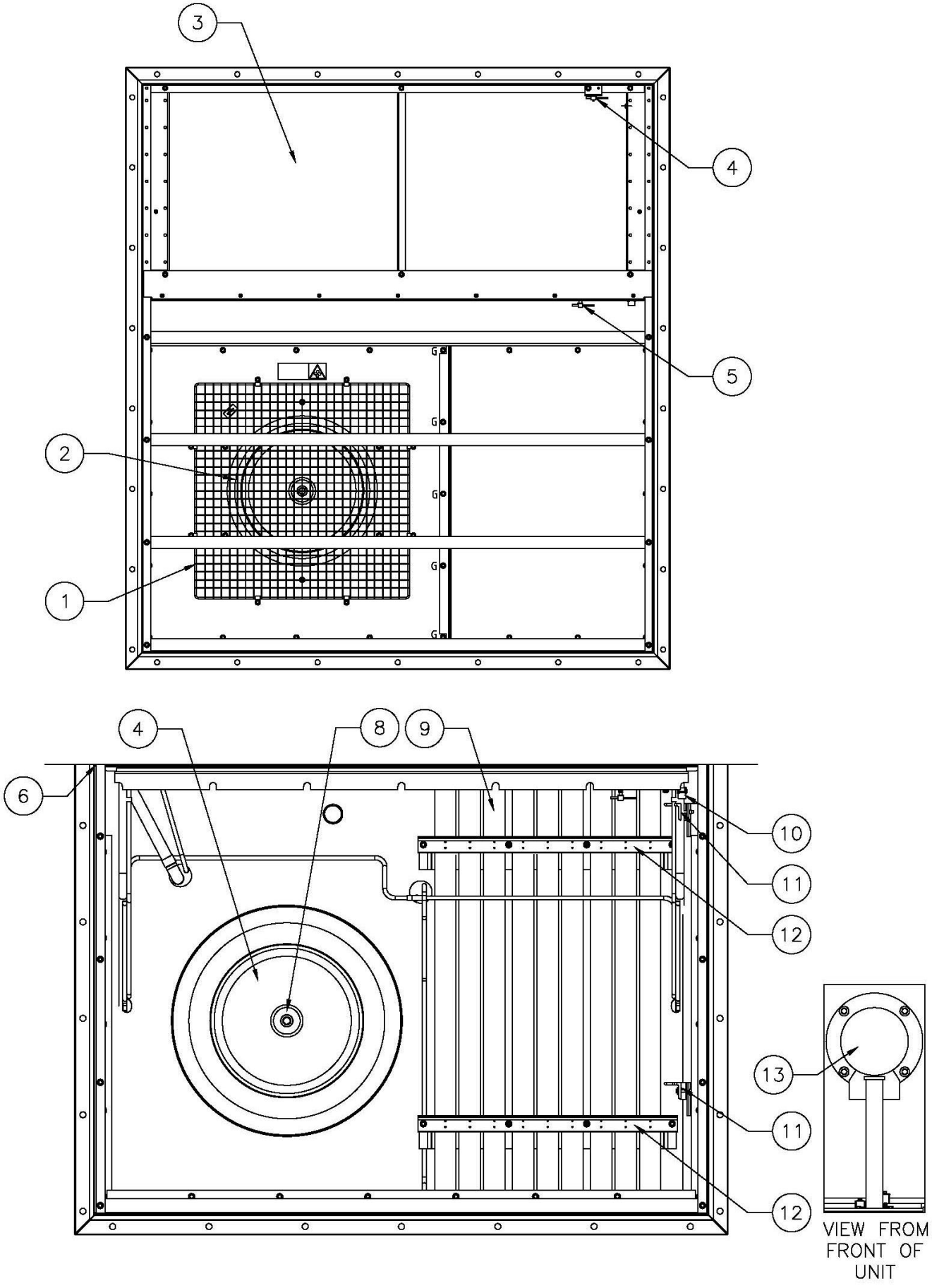
9.2 COMPRESSOR SECTION



9.2 COMPRESSOR SECTION

ITEM	PART NO.	DESCRIPTION	QTY.
1	K26-14190-01	MOISTURE INDICATOR R134a	2
2	K25-26810-00	PRESSURE TRANSDUCER HP	2
3	K22-07030-04	SHUT-OFF VALVE R134a	1
4	K25-26544-00	SOLENOID VALVE	2
5	360-16405-08	COIL, SOLENOID VALVE	1
6	K22-07027-00	PRESSURE REG, HOTGAS	1
7	K25-26778-06	SOLENOID VALVE EVR 25 (R23 BYPASS)	1
8	360-16405-011	COIL, SOLENOID VALVE	1
9	K22-07030-03	SHUT-OFF VALVE R23	1
10	K22-04392-01	VALVE CHECK R23	1
11	K22-07031-00	VALVE SUCT PRESS REG	1
12	K22-07028-03	SAFETY RELIEF VALVE, HP (475 PSIG)	3
13	K25-26809-00	PRESSURE TRANSDUCER LP. R134a/R23	2
14		VACUUM VALVE, AIR CONTAINER (See manual Section 10)	1
15	K25-26778-01	SOLENOID VALVE EVR 2 (R23 FULL FLOW)	1
16	360-16405-09	COIL, SOLENOID VALVE	1
17	360-16428-00	COIL, CONDENSER SUPER HEAT REMOVER	1
18	K25-25728-00	EXPANSION VALVE R23	1
19	K25-26777-03	NOZZLE SPRAY TXV TE2 FOR K25 25728 00	1
20	K26-25297-00	HEAT EXCHANGER, R23	1
21	360-16405-26	SENSOR, COMPRESSOR 1 TEMPERATURE	1
22	K15-00042-14	COMPRESSOR LIQUID INJECTION VALVE (Same on all Compressors)	3
23	K28-08249-00	SEAL TEFLON	3
24	360-16417-01	COMPRESSOR NUMBER 1 R134a	1
25	K15-00042-17	SIGHTGLASS, COMPRESSOR	3
26	360-16405-30	CABLE R134A HP PRESSURE TRANSDUCER	1
27	K22-04392-00	CHECK VALVE (Compressors 1 and 2)	2
28	K26-25287-00	HEATEXCHANGER, R134a/R23	1
29	K26-25216-00	SIGHT GLASS R23	1
30	K25-26776-01	EXPANSION VALVE R134a	1
31	060-16479-00	VALVE PIN MOD R134A	1
32	K26-10795-01	FILTER DRIER R23	1
33	060-06902-00	BRACKET, FILTER DRIER	2
34	360-56093-00	T- BOLT, FILTER DRIER	2
35	360-16417-02	COMPRESSOR NUMBER 2 R134a	1
36	360-16405-10	COIL, SOLENOID VALVE	1
37	360-16417-03	COMPRESSOR NUMBER 3 R23	1
38	K22-01663-00	ROTALOCK VALVE, SUCTION (Same on all Compressors)	3
39	K15-00017-10	GASKET, SEAL SUCTION (Same on all Compressors)	3
40	360-16405-20	HIGH-PRESSURE SWITCH (Same on all Compressors)	3
41	K22-06910-00	ROTALOCK VALVE, DISCHARGE. (Same on all Compressors)	3
42	K28-04836-00	SEAL TEFLON (Same on all Compressors)	3
43	K26-25295-00	FILTER DRIER R134a	1
44	360-16408-12	RECEIVER	1
45	K22-07028-00	VALVE RELIEF (300 PSIG) (Mounted behind Compressor 3)	1
46	360-16405-27	PROBE COMPRESSOR 2	1
47	360-16405-28	PROBE COMPRESSOR 3	1
48	360-16405-31	CABLE R23 PRESSURE TRANSDUCER	1
49	360-16405-32	CABLE R134A PRESSURE TRANSDUCER	1
50	360-16405-33	CABLE R23 LOW PRESSURE TRANSDUCER	1
51	K25-26776-02	VALVE TX HOUSING TE 12/20 5/8 IN 7/8 OUT	1
Not shown	360-16405-19	LOW-PRESSURE SWITCH (Mounted on side behind box all Compressors)	3

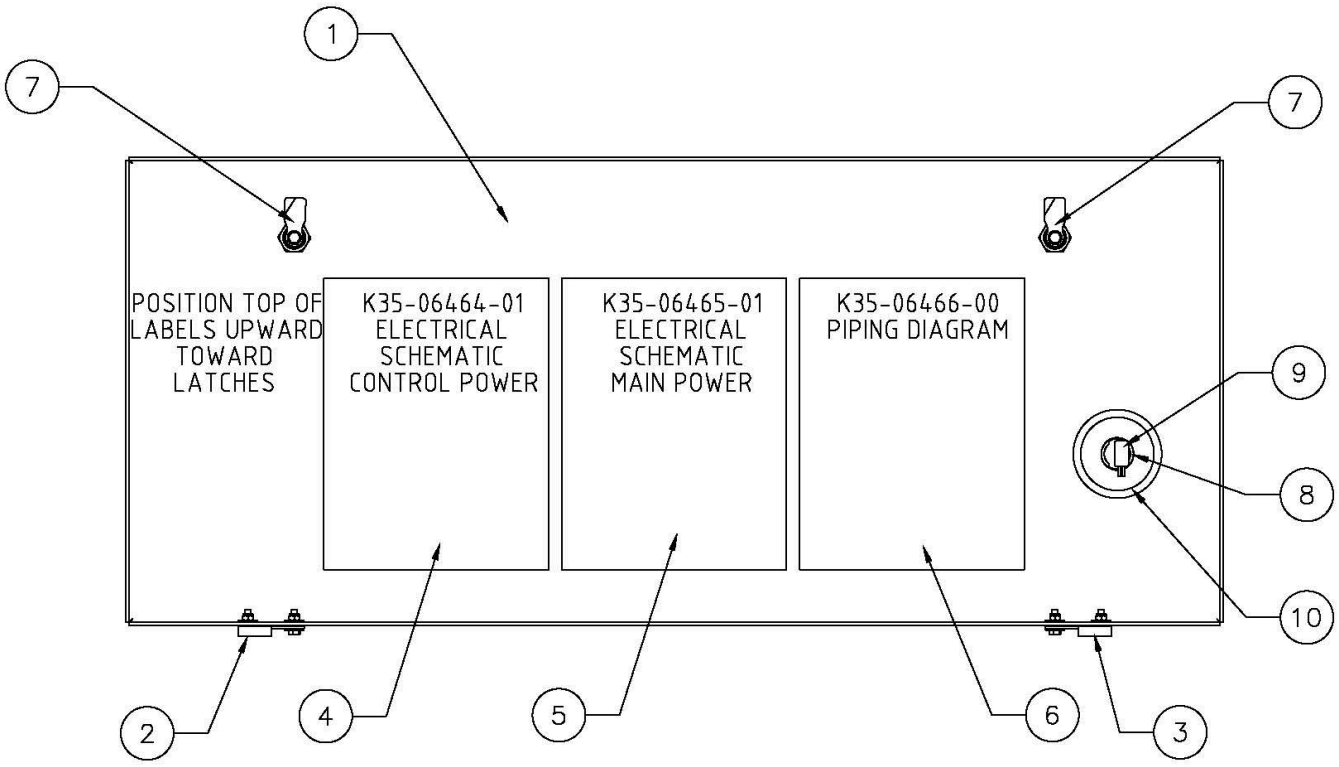
9.3 EVAPORATOR SECTION



9.3 EVAPORATOR SECTION

ITEM	PART NO.	DESCRIPTION	QTY.
1	K26-25251-00	GRILL, EVAP. FAN	1
2	K26-25250-00	INLETRING, EVAP.FAN	1
3	K26-25284-00	COIL EVAPORATOR	1
4	360-16405-23	SENSOR, SUPPLY AIR	1
5	360-16405-22	SENSOR, RETURN AIR	1
6	360-16405-24	SENSOR, DEFROST	1
7	K26-25249-00	IMPELLER ALUMINUN	1
8	060-16491-00	WASHER ALUMINUM	1
9	360-16414-00	TANK BUFFER	1
10	K25-52155-02	PROBE SOCKET PLUG CARGO SENSOR	1
11	360-16810-00	ANGLE SUPPORT BUFFER TANK SHORT	2
12	360-16809-00	ANGLE SUPPORT BUFFER TANK LONG	2
13	360-16493-00	MOTOR EVAPORATOR FAN	1

9.4A ELECTRICAL BOX DOOR

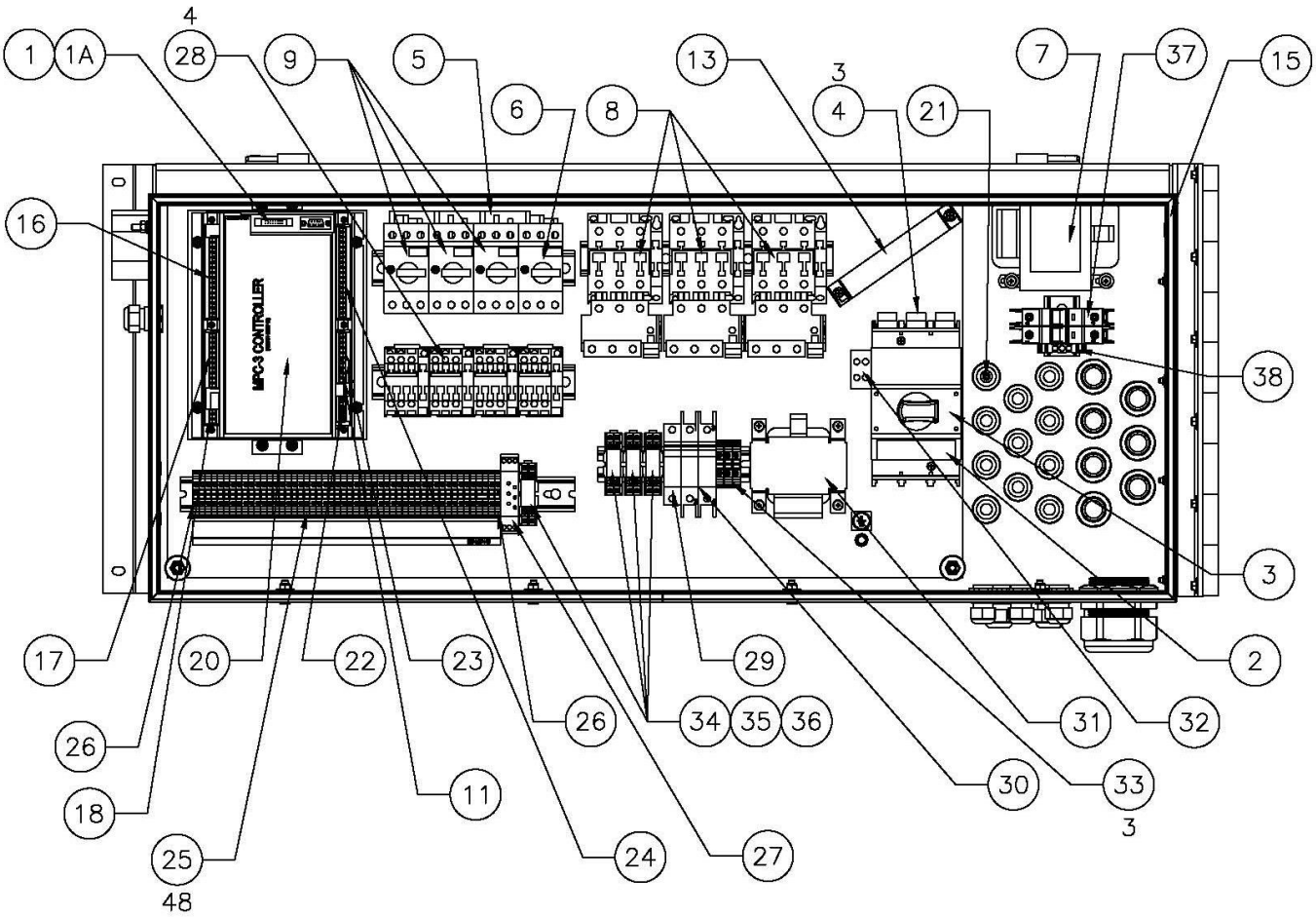


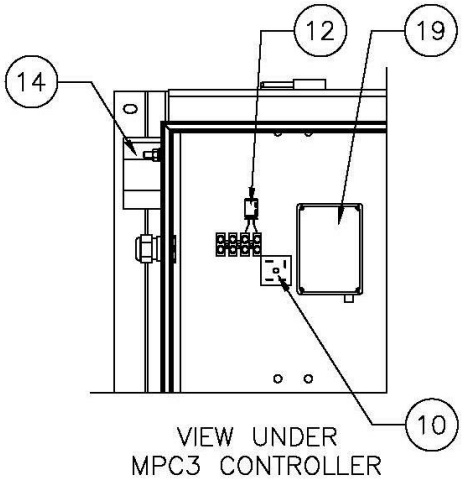
VIEW OF INSIDE OF
DOOR OPENED UPWARD

9.4A ELECTRICAL BOX DOOR

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16495-00	DOOR ELECTRICAL BOX CBU-30 (Part of Electrical Box)	1
		(INCLUDES ITEMS 2 THRU 11)	
2	060-16495-01	DOOR ELECTRICAL BOX SHEET METAL WHITE	1
3	K29-17879-00	HINGE	1
4	K29-17880-00	HINGE	1
5	K35-06464-01	ELECTRICAL DIAGRAM, CONTROL POWER	1
6	K35-06465-01	ELECTRICAL DIAGRAM, MAIN POWER	1
7	K35-06466-00	PIPING DIAGRAM	1
8	K29-18680-00	LATCH, DOOR	2
9	K25-26579-00	LAMP ALARM RED LED 2.5 IN OD 12 V	1
10	K25-26944-00	PLUG LED RIGHT ANGLE 2-PIN 1/2 INCH CENTERS	1
11	K28-11052-00	GROMMET ALARM LAMP BLACK VINYL	1

9.4B ELECTRICAL BOX

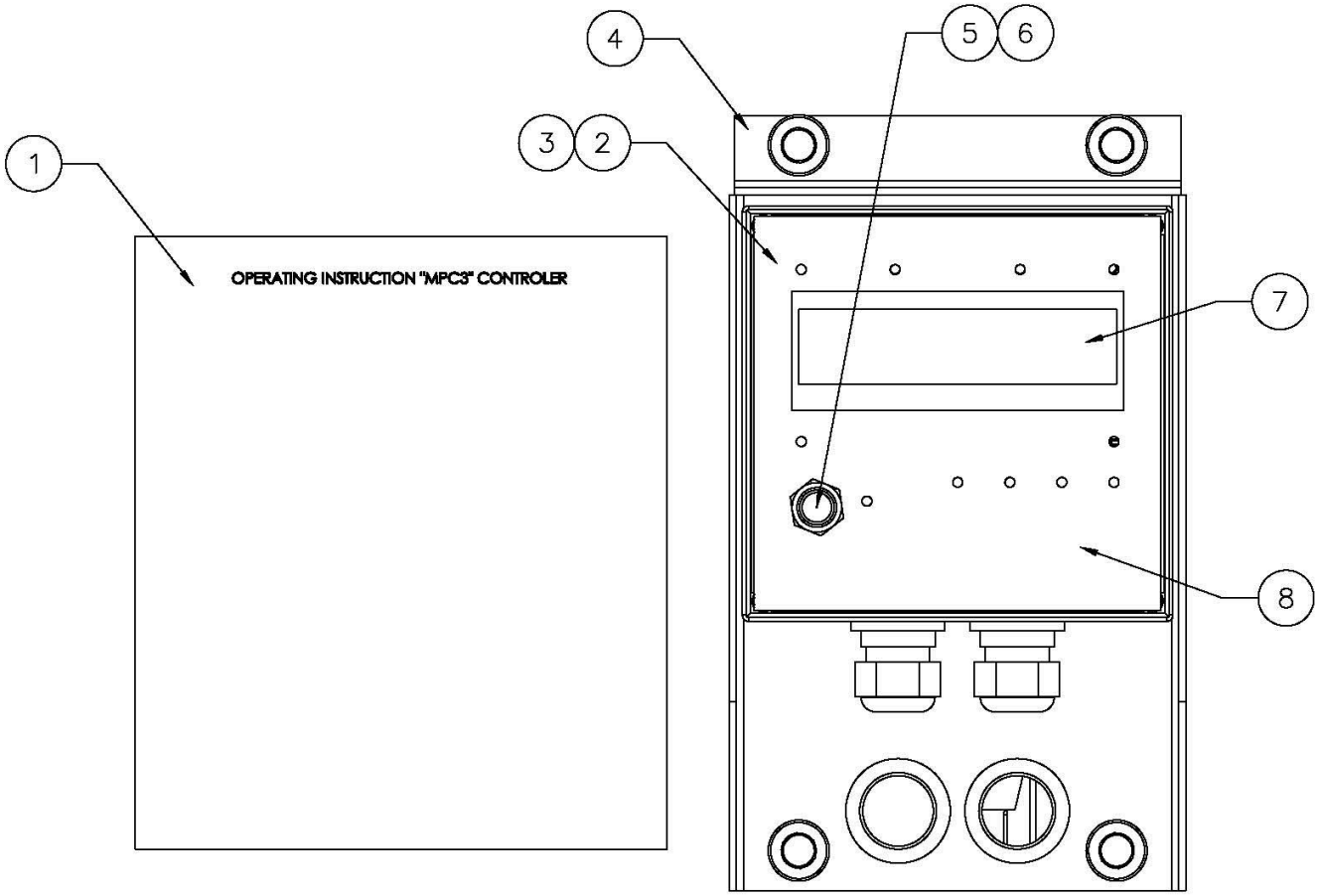




9.4B ELECTRICAL BOX

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16404-19	CABLE, DISPLAY (16 CORE)	1
1A	K25-26742-00	MULTI PLUG 16 POLE (PART OF ITEM #1))	2
2	K24-22464-00	CIRCUIT BREAKER 100 AMP 3 POLE 480 VAC MAIN	1
3	K24-22467-00	HANDLER AND ACTIVATOR, MAIN SWITCH	1
4	K24-26740-00	COVER, WIRE TERMINALS MAIN SWITCH	3
5	K25-26745-00	CURRENT BAR	1
6	K24-22361-09	OVER LOAD RELAY (EVAP. FAN)	3
7	K25-26762-00	TRANSFORMER 480V PRIM 230V/ 24V/ 12V SEC 50/60 HZ	1
8	K24-22501-00	START 45A 3P 24/ 29 VAC 30-40 OL 50/60 HZ	3
9	K24-22361-17	CIRCUIT BREAKER OVER LOAD 1.6 - 2.5 AMP (COND. FANS)	3
10	360-17646-00	RECTIFIER BRIDGE 1 PH 25 A 200 V MTG TAPE 1”	1
11	K25-25733-02	BLOCK TERMINAL M3 10 POLE 12 AMP	1
12	360-18269-01	CAPACITOR MODIFIED 1000 vF 35 V 20%	1
13	K25-26743-00	CURRENT TRANSFORMER	1
14	360-13349-12	HORN ALARM	1
15	K28-10960-02	GASKET DOOR (ORDER IN FEET.)	9.417
16	K25-25733-04	BLOCK TERMINAL M3 16 POLE 12 AMP	1
17	K25-25733-03	BLOCK TERMINAL M3 11 POLE 12 AMP	1
18	K25-25733-00	BLOCK TERMINAL M3 3 POLE 12 AMP	1
19	K25-26756-00	BATTERY PACK	1
20	K31-00927-10	CONTROLLER	1
21	360-16405-21	PROBE AMBIENT AIR	1
22	K25-26532-05	BLOCK TERMINAL M3 5 POLE 12 AMP	1
23	K25-26566-03	RESISTER 1.5K OHM WITH METAL FILM	1
24	K25-25733-05	BLOCK TERMINAL M3 18 POLE 12 AMP	1
25	K25-26739-01	TERMINAL UT4 GRAY	48
26	K25-26739-02	TERMINAL UT4 GROUND GREEN	2
27	K24-22466-00	TIMER, DELAY POWER	1
28	K24-58160-03	CONTACTOR 12A 3P 24V/ 29V 50/60 HZ	4
29	K24-22361-06	CIRCUIT BREAKER 6 AMP	1
30	K24-58157-14	CIRCUIT BREAKER 10 AMP 2 POLE	1
31	K25-26741-00	TRANSFORMER 480/ 28-4.6A/ 24-1A 166AVA (UL/CSA)	1
32	K24-22469-00	SHUNT RELEASE DE-ACTIVATOR MAIN SWITCH	1
33	K25-58645-06	TERMINAL UT6 GREEN	3
34	K25-26265-02	SOCKET RELAY DPDT 3A	4
35	K24-22264-03	RELAY 24 VAC COIL MINI DPDT	4
36	K25-26266-02	SPRING RELAY HOLD DOWN 2 POLE	4
37	K24-22543-01	CIRCUIT BREAKER 1A 2 POLE 480 VAC	1
38	K25-26933-00	END CLAMP NS 35 DIN RAIL MOUNTED TERMINAL STRIP	1

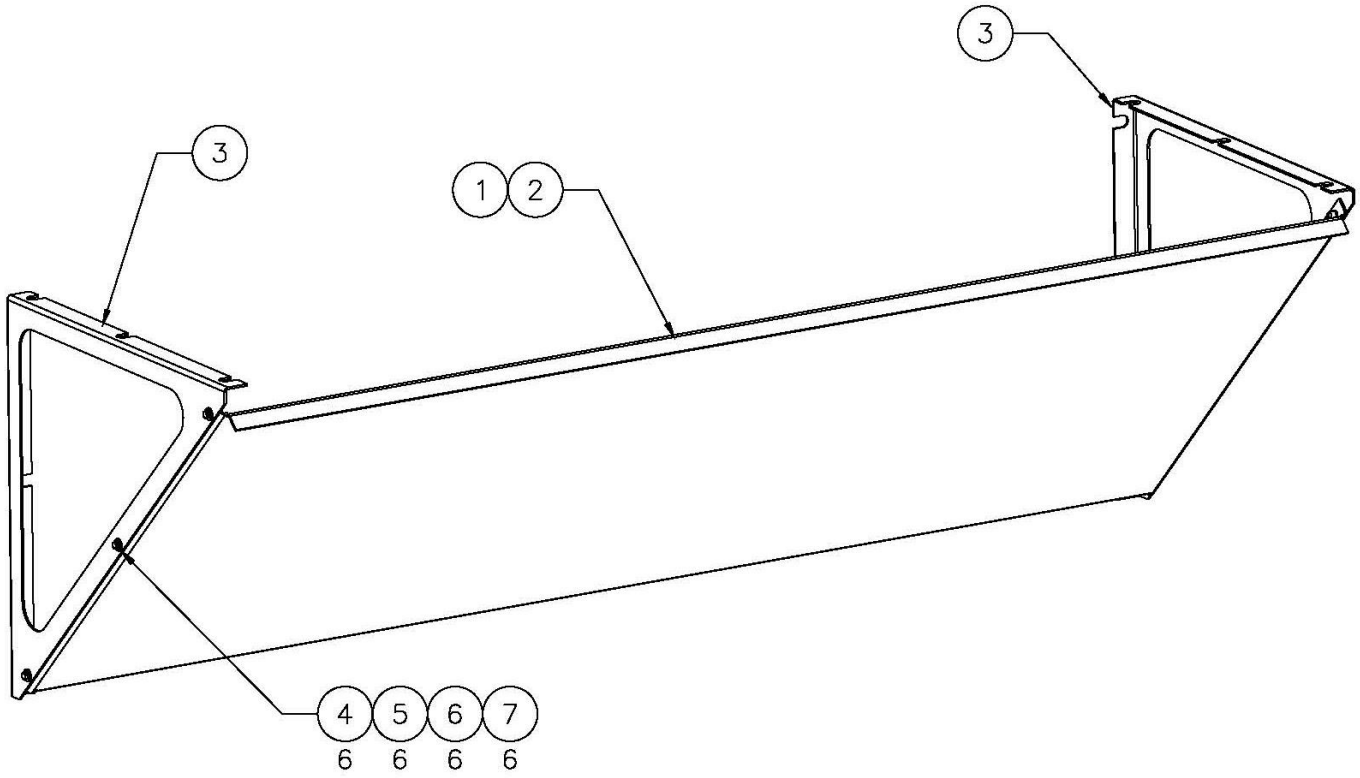
9.4C DISPLAY PANEL MPC3



9.4C DISPLAY PANEL MPC3

ITEM	PART NO.	DESCRIPTION	QTY.
1	K35-06467-00	OPERATING INSTRUCTION.	1
2	360-16824-00	PANEL DISPLAY MPC3	1
3	360-16424-01	DISPLAY MPC3 COMPLETE (PART OF ITEM #2)	1
4	360-16489-00	BOX DISPLAY WHITE	1
5	K24-07458-00	SWITCH ON/OFF 2 POLE (PART OF ITEM #3)	1
6	K24-17239-00	BOOT SWITCH (PART OF ITEM #3)	1
7	K31-00929-00	DISPLAY/ KEYBOARD (PART OF ITEM #3)	1
8	K35-06460-00	LABEL DISPLAY BOX (PART OF ITEM #3)	1

9.5 KIT AIR DEFLECTOR

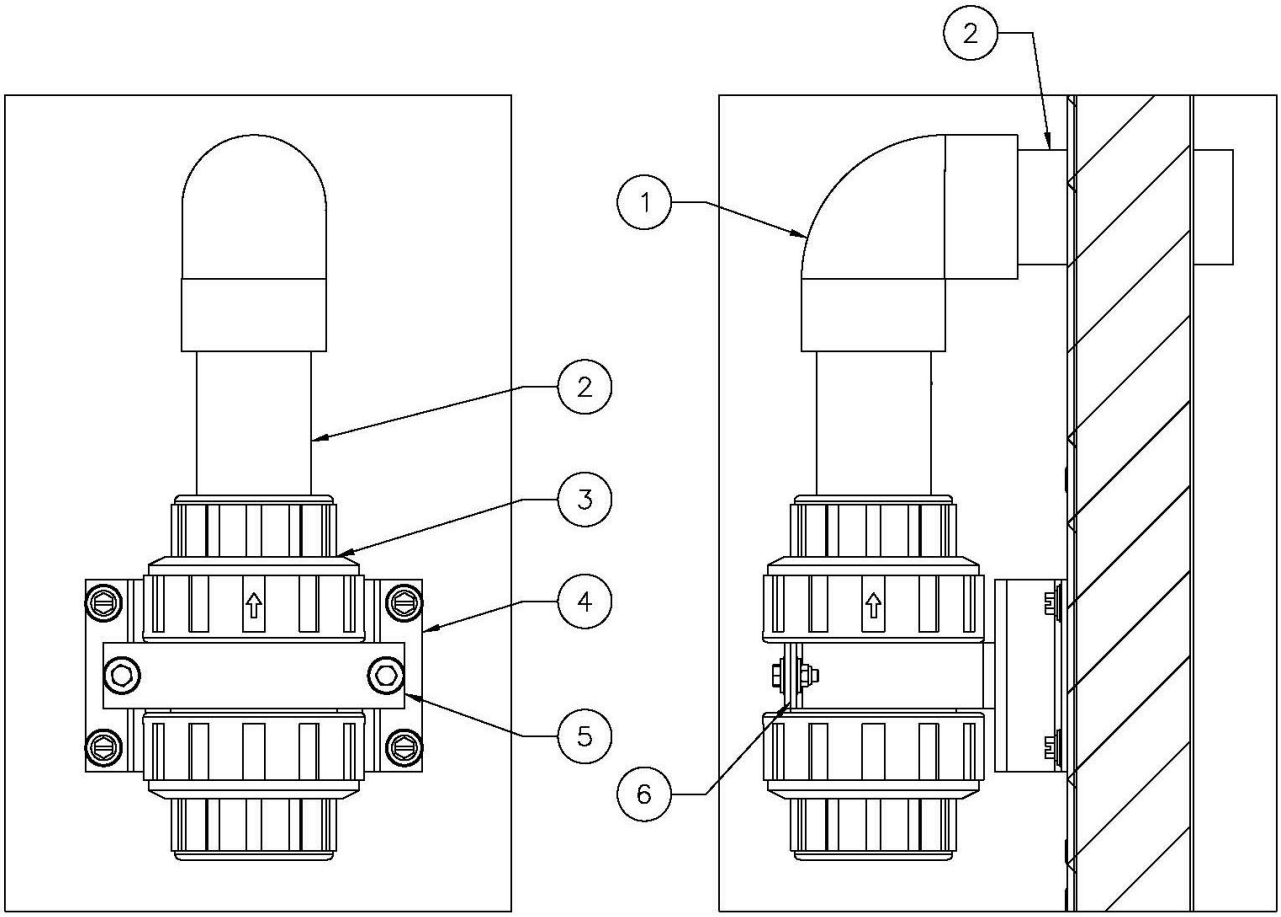


9.5 KIT AIR DEFLECTOR

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-16770-00	KIT AIR DEFLECTOR (INCLUDES ITEMS 2 THRU 7)	1
2	360-16772-00	PLATE AIR DEFLECTOR CONDENSER	1
3	060-16771-00	PLATE SIDE AIR DEFLECTOR CONDENSER	2
4	K21-18510-06	WASHER INSULATED PVC M6	6
5	K21-16547-06	WASH FLAT SS M6 LARGE OD 18MM	6
6	K21-50421-06	WASHER LK SPG SS M6 18-8	6
7	K21-50224-24	SCREW HEX SS M6 X 1 X 25	6

SECTION 10. CONTAINER EQUIPMENT AND OPTION PARTS

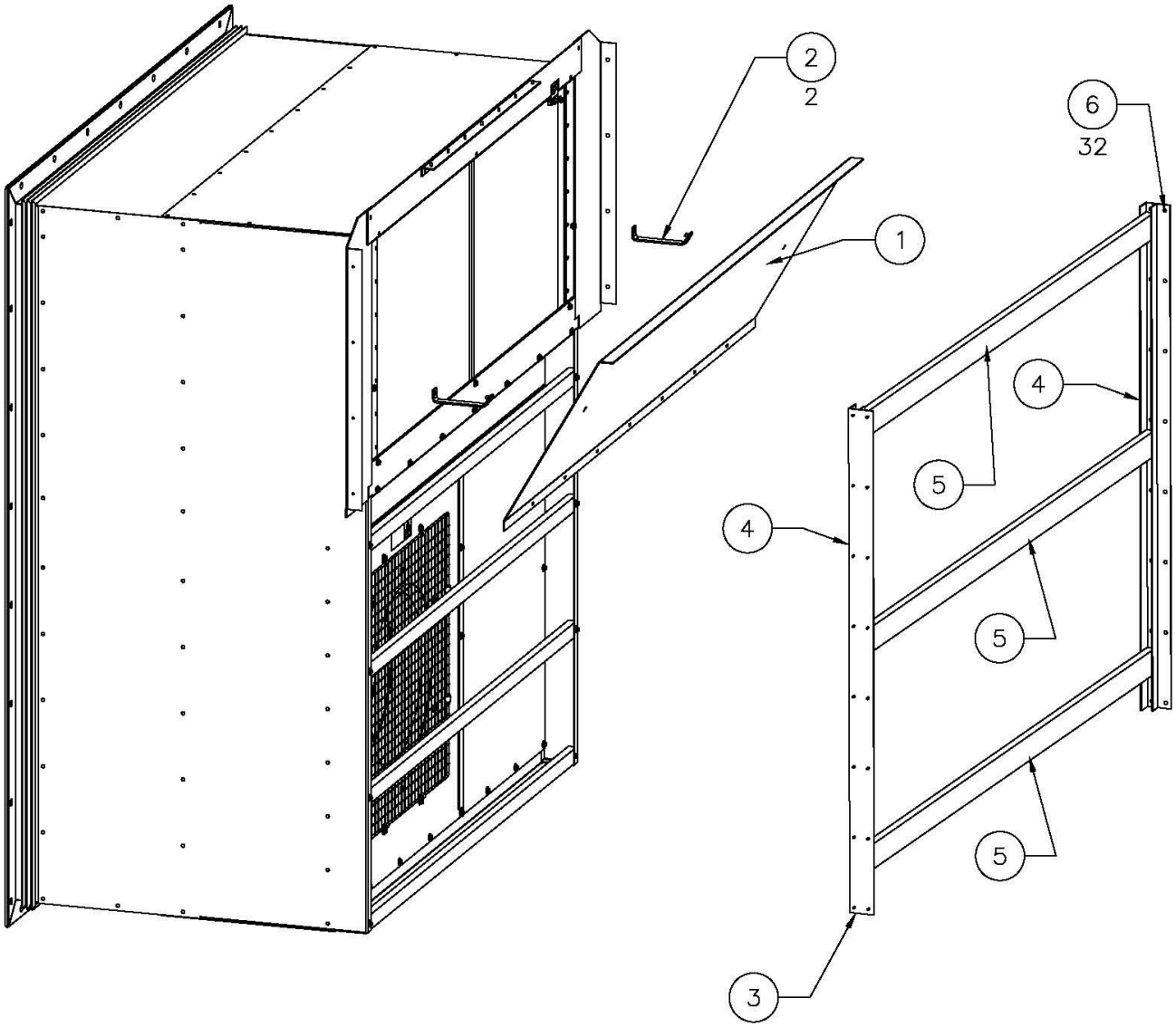
10.1 VACUUM RELIEF VALVE



10.1 VACUUM RELIEF VALVE

ITEM	PART NO.	DESCRIPTION	QTY.
1	K23-13063-00	FITTING, ELBOW	1
2	060-16580-00	PIPE PVC	2
3	K22-07032-00	VALVE VACUUM	1
4	060-16478-00	BRACKET, VACUUM VALVE	1
5	060-16552-00	PLATE VACUUM VALVE	1
6	060-16553-00	BRACKET VACUUM VALVE	1

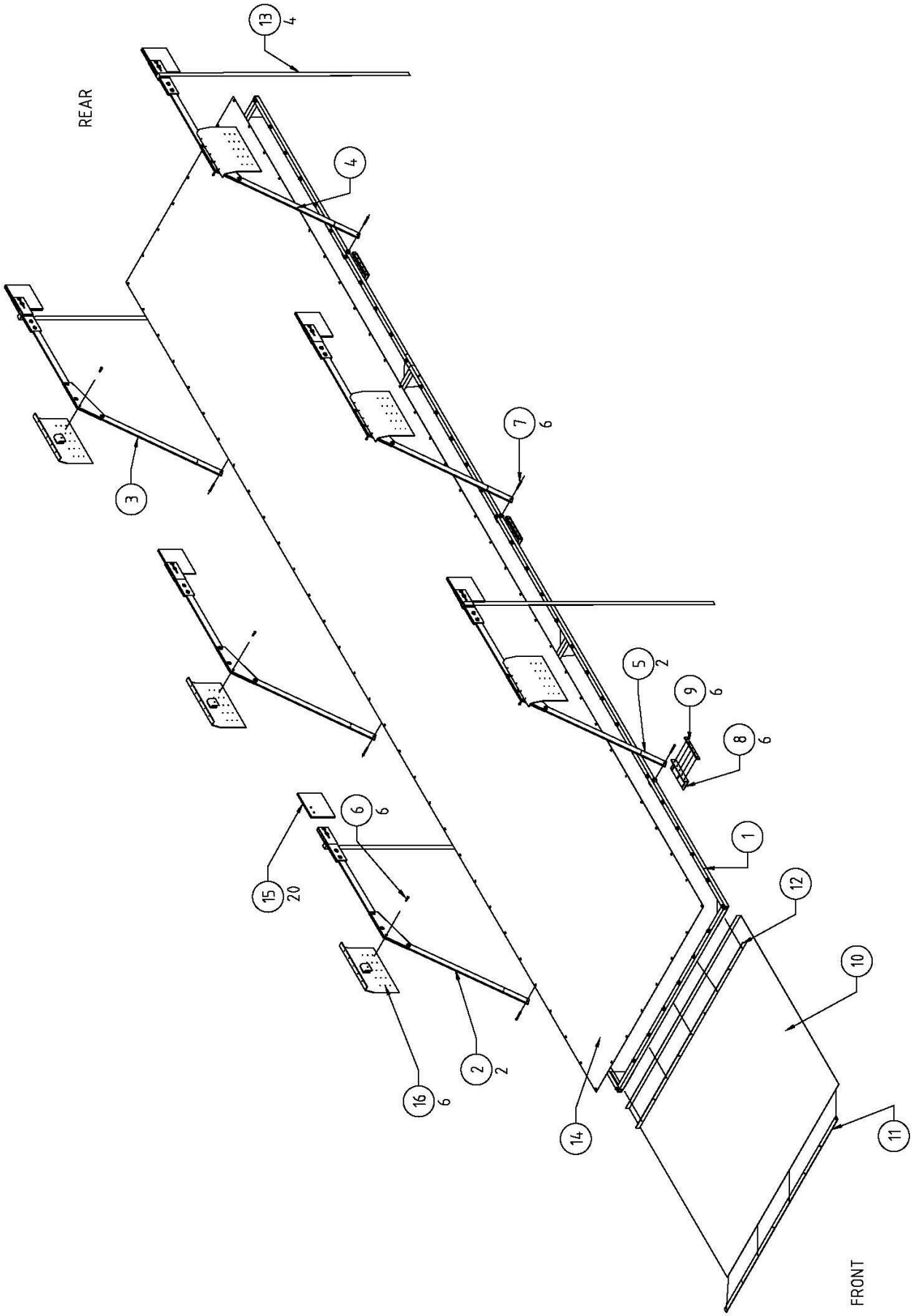
10.2 INTERNAL DEFLECTION PLATE AND PALLET STOP



10.2 INTERNAL DEFLECTION PLATE AND PALLET STOP

ITEM	PART NO.	DESCRIPTION	QTY.
1	060-17334-00	PLATE ANGLED DIRECTING COLD AIR ADJ CEILING	1
2	360-17375-01	BRKT FOR PLATE DIRECTING COLD AIR ADJ CEILING W/ INSERT	2
3	360-16762-00	KIT PALLET STOP (INCLUDES ITEMS 3 THRU 7)	1
4	360-16763-00	WELDMENT PALLET STOP	2
5	060-16767-00	BAR PALLET STOP	3
6	K21-16566-20	RIVET SS 3/16 (.188-.25) CLOSED END	32
7	K13-03160-00	SEALANT SIKAFLEX 221 WHITE (QTY IN TUBES) (NOT SHOWN)	1

10.3 ADJUSTABLE CEILING, 40 FT



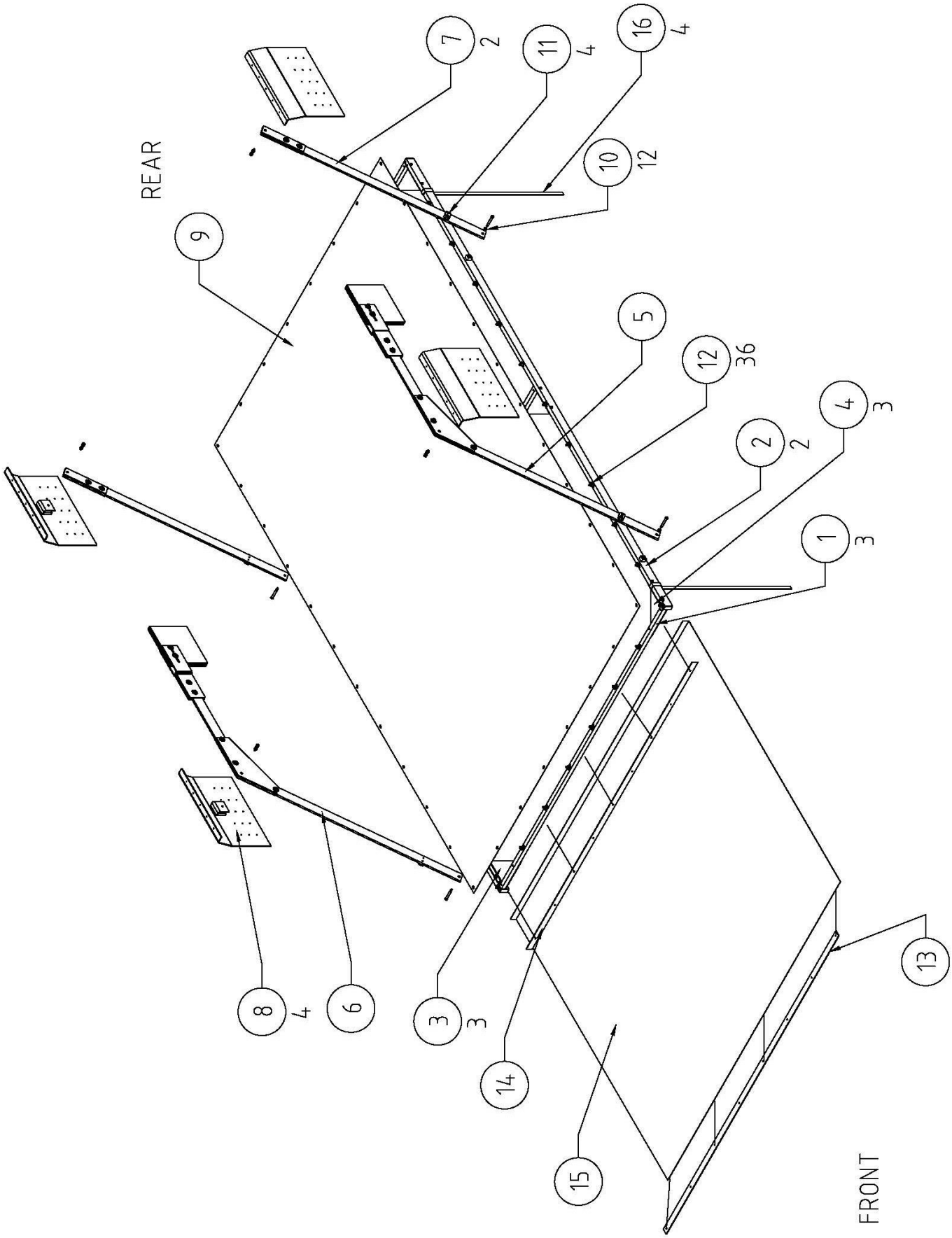
10.3 ADJUSTABLE CEILING, 40 FT

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-17250-00	ASSEMBLY ADJUSTABLE CEILING 4O FT CONTAINER	1
2	360-17267-00	ASSY LEVER ARM AND WEIGHTS RIGHT ADJ CEILING	2
3	360-17267-03	ASSY END LEVER ARM AND WEIGHTS RIGHT ADJ CEILING	1
4	360-17267-04	ASSY END LEVER ARM AND WEIGHTS LEFT ADJ CEILING	1
5	360-17267-01	ASSY LEVER ARM AND WEIGHTS LEFT ADJ CEILING	2
6	K21-16620-00	SCREW SHOULDER, 18-8 SS,3/8" X 1" SHOULDER, ADJ CEILING	6
7	K21-16621-00	SCREW SHOULDER, 18-8 SS, 3/8"X2.75" SHOULDER, ADJ CEILING	6
8	060-17364-00	ANGLE SPACER SIDE WALLS ADJ CEILING	6
9	060-17358-00	BAR SLIDER UHMW ADJ CEILING	6
10	360-16966-00	SHEET SILICONE 1/16" THK 86” X 56”	1
11	060-17332-00	ATTACHMENT SILICONE MOUNT UNIT END, ADJ CEILING	1
12	060-17333-00	ATTACHMENT SILICONE MOUNT ON CEILING END, ADJ CIELING	1
13	K29-18714-00	STRAP CAM BUCKLE 8 FT	4
14	K29-18704-00	TARP 40 FT ADJUSTABLE CEILING (PART OF 1)	1
15	060-17273-01	WEIGHT COUNTER BALANCE 1/4" THK, ADJ CEILING (PART OF 2,3,4,5)	20
16	360-17272-00	ASSEMBLY WELDING WALL MOUNT BRACKET ADJ CEILING	6

ADJUSTABLE CEILING OPERATION INSTRUCTIONS

1. There are two lashing straps which help to secure the ceiling while loading and unloading the cargo. (Each lashing strap is made up by lacing together two tie-down straps, each fitted with a cam buckle.)
2. **To position the ceiling in the up position**, manually raise the ceiling to the height desired. Position the lashing straps over the lever arms nearest the container doors, and thread the straps under the lashing bars in the container floor. Use the cam buckles to secure.
3. **To release the ceiling from the up position**, manually support the ceiling, then release the cam buckles holding the straps.
4. **To position the ceiling in the down position**, manually lower the ceiling to the height desired. Thread the straps between the ceiling frame and the ceiling tarp through the cam buckles on the straps and attach to the lashing bars in the container floor. Then tighten the straps through the cam buckles.
5. **To release the ceiling from the down position**, manually support the ceiling, then release the cam buckles holding the straps.

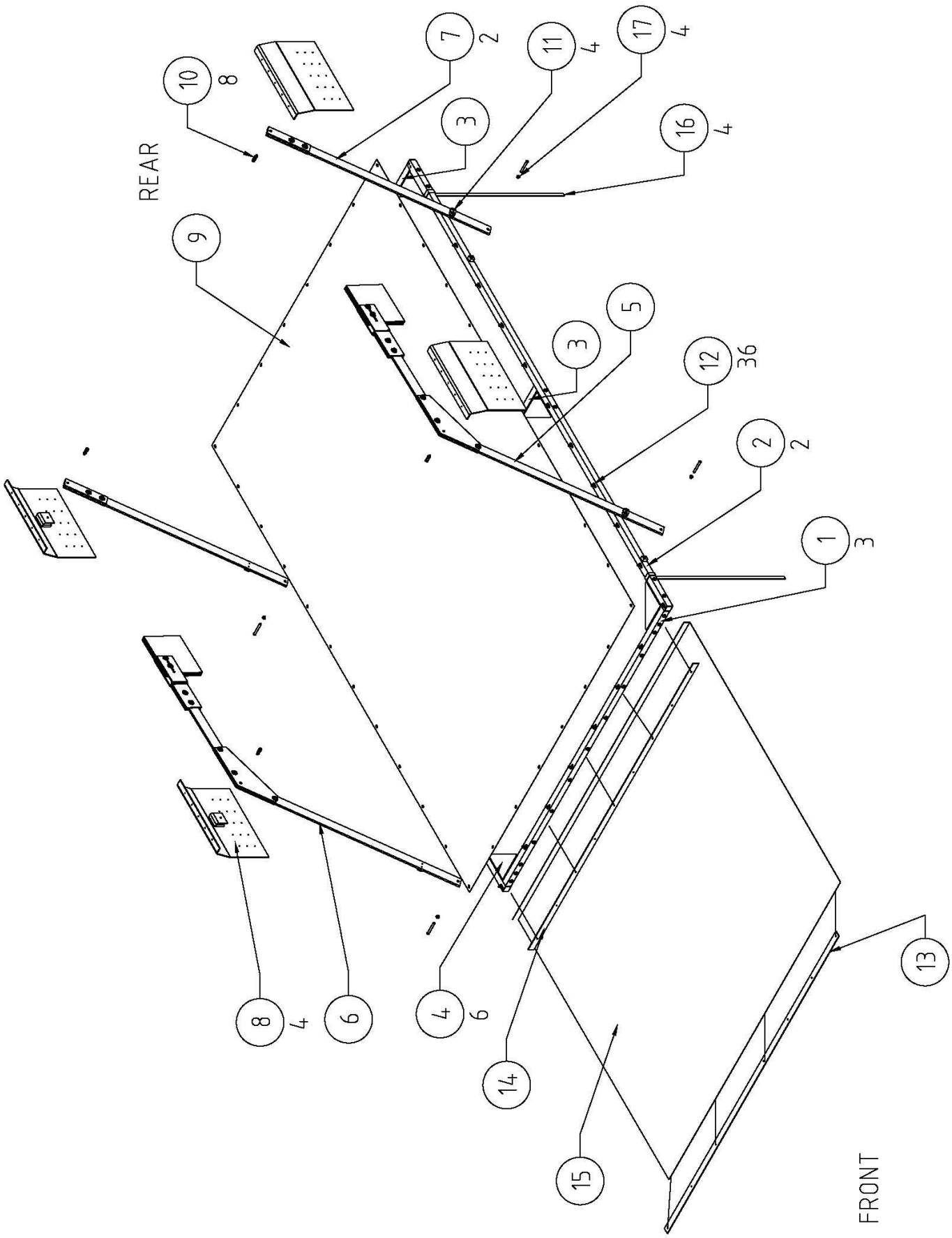
10.4A ADJUSTABLE CEILING, 20 FT (460-16401-01)



10.4A ADJUSTABLE CEILING, 20 FT (460-16401-01)

ITEM	PART NO.	DESCRIPTION	QTY.
1	060-18419-00	END BEAM ADJ CEILING	3
2	060-18418-00	SIDE BEAM ADJ CEILING	2
3	060-16995-00	GUSSET FRAME LH CEILING	3
4	060-16996-00	GUSSET FRAME RH CEILING	3
5	360-17267-06	ASSY END LEVER ARM AND WEIGHTS LEFT ADJ CEILING	1
6	360-17267-05	ASSY END LEVER ARM AND WEIGHTS RIGHT ADJ CEILING	1
7	360-17267-20	ASSY LEVER ARM LEFT ADJ CEILING	2
8	360-17272-00	ASSEMBLY WELDING WALL MOUNT BRACKET ADJ CEILING	4
9	K29-18704-20	TARP 20 FT CEILING CBU-30	1
10	K28-11097-01	BUSHING PLASTIC 3/8"ID 1/2"OD	12
11	K21-16591-04	PIPE CLAMP BODY OD 5/8" POLY (PART OF ITEMS 5, 6, & 7)	4
12	K29-18759-00	FASTENER LOCK-TWIST FOR TARPS	36
13	060-17332-00	ATTACHMENT SILICONE MOUNT CEILING END ADJ CEILING	1
14	060-17333-01	ATTACHMENT SILICONE MOUNT UNIT END ADJ CEILING	1
15	360-16966--00	SHEET SILICONE 1/16" THK 86” X 56”	1
16	K29-18714-00	STRAP CAM BUCKLE 8 FT	4

10.4B ADJUSTABLE CEILING, 20 FT (460-16401-02)



10.4B ADJUSTABLE CEILING, 20 FT (460-16401-02)

ITEM	PART NO.	DESCRIPTION	QTY.
1	360-18619-21	RAIL CROSSMEMBER CEILING WITH NUT INSERTS	1
2	060-18619-06	SIDE BEAM ADJ CEILING	2
3	060-18619-07	RAIL CROSS MEMBER CEILING	2
4	060-18621-00	GUSSET CORNER CEILING	3
5	360-17267-06	ASSY END LEVER ARM AND WEIGHTS LEFT ADJ CEILING	1
6	360-17267-05	ASSY END LEVER ARM AND WEIGHTS RIGHT ADJ CEILING	1
7	360-17267-20	ASSY LEVER ARM LEFT ADJ CEILING	2
8	360-17272-00	ASSEMBLY WELDING WALL MOUNT BRACKET ADJ CEILING	4
9	K29-18704-20	TARP 20 FT CEILING CBU-30	1
10	K28-11097-01	BUSHING PLASTIC 3/8"ID 1/2"OD	8
11	K21-16591-04	PIPE CLAMP BODY OD 5/8" POLY (PART OF ITEMS 5, 6, & 7)	4
12	K29-18759-02	FASTENER LOCK-TWIST FOR TARPS	36
13	060-17332-00	ATTACHMENT SILICONE MOUNT CEILING END ADJ CEILING	1
14	060-17333-01	ATTACHMENT SILICONE MOUNT UNIT END ADJ CEILING	1
15	360-16966--00	SHEET SILICONE 1/16" THK 86” X 56”	1
16	K29-18714-00	STRAP CAM BUCKLE 8 FT	4
17	K21-16673-00	BUSHING PLASTIC M10 ID X M12 OD	4