Carrier TRANSICOLD

Container Refrigeration


# OPERATIONS AND SERVICE MANUAL

For

## 69NT40-601-100 to 199

Container Refrigeration Units

T-370 Rev F

# OPERATIONS AND SERVICE MANUAL

For

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Container Refrigeration Units

 Printed in U. S. A. October 2021

# TABLE OF CONTENTS

# LIST OF ILLUSTRATIONS

**FIGURE NUMBER** **Page**

# LIST OF TABLES

# SECTION 1
# SAFETY SUMMARY

## 1.1 General Safety Notices

The following general safety notices supplement specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein. The general safety notices are presented in the following three sections labeled: First Aid, Operating Precautions and Maintenance Precautions. A listing of the specific warnings and cautions appearing elsewhere in the manual follows the general safety notices.

## 1.2 First Aid

An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

## 1.3 Operating Precautions

Always wear safety glasses.

Keep hands, clothing and tools clear of the evaporator and gas cooler fans.

No work should be performed on the unit until all circuit breakers and start-stop switches are turned off, power supply is disconnected, and Lock Out / Tag Out has been applied.

In case of severe vibration or unusual noise, stop the unit and investigate.

## 1.4 Maintenance Precautions

The Carrier NaturaLINE unit requires the same training and certifications that are required for servicing a conventional refrigeration unit and it is expected that maintenance will only be performed by qualified personnel.

Beware of unannounced starting of the evaporator and gas cooler fans. Do not open the gas cooler fan grille or evaporator access panels before turning power off, disconnecting and securing the power plug and performing the Lock Out / Tag Out procedure at the end if the Safety Summary.

Be sure power is turned off before working on motors, controllers, solenoid valves and electrical control switches. Lock Out / Tag Out the circuit breaker and power supply to prevent accidental energizing of circuit.

Do not bypass any electrical safety devices, e.g. bridging an overload, or using any sort of jumper wires. Problems with the system should be diagnosed, and any necessary repairs performed by qualified service personnel.

When performing any arc welding on the unit or container, disconnect all wire harness connectors from the modules in control boxes. Do not remove wire harness from the modules unless you are grounded to the unit frame with a static safe wrist strap.

In case of electrical fire, open circuit switch and extinguish with $CO_2$ (never use water).

## 1.5 Specific Warning And Caution Statements

To help identify the label hazards on the unit and explain the level of awareness each one carries, an explanation is given with the appropriate consequences:


**DANGER - means an immediate hazard that WILL result in severe personal injury or death.**


**WARNING - means to warn against hazards or unsafe conditions that COULD result in severe personal injury or death.**

**⚠ CAUTION**

**CAUTION - means to warn against potential hazard or unsafe practice that could result in minor personal injury, product or property damage.**

***NOTICE***

**NOTICE - means to warn against potential product or property damage.**

*The following statements are applicable to the refrigeration unit and appear elsewhere in this manual. These recommended precautions must be understood and applied during operation and maintenance of the equipment covered herein.*

**⚠ DANGER**

**Only manifold gauge sets designed and manufactured for R-744 ($CO_2$) are to be used on these units.**

**⚠ DANGER**

**There are no serviceable parts on the Pressure Relief Valve (PRV). Attempting to repair or alter the PRV is not permitted. If the PRV has released pressure, the entire PRV must be replaced.**

**⚠ DANGER**

**There are no serviceable parts on the flash tank. Attempting to repair the flash tank or welding on the flash tank vessel is not permitted. If the flash tank should be damaged in any way the entire flash tank must be replaced.**

**⚠ WARNING**

**Beware of unannounced starting of the evaporator and gas cooler fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.**

**⚠ WARNING**

**Make sure that the unit circuit breaker (CB-1) and the START-STOP switch (ST) are in the "O" (OFF) position before connecting to any electrical power source.**

**⚠ WARNING**

**Always turn OFF the unit circuit breaker (CB-1), disconnect main power supply, and perform Lock Out / Tag Out before working on moving parts.**

**⚠ WARNING**

**Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.**

**⚠ WARNING**

**Before disassembly of the compressor, be sure to relieve the internal pressure very carefully by slightly loosening the couplings to break the seal.**

**⚠ WARNING**

**Do not use a nitrogen or $CO_2$ cylinder without a pressure regulator. Do not use oxygen in or near a refrigeration system as an explosion may occur.**

**⚠ WARNING**

**Do not open the Gas Cooler fan grille before turning power OFF, disconnecting power plug, and performing Lock Out / Tag Out procedure.**

**⚠ WARNING**

**Always turn OFF the unit circuit breaker (CB-1) and disconnect main power supply before working on moving parts.**

**⚠ WARNING**

**Installation requires wiring to the main unit circuit breaker, CB-1. Make sure the power to the unit is off and power plug disconnected before beginning installation.**

**⚠ WARNING**

**Do not use in a potentially explosive atmosphere.**

**⚠ WARNING**

**Do not operate unit near flammable gases.**

**⚠ WARNING**

**Do not use unit for any other use other than intermodal refrigerated transportation.**

**⚠ WARNING**

**Any technical modifications to the unit must be performed using authorized service personnel.**

**⚠ CAUTION**

**Charge according to nameplate specifications to ensure optimal unit performance.**

**⚠ CAUTION**

**Use only thick walled tubing.**

**⚠ CAUTION**

**Do not remove wire harnesses from controller modules unless you are grounded to the unit frame with a static safe wrist strap.**

**⚠ CAUTION**

**Unplug all controller module wire harness connectors before performing arc welding on any part of the container.**

**⚠ CAUTION**

**Do not attempt to use an ML2i PC card in an ML3 equipped unit. The PC cards are physically different and will result in damage to the controller.**

**⚠ CAUTION**

**Pre-trip diagnostics should not be performed with critical temperature cargoes in the container.**

**⚠ CAUTION**

**When PRE-TRIP key is pressed, economy, dehumidification and bulb mode will be deactivated. At the completion of Pre-trip activity, economy, dehumidification and bulb mode must be reactivated.**

**⚠ CAUTION**

**When a failure occurs during automatic testing, the unit will suspend operation awaiting operator intervention.**

**⚠ CAUTION**

**When Pre-trip test Auto 2 runs to completion without being interrupted, the unit will terminate Pre-trip and display “Auto 2” “end.” The unit will suspend operation until the user depresses the ENTER key.**

**⚠ CAUTION**

**To prevent trapping liquid refrigerant in the manifold gauge set be sure that the set is isolated from the system and pressure is released before disconnecting.**

**⚠ CAUTION**

**Never use air or gases containing oxygen for leak testing or operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to explosion.**

**⚠ CAUTION**

**Opening the Manifold Gauge Valve wide open quickly can cause excessive noise and possible loss of the system oil charge.**

**⚠ CAUTION**

**Do not touch the filter drier to check for temperature difference while the unit is operating. Refer to troubleshooting for when to replace the filter drier due to restriction.**

**⚠ CAUTION**

**Unplug all module connectors before performing arc welding on any part of the container.**

**⚠ CAUTION**

**The unit must be OFF whenever a programming card is inserted or removed from the controller programming port.**

**⚠ CAUTION**

**Use care when cutting wire ties to avoid nicking or cutting wires.**

**⚠ CAUTION**

**Do not allow moisture to enter wire splice area as this may affect the sensor resistance.**

**⚠ CAUTION**

**Variable Frequency Drive Electrical Hazard. After disconnecting from power supply, wait seven minutes before servicing.**

**⚠ CAUTION**

**Sound pressure level of 79dB(A) was measured at workstation.**

**⚠ CAUTION**

**Operator needs to provide sufficient lighting when ambient light is low.**

**⚠ CAUTION**

**Installation: Refrigeration unit must be inserted into the container so that all four flanges contact the container at nearly the same time and no “wrenching” of the unit occurs. Inserting the unit into the container while the unit remains tilted on forks so that one flange of the unit hits hard against the container first can cause serious damage to the unit.**

***NOTICE***

**The NaturaLINE platform must use the green label controller only (part number 12-55011).**

***NOTICE***

**Compressor is shipped without oil in the compressor.**

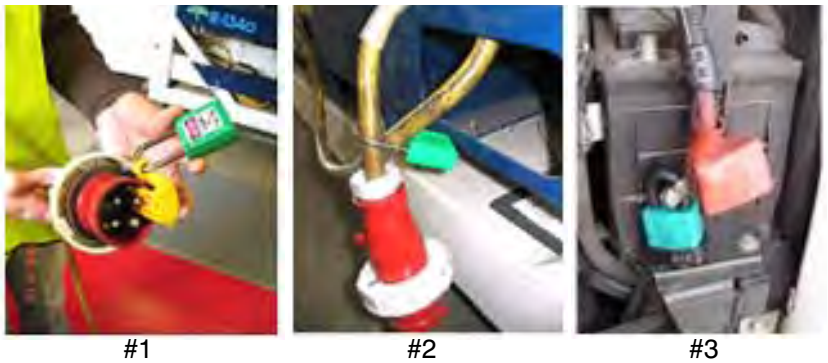
***NOTICE***

**When installing service fittings and the suction pressure transducer, a new O-ring must installed with each. See Section 7.4 for instructions on installing the O-rings.**

## 1.6 Lockout / Tagout (LO/TO)

1. Shut down the unit by turning the START-STOP switch (SW) to the “O” (Off) position.
2. Ensure CB-1 (460V) circuit breaker is in the off position.
3. Disconnect, lock and tag the power plug using a plug clip or locking directly on the power cable (pic #1 & 2).
4. Remove and lock the battery connection (picture #3) for Genset units.
5. All employees working on the reefer must have their own personal lock in place.
6. Check that circuit−testing devices are working properly by using an energized test source.
7. Prior to servicing the unit, a check must be made with a “proximity voltage sensor” to ensure that the reefer unit and the container body are not energized.
8. Verify the absence of electrical current or voltage with a circuit−testing device.

**Figure 1.1 Lockout/Tagout**



#1 #2 #3

# SECTION 2
# INTRODUCTION

## 2.1 Introduction

The Carrier Transicold model 69NT40-601-XXX series units are of lightweight aluminum frame construction, designed to fit in the front of a container and serve as the container's front wall.

They are one piece, self-contained, all electric units, which include cooling and heating systems to provide precise temperature control.

The units are supplied with a complete charge of refrigerant R-744 ($CO_2$) and compressor lubricating oil. Units are ready for operation upon installation.

The base unit operates on nominal 380/460 volt, 3-phase, 50/60 hertz (Hz) power. Power for the control system is provided by a transformer which steps the supply power down to 18 and 24 volts, single phase.

The controller is a Carrier Transicold Micro-Link 3 microprocessor. The controller will operate automatically to select cooling, holding or heating as required to maintain the desired set point temperature within very close limits.

The controller has a keypad and display for viewing or changing operating parameters. The display is also equipped with lights to indicate various modes of operation.

## 2.2 Configuration Identification

Unit information is provided on a unit nameplate and PED label (see **Figure 2.1**) located to the right of the compressor, on the side wall next to the Variable Frequency Drive (VFD) section. The nameplate provides the unit model number, serial number and parts identification number (PID). The model number (69NT40-601-XXX) identifies the overall unit configuration, while the PID number provides information on specific optional equipment, factory provisioned to allow for field installation of optional equipment, and differences in detailed parts.

If a problem occurs, please refer to the information on this nameplate and make a note of the model and serial number before calling for assistance. This information will be needed when you contact the technician so that he may properly assist you.

**Figure 2.1 Unit Nameplate and PED Label Location**

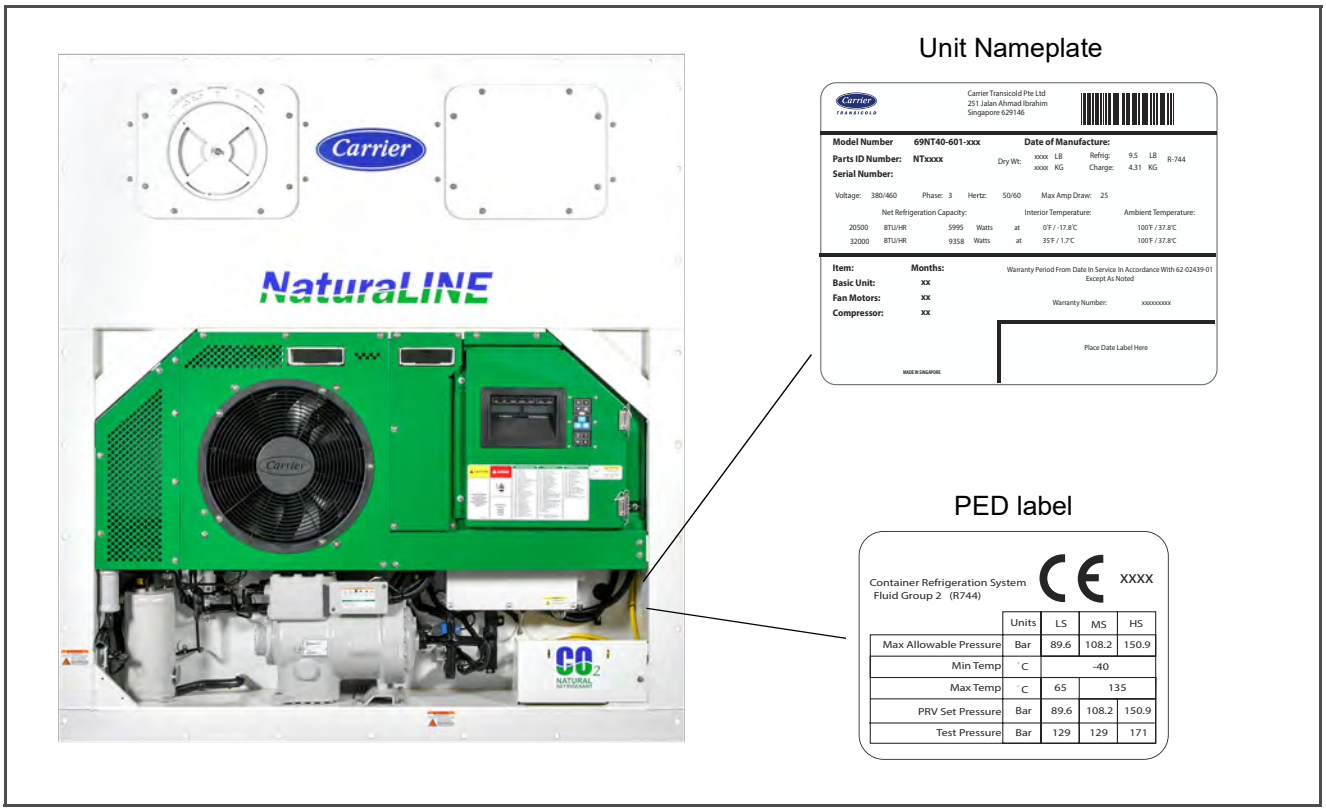


**Figure 2.2 Unit Nameplate**

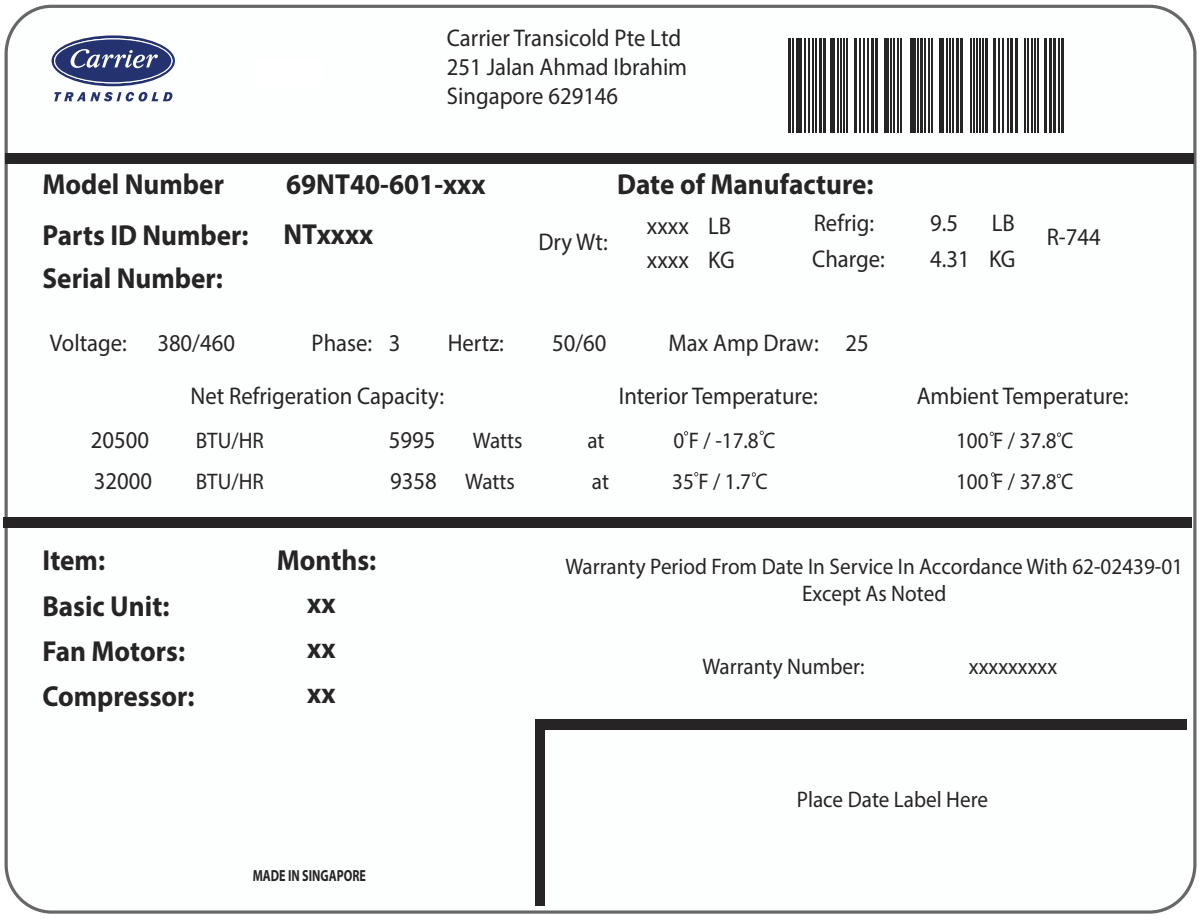
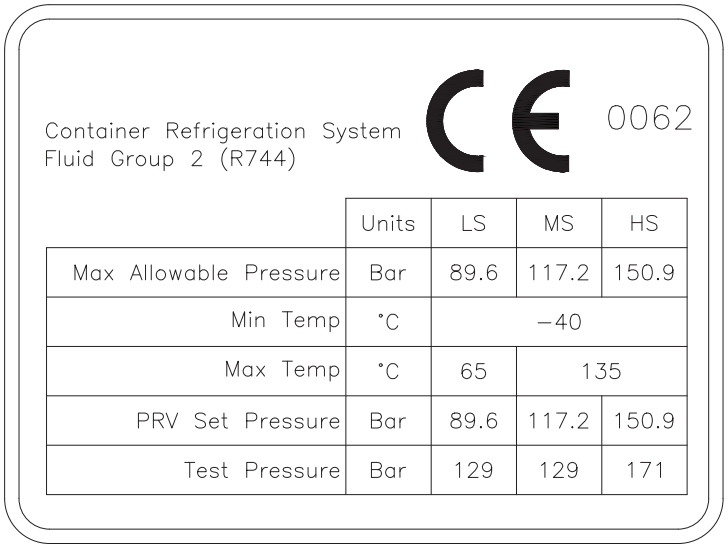



**Figure 2.3 PED Label (from PID NT5010)**




| | Units | LS | MS | HS |
|---|---|---|---|---|
| Max Allowable Pressure | Bar | 89.6 | 117.2 | 150.9 |
| Min Temp | °C | −40 | | |
| Max Temp | °C | 65 | 135 | |
| PRV Set Pressure | Bar | 89.6 | 117.2 | 150.9 |
| Test Pressure | Bar | 129 | 129 | 171 |

## 2.3 Installation Guidelines

1. Refrigeration unit is provided by Carrier Transicold. Dimensional outline is available upon request.
2. Installation and material guidelines are the responsibility of the container box manufacturer. Refer to the box manufacturer for final instructions.

**⚠ CAUTION**

**Installation: Refrigeration unit must be inserted into the container so that all four flanges contact the container at nearly the same time and no "wrenching" of the unit occurs. Inserting the unit into the container while the unit remains tilted on forks so that one flange of the unit hits hard against the container first can cause serious damage to the unit.**

## 2.4 Feature Descriptions

### 2.4.1 Control Box

Units are equipped with a control box that may be fitted with a lockable door.

### 2.4.2 Temperature Readout - Refrigerant Temperature

The unit is fitted with a Compressor Discharge Temperature Sensor (CPDS), an Evaporator Temperature Sensor (ETS), and a Gas Cooler Temperature Sensor (GCTS).

### 2.4.3 Temperature Readout - Air Temperature

The unit is fitted with an Ambient Temperature Sensor (AMBS), a Return Temperature Sensor (RTS), a Return Recorder Sensor (RRS), a Supply Temperature Sensor (STS), a Supply Recorder Sensor (SRS), and a Defrost Temperature Sensor (DTS).

### 2.4.4 Pressure Readout

The unit is fitted with a Suction Pressure Transducer (SPT), a Flash Tank Pressure Transducer (FPT), and a Discharge Pressure Transducer (DPT).

### 2.4.5 Compressor

The unit is fitted with a reciprocating compressor equipped with suction, discharge and mid-stage connections.

### 2.4.6 Gas Cooler / Intercooler Coil

The unit is fitted with a three row Gas Cooler / Intercooler coil using heavy wall tubing.

### 2.4.7 Evaporator

The Evaporator section contains an evaporator coil and heaters, two three-phase fan motors, and is equipped with an Electronic Expansion Valve (EEV). Opening of an evaporator fan internal protector will shut down the unit.

### 2.4.8 Flash Tank

The unit is fitted with a Flash Tank.

### 2.4.9 Variable Frequency Drive (VFD)

The unit is fitted with a Variable Frequency Drive (VFD).

### 2.4.10 Interrogator

Units that use the DataCORDER function are fitted with interrogator receptacles for connection of equipment to download the recorded data. Two receptacles may be fitted; one is accessible from the front of the container and the other is mounted inside the container (with the USDA receptacles).

### 2.4.11 Plate Set

Each unit is equipped with a tethered set of wiring schematics and wiring diagram plates. The plate sets are ordered using a seven-digit base part number and a two-digit dash number.

## 2.5 Option Descriptions

Various options may be factory or field equipped to the base unit. These options are listed and described in the following sub-paragraphs.

### 2.5.1 Battery

The refrigeration controller may be fitted with standard replaceable batteries or a rechargeable battery pack. Rechargeable battery packs may be fitted in the standard or in a secure location.

### 2.5.2 Dehumidification

The unit may be fitted with a Humidity Sensor (HS). This sensor allows setting of a humidity set point in the controller. In dehumidification mode, the controller will operate to reduce internal container moisture level.

### 2.5.3 USDA

The unit may be supplied with fittings for additional temperature probes, which allow recording of USDA Cold Treatment data by the integral DataCORDER function of the Micro-Link refrigeration controller.

### 2.5.4 Remote Monitoring

The unit may be fitted with a remote monitoring receptacle. This item allows connection of remote indicators for COOL, DEFROST and IN RANGE. Unless otherwise indicated, the receptacle is mounted at the control box location.

### 2.5.5 Communications Interface Module

The unit may be fitted with a communications interface module. The communications interface module is a slave module, which allows communication with a master central monitoring station. The module will respond to communication and return information over the main power line. Refer to the ship master system technical manual for further information.

### 2.5.6 Handles

The unit may be equipped with handles to facilitate access to stacked containers. These fixed handles are located on either side of the unit.

### 2.5.7 Thermometer Port

The unit may be fitted with ports in the front of the frame for insertion of a thermometer to measure supply and/or return air temperature. If fitted, the port(s) will require a cap and chain.

### 2.5.8 Back Panels

Aluminum back panels may have access doors and/or hinge mounting.

### 2.5.9 460 Volt Cable

Various power cable and plug designs are available for the main 460 volt supply. The plug options tailor the cables to each customer’s requirements.

### 2.5.10 Cable Restraint

Various designs are available for storage of the power cables. These options are variations of the compressor section cable guard.

### 2.5.11 Vent Position Sensor (VPS)

The unit may be fitted with a fresh air makeup assembly, upper or lower. The fresh air makeup assembly is available with a Vent Position Sensor (VPS) and may also be fitted with screens.

### 2.5.12 Labels

Safety instruction and function code listing labels differ, depending on the options installed. Labels available with additional languages are listed in the parts list.

### 2.5.13 Gas Cooler / Intercooler Grille

The Gas Cooler / Intercooler grilles are direct bolted (standard) or hinged (option).

# SECTION 3
# DESCRIPTION

## 3.1 General Description

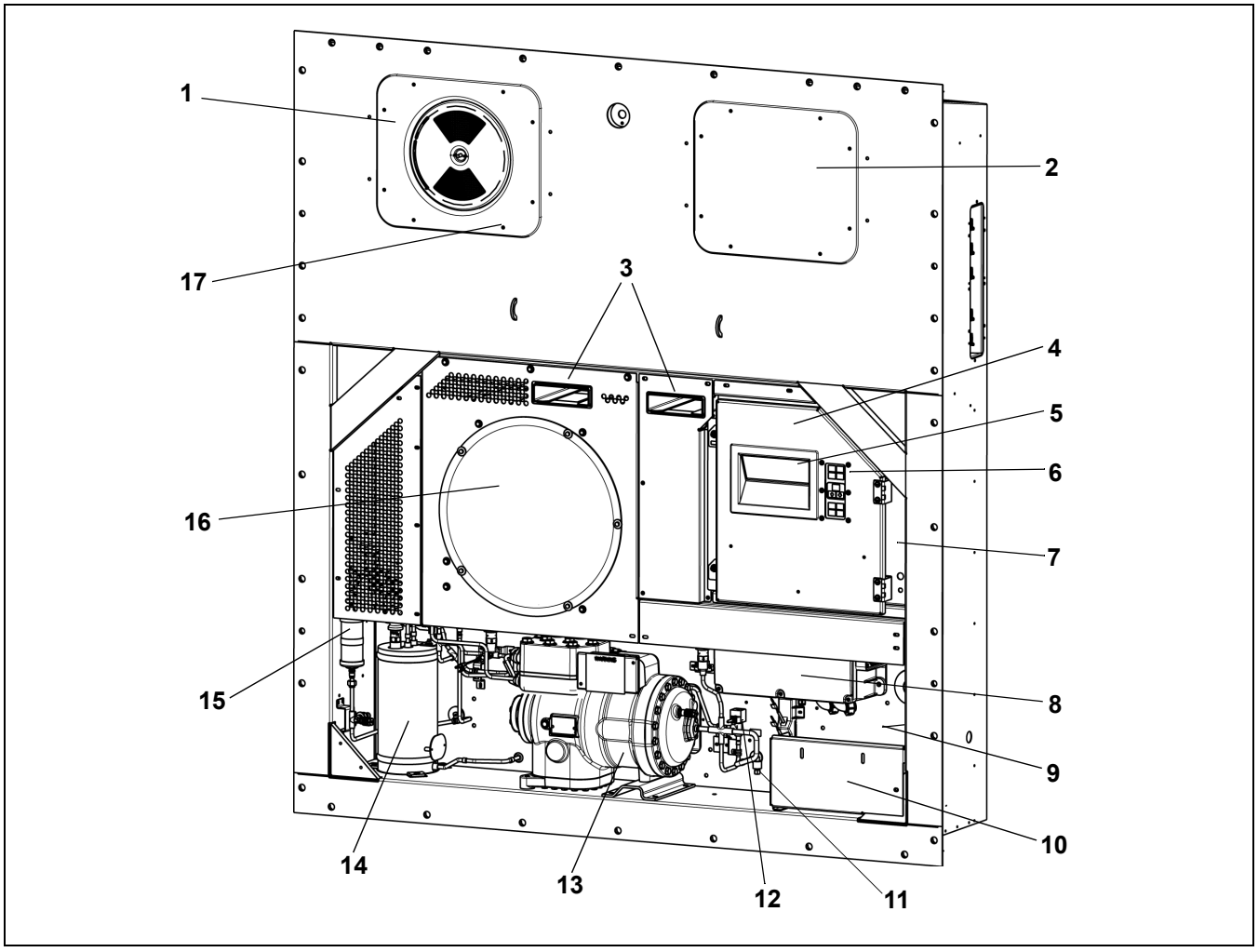
### 3.1.1 Refrigeration Unit - Front Section

The refrigeration unit is designed so that the majority of components are accessible from the front (see **Figure 3.1**).

### 3.1.2 Fresh Air Makeup Vent

The function of the upper fresh air makeup vent is to provide ventilation for commodities that require fresh air circulation. The venting system / Vent Position Sensor (VPS) is located in the upper left access panel.

**Figure 3.1 Refrigeration Unit - Front Section**




1) Upper Fresh Air Makeup Vent Panel. Located inside are Evaporator Fan #2, Defrost Temperature Sensor (DTS)
2) Access Panel. Located inside are Evaporator Fan #1, Electronic Expansion Valve (EEV), Heat Termination Thermostat (HTT)
3) Fork Lift Pockets
4) Control Box
5) Unit Display
6) Key Pad
7) Interrogator Connector (Front right)
8) Variable Frequency Drive (VFD)
9) Unit Nameplate: Serial Number, Model Number and Parts Identification Number (PID)
10) Power Cables & Plug location
11) Ambient Temperature Sensor (AMBS)
12) Unloader Solenoid Valve (USV)
13) Compressor
14) Flash Tank
15) Filter Drier
16) Gas Cooler Fan
17) TIR (Transports Internationaux Routiers) Sealing Provisions - Typical All Panels

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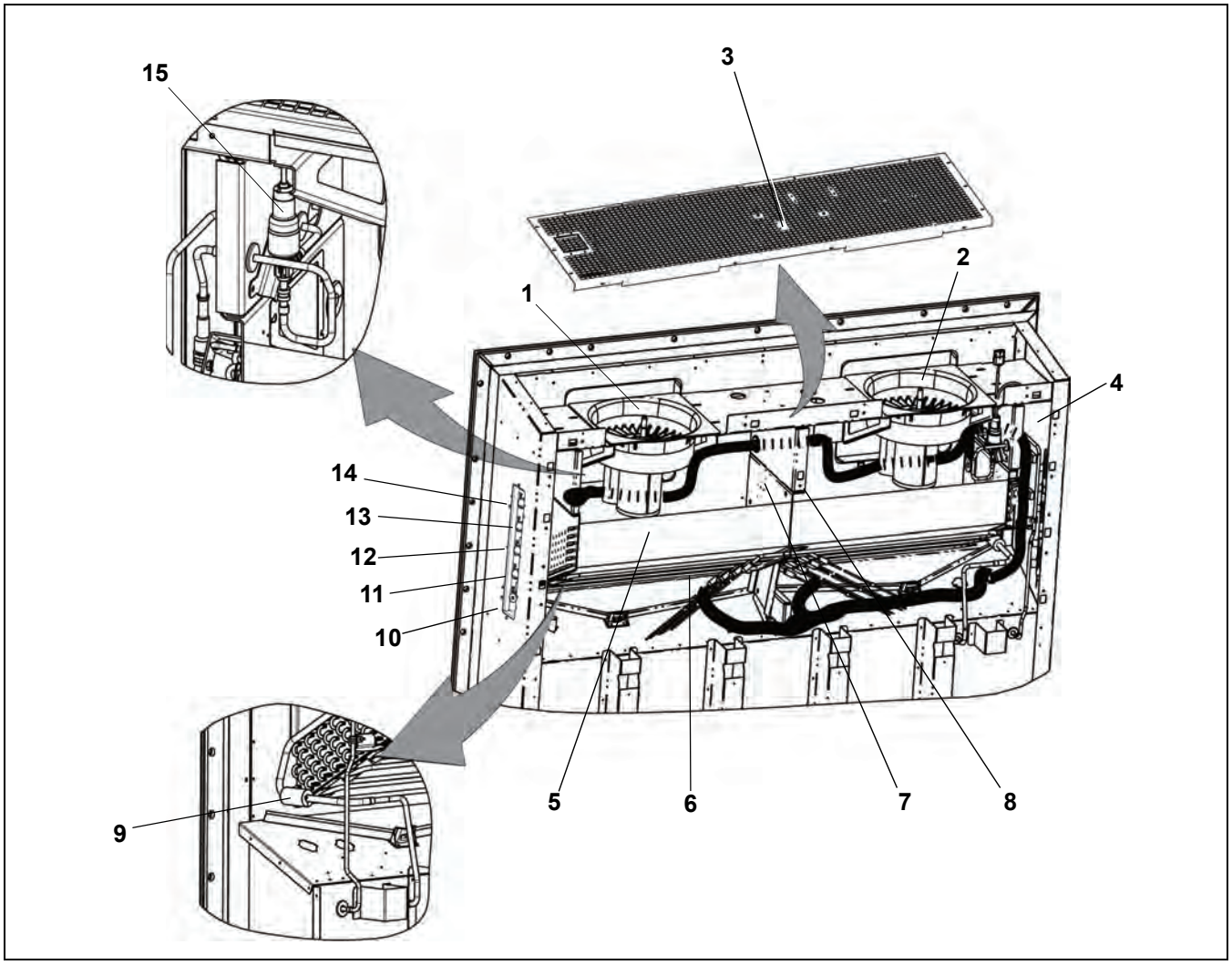
### 3.1.3 Evaporator Section

The two evaporator fans circulate air through the container by pulling air in from the top of the unit, directing the air through the evaporator coil where it is cooled or heated, and then discharging the conditioned air at the bottom of the unit.

Most evaporator components are accessible by removing the upper rear panel (as shown in **Figure 3.2**) or by removing the evaporator fan access panels (see **Figure 3.1**).

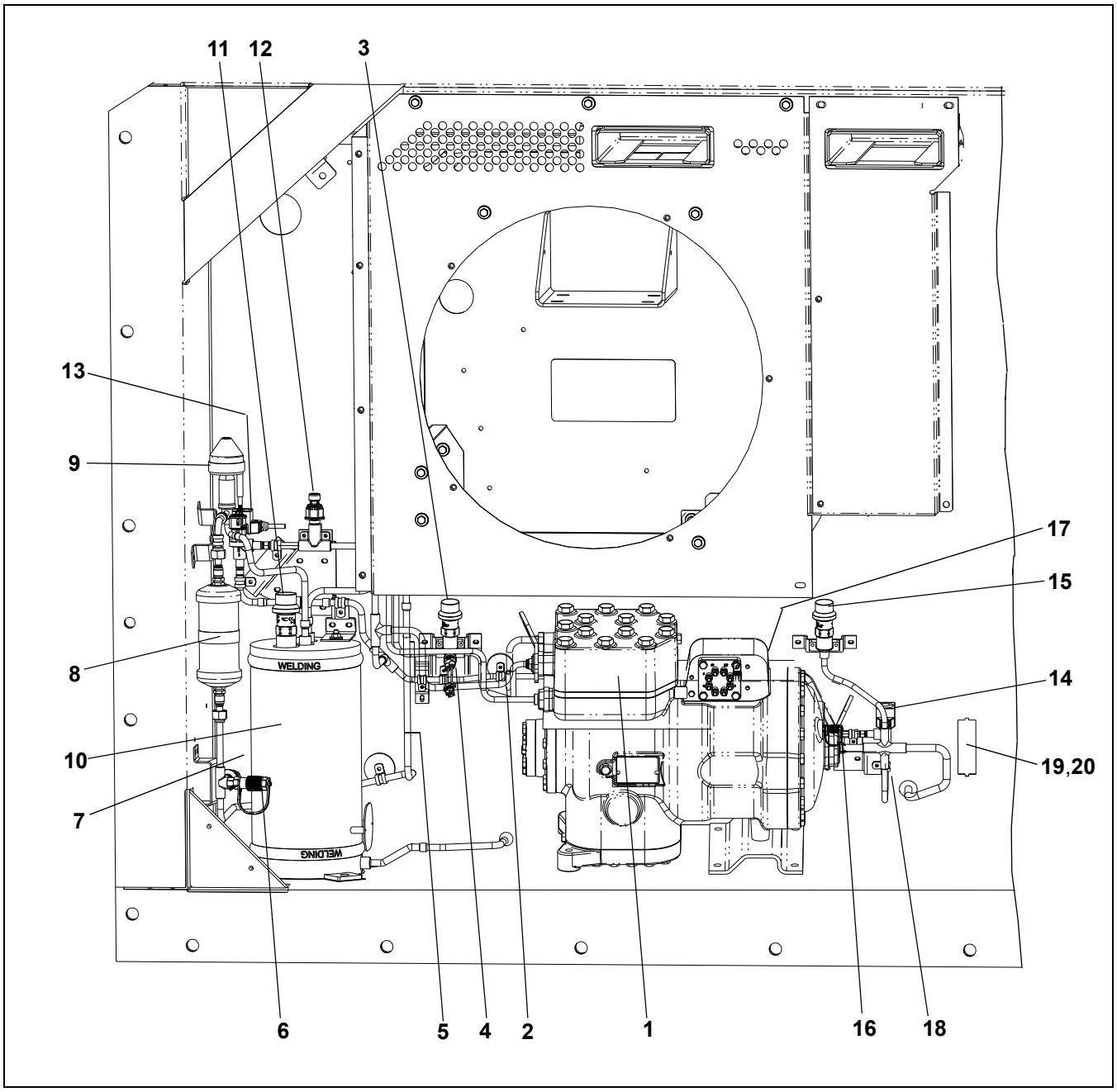
**Figure 3.2 Evaporator Section**




1) Evaporator Fan Motor #1 (EM1)
2) Evaporator Fan Motor #2 (EM2)
3) Return Recorder Sensor (RRS)
   Return Temperature Sensor (RTS)
4) Humidity Sensor (HS)
5) Evaporator Coil
6) Evaporator Coil Heaters (Underside of Coil)
7) Heat Termination Thermostat (HTT)
8) Defrost Temperature Sensor (DTS)
9) Evaporator Temperature Sensor (ETS1)
10) Interrogator Connector (Rear) (ICR)
11) USDA Probe Receptacle PR2
12) USDA Probe Receptacle PR1
13) USDA Probe Receptacle PR3
14) Cargo Probe Receptacle PR4
15) Electronic Expansion Valve (EEV)

### 3.1.4 Compressor and Flash Tank Section

**Figure 3.3 Compressor and Flash Tank Section - PIDs lower than NT5010**




1) Compressor
2) Compressor Discharge Temperature Sensor (CPDS)
3) High Pressure Relief Valve (HPRV)
4) High Pressure Switch (HPS)
5) Gas Cooler Temperature Sensor (GCTS)
6) High Side Service Connection
7) Discharge Pressure Transducer (DPT)
8) Filter Drier
9) High Pressure Expansion Valve (HPXV)
10) Flash Tank
11) Flash Tank Pressure Relief Valve (FTPRV)
12) Flash Tank Pressure Transducer (FPT)
13) Economizer Solenoid Valve (ESV)
14) Unloader Solenoid Valve (USV)
15) Low Pressure Relief Valve (LPRV)
16) Low Side Service Connection
17) Suction Pressure Transducer (SPT)
18) Ambient Temperature Sensor (AMBS)
19) Supply Recorder Sensor (SRS)
20) Supply Temperature Sensor (STS)

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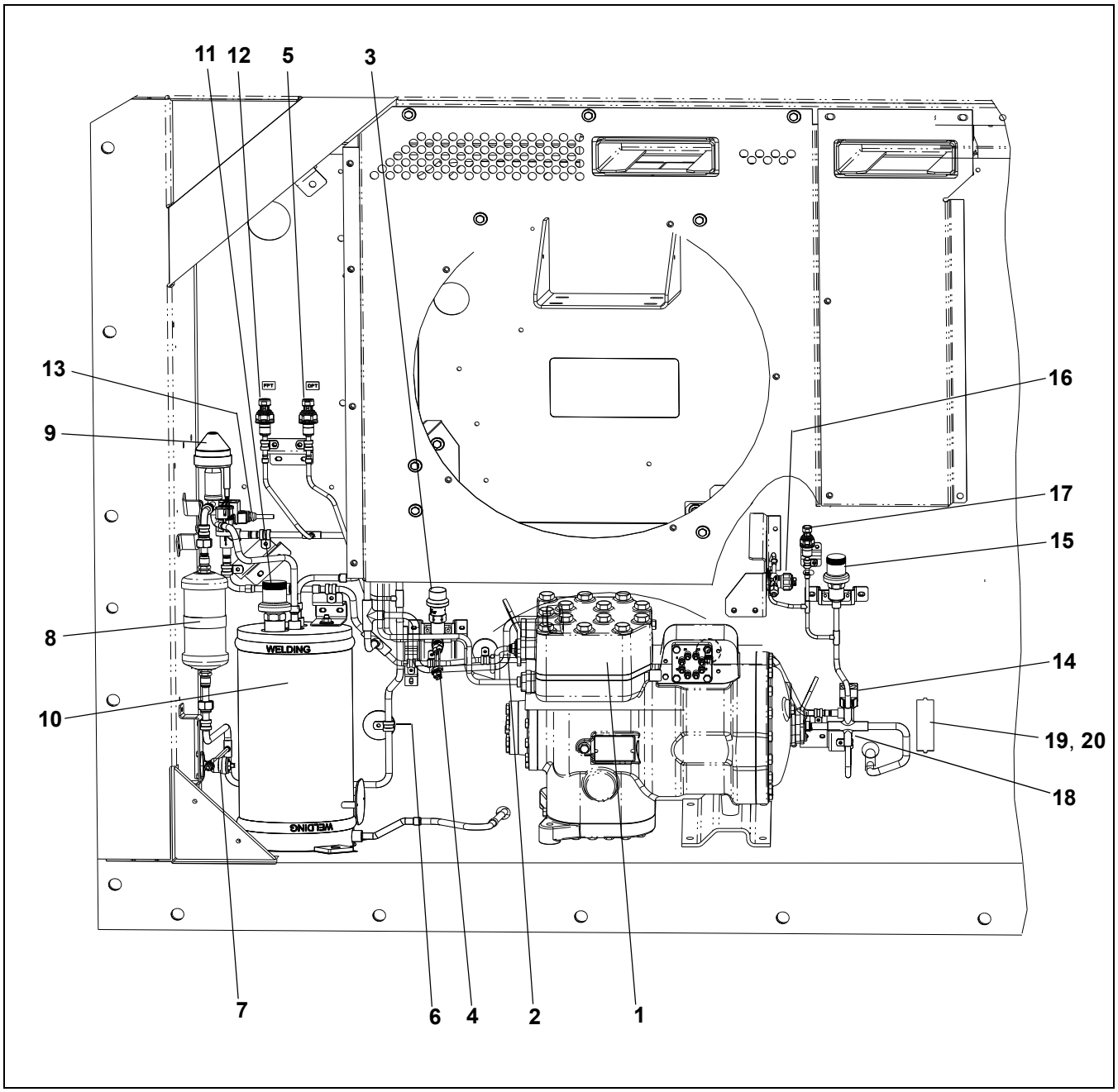
**Figure 3.4 Compressor and Flash Tank Section - PIDs NT5010 and higher**




1) Compressor
2) Compressor Discharge Temperature Sensor (CPDS)
3) High Pressure Relief Valve (HPRV)
4) High Pressure Switch (HPS)
5) Discharge Pressure Transducer (DPT)
6) Gas Cooler Temperature Sensor (GCTS)
7) High Side Service Connection
8) Filter Drier
9) High Pressure Expansion Valve (HPXV)
10) Flash Tank
11) Flash Tank Pressure Relief Valve (FTPRV)
12) Flash Tank Pressure Transducer (FPT)
13) Economizer Solenoid Valve (ESV)
14) Unloader Solenoid Valve (USV)
15) Low Pressure Relief Valve (LPRV)
16) Low Side Service Connection
17) Suction Pressure Transducer (SPT)
18) Ambient Temperature Sensor (AMBS)
19) Supply Recorder Sensor (SRS)
20) Supply Temperature Sensor (STS)

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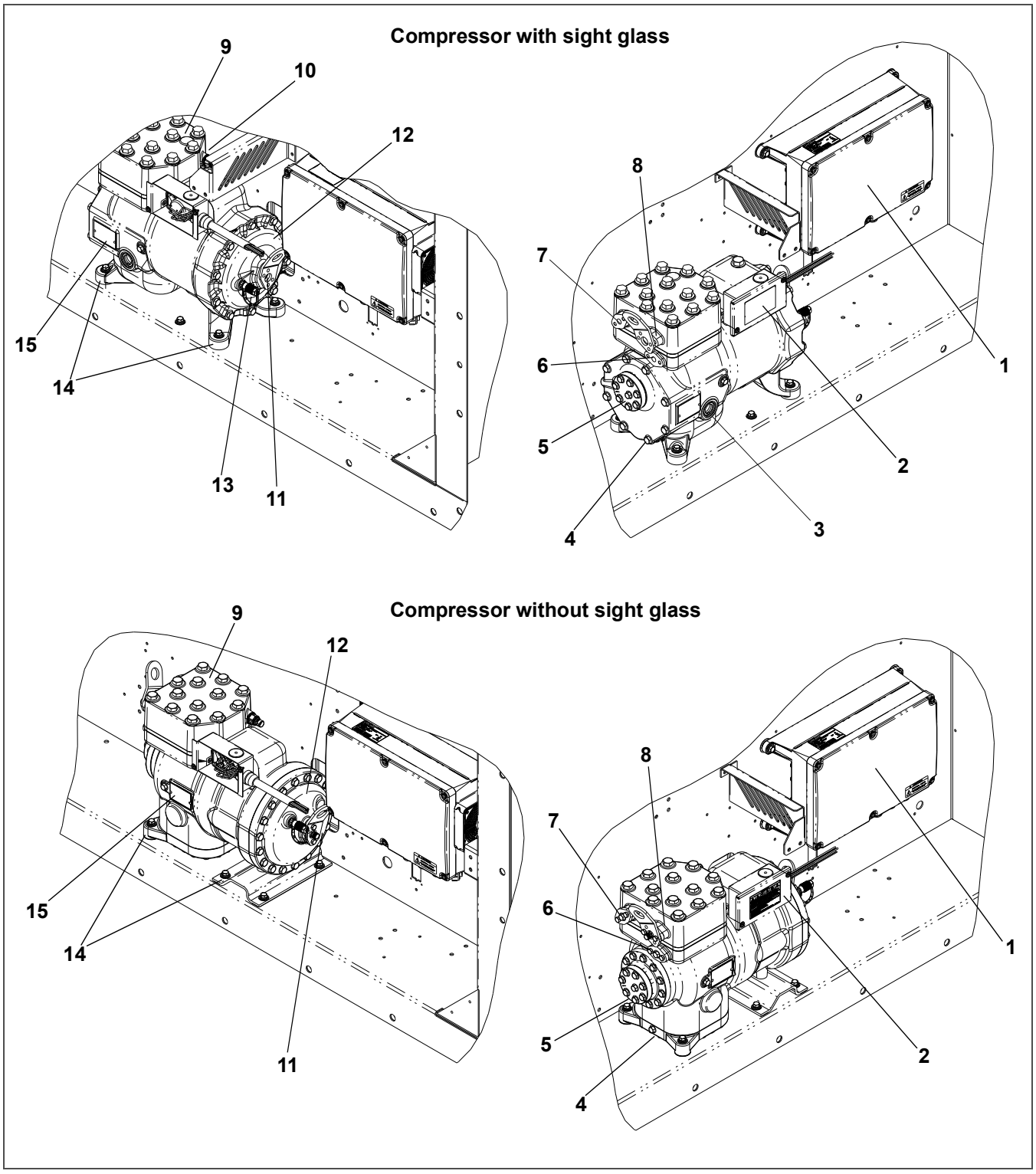
**Figure 3.5 Compressor Detail**




1) Variable Frequency Drive (VFD)
2) Compressor Terminal Box
3) Moisture Indicator / Sight Glass (if equipped)
4) Oil Drain Port
5) Oil Pump
6) First Stage Discharge Port / Flange
7) Second Stage Suction Port / Flange
8) Second Stage Discharge Port / Flange
9) Cylinder Head
10) Suction Pressure Transducer (SPT)
11) Suction Port / Flange
12) Compressor Motor End Cover
13) Service Connection, Suction
14) Compressor Mounting Bolts
15) Compressor Serial / Model Number Plate

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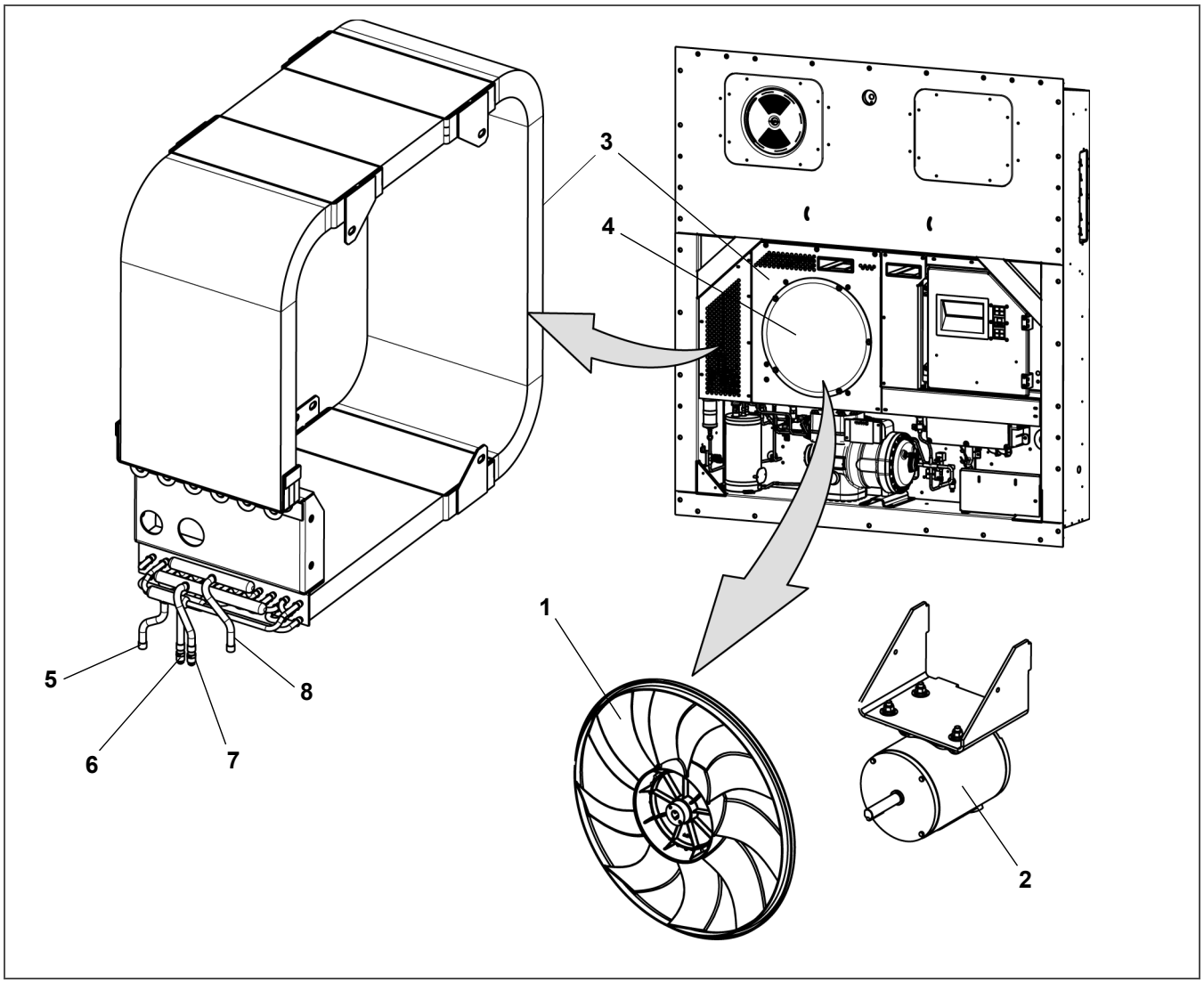
### 3.1.5 Gas Cooler / Intercooler

The gas cooler / intercooler coil acts as a heat exchanger in which compressed refrigerant gas from the compressor is lowered in temperature as it circulates through the coil tubes. The gas cooler / intercooler fan pulls external, ambient air through all four sides of the coil, heat from the refrigerant is transferred to the air, and then the warm air is discharged horizontally through the front of the fan grille.

**Figure 3.6 Gas Cooler / Intercooler**




1) Gas Cooler Fan
2) Gas Cooler Fan Motor
3) Gas Cooler Coil
4) Gas Cooler Coil Cover
5) Gas Cooler Inlet
6) Gas Cooler Outlet
7) Intercooler Inlet
8) Intercooler Outlet

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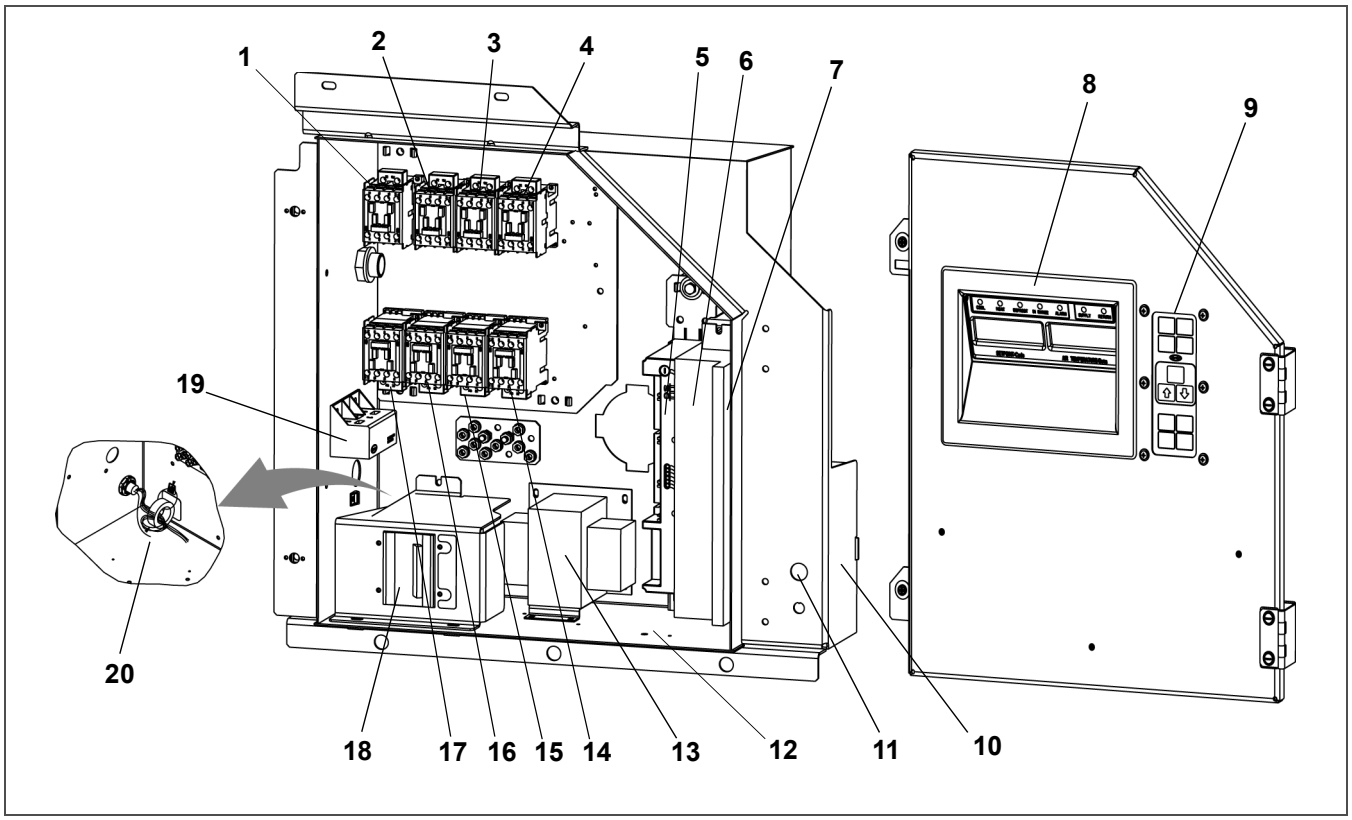
### 3.1.6 Control Box Section

**Figure 3.7 Control Box Section**




1) Compressor Contactor - CH
2) Phase A Contactor - PA
3) Phase B Contactor - PB
4) Heater Contactor - HR
5) Communications Interface Module
6) Controller / DataCORDER Module (Controller)
7) Variable Frequency Interface Module (VIM)
8) Display Module
9) Keypad
10) Controller Battery Pack standard location
11) Start - Stop Switch, ST
12) Interrogator Connector Box location
13) Control Transformer
14) High Speed Evap. Fan Contactor - EF
15) Low Speed Evap. Fan Contactor - ES
16) High Speed Gas Cooler Fan Contactor - GF
17) Low Speed Gas Cooler Fan Contactor - GS
18) Circuit Breaker (CB-1) - 25 Amps
19) Current Sensor Module
20) Ferrite Core

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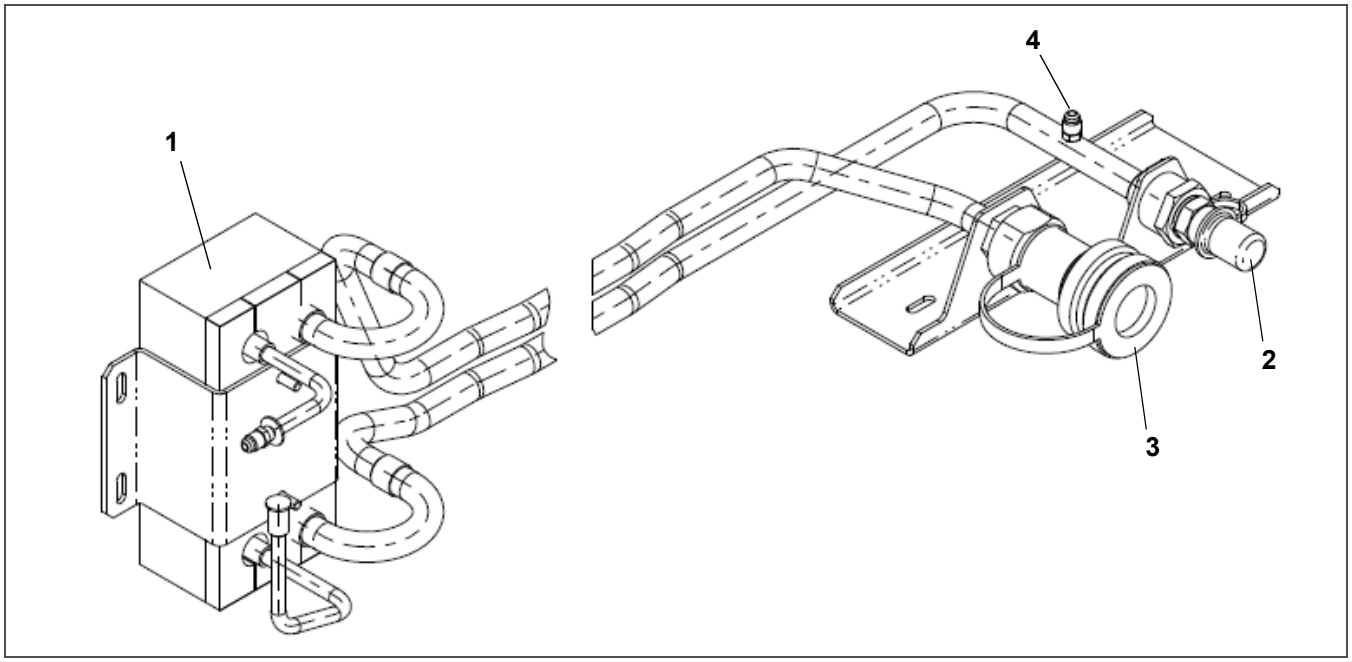
### 3.1.7 Communications Interface Module

The optional communications interface module (see **Figure 3.7**) is a slave module that allows communication with a master central monitoring station. The module will respond to communication and return information over the main power line. Refer to the master central monitoring station technical manual for additional information.

### 3.1.8 Water-Cooled Condenser Section

The water-cooled condenser section (**Figure 3.8**) consists of a water-cooled condenser, water couplings, and a water pressure switch.

**Figure 3.8 Water-Cooled Condenser**




1) Water-Cooled Condenser
2) Coupling (Water In)
3) Self Draining Coupling (Water Out)
4) Water Pressure Switch (WP)

- - - - -

## 3.2 Refrigeration System Data

| | | |
|---|---|---|
| **Compressor / Motor Assembly** | Weight (With Oil) | 158 kg (348 lb) |
| | Approved Oil | Carrier P/N 46-00025-06<br>Idemitsu FVC 100D |
| | Oil Charge | 2000 ml (67 ounces) |
| | Oil Sight Glass (Service Compressor Only) | The oil level range, while the unit operating, should be between 1/4 and 3/4 level of the sight glass. |
| **Electronic Expansion Valve Superheat (Evaporator)** | Variable | |
| **High Pressure Expansion Valve (HPXV)** | Variable | |
| **Heater Termination Thermostat (HTT)** | Opens | 54°(+/- 3) C = 130°(+/- 5) F |
| | Closes | 38°(+/- 4) C = 100°(+/- 7) F |
| **High Pressure Switch (HPS)** | Cut-Out | 138 (+7/-11) bar = 2000 (+100/-156) psig |
| | Cut-In | 99 (+/- 10) bar = 1430 (+/- 140) psig |

**⚠ CAUTION**

**Charge according to nameplate specifications to ensure optimal unit performance.**

| | | |
|---|---|---|
| **Refrigerant Charge - R-744** | **Unit Configuration** | **Charge Requirements** |
| | 99.9% pure $CO_2$ with maximum 10 ppm of water (AHRI 700) | For servicing, charge to 9.5 lbs / 4.31kg. Also refer to nameplate, see **Figure 2.2** |
| **Pressure Relief Valves - Set Pressure** | **PIDs lower than NT5010** | |
| | Opens, Low Side | 89.6 bar = 1300 psig |
| | Opens, Flash Tank | 108.2 bar = 1569 psig |
| | Opens, High Side | 150.9 bar = 2189 psig |
| | **PIDs NT5010 and higher** | |
| | Opens, Low Side | 89.6 bar = 1300 psig |
| | Opens, Flash Tank | 117.2 bar = 1700 psig |
| | Opens, High Side | 150.9 bar = 2189 psig |
| **Unit Weight** | Refer to nameplate, see **Figure 2.2** | |
| **Water Pressure Switch (WP)** | Cut-In | 0.5 ± 0.2 kg/cm$^3$ (7 ± 3 psig) |
| | Cut-Out | 1.6 ± 0.4 kg/cm$^3$ (22 ± 5 psig) |

## 3.3 Torque Requirements

| | | |
|---|---|---|
| **Pressure Relief Valves** | **PIDs lower than NT5010** | |
| | Low Side Pressure Relief Valve (LPRV) | 88.1-96.3 Nm (65-71 ft-lb) |
| | Flash Tank Pressure Relief Valve (FTPRV) | 29.8-32.5 Nm (22-24 ft-lb) |
| | High Side Pressure Relief Valve (HPRV) | 51.5-56.9 Nm (38-42 ft-lb) |
| | **PIDs NT5010 and higher** | |
| | Low Side Pressure Relief Valve (LPRV) | 77.3-85.4 Nm (57-63 ft-lb) |
| | Flash Tank Pressure Relief Valve (FTPRV) | 29.8-32.5 Nm (22-24 ft-lb) |
| | High Side Pressure Relief Valve (HPRV) | 51.5-56.9 Nm (38-42 ft-lb) |
| **Pressure Transducers** | **PIDs lower than NT5010** | |
| | Suction Pressure Transducer (SPT) | 25.7-28.5 Nm (19-21 ft-lb) |
| | Flash Tank Pressure Transducer (FPT) | 9.5-12.2 Nm (7-8 ft-lb) |
| | Discharge Pressure Transducer (DPT) | 9.5-12.2 Nm (7-8 ft-lb) |

| | | |
|---|---|---|
| **Service Fittings / Service Valves** | **PIDs lower than NT5010** | |
| | Suction Service Fitting | 25.7-28.5 Nm (19-21 ft-lb) |
| | Discharge Service Fitting | 9.5-12.2 Nm (7-8 ft-lb) |
| | **PIDs NT5010 and higher** | |
| | Suction or Discharge Service Valve | |
| | Top Cap | 10-14 Nm (7-10 ft-lb) |
| | Stem, Open | Max. 2 Nm (1.5 ft-lb) |
| | Stem, Closed | 6-8 Nm (4-6 ft-lb) |
| | Flare Cap | 10-14 Nm (7-10 ft-lb) |
| **Filter Drier** | Filter Drier | 18.4-22.1 Nm (25-30 ft-lb) |
| **Pressure Switch** | High Pressure Switch | 17.6-19 Nm (13-14 ft-lb) |
| **Bolts** | Compressor Flange Bolts | 35.3-38 Nm (26-28 ft-lb) |

## 3.4 Electrical System Data

| | | | |
|---|---|---|---|
| **Circuit Breaker** | CB-1 | 25 amps | |
| **Compressor Motor** | Full Load Amps (FLA) | 13 amps @ 460 VAC | |
| **Gas Cooler Fan Motor** | Nominal Supply | **380 VAC, 3 Phase, 50 Hz +/- 2.5% Hz** | **460 VAC, 3 Phase, 60 Hz +/- 2.5% Hz** |
| | Full Load Amps, High Speed | 1.10 amps | 1.20 amps |
| | Full Load Amps, Low Speed | 0.68 amps | 0.69 amps |
| | Horsepower, High Speed | 0.35 hp | 0.60 hp |
| | Horsepower, Low Speed | 0.04 hp | 0.06 hp |
| | RPM, High Speed | 1450 rpm | 1725 rpm |
| | RPM, Low Speed | 700 rpm | 825 rpm |
| | Voltage | 360 - 460 VAC | 400 - 500 VAC |
| | Bearing Lubrication | Factory lubricated, additional grease not required. | |
| | Rotation | Counter-clockwise when viewed from shaft end. | |
| **Evaporator Coil Heaters** | Number of Heaters | 6 | |
| | Rating | 750 watts +/- 5% each @ 230 VAC | |
| | Resistance (cold) | 72 ohms +/- 5% @ 20°C (68°F) | |
| | Type | Sheath | |

| | | | |
|---|---|---|---|
| **Evaporator Fan Motors** | Nominal Supply | **380 VAC, 3 Phase, 50 Hz +/- 2.5% Hz** | **460 VAC, 3 Phase, 60 Hz +/- 2.5% Hz** |
| | Full Load Amps High Speed | 1.07 | 0.9 |
| | Full Load Amps Low Speed | 0.47 | 0.47 |
| | Nominal Horsepower High Speed | 0.36 | 0.63 |
| | Nominal Horsepower Low Speed | 0.05 | 0.08 |
| | Rotations Per Minute High Speed | 2850 rpm | 3450 rpm |
| | Rotations Per Minute Low Speed | 1425 rpm | 1725 rpm |
| | Voltage | 360 - 460 VAC | 400 - 500 VAC |
| | Bearing Lubrication | Factory lubricated, additional grease not required | |
| | Rotation | CW when viewed from shaft end | |
| **Fuses** | Control Circuit | 7.5 amps (F3A, F3B) | |
| | Controller / DataCORDER | 5 amps (F1, F2) | |
| **Vent Position Sensor (VPS)** | Electrical Output | 0.5 VDC to 4.5 VDC over 90 degree range | |
| | Supply Voltage | 5 VDC +/- 10% | |
| | Supply Current | 5 mA (typical) | |
| **Solenoid Valve Coils (ESV/USV) 24 VAC** | Nominal Resistance @ 20° C (68°F) | 12.4 ohms +/- 5% | |
| | Maximum Current Draw | 0.7 amps | |
| **Electronic Expansion Valve (EEV)** | Nominal Resistance | 100 ohms A-B and C-D | |
| | Supply Voltage | 12 VDC +/- 10% | |
| **High Pressure Expansion Valve (HPXV)** | Nominal Resistance | 30 ohms from Ground / Common 1 to 2, 3, 4 and 5 on the KE plug | |
| | Supply Voltage | 12 VDC +/- 10% | |
| **Variable Frequency Drive (VFD)** | 460 Volts | Variable Frequency | |
| **Humidity Sensor (HS)** | Orange wire | Power | |
| | Red wire | Output | |
| | Brown wire | Ground | |
| | Input voltage | 5 VDC | |
| | Output voltage | 0 to 3.3 VDC | |
| | Output voltage readings verses relative humidity (RH) percentage: | | |
| | 30% | 0.99 V | |
| | 50% | 1.65 V | |
| | 70% | 2.31 V | |
| | 90% | 2.97 V | |
| **Controller** | Setpoint Range | -40 to +30°C (-40 to +86°F) | |

## 3.5 Safety and Protective Devices

Unit components are protected from damage by safety and protective devices listed in **Table 3–1**. These devices monitor the unit operating conditions and open a set of electrical contacts when an unsafe condition occurs.

Open safety switch contacts on either or both of devices IP-CP or HPS will shut down the compressor.

Open safety switch contacts on device IP-CM will shut down the Gas Cooler fan motor.

The entire refrigeration unit will shut down if one of the following safety devices open: (a) circuit breaker(s); (b) fuse (F3A / F3B, 7.5A); or (c) evaporator fan motor internal protector(s) - (IP).

**Table 3–1 Safety and Protective Devices**

| Unsafe Condition | Device | Device Setting |
|---|---|---|
| Excessive current draw | Circuit Breaker (CB-1) - Manual Reset | Trips at 25 amps (460 VAC) |
| Excessive current draw in the control circuit | Fuse (F3A & F3B) | 7.5 amp rating |
| Excessive current draw by the controller Fuse | Fuse (F1 & F2) | 5 amp rating |
| Excessive Gas Cooler fan motor winding temperature | Internal Protector (IP-CM) - Automatic Reset | N/A |
| Excessive compressor motor winding temperature | Internal Protector (IP-CP) - Automatic Reset | N/A |
| Excessive evaporator fan motor(s) winding temperature | Internal Protector(s) (IP-EM) - Automatic Reset | N/A |
| Abnormal pressures in the refrigerant system | Low Side PRV | 89.6 bar = 1300 psig |
| | Flash Tank PRV | 108.2 bar = 1569 psig |
| | High Side PRV | 150.9 bar = 2189 psig |
| Abnormally high discharge pressure | High Pressure Switch (HPS), Cut-Out | 138 (+7/-11) bar<br>= 2000 (+100/-156) psig |
| | High Pressure Switch (HPS), Cut-In | 99 (+/- 10) bar<br>= 1430 (+/- 140) psig |

## 3.6 Refrigeration Circuit

The NaturaLINE unit operates as a vapor compression refrigeration system using R-744 ($CO_2$) as the refrigerant. The main components of the system are a Reciprocating Compressor, Gas Cooler/Intercooler, High Pressure Expansion Valve (HPXV), Flash Tank, Electronic Expansion Valve (EEV), Economizer Solenoid Valve (ESV), Unloader Solenoid Valve (USV) and an Evaporator.

The refrigeration system operates in one of three modes; Standard, Unloaded, or Economized. At system start up, and during periods of low refrigeration load, the unit will operate in Unloaded Mode. This allows the microprocessor to place the system in operation at reduced capacity in order to measure the actual load. If the microprocessor determines that further capacity is required, such as periods of high load or pull down, the system will transition to Economized Mode. Standard Mode is used to maintain temperature during stable load conditions.

### 3.6.1 Standard Mode

At the compressor, the $CO_2$ refrigerant is drawn in at the suction port and compressed into a higher pressure, higher temperature gas. The compressed gas exits the first stage of the Compressor, enters the Intercooler, then returns back to the Compressor at the second stage suction port, where the gas is compressed to a higher pressure and higher temperature. The compressed gas then exits the Compressor at the discharge port and flows through the Gas Cooler. Discharge temperature of the refrigerant is continuously monitored by the Compressor Discharge Temperature Sensor (CPDS).

As refrigerant travels through the tubes in the Gas Cooler, ambient air flowing across the coil fins and tubes removes heat from the refrigerant gas. As heat from the refrigerant is transferred to the ambient air, the refrigerant gas cools and then passes through the Filter Drier. The Filter Drier ensures that the refrigerant is clean and dry.

The flow of refrigerant from the Filter Drier to the Flash Tank is regulated by the High Pressure Expansion Valve (HPXV). The HPXV is controlled by the operating software for optimal performance and efficiency. As the microprocessor receives temperature and pressure data, the HPXV stepper motor will open or close in order to control and maintain maximum system efficiency. As refrigerant flows through the variable orifice of the HPXV, the reduced pressure causes the refrigerant to flash (flash gas) while entering the Flash Tank. In the Flash Tank, vapor and liquid are separated.

The liquid refrigerant from the Flash Tank continues through the liquid line to the Electronic Expansion Valve (EEV). The EEV is used to control the superheat of the refrigerant leaving the Evaporator. As the microprocessor receives suction pressure and temperature data, the microprocessor transmits electronic pulses to the EEV stepper motor which opens or closes the variable valve orifice in order to control and maintain proper superheat. Superheat is controlled to ensure that liquid refrigerant never enters the compressor.

The liquid refrigerant flows through the Evaporator, absorbing heat from the return air as the return air flows across the fins and tubes of the Evaporator coil. As the liquid refrigerant in the Evaporator coil absorbs heat, the refrigerant vaporizes, and the vapor flows through the suction port back to the compressor.

### 3.6.2 First Stage Discharge Port & Suction Port

The high pressure, high temperature refrigerant that is discharged from the first stage discharge port flows directly to the Intercooler section of the Gas Cooler / Intercooler. As the refrigerant travels through the tubes in the Intercooler, ambient air flowing across the coil fins and tubes removes heat, cooling but not condensing the gas. The refrigerant leaving the Intercooler flows to three locations: the check valve (where it is stopped), the Unloader Solenoid Valve (USV) (which is normally closed in Standard and Economized Mode), and to the mid-stage suction port where refrigerant returns to the Compressor.

### 3.6.3 Unloaded Mode

During system start up and periods of low cooling load, the unit will operate in Unloaded Mode to conserve energy. In Unloaded Mode, the normally closed USV opens. While in Unloaded Mode, a portion of the refrigerant leaving the Intercooler is redirected to the suction port, back to the Compressor. The remaining portion of the refrigerant leaving the Intercooler continues to the second stage suction port. To further reduce cooling, the Variable Frequency Drive (VFD) may reduce Compressor speed.

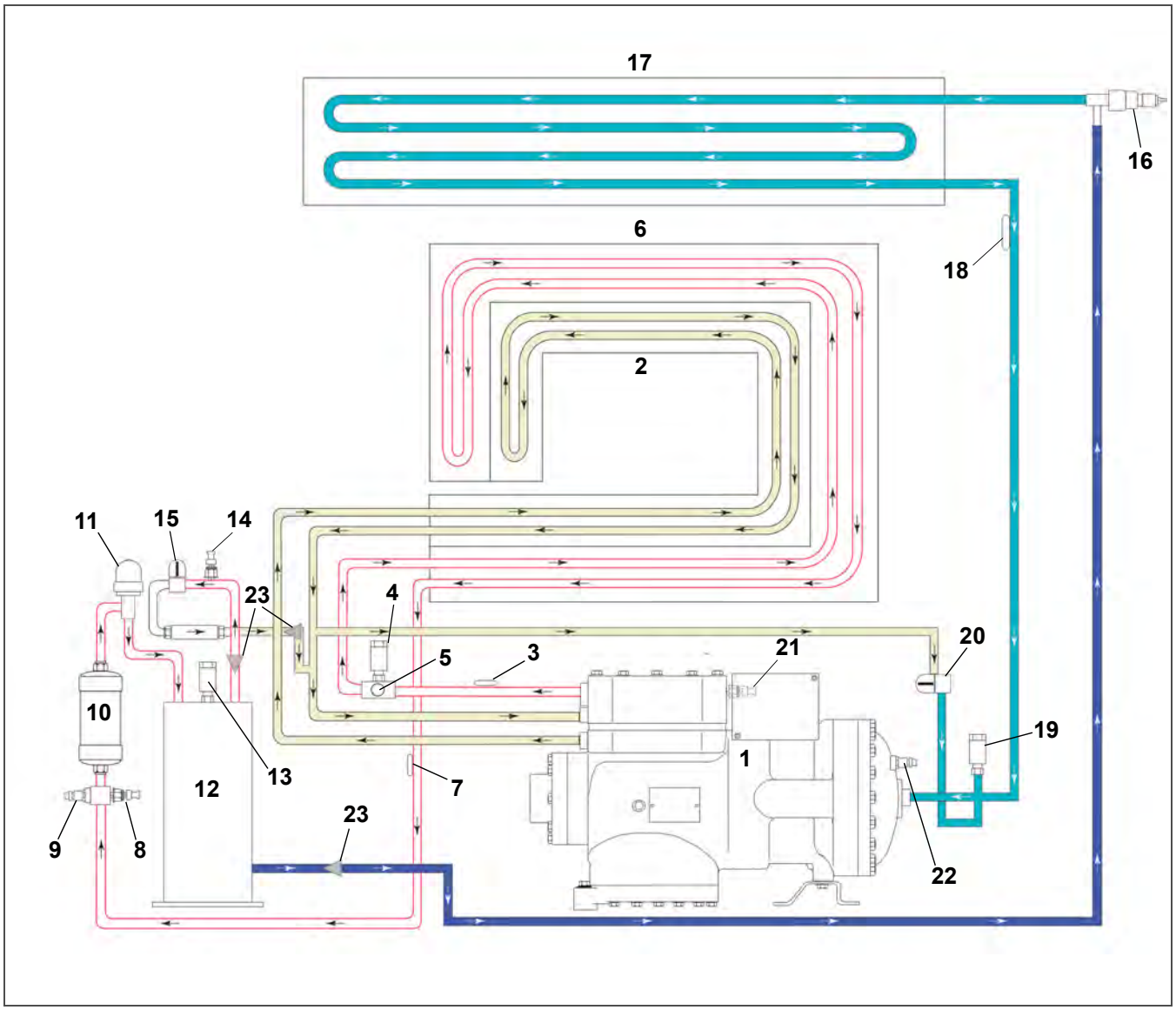
### 3.6.4 Economized Mode

In Economized Mode, the main refrigeration system operates the same as in Standard Mode, except the microprocessor energizes (opens) the Economizer Solenoid Valve (ESV). When the ESV is open, frozen and pull down capacity of the unit is increased by allowing refrigerant vapor to flow from the Flash Tank through the check valve, and to the mid-stage suction port where the refrigerant returns to the Compressor. During Economized Mode, the USV will remained closed.

### 3.6.5 Electronic Expansion Valve (EEV)

The microprocessor controls the superheat of refrigerant leaving the evaporator by opening and closing the variable orifice in the EEV. The microprocessor transmits electronic pulses to the EEV stepper motor, which opens or closes the valve orifice to maintain superheat. EEV control is based on inputs from the Suction Pressure Transducer (SPT) and the Evaporator Temperature Sensor (ETS).

**Figure 3.9 Refrigeration Circuit Schematic - PIDs lower than NT5010**




1) Compressor
2) Intercooler
3) Compressor Discharge Temperature Sensor (CPDS)
4) High Pressure Relief Valve (HPRV)
5) High Pressure Safety Switch (HPS)
6) Gas Cooler
7) Gas Cooler Temperature Sensor (GCTS)
8) Discharge Pressure Transducer (DPT)
9) High Side Service Fitting
10) Filter Drier
11) High Pressure Expansion Valve (HPXV)
12) Flash Tank
13) Flash Tank Pressure Relief Valve (FTPRV)
14) Flash Tank Pressure Transducer (FPT)
15) Economizer Solenoid Valve (ESV)
16) Electronic Expansion Valve (EEV)
17) Evaporator
18) Evaporator Temperature Sensor (ETS)
19) Low Pressure Relief Valve (LPRV)
20) Unloader Solenoid Valve (USV)
21) Suction Pressure Transducer (SPT), located on back of compressor
22) Low Side Service Fitting
23) Filter Screens

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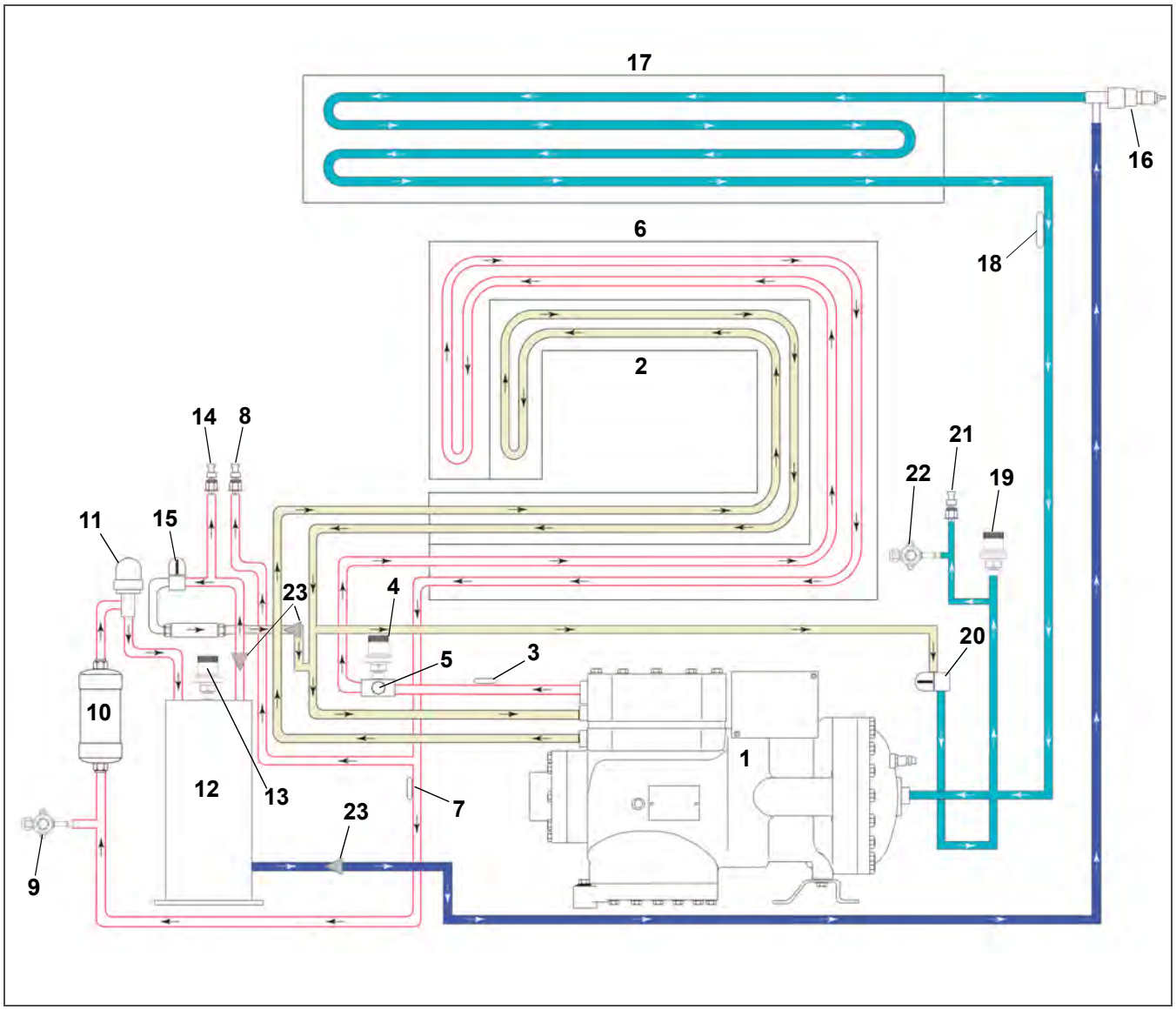
**Figure 3.10 Refrigeration Circuit Schematic - PIDs NT5010 and higher**




1) Compressor
2) Intercooler
3) Compressor Discharge Temperature Sensor (CPDS)
4) High Pressure Relief Valve (HPRV)
5) High Pressure Safety Switch (HPS)
6) Gas Cooler
7) Gas Cooler Temperature Sensor (GCTS)
8) Discharge Pressure Transducer (DPT)
9) High Side Service Valve
10) Filter Drier
11) High Pressure Expansion Valve (HPXV)
12) Flash Tank
13) Flash Tank Pressure Relief Valve (FTPRV)
14) Flash Tank Pressure Transducer (FPT)
15) Economizer Solenoid Valve (ESV)
16) Electronic Expansion Valve (EEV)
17) Evaporator
18) Evaporator Temperature Sensor (ETS)
19) Low Pressure Relief Valve (LPRV)
20) Unloader Solenoid Valve (USV)
21) Suction Pressure Transducer (SPT)
22) Low Side Service Valve
23) Filter Screens

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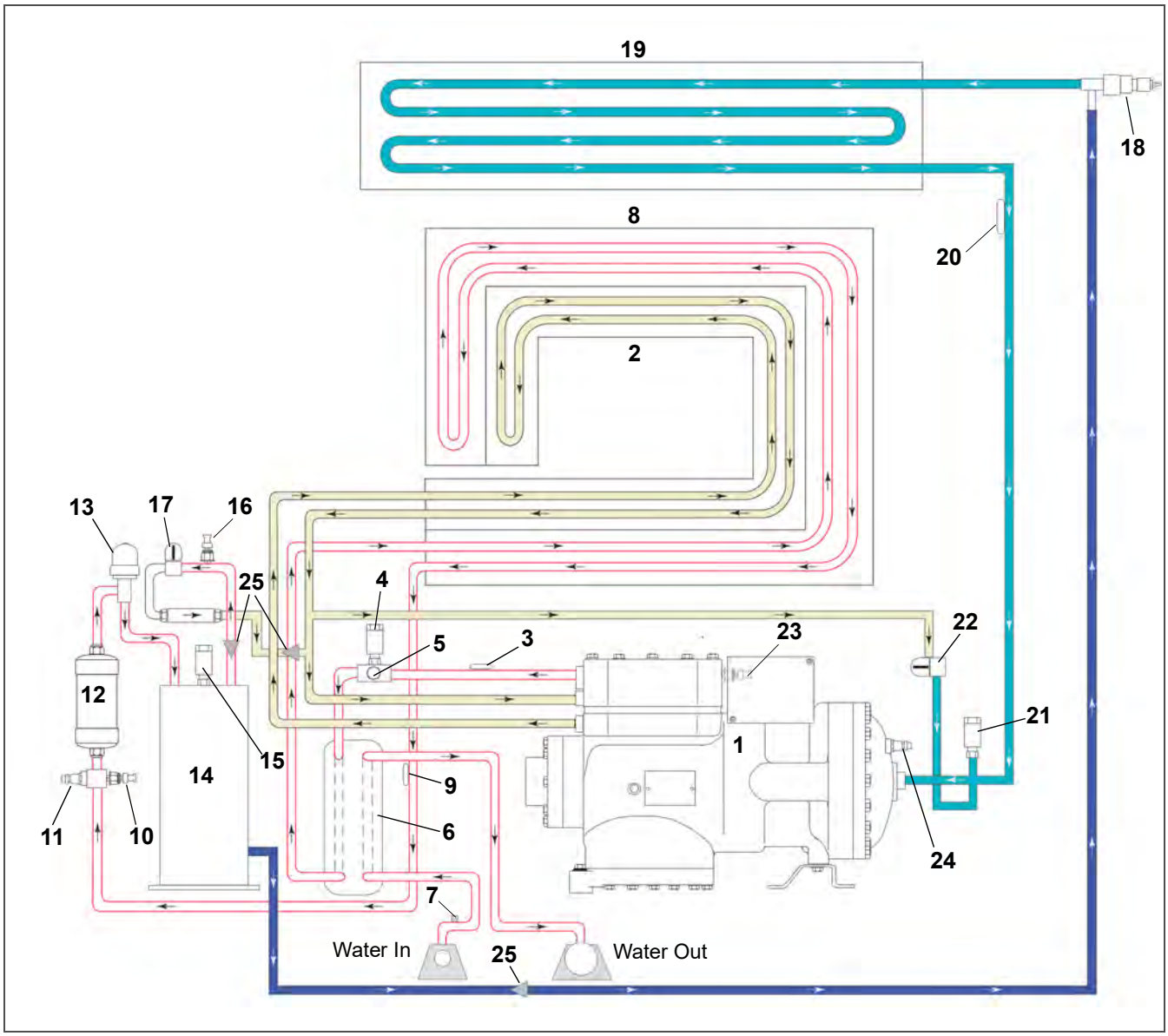
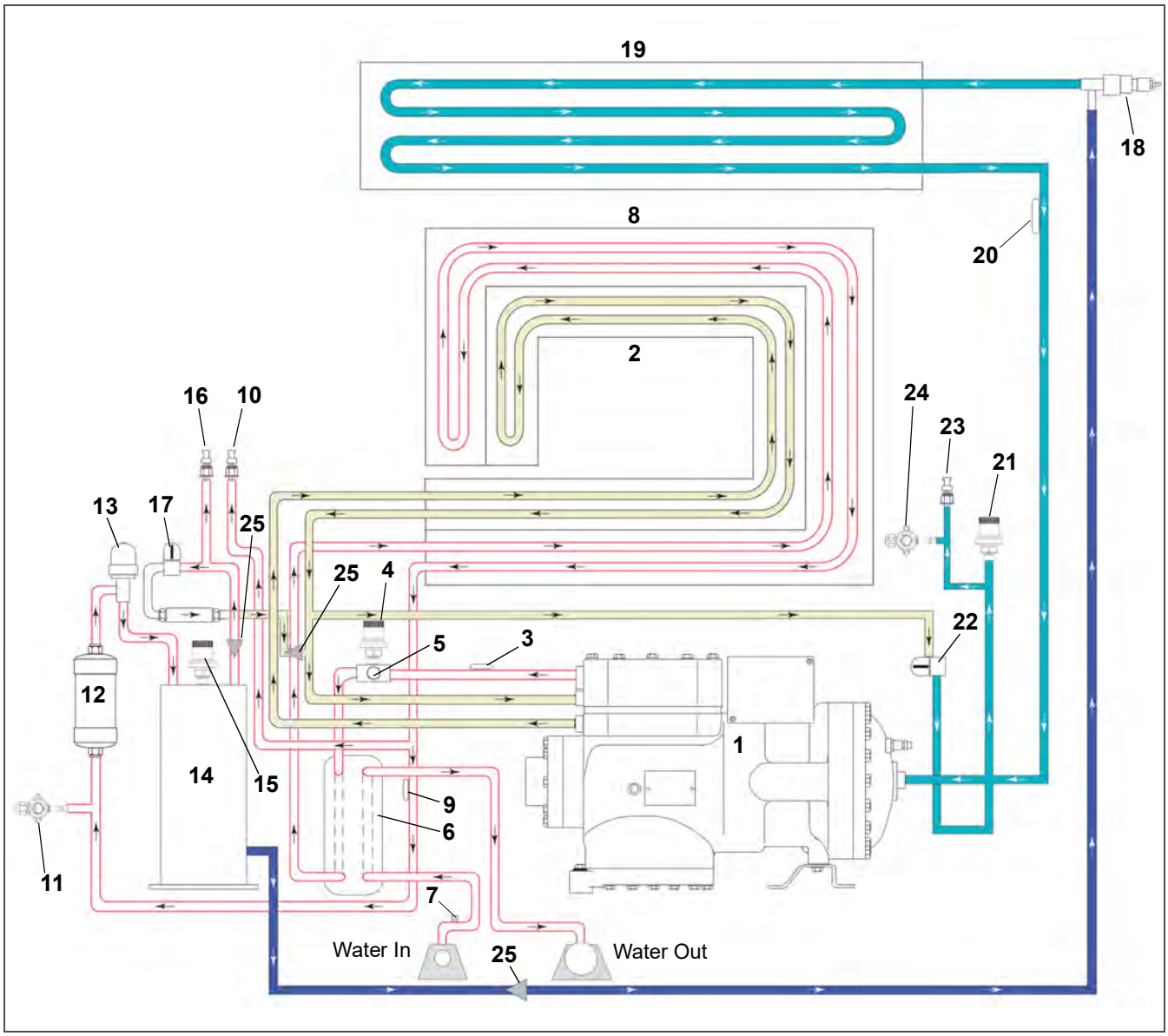
**Figure 3.11 Refrigeration Circuit Schematic (WCC) - PIDs lower than NT5010**




1) Compressor
2) Intercooler
3) Compressor Discharge Temperature Sensor (CPDS)
4) High Side Pressure Relief Valve (HPRV)
5) High Pressure Safety Switch (HPS)
6) Water Cooled Condenser (WCC)
7) Water Pressure Switch (WPS)
8) Gas Cooler
9) Gas Cooler Temperature Sensor (GCTS)
10) Discharge Pressure Transducer (DPT)
11) High Side Service Fitting
12) Filter Drier
13) High Pressure Expansion Valve (HPXV)
14) Flash Tank
15) Flash Tank Pressure Relief Valve (FTPRV)
16) Flash Tank Pressure Transducer (FPT)
17) Economizer Solenoid Valve (ESV)
18) Electronic Expansion Valve (EEV)
19) Evaporator
20) Evaporator Temperature Sensor (ETS)
21) Low Side Pressure Relief Valve (LPRV)
22) Unloader Solenoid Valve (USV)
23) Suction Pressure Transducer (SPT)
24) Low Side Service Fitting
25) Filter Screens

- - - - -

**Figure 3.12 Refrigeration Circuit Schematic (WCC) - PIDs NT5010 and higher**




1) Compressor
2) Intercooler
3) Compressor Discharge Temperature Sensor (CPDS)
4) High Side Pressure Relief Valve (HPRV)
5) High Pressure Safety Switch (HPS)
6) Water Cooled Condenser (WCC)
7) Water Pressure Switch (WPS)
8) Gas Cooler
9) Gas Cooler Temperature Sensor (GCTS)
10) Discharge Pressure Transducer (DPT)
11) High Side Service Valve
12) Filter Drier
13) High Pressure Expansion Valve (HPXV)
14) Flash Tank
15) Flash Tank Pressure Relief Valve (FTPRV)
16) Flash Tank Pressure Transducer (FPT)
17) Economizer Solenoid Valve (ESV)
18) Electronic Expansion Valve (EEV)
19) Evaporator
20) Evaporator Temperature Sensor (ETS)
21) Low Side Pressure Relief Valve (LPRV)
22) Unloader Solenoid Valve (USV)
23) Suction Pressure Transducer (SPT)
24) Low Side Service Valve
25) Filter Screens

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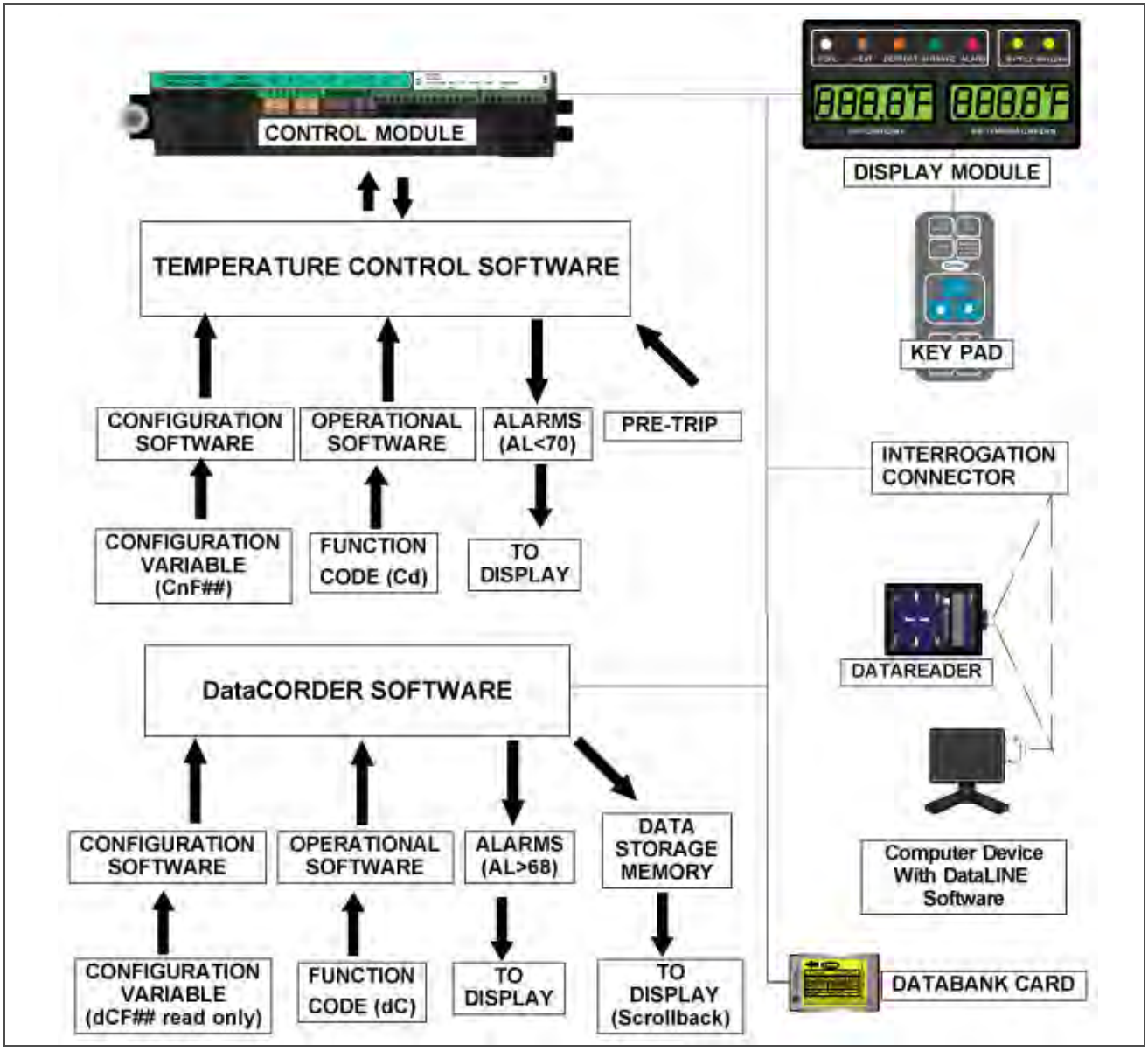
# SECTION 4
# MICROPROCESSOR

## 4.1 Temperature Control Microprocessor System

The temperature control Micro-Link 3 microprocessor system (see **Figure 4.1**) consists of a keypad, display module, the control module (controller) and interconnecting wiring. The controller houses the temperature control software and the DataCORDER software. The temperature control software functions to operate the unit components as required to provide the desired cargo temperature and humidity. The DataCORDER software functions to record unit operating parameters and cargo temperature parameters for future retrieval. Coverage of the temperature control software begins with **Section 4.2**. Coverage of the DataCORDER software is provided in **Section 4.7**.

**Figure 4.1 Temperature Control System**




### 4.1.1 Display Module and Keypad

The display module and keypad serve to provide user access and readouts for both of the controller functions, temperature control and DataCORDER. The functions are accessed by keypad selections and viewed on the display module.

The display module (see **Figure 4.2**) consists of two 5-digit displays and seven indicator lights. Descriptions of the indicator lights are provided in **Figure 4–1**. The keypad (see **Figure 4.3**) consists of eleven push button switches that act as the user's interface with the controller. Description of the switch functions are provided in **Figure 4–2**.

**Figure 4.2 Display Module**

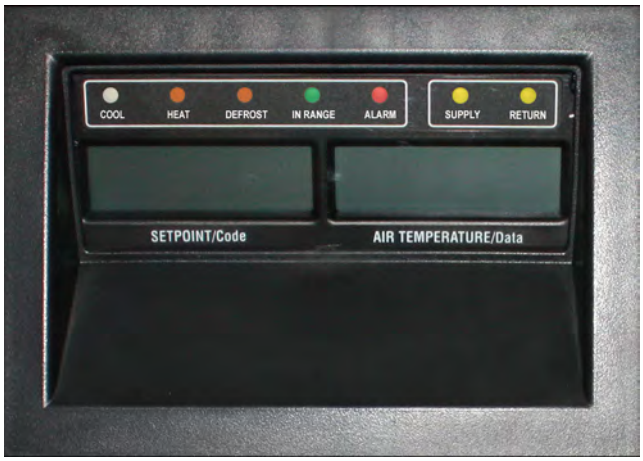



**Figure 4.3 Keypad**

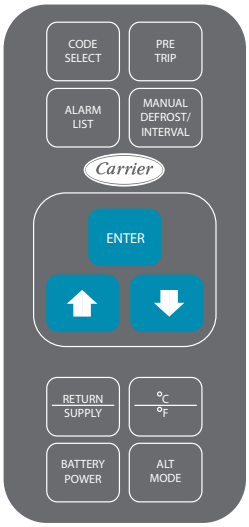



**Table 4–1 Display Module LEDs**

| Light | Function |
|---|---|
| COOL (White / Blue) | Energized when the refrigerant compressor is energized. |
| HEAT (Orange) | Energized to indicate heater operation in heat mode, defrost mode, or dehumidification. |
| DEFROST (Orange) | Energized when the unit is in defrost mode. |
| IN RANGE (Green) | Energized when the controlled temperature probe is within specified tolerance of setpoint. The controlling probe in perishable range is the SUPPLY air probe and in frozen range is the RETURN air probe. |
| SUPPLY (Yellow) | Energized when the supply air probe is used for control. When this LED is illuminated, the temperature displayed in the AIR TEMPERATURE display is the reading at the supply air probe. This LED will flash if dehumidification or humidification is enabled. |
| RETURN (Yellow) | Energized when the return air probe is used for control. When this LED is illuminated, the temperature displayed in the AIR TEMPERATURE display is the reading at the return air probe. |
| ALARM (Red) | Energized when an active or inactive shutdown alarm is in the alarm queue. |

**Table 4–2 Keypad Function**

| Key | Function |
|---|---|
| CODE SELECT | Access function codes. |
| PRE-TRIP | Display Pre-trip selection menu. Discontinue Pre-trip in progress. |
| ALARM LIST | Display alarm list and clear alarm queue. |
| MANUAL DEFROST / INTERVAL | Display selected defrost mode. Press and hold this key for five seconds to initiate defrost using same logic as if the optional manual defrost switch was toggled on. |
| ENTER | Confirm a selection or save a selection to the controller. |
| Arrow Up | Change or scroll a selection up. Pre-trip advance or test interrupt. |
| Arrow Down | Change or scroll selection down. Pre-trip repeat backward. |
| RETURN / SUPPLY | Display non-controlling probe temperature (momentary display). |
| °C / °F | Display alternate english / metric scale (momentary display). When set to F, pressure is displayed in psig and vacuum in “/hg.” “P” appears after the value to indicate psig and “i” appears for inches of mercury. When set to C, pressure readings are in bars. “b” appears after the value to indicate bars. |
| BATTERY POWER | Initiate battery backup mode to allow setpoint & function code selection if AC power is not connected. |
| ALT MODE | Switch the functions from temperature software to DataCORDER software. The remaining keys function the same as described above except the readings or changes are made to the DataCORDER programming. |

### 4.1.2 Controller

**⚠ CAUTION**

**Do not remove wire harnesses from controller modules unless you are grounded to the unit frame with a static safe wrist strap.**

**⚠ CAUTION**

**Unplug all controller module wire harness connectors before performing arc welding on any part of the container.**

**⚠ CAUTION**

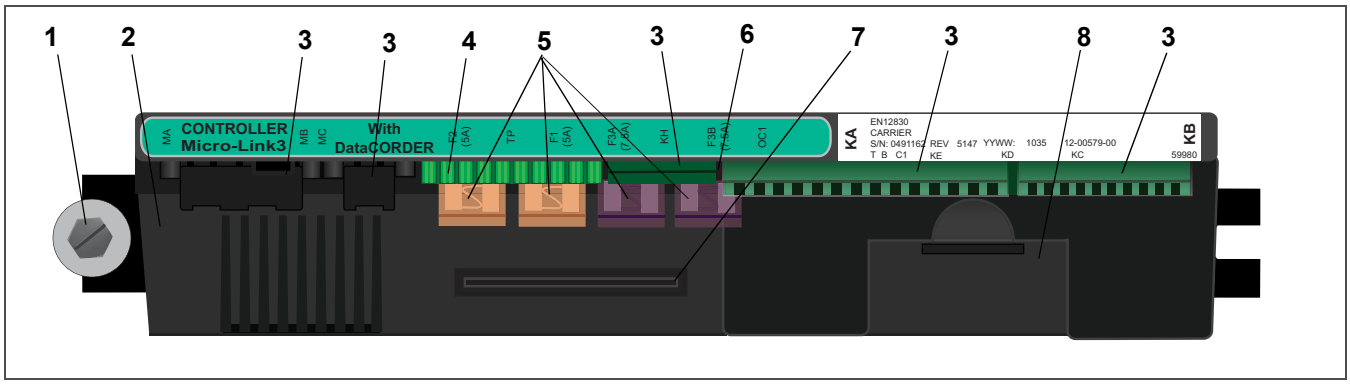
**Do not attempt to use an ML2i PC card in an ML3 equipped unit. The PC cards are physically different and will result in damage to the controller.**

**NOTICE**

**Do not attempt to service the controller modules. Breaking the seal will void the warranty.**

The Micro-Link 3 controller is a dual module microprocessor as shown in **Figure 4.4**. It is fitted with test points, harness connectors and a software card programming port.

**Figure 4.4 Control Module**




1) Mounting Screw
2) Micro-Link 3 Control/DataCORDER Module
3) Connectors
4) Test Points
5) Fuses
6) Control Circuit Power Connection
7) Software / Programming Slot
8) Battery Pack (Standard Location)

- - - - -

## 4.2 Controller Software

The controller software is a custom designed program that is subdivided into configuration software and operational software. The controller software performs the following functions:

- Control supply or return air temperature to required limits, provide modulated refrigeration operation, economized operation, unloaded operation, electric heat control and defrost. Defrost is performed to clear buildup of frost and ice in order to ensure proper air flow across the evaporator coil.
- Provide default independent readouts of setpoint and supply or return air temperatures.
- Provide ability to read and (if applicable) modify the configuration software variables (CnF, see **Table 4–6**), operating software function codes (Cd, see **Table 4–7**) and alarm code (AL, see **Table 4–8**) indications.
- Provide a Pre-trip step by step checkout of refrigeration unit performance including: proper component operation, electronic and refrigeration control operation, heater operation, probe calibration, pressure limiting and current limiting settings. See **Section 4.12**.
- Provide battery-powered ability to access or change selected codes and setpoint without AC power connected.
- Provide the ability to reprogram the software through the use of a memory card.

### 4.2.1 Configuration Variables (CnF)

The configuration software is a variable listing of the components available for use by the operational software. This software is factory installed in accordance with the equipment fitted and options listed on the original purchase order. Changes to the configuration software are required only when a new controller has been installed or a physical change has been made to the unit such as the addition or removal of an option. A configuration variable list is provided in **Table 4–6**. Change to the factory-installed configuration software is achieved via a configuration card or by communications.

### 4.2.2 Operational Software (Cd Function Codes)

The operational software is the actual operation programming of the controller which activates or deactivates components in accordance with current unit operating conditions and operator selected modes of operation.

The programming is divided into function codes. Some of the codes are read only while the remaining codes may be user configured. The value of the user configurable codes can be assigned in accordance with user desired mode of operation. A list of the function codes is provided in **Table 4–7**.

To access the function codes, perform the following:

1. Press the CODE SELECT key, then press an Arrow key until the left window displays the desired code.
2. The right window will display the value of this code for five seconds before returning to normal display mode.
3. If a longer time is desired, press the ENTER key to extend the time to five minutes.

## 4.3 Controller Sequence And Modes Of Operation

**NOTICE**

**Compressor Contactor is always ON. The compressor speed is determined by specific operating conditions then the Micro will send commands to the Variable Frequency Drive.**

General operation sequences for cooling, heating and defrost are provided in the following sub-paragraphs. Schematic representation of controller action is provided in **Figure 4.5**.

The operational software responds to various inputs. These inputs come from the temperature and pressure sensors, the temperature setpoint, the settings of the configuration variables and the function code assignments. The action taken by the operational software will change if any one of the inputs change. Overall interaction of the inputs is described as a “mode” of operation. The modes of operation include perishable (chill) mode and frozen mode. Descriptions of the controller interaction and modes of operation are provided in the following sub paragraphs.

### 4.3.1 System Start Up

At start up, the controller logic checks for proper phase sequencing and compressor rotation. If incorrect sequencing is causing the compressor and three-phase evaporator and condenser fan motors to rotate in the wrong direction, the controller will energize or de-energize relay TCP as required (see **Figure 8.2**). Relay TCP will switch its contacts, energizing or de-energizing relays PA and PB. Relay PA is wired to energize the circuits on L1, L2 and L3. Relay PB is wired to energize the circuits on L3, L2, and L1, thus providing reverse rotation.

Upon start up, valves are opened to allow for equalization of system pressures. As the start up procedure transitions to control mode, the evaporator and gas cooler fans cycle on, the Economizer Solenoid Valve (ESV) will energize, and the compressor and Variable Frequency Drive (VFD) ramp up.

During normal operation of the refrigeration system, system pressures and suction superheat are controlled by predetermined algorithms within the software. Temperature control is maintained by VFD speed and cycling of the gas cooler fan (high / low / off).

### 4.3.2 Perishable Mode Temperature Control

**NOTICE**

**In the Standard Perishable Mode of Operation, the evaporator fan motors run in high speed.**

In Perishable Mode, the yellow SUPPLY indicator light is illuminated on the display module, the default reading on the display window reflects the Supply Temperature Sensor (STS) reading, and the controller maintains supply air temperature to setpoint. When supply air temperature reaches the In-Range Tolerance (Cd30), the green IN RANGE light will energize.

The unit will be in Perishable Mode whenever setpoint is higher than -10°C (+14°F) [-5°C (+23°F) depends upon the CnF26 (Heat Lockout Change Option) setting].

When operating in Perishable Mode, the microprocessor continuously controls the system in an effort to maintain supply air temperature within the perishable limit of +/-0.25°C. In Perishable Mode, capacity reduction controls may be implemented to ensure that the refrigeration system (compressor) does not shut down. Capacity reduction measures include modulation of the Gas Cooler Fan speed (high, low, off), closing of the ESV, opening of the USV, and VFD speed reduction. After all of the capacity reduction measures have been implemented, if the temperature continues to fall below the control limit, the unit will turn off the refrigeration circuit (compressor) and run with evaporator fans only. If the temperature continues to fall below setpoint, the unit will engage the heaters to maintain temperature within the control band.

### 4.3.3 Perishable Mode Cooling - Sequence of Operation

a. When the supply air temperature is above setpoint and decreasing, the unit will energize the compressor contactor (CH), gas cooler fan motor / (GF), Economizer Solenoid Valve (ESV), evaporator fan motors (EM) / high speed contactor (EF), and the white COOL light is energized. If pressure limiting is not active, the controller will close contacts TS to open the Economizer Solenoid Valve (ESV), placing the unit in economized operation.

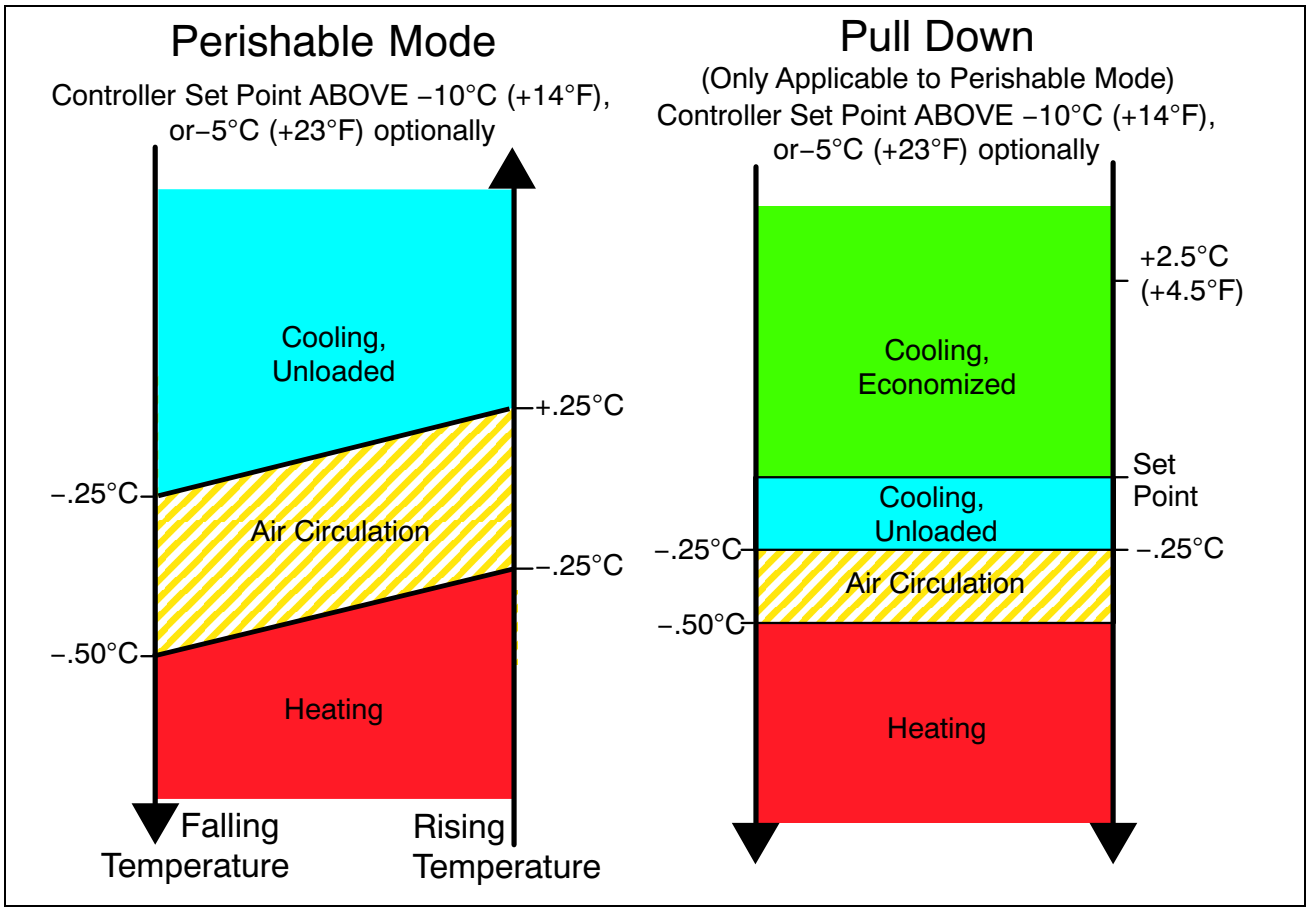
b. When the supply air temperature decreases to a predetermined tolerance (Cd30) above setpoint, the green IN RANGE light is energized.

c. As the supply air temperature continues to fall, VFD speed reduction will reduce compressor speed, and the ESV will be closed, taking the system out of economized operation. As supply air temperature approaches setpoint, the controller will cycle the gas cooler fan on/off.

d. As the controller continuously monitors supply air temperature, calculations are performed to determine temperature drift from setpoint over time. If the calculations determine that cooling is no longer required, the compressor will cycle off, and the white COOL light is de-energized.

e. Evaporator fan motors will continue to operate in order to circulate air throughout the container. The green IN RANGE light will remain energized as long as the supply air temperature is maintained within tolerance of setpoint.

**Figure 4.5 Controller Operation - Perishable Mode**




### 4.3.4 Perishable Mode Heating - Sequence of Operation

a. If the supply air temperature falls to 0.5°C (0.9°F) below setpoint, the system will enter Perishable Mode Heating (see **Figure 4.5**). The controller will close contacts TH to allow power to flow through the Heat Termination Thermostat (HTT) to energize the Heater Contactor (HR). The orange HEAT light will be energized, and the evaporator fans will continue to operate in order to circulate heated air throughout the container.

b. When the supply temperature rises to 0.25°C (0.45°F) below setpoint, contacts TH open to de-energize the heaters. The orange HEAT light will be de-energized, and the evaporator fans continue to operate in order to circulate air throughout the container.

c. If supply rises to 54°C (130°F), the Heat Termination Thermostat (HTT) will open and de-energize HR. HTT is mounted to the evaporator center tube sheet.

### 4.3.5 Perishable Mode Dehumidification

Perishable Mode Dehumidification is activated to reduce humidity levels inside the container. The dehumidification setpoint is entered using function code Cd33, Humidity Setpoint. When dehumidification is active, the controller will energize the Heater Contactor (HR), and the yellow SUPPLY light will flash ON and OFF every second. In order for dehumidification to be activated, the following conditions must be satisfied:

- The Humidity Sensor (HS) reading is above the Humidity Setpoint, Cd33.
- The unit is in Perishable Steady State mode and supply air temperature is less than 0.25°C (0.45°F) above setpoint.
- The Heater Debounce Timer has timed out (five minutes).
- The High Pressure Switch (HPS) is not open.
- The Heat Termination Thermostat (HTT) is closed.

If the above conditions are true, the evaporator fans will switch from high speed to low speed; evaporator fan speed will switch every hour thereafter as long as all conditions are maintained. If any condition except item (1) becomes false OR if the relative humidity sensed is 2% below the humidity setpoint, the high speed evaporator fans will be energized.

During dehumidification, power is applied to the heaters; this added heat causes the controller to force the evaporator temperature down in order to compensate for the increased load. The low coil temperature chills the return air (below dew point), causing excess moisture to condensate on the coil. The water that is collected from the coil is drained out of the system through the drain pan. The air is then reheated to setpoint, and the dehumidified supply air is sent back to the container.

When the relative humidity sensed is 2% below the humidity setpoint, the controller will de-energize the heat relay, however the controller will continue to cycle heating, when required, to maintain relative humidity below the selected setpoint. If the dehumidification is terminated by a condition other than the sensed humidity level, e.g., an out-of-range or compressor shutdown condition, the Heater Contactor (HR) is de-energized immediately.

To prevent rapid cycling and consequent Heater Contactor (HR) wear, two timers are activated during dehumidification mode:

1. Heater Debounce Timer (five minutes) - The Heater Debounce Timer is started whenever the Heater Contactor (HR) status is changed. The HR remains energized (or de-energized) for at least five minutes even if the setpoint criteria are satisfied.
2. Out-of-Range Timer (five minutes) - The out-of-range timer is started to maintain heater operation for dehumidification during a temporary temperature out-of-range condition. If the supply air temperature remains out of range for more than five minutes, the heaters will be de-energized to allow the system to recover. The out-of-range timer starts as soon as the temperature exceeds the in-range tolerance value set by function code Cd30.

### 4.3.6 Perishable Dehumidification - Bulb Mode

Bulb mode is an extension of dehumidification which allows changes to the evaporator fan speed and/or defrost termination setpoints.

Bulb mode is active when Cd35 is set to “Bulb.” Once bulb mode is activated, the user may then change dehumidification evaporator fan operation from the default to constant low or constant high speed. This is done by toggling Cd36 from its default of “alt” to “Lo” or “Hi” as desired. If low speed evaporator fan operation is selected, this gives the user the additional capability of selecting dehumidification setpoints from 60 to 95%.

In addition, if bulb mode is active, Cd37 may be set to override the previous defrost termination thermostat (DTT) settings. The temperature at which the DTT will be considered “open” may be changed [in 0.1°C (0.2°F) increments] to any value between 25.6°C (78°F) and 4°C (39.2°F). The temperature at which the DTT is considered closed for interval timer start or demand defrost is 10°C for “open” values from 25.6°C (78°F) down to a 10°C setting. For “open” values lower than 10°C, the “closed” values will decrease to the same value as the “open” setting. Bulb mode is terminated when:

1. Bulb mode code Cd35 is set to “Nor.”
2. Dehumidification code Cd33 is set to “Off.”
3. The user changes the setpoint to one that is in the frozen range.

When bulb mode is disabled by any of the above conditions, evaporator fan operation for dehumidification reverts to “alt” and the DTS termination setting resets to the value determined by CnF41.

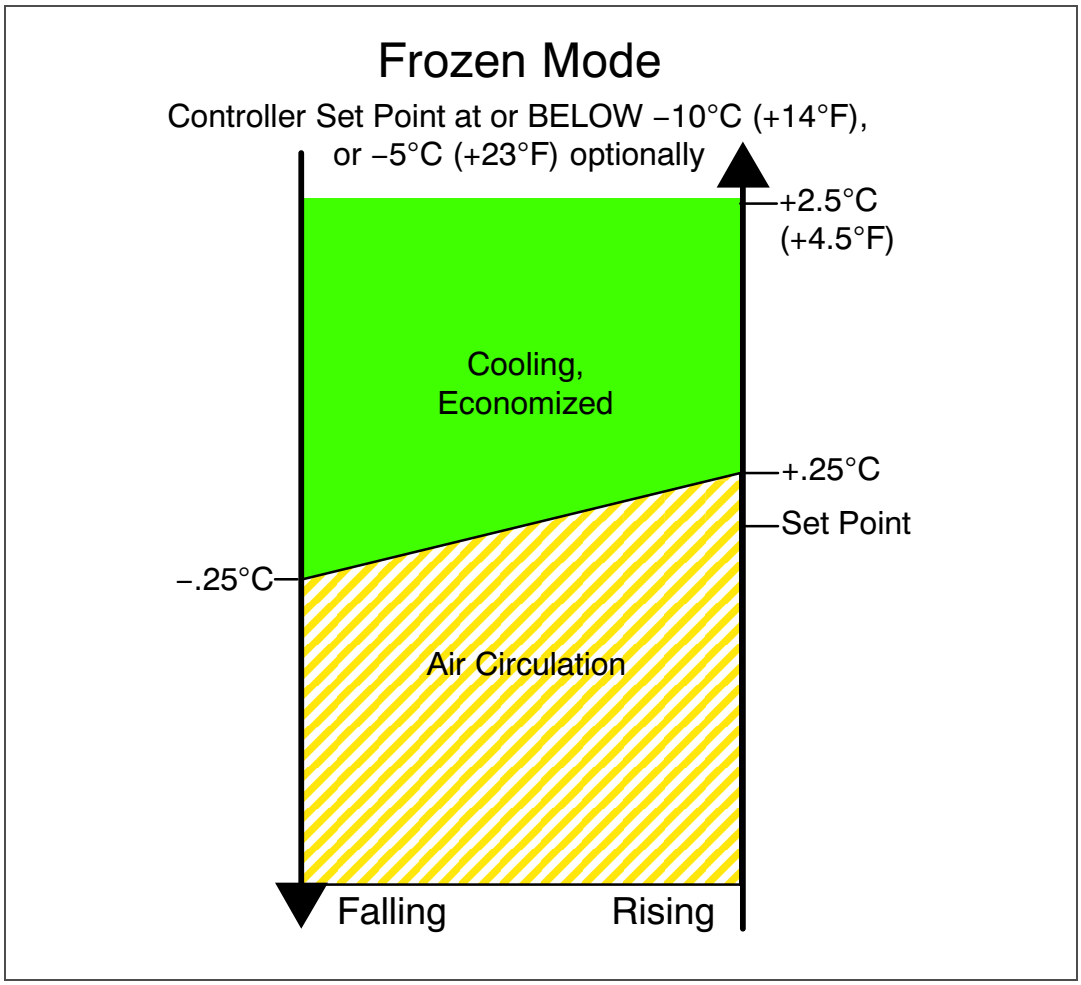
### 4.3.7 Frozen Mode Temperature Control

When configuration variable CnF26 (Heat Lockout Change Option) is set to -10C, Frozen Mode is active with setpoints at or below -10°C (+14°F). When CnF26 is set to -5°C, Frozen Mode is active at or below -5°C (+23°F).

In Frozen Mode, the yellow RETURN indicator light is energized, the default reading on the display window reflects the Return Temperature Sensor (RTS) reading, and the controller maintains return air temperature to setpoint. When return air temperature reaches the In-Range Tolerance (Cd30) the green IN RANGE light will energize.

When operating in Frozen Mode additional controls are applied to the Evaporator Fans and VFD Speed. If temperature is above the setpoint plus the control band, the VFD will operate at maximum allowable speed. As the control temperature approaches setpoint, the compressor speed will be reduced to maintain temperature to within -0.2°C (0.36°F) of setpoint. If the temperature should continue to fall, the system will turn off the refrigeration circuit and operate with evaporator fans at low speed only.

**Figure 4.6 Controller Operation - Frozen Mode**




### 4.3.8 Frozen Mode Cooling - Sequence of Operation

Unit will be in Frozen Mode whenever setpoint is at or lower than -10°C (+14°F) or -5°C (+23°F) depending upon the CnF26 (Heat Lockout Change Option) setting.

a. When the return air temperature is above setpoint and decreasing, the unit will energize the compressor contactor (CH), the gas cooler fan motor (GM), the gas cooler high speed contactor (GF), the evaporator fan motors (EM), the evaporator low speed contactor (ES), and the Economizer Solenoid Valve (ESV). The white COOL light is also energized.

b. When return air temperature decreases to a predetermined tolerance above setpoint, the green IN RANGE light is energized.

c. When the return air temperature decreases to a predetermined point below setpoint, the controller will set the VFD to 0%, and de-energize the gas cooler fan motor (GM), the gas cooler high speed contactor (GF), and Economizer Solenoid Valve (ESV). The white COOL light is also de-energized.

d. The evaporator fan motors continue to run in low speed to circulate air throughout the container. The green IN RANGE light remains energized as long as the return air is within tolerance of setpoint.

e. If return air temperature drops to 10°C (18°F) or more below setpoint, the evaporator high speed contactor (EF) energizes to increase fans to high speed to initiate Frozen Mode “heating”.

f. When the return air temperature increases to 0.25°C (0.45°F) above setpoint and three minutes have elapsed, the controller will return to the frozen cooling mode.

### 4.3.9 Defrost

Defrost is initiated to remove ice buildup from the evaporator coil which can obstruct air flow and reduce the cooling capacity of the unit. The defrost cycle may consist of up to three distinct operations depending upon the reason for the defrost or model number configuration. The first is de-icing of the coil, the second is defrost due to a probe check cycle and the third is a snap freeze process based on the unit model configuration.

- De-icing the coil consists of removing power to the cooling components (compressor, evaporator fans, and condenser fan), closing the EEV, and turning on the heaters, which are located below the evaporator coil. During normal operation, de-icing will continue until temperatures indicate that the ice on the coil has been removed, proper air flow has been restored, and the unit is ready to control temperature efficiently.
- If defrost was initiated by the probe check logic, then the Probe Check is carried out after the completion of the defrost cycle. A Probe Check is initiated only when there is an inaccuracy between the controller temperature sensors.
- Snap Freeze allows the system to cool for a period of time after de-icing, with the evaporator fans turned off and is only carried out if configured by model number. Snap-Freeze allows for the removal of latent de-icing heat from the evaporator coils, and freezes any remaining moisture that might otherwise be blown into the container.

For more information on Probe Check, see **Section 5.8**.

### 4.3.10 Defrost Operation

Initiation of defrost is dependent on the state of the Defrost Temperature Sensor (DTS). When the DTS senses a temperature less than 10°C (50°F), the defrost options become active and the timer is engaged for the initiation of the defrost cycle. The defrost time accumulates when the compressor is running. In the perishable mode, this is the same as real time as the compressor in general runs continuously. In frozen mode, the actual time necessary to count down to the next defrost will exceed the defrost interval depending on the compressor duty-cycle.

When the defrost mode is in the active state, defrost can be initiated when any one of the following additional conditions become true:

1. **Manually:** Press and hold the MANUAL DEFROST / INTERVAL key for 5 seconds.
2. **Timer:** The Defrost Interval Timer reaches the user selectable Interval. The user-selected intervals are 3, 6, 9, 12, 24 Hours, Off, AUTO, or Pulse; factory default is AUTO. Refer to Defrost Interval setting on the Trip Settings screen.
    a. Automatic defrost starts with an initial defrost at three hours and then adjusts the interval to the next defrost based on the accumulation of ice on the evaporator coil. Following a start-up or after termination of defrost, the time will not begin counting down until the DTS reading falls below 10°C (50°F). If the reading of DTS rises above termination setting any time during the timer count down, the interval is reset and the countdown starts over. The Auto defrost time is reset to three hours start time after every PTI initiation or trip start interval.
    b. Fan Pulsing Logic is used to help prevent ice formation in the drain gutter and drain cup and ice buildup in supply air channel by using the evaporator fans to blow the warm air onto these areas during unit defrost. When cooling at lower setpoints, evaporator fan pulsing can be used during Defrost / De-ice when the “Pulse” option is selected for the Defrost Interval setting on the Trip Settings screen. When enabled, evaporator fan pulsing will occur based on the unit temperature setpoint and the Evap Fan Pulsing Temp setting on the Trip Settings screen. QUEST II also pulses the evaporator fans during Defrost/De-ice within a narrow perishable setpoint range. The logic for each evaporator fan pulsing feature is described below.
    c. After a new Defrost Interval is selected, the previously selected Interval is used until the next defrost termination, the next time the DTS contacts are OPEN, or the next time power to the control is interrupted. If the previous value or the new value is “OFF”, the newly selected value will be used immediately.
3. **Probe Check:** If defrost is initiated due to Probe Check immediately following the defrost cycle the evaporation fans are started and run for eight minutes to stabilize the temperature throughout the container. A probe check comparison is carried out at the end of the eight minute period if any sensor is found out of calibration. At this time its alarm set is no longer used for control/reorder purposes.
4. **Delta T Logic:** If the difference between return and supply air temperature (Delta T) becomes too great indicating possible reduced airflow over the evaporator coil caused by ice buildup requiring a defrost.

a. In Perishable Pull Down - Delta T increases to greater than 12°C, and 90 minutes of compressor run time have been recorded.

b. In Perishable Steady State - A baseline Delta T is recorded following the first defrost cycle after steady state conditions are reached, (the unit is cooling, and the evaporator fans and heaters must remain in a stable state for a period of five minutes). Defrost will be initiated if Delta T increases to greater than 4°C above the baseline, and 90 minutes of compressor run time have been recorded.

c. In Frozen Mode - Defrost will be initiated if Delta T increases to greater than 16°C and 90 minutes of compressor run time have been recorded.

When defrost is initiated, the controller closes the EEV, opens contacts TC, TN and TE (or TV) to de-energize the compressor, condenser fan and evaporator fans.

The controller then closes contacts TH to supply power to the heaters. The orange DEFROST light and heat light are illuminated and the COOL light is also de-energized.

The EEV and DUV are independently operated by the microprocessor. Complete schematics and legends are located in Section 9.

Defrost will terminate when the DTS reading rises above one of two model number configurable options selection, either an upper setting of 25.6°C (78°F) which is default or lower setting of 18°C (64°F). When the DTS reading rises to the configured setting, the de-icing operation is terminated.

### 4.3.11 Defrost Related Settings

**DTS Failure**

When the return air temperature falls to 7°C (45°F), the controller ensures that the defrost temperature sensor (DTS) reading has dropped to 10°C or below. If it has not, it indicates a failed DTS. A DTS failure alarm is triggered and the defrost mode is operated by the Return Temperature Sensor (RTS). Defrost will terminate after 1 hour.

If the DTS fails to reach is termination setting, the defrost terminate after 2 hours of operation.

**Defrost Timer**

If CnF23 is configured to “SAv” (save), then the value of the defrost interval timer will be saved at power down and restored at power up. This option prevents short power interruptions from resetting an almost expired defrost interval, and possibly delaying a needed defrost cycle. If the save option is not selected the defrost timer will re-initiate and begin recounting.

If CnF11 is model number configured to OFF the operator will be allowed to choose “OFF” as a defrost interval option.

If CnF64 is configured in the operator will be allowed to choose “PuLS” as a defrost interval option. For units operating with “PuLS” selected, defrost interval is determined by the unit temperature setpoint and the Evap Fan Pulsing Temp setting on the Trip Settings screen. When the unit temperature setpoint is equal to or less than the Evaporator Fan Pulsing Temperature Setting, the defrost interval is set to 6 hours. Otherwise, the defrost interval is determined using the Automatic Defrost Interval Determination logic. In either case, “PuLS” remains displayed in this function select code.

If any Auto Pretrip sequence is initiated, the Defrost Interval setting will be set to “AUTO” unless CnF49 (OEM Reset) is set to “Custom” AND CnF64 (Evaporator Fan Pulsing Logic) configuration variable is set to IN, in which case the Defrost Interval setting on the Trip Settings screen will be set to “Pulse”.

If defrost does not terminate correctly and temperature reaches the setpoint of the Heat Termination Thermostat (HTT) 54°C (130°F), the HTT will open to de-energize the heaters (AL059 & AL060). If the HTT does not open and termination does not occur within two hours, the controller will terminate defrost. AL060 will be activated to inform of a possible DTS failure.

## 4.4 Protection Modes Of Operation

### 4.4.1 Evaporator Fan Operation

Opening of an evaporator fan internal protector will shut down the unit.

### 4.4.2 Failure Action, Cd29

Function code Cd29 may be operator set to select action the controller will take upon system failure. The factory default is full system shutdown. See **Table 4–7**.

### 4.4.3 Generator Protection

Function codes Cd31(Stagger Start, Offset Time) and Cd32 (Current Limit) may be operator set to control the start up sequence of multiple units and operating current draw. The factory default allows on demand starting (no delay) of units and normal current draw. See **Table 4–7**.

### 4.4.4 Compressor High Temperature, Low Pressure Protection

The controller monitors the temperatures and pressures within the system. If pressure or temperatures rise above or below the allowed limit, the compressor will be cycled off and all system valves will be moved to preset positions. The gas cooler fan will continue to run for 30 seconds. After 3 minutes the temperature and pressures will be checked, if they have returned to allowable values the unit will restart according to normal control algorithm. The controller will continue to monitor these limits. If they continue to trip, the controller will adjust the off time in order to allow for unit stabilization.

### 4.4.5 Compressor Internal Protector (IP)

The reciprocating compressor internal protector (IP) is a thermal switch that is integrated into the 24 volt circuit. When the internal temperature of the compressor gets too high, the thermal switch (IP), which is embedded in the compressor motor windings, opens. This causes a break in the 24 volt circuit which de-energizes the compressor contactor (CH) and removes power to the compressor. When the microprocessor senses the open circuit AL24 is triggered on.

Once the compressor internal temperature falls below the setpoint, the thermal switch (IP) closes and restores the 24 volt circuit. This closes the compressor contactor (CH), restores power to the compressor, and AL24 is triggered off.

## 4.5 Controller Alarms

Alarm display is an independent controller software function. If an operating parameter is outside of expected range or a component does not return the correct signals back to the controller, an alarm is generated. A listing of the alarms is provided in **Table 4–8**.

The alarm philosophy balances the protection of the refrigeration unit and that of the refrigerated cargo. The action taken when an error is detected always considers the survival of the cargo. Rechecks are made to confirm that an error actually exists.

Some alarms requiring compressor shutdown have time delays before and after to try to keep the compressor on line. An example is alarm code “LO,” (low main voltage), when a voltage drop of over 25% occurs, an indication is given on the display, but the unit will continue to run.

When an Alarm Occurs:

- The red ALARM light will energize for critical alarm code numbers 20, 21, 22, 23, 24, 25, 26, and 27.
- If a detectable problem exists, its alarm code will be alternately displayed with the setpoint on the left display.
- The user should scroll through the alarm list to determine what alarms exist or have existed. Alarms must be diagnosed and corrected before the alarm list can be cleared.

### 4.5.1 Displaying Alarm Codes

1. While in the Default Display mode, press the ALARM LIST key. This accesses the Alarm List Display Mode, which displays any alarms archived in the alarm queue.
2. The alarm queue stores up to 16 alarms in the sequence in which they occurred. The user may scroll through the list by pressing an Arrow key.
3. The left display will show “AL##,” where ## is the alarm number sequentially in the queue.
4. The right display will show the actual alarm code. “AA##” will display for an active alarm, where “##” is the alarm code. Or “IA##” will display for an inactive alarm, see **Table 4–8**.
5. “END” is displayed to indicate the end of the alarm list if any alarms are active.
6. “CLEAr” is displayed if all alarms are inactive. The alarm queue may then be cleared by pressing the ENTER key. The alarm list will clear and “-----” will be displayed.

**NOTICE**

**AL26 is active when all of the sensors are not responding. Check the connector at the back of the controller; if it is loose or unplugged, reconnect it, then run a Pre-trip test P5 to clear AL26.**

## 4.6 Pre-Trip Diagnostics

Pre-trip Diagnostics is an independent mode that suspends normal Control Mode activities to verify system functionality by running a series of individual tests. The tests can be run in Auto Mode, which automatically performs a pre programmed sequence of tests, or Manual Mode, which allows the operator to select and run any of the tests individually.

A description of each individual Pre-trip test can be found in **Section 4.12**. Detailed operating instructions are provided in **Section 5.7**.

**⚠ CAUTION**

**Pre-trip diagnostics should not be performed with critical temperature cargoes in the container.**

**⚠ CAUTION**

**When PRE-TRIP key is pressed, economy, dehumidification and bulb mode will be deactivated. At the completion of Pre-trip activity, economy, dehumidification and bulb mode must be reactivated.**

Pre-trip testing is initiated by pressing the PRE-TRIP key. This causes “SeLCt PrtrP” to be displayed for five seconds or until an Arrow key is pressed. Pressing an Arrow key opens the test selection menu. Scroll through the menu with the Arrow keys and then press the ENTER key to start the indicated test sequence or individual test.

Selecting “P rSLts” and pressing the ENTER key displays the results of all Pre-trip sub-tests. The results are displayed as “PASS” or “FAIL” for all tests run to completion since power on, and displayed as “-----” for tests not run.

During selection mode, failure to press either an Arrow key or ENTER key for 5 seconds will return the system to its default display, and normal operating mode.

There are two Auto Mode test sequences:

- **Short Pre-trip Sequence** tests most functions, sensors, and system components. The Short Sequence does not test the high pressure switch, heater performance, or cooling performance, due to their duration.
- **Long Pre-trip Sequence** includes all of the Short Sequence Tests, as well as tests for the high pressure switch, heater performance, and cooling performance. The Long Sequence is only available if enabled by configuration. Units configured for the Long Sequence can run either the Short Sequence or the Long Sequence.

Manual Mode allows individual Pre-trip tests to be run one at a time, giving operators the ability to test individual system components.

Pre-trip diagnostics may also be initiated via communication; however individual Manual Mode tests can only be initiated at the keypad.

While a Pre-trip test is running, PX-X will be displayed on the left, where the X’s indicate the test number and sub-test. The right display will show a countdown timer in minutes and seconds. During the Long Sequence, various relevant temperature and pressure information will replace the countdown timer on the right display.

### 4.6.1 Auto Test Operation from Keypad

When a Pre-trip auto test is initiated, the system executes a series of individual tests without any need for operator interface (except P0-0 where the proper functioning of the display must be observed). Each individual Pre-trip test varies in length, depending on the component being tested.

When the auto or auto1 testing is allowed to run to completion, without operator interruption, the system will exit Pre-trip mode and return to normal control operation. When the auto2 or auto3 test series is selected, and runs uninterrupted to successful completion, the unit will turn off all machinery, display either “AUtO2” “end” or “AUtO3” “end”, and wait for an ENTER key press before returning to normal control operation.

If an individual test fails, the test will be repeated once automatically from the beginning of the current Pre-trip test (not sub-test). An exception to this is with Long Sequence sub-tests P8-0 and P10-0. If either one of these sub-tests fails they will not be automatically repeated; failure of sub-tests P8-1, P8-2, P10-1 and P10-2 will cause automatic repeat. Repeated failure of a test will cause “FAIL” to be shown on the right display, with the corresponding test number to the left, and the SUPPLY and RETURN LED’s will be flashed alternately. Pressing the Down Arrow key will repeat the test, pressing the Up Arrow key will skip to the next test. The system will wait indefinitely for operator input. Holding the PRE-TRIP key will terminate Pre-trip mode operation. This is true for both auto2 and auto3 tests (auto3 does not include P10).

### 4.6.2 Manual Test Operation

Individually selected Pre-trip tests, other than the LED / Display test (P0-0), allow the operator to verify the functionality of an individual component. At the conclusion of the selected test, “PASS” or “FAIL” will be displayed. Upon failure, the SUPPLY and RETURN LED’s will flash on alternately. This message will remain displayed for up to three minutes, in which time the operator may select another test. If three minutes expires, the system will terminate Pre-trip and return to control mode operation. Following any individually selected Pre-trip test, all outputs will be de-energized.

### 4.6.3 Auto Test Operation from Serial Communications

Pre-trip may also be initiated via communications. The operation is the same as for the Auto Test mode except that if a test fails, Pre-trip mode will automatically terminate. When initiated via communications, a test may not be interrupted with an Arrow key, but Pre-trip mode can be terminated with the PRE-TRIP key.

### 4.6.4 Terminating Pre-trip

A Pre-trip test can be terminated by pressing and holding the PRE-TRIP key for 1 to 2 seconds. The system will then resume normal operation. Any Pre-trip test may be interrupted by pressing the Up Arrow key. This will return the operator to the test selection mode described above, and all machinery outputs will be de-energized. Pre-trip may also be terminated via communications.

### 4.6.5 Results Reporting

The system may be configured to send Pre-trip test results along with embedded test data points to the DataCORDER at the end of Pre-trip test. If not configured for data points, only results will be reported to the DataCORDER.

At the end of a Pre-trip test, the message “P rSLts” (Pre-trip results) will be displayed. Pressing the ENTER key will allow the user to see the results for all sub-tests. The results will be displayed as “PASS” or “FAIL” for all the Pre-trip tests run to completion.

## 4.7 DataCORDER

### 4.7.1 Description

Carrier Transicold “DataCORDER” software is integrated into the controller and serves to eliminate the temperature recorder and paper chart. DataCORDER functions may be accessed by keypad selections and viewed on the display module. The unit is also fitted with interrogation connections (see **Figure 4.1**) which may be used with the Carrier Transicold Data Reader to download data. A computer with Carrier Transicold DataLINE software may also be used to download data and configure settings. The DataCORDER consists of:

Configuration Software

Operational Software

Data Storage Memory

Real Time Clock (with internal battery backup)

Six Thermistor Inputs

Interrogation Connections

Power Supply (battery pack)

The DataCORDER performs the following functions:

a. Logs data at 15, 30, 60 or 120 minute intervals and stores two years of data (based on one hour interval).

b. Records and displays alarms on the display module.

c. Records results of Pre-trip testing.

d. Records DataCORDER and temperature control software generated data and events as follows:

Container ID Change

Software Upgrades

Alarm Activity

Battery Low (battery pack)

Data Retrieval

Defrost Start and End

Dehumidification Start and End
Power Loss (with and without battery pack)
Power Up (with and without battery pack)
Remote Probe Temperatures in the Container (USDA
Cold treatment and Cargo probe recording)
Return Air Temperature
Set Point Change
Supply Air Temperature
Real Time Clock Battery (internal) Replacement
Real Time Clock Modification
Trip Start
ISO Trip Header (When entered via
Interrogation program)
Economy Mode Start and End
“Auto 1/Auto 2/Auto 3” Pre-trip Start and End
Bulb Mode Start
Bulb Mode Changes
Bulb Mode End
USDA Trip Comment
Humidification Start and End
USDA Probe Calibration
Fresh Air Vent Position

### 4.7.2 DataCORDER Software

DataCORDER Software is subdivided into Operational Software, Configurations, and the Data Memory.

#### Operational Software

The Operational Software reads and records inputs from the operational components. How the component information is recorded and stored is determined the DataCORDER configurations. The values of these components can be viewed through the DataCORDER function codes. To access the function codes, do the following:

1. Press the ALT. MODE and CODE SELECT keys.
2. Press an Arrow key until the left window displays the desired code number. The right window will display the value of this item for five seconds before returning to the normal display mode.
3. If a longer display time is desired, press the ENTER key to extend the display time to five minutes.

#### Configurations

The recording and alarm functions of the DataCORDER based on the configurations. Reprogramming to the factory installed configuration is achieved via a configuration card. Changes to the unit DataCORDER configuration may be made using the DataLINE interrogation software. A listing of the configuration variables is provided in **Table 4–3**. Descriptions of DataCORDER operation for each variable setting are provided in the following paragraphs.

### 4.7.3 Sensor Configuration (dCF02)

Two modes of operation may be configured, the Standard Mode and the Generic Mode.

#### Standard Mode

In Standard Mode, the user may configure the DataCORDER to record data using one of seven standard configurations. The seven standard configuration variables, with their descriptions, are listed in **Table 4–3**. The inputs of the six thermistors (supply, return, USDA #1, #2, #3 and cargo probe) and the Humidity Sensor (HS) input will be generated by the DataCORDER.

**NOTICE**

**The DataCORDER software uses the Supply and Return Recorder Sensors (SRS, RRS). The temperature control software uses the Supply and Return Temperature Sensors (STS, RTS).**

**Generic Mode**

Generic Mode allows user selection of the network data points to be recorded. The user may select up to a total of eight data points for recording. A list of data points available for recording follows. Changing the configuration to generic and selecting which data points to record may be done using the Carrier Transicold Data Retrieval Program.

1. Control mode
2. Control temperature
3. Frequency
4. Humidity
5. Phase A current
6. Phase B current
7. Phase C current
8. Main voltage
9. Evaporator Expansion Valve percentage
10. Discrete outputs (Bit mapped - require special handling if used)
11. Discrete inputs (Bit mapped - require special handling if used)
12. Ambient Temperature Sensor (AMBS)
13. Evaporator Temperature Sensor (ETS)
14. Compressor Discharge Sensor (CPDS)
15. Return Temperature Sensor (RTS)
16. Supply Temperature Sensor (STS)
17. Defrost Temperature Sensor (DTS)
18. Discharge Pressure Transducer (DPT)
19. Suction Pressure Transducer (SPT)
20. Flash Tank Pressure Transducer (FPT)
21. Vent Position Sensor (VPS)

### 4.7.4 Logging Interval (dCF03)

The user may select four different time intervals between data recordings. Data is logged at exact intervals in accordance with the real time clock. The clock is factory set at Greenwich Mean Time (GMT).

### 4.7.5 Thermistor Format (dCF04)

The user may configure the format in which thermistor readings are recorded. The short resolution is a 1 byte format and the long resolution is a 2 byte format. The short requires less memory and records temperature with variable resolutions depending on temperature range. The long records temperature in 0.01°C (0.02°F) steps for the entire range.

### 4.7.6 Sampling Type (dCF05 & dCF06)

Three types of data sampling are available: average, snapshot and USDA. When configured to average, the average of readings taken every minute over the recording period is recorded. When configured to snapshot, the sensor reading at the log interval time is recorded. When USDA is configured, the supply and return temperature readings are averaged and the three USDA probe readings are snapshot.

### 4.7.7 Alarm Configuration (dCF07 - dCF10)

The USDA and cargo probe alarms may be configured to OFF, ON or AUTO.

If a probe alarm is configured to OFF, the alarm for this probe is always disabled.

If a probe alarm is configured to ON, the associated alarm is always enabled.

If the probes are configured to AUTO, they act as a group. This function is designed to assist users who keep their DataCORDER configured for USDA recording, but do not install the probes for every trip. If all the probes are disconnected, no alarms are activated. As soon as one of the probes is installed, all of the alarms are enabled and the remaining probes that are not installed will give active alarm indications.

**Table 4–3 DataCORDER Configuration Variables**

| Config | Title | Default | Option |
|---|---|---|---|
| dCF01 | (Future Use) | –– | –– |
| dCF02 | Sensor Configuration | 2 | 2, 5, 6, 9, 54, 64, 94 |
| dCF03 | Logging Interval (Minutes) | 60 | 15, 30, 60, 120 |
| dCF04 | Thermistor Format | Short | Long |
| dCF05 | Thermistor Sampling | Type A | A, b, C |
| dCF06 | Controlled Atmosphere / Humidity Sampling | A | A, b |
| dCF07 | Alarm Configuration USDA Sensor 1 | A | Auto, On, Off |
| dCF08 | Alarm Configuration USDA Sensor 2 | A | Auto, On, Off |
| dCF09 | Alarm Configuration USDA Sensor 3 | A | Auto, On, Off |
| dCF10 | Alarm Configuration Cargo Sensor | A | Auto, On, Off |

**Table 4–4 DataCORDER Standard Variables**

| Standard Config | Description |
|---|---|
| 2 sensors (dCF02=2) | 2 thermistor inputs (supply & return) |
| 5 sensors (dCF02=5) | 2 thermistor inputs (supply & return)<br>3 USDA thermistor inputs |
| 6 sensors (dCF02=6) | 2 thermistor inputs (supply & return)<br>3 USDA thermistor inputs<br>1 humidity input |
| 9 sensors (dCF02=9) | Not Applicable |
| 6 sensors (dCF02=54) | 2 thermistor inputs (supply & return)<br>3 USDA thermistor inputs<br>1 cargo probe (thermistor input) |
| 7 sensors (dCF02=64) | 2 thermistor inputs (supply & return)<br>3 USDA thermistor inputs<br>1 humidity input<br>1 cargo probe (thermistor input) |
| 10 sensors (dCF02=94) | 2 thermistor inputs (supply & return)<br>3 USDA thermistor inputs<br>1 humidity input<br>1 cargo probe (thermistor input)<br>3 C.A. inputs (NOT APPLICABLE) |

### 4.7.8 DataCORDER Power Up

The DataCORDER may be powered up in any one of four ways:

a. Normal AC power: The DataCORDER is powered up when the unit is turned on via the stop-start switch.

b. Controller DC battery pack power: If a battery pack is installed, the DataCORDER will power up for communication when an interrogation cable is plugged into an interrogation receptacle.

c. External DC battery pack power: A 12 volt battery pack may also be plugged into the back of the interrogation cable, which is then plugged into an interrogation port. No controller battery pack is required with this method.

d. Real Time Clock demand: If the DataCORDER is equipped with a charged battery pack and AC power is not present, the DataCORDER will power up when the real time clock indicates that a data recording should take place. When the DataCORDER is finished recording, it will power down.

During DataCORDER power-up, while using battery-pack power, the controller will perform a hardware voltage check on the battery. If the hardware check passes, the controller will energize and perform a software battery voltage check before DataCORDER logging. If either test fails, the real time clock battery power-up will be disabled until the next AC power cycle. Further DataCORDER temperature logging will be prohibited until that time.

An alarm will be generated when the battery voltage transitions from good to bad indicating that the battery pack needs recharging. If the alarm condition persists for more than 24 hours on continuous AC power, the battery pack needs replacement.

### 4.7.9 Pre-Trip Data Recording

The DataCORDER will record the initiation of a Pre-trip test (see **Section 4.6**) and the results of each of the tests included in Pre-trip. The data is time-stamped and may be extracted via the Data Retrieval program. See **Table 4–10** for a description of the data stored in the DataCORDER for each corresponding Pre-trip test.

### 4.7.10 DataCORDER Communications

Data retrieval from the DataCORDER can be accomplished by using one of the following: DataLINE or a communications interface module.

A DataLINE or a communications interface module display of Communication Failed is caused by faulty data transfer between the DataCORDER and the data retrieval device. Common causes include:

- Bad cable or connection between DataCORDER and data retrieval device.
- PC communication port(s) unavailable or mis-assigned.
- Chart Recorder Fuse (FCR) blown.

Configuration identification for the models covered herein may be obtained on the Container Products Group Information Center by authorized Carrier Transicold Service Centers.

#### DataBANK Card

The DataBANK™ card is a PCMCIA card that interfaces with the controller through the programming slot and can download the data at a much faster rate compared to the PC or DataReader. Files downloaded to DataBANK card files are accessible through an Omni PC Card Drive. The files can then be viewed using the DataLINE software.

#### DataLINE Software

DataLINE software for a personal computer is supplied on both floppy disks and CD. This software allows interrogation, configuration variable assignment, screen view of the data, hard copy report generation, cold treatment probe calibration and file management. Refer to Data Retrieval manual 62-10629 for a more detailed explanation of the DataLINE interrogation software. The DataLINE manual may be found on the internet at www.container.carrier.com.

#### Communications Interface Module

The communications interface module is a slave module, which allows communication with a master central monitoring station. The module will respond to communication and return information over the main power line. With a communications interface module installed, all functions and selectable features that are accessible at the unit may be performed at the master station. Retrieval of all DataCORDER reports may also be performed. Refer to the master system technical manual for further information.

### 4.7.11 DataCORDER Alarms

The alarm display is an independent DataCORDER function. If an operating parameter is outside of the expected range or a component does not return the correct values to the DataCORDER, an alarm is generated. The DataCORDER contains a buffer of up to eight alarms. A listing of the DataCORDER alarms is provided in **Table 4–5**. See **Section 4.7.7** for configuration information.

**To Display Alarm Codes:**

1. While in the Default Display mode, press the ALT. MODE & ALARM LIST keys. This accesses the DataCORDER Alarm List Display Mode, which displays any alarms stored in the alarm queue.
2. To scroll through the alarm list, use the Arrow keys.
3. The left display will show “AL#” where # is the alarms number in the queue. The right display will show “AA##,” if the alarm is active, where ## is the alarm number. “IA##,” will show if the alarm is inactive
4. “END” is displayed to indicate the end of the alarm list if any alarms are active. “CLEAr” is displayed if all the alarms in the list are inactive.
5. If no alarms are active, the alarm queue may be cleared. The exception to this rule is the DataCORDER Alarm List Full alarm (dAL91), which does not have to be inactive in order to clear the alarm list.

**To Clear the Alarm List:**

1. Press the ALT. MODE and ALARM LIST keys.
2. Press an Arrow key until “CLEAr” is displayed.
3. Press the ENTER key. The alarm list will clear and “-----” will be displayed.
4. Press the ALARM LIST key. “AL” will show on the left display and “-----” on the right display when there are no alarms in the list.
5. Upon clearing of the alarm queue, the alarm light will be turned off.

**Table 4–5 DataCORDER Alarm Indications**

| Code | Title | Description |
|---|---|---|
| dAL70 | Sensor 1, Recorder Supply Temperature Out of Range | The supply recorder sensor reading is outside of the range of -50°C to 70°C (-58°F to +158°F), or the probe check logic has determined there is a fault with this sensor.<br>**NOTE:**<br>The P5 Pre-trip test must be run to inactivate the alarm. |
| dAL71 | Recorder Return Temperature Out of Range | The return recorder sensor reading is outside of the range of -50°C to 70°C (-58°F to +158°F), or the probe check logic has determined there is a fault with this sensor.<br>**NOTE:**<br>The P5 Pre-trip test must be run to inactivate the alarm. |
| dAL72-74 | USDA1, USDA2, & USDA3 Temperature Sensor (3, 4, & 5) Out of Range | The USDA probe temperature reading is outside of -50°C to 70°C (-58°F to +158°F) range. |
| dAL75 | Cargo Probe, Sensor 6 Out of Range | The cargo probe temperature reading is outside of -50°C to 70°C (-58°F to +158°F) range. |
| dAL76, 77 | Future Expansion | These alarms are for future expansion and are not in use at this time. |
| dAL78-85 | Network Data Point 1 - 8 Out of Range | The network data point is outside of its specified range. The DataCORDER is configured by default to record the supply and return recorder sensors. The DataCORDER may be configured to record up to eight additional network data points. An alarm number (AL78 to AL85) is assigned to each configured point. When an alarm occurs, the DataCORDER must be interrogated to identify the data point assigned. When a Humidity Sensor (HS) is installed, it is usually assigned to AL78. |

**Table 4–5 DataCORDER Alarm Indications**

| Code | Title | Description |
|---|---|---|
| dAL86 | RTC Battery Low | The real time clock (RTC) backup battery is too low to adequately maintain the RTC reading.<br>A real time clock failure is critical to the operation of the unit. If this alarm occurs, replace the RTC battery at the next available opportunity. After replacing the battery the following actions are required:<br>Update the RTC setting<br>• Update the unit's software configuration<br>• Update the operational software<br>• Update all user selectable function code settings (defrost, set-point, etc) |
| dAL87 | RTC Failure | An invalid time has been detected. Either the DataCORDER run time hour and minute have not changed at the start of the hour, or the real time clock (RTC) time has gained or lost more than 2 minutes in the hour. This situation may be corrected by cycling the power, setting the clock or meeting the above criteria for an hour. |
| dAL88 | DataCORDER EEPROM Failure | A write of a critical DataCORDER item to Persistent Memory Block A location has failed after a retry. |
| dAL89 | Flash Memory | Error An error has been detected in the process of writing daily data to the non-volatile FLASH memory. |
| dAL90 | Future Expansion | This alarm is for future expansion, and is not in use at this time. |
| dAL91 | Alarm List Full | The DataCORDER alarm queue is determined to be full (eight alarms). |

### 4.7.12 ISO Trip Header

DataLINE provides the user with an interface to view / modify current settings of the ISO trip header through the ISO Trip Header screen. The ISO Trip Header screen is displayed when the user clicks on the "ISO Trip Header" button in the "Trip Functions" Group Box on the System Tools screen.

F9 function - Provides the user with a shortcut for manually triggering the refresh operation. Before sending modified parameter values, the user must ensure that a successful connection is established with the controller.

If the connection is established with the DataCORDER, the current contents of the ISO Trip Header from the DataCORDER will be displayed in each field. If the connection is not established with the DataCORDER, all fields on the screen will be displayed as "Xs." If at any time during the display of the ISO Trip Header screen the connection is not established or is lost, the user is alerted to the status of the connection.

After modifying the values and ensuring a successful connection has been made with the DataCORDER, click on the "Send" button to send the modified parameter values. The maximum allowed length of the ISO Trip Header is 128 characters. If the user tries to refresh the screen or close the utility without sending the changes made on the screen to the DataCORDER, the user is alerted with a message.

### 4.7.13 USDA Cold Treatment

Sustained cold temperature has been employed as a post-harvest method for the control of fruit flies and other insect genera. The commodity, insect species, treatment temperatures and exposure times are found in sections T107, T108, and T109 of the USDA Treatment Manual. In response to the demand to replace fumigation with this environmentally sound process, Carrier has integrated Cold Treatment capability into its microprocessor system. These units have the ability to maintain supply air temperature within one quarter degree Celsius of setpoint and record minute changes in product temperature within the DataCORDER memory, thus meeting USDA criteria. Information on USDA is provided in the following sub-paragraphs.

#### USDA Recording

A special type of recording is used for USDA cold treatment purposes. Cold treatment recording requires three remote temperature probes be placed at prescribed locations in the cargo. Provision is made to connect these probes to the DataCORDER via receptacles located at the rear left-hand side of the unit. Four or five receptacles are provided. The four 3-pin receptacles are for the probes. The 5-pin receptacle is the rear connection for the Interrogator. The probe receptacles are sized to accept plugs with tricam coupling locking devices. A label on the back panel of the unit shows which receptacle is used for each probe.

The standard DataCORDER report displays the supply and return air temperatures. The cold treatment report displays USDA #1, #2, #3 and the supply and return air temperatures. Cold treatment recording is backed up by a battery so recording can continue if AC power is lost.

**USDA/ Message Trip Comment**

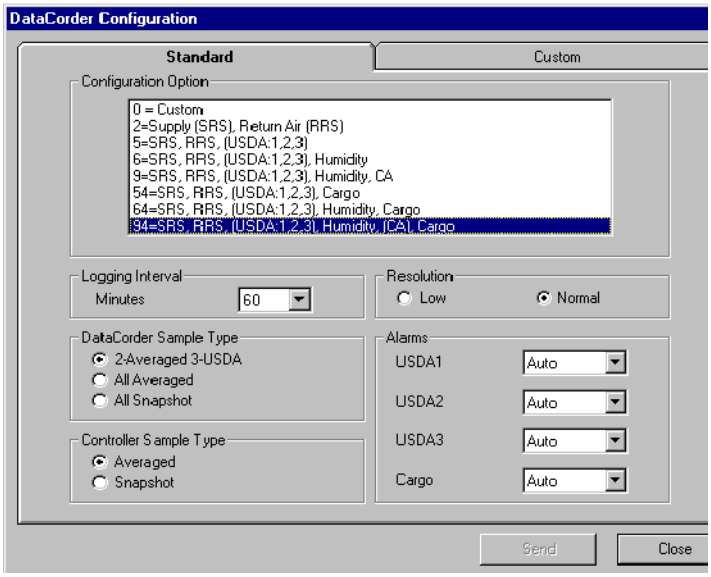
A special feature in DataLINE allows the user to enter a USDA (or other) message in the header of a data report. The maximum message length is 78 characters. Only one message will be recorded per day.

### 4.7.14 USDA Cold Treatment Procedure

If configured for USDA probes, the following is a summary of the steps required to initiate a USDA Cold Treatment. Refer to the **DataLINE User manual 62-10629** for more details.

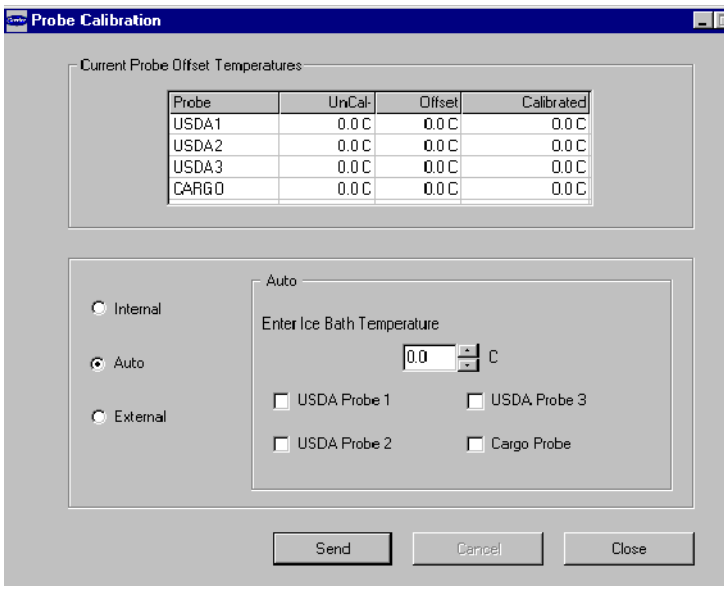
1. Ensure the DataCORDER is configured as follows:
   a. DataCORDER is configured for USDA probes, and logging interval set for 60 minutes.
   b. Sensor is set to “2 Averaged 3-USDA.”
   c. The resolution is set to “Normal.”

**Figure 4.7 DataCorder Configuration Screen**




2. Calibrate the three USDA probes by ice bathing the probes and performing the calibration function with the DataLINE. This calibration procedure generates the probe offsets which are stored in the controller and applied to the USDA sensors for use in generating sensor type reports. See **Figure 4.8**.

**Figure 4.8 DataCorder Probe Calibration Screen**



3. Pre-cool the container to the treatment temperature or below.
4. Install the DataCORDER module battery pack (if not already installed).
5. Place the three probes. Refer to USDA Treatment Manual for directions on placement of probes in fruit and probe locations in container.

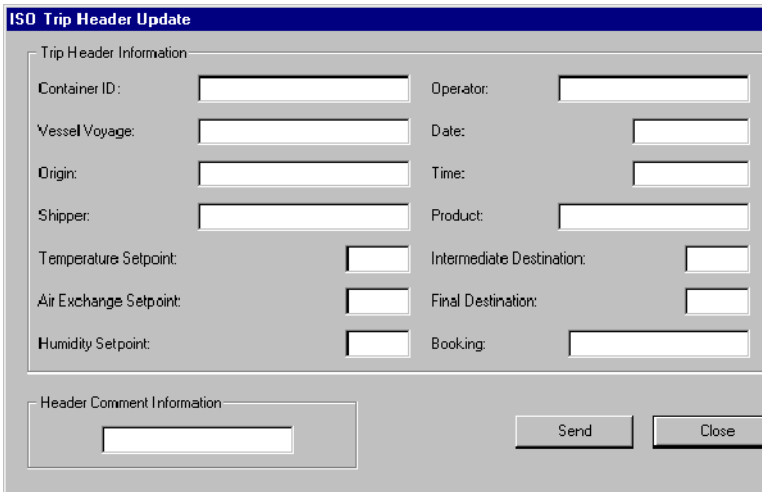
| | |
|---|---|
| Sensor 1 | Place the first sensor, labeled USDA1, in a box at the top of the stack of the fruit nearest to the air return intake. |
| Sensor 2 | Place the second sensor, labeled USDA2, slightly aft of the middle of the container, halfway between the top and bottom of the stack. |
| Sensor 3 | Place the third sensor, labeled USDA3, one pallet stack in from the doors of the container, halfway between the top and bottom of the stack. |

6. To initiate USDA recording, connect the personal computer and Enter ISO header information using the DataLINE software. See **Figure 4.9**.

a. Enter ISO header information.

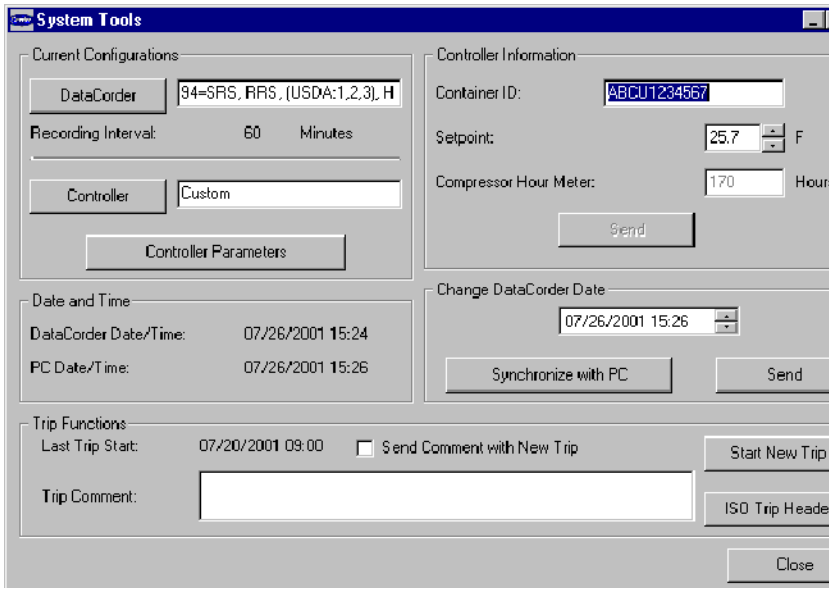
b. Enter a trip comment if desired.

**Figure 4.9 DataCorder ISO Trip Header Screen**




c. Using the System Tools screen in the DataLINE software perform a “trip start.” See **Figure 4.10**.

**Figure 4.10 DataCorder Systems Tool Screen**



## 4.8 Optional Features

### 4.8.1 Automatic Cold Treatment (ACT) Cd51

Cold Treatment has been employed as an effective post-harvest method for the control of Mediterranean and certain other tropical fruit flies. Exposing infested fruit to temperatures of 2.2°C (3.6°F) or below for specific time periods results in the mortality of various life stages for this group of insects.

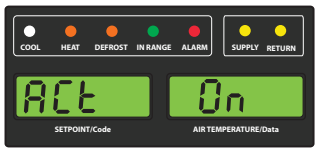
Automated Cold Treatment (ACT) in the Carrier Transicold unit is a method to simplify the task of completing cold treatment by automating the process of changing the setpoints. ACT is set up through function code Cd51. Refer to Function Code table in this manual for Cd51 menu processing and displays.

**NOTE**

ACT, setup with Cd51, and Automatic Setpoint Change (ASC), setup with Cd53, will not work simultaneously. Setting one will deactivate the other.

Procedure to Set ACT:

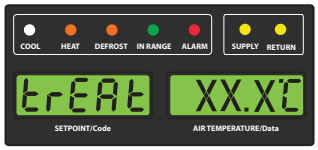
1. Enter the required cargo setpoint. It must be lower than the treatment temperature discussed in step 5.
2. Press the CODE SELECT key.
3. Use the Arrow keys to scroll to Cd51, and then press the ENTER key.
4. "ACt" is now displayed in the left display and the right will display "Off". Use the Arrow keys to bring up "On" in the right display and press the ENTER key.



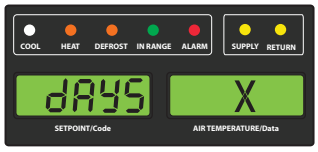

5. “trEAt" is now displayed in the left display and the right will be flashing the last setting (shown as XX.X°C). Use the Arrow keys to select the desired cold treatment setpoint and press the ENTER key.

**NOTE**

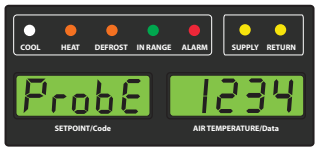
"trEAt" is the maximum value that the USDA probes need to remain below, to pass the Cold Treatment protocol. For instance, if the treat value is set at 35.0°F (1.7°C) then the USDA probe temperatures must remain below 35.0°F (1.7°C) to pass.



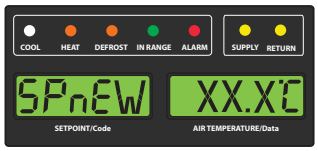

6. "dAyS" is now displayed in the left display and the right will be flashing. Use the Arrow keys to select the desired days for cold treatment and press the ENTER key.



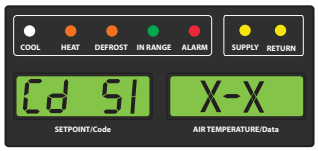

7. "ProbE" is now displayed in the left display and the right will display the probe numbers that are connected. Press the ENTER key. For instance, if "1234" is displayed, then all four of the probes are connected.



8. "SPnEW" is now displayed in the left display and the right will be flashing. Use the Arrow keys to select the desired setpoint after the cold treatment process has successfully completed and press the ENTER key. This would be the final temperature prior to the delivery of the cargo.




9. Cd51 is now displayed in the left display and the right will display days / hours remaining in cold treatment.

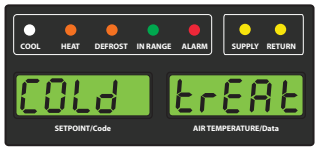



10. The unit will start to countdown once all detected USDA probes have reached the specified cold treatment temperature. The cold treatment process will continue until the specified number of days is reached. During operation, Cd51 will show the number of days and hours remaining in the cold treatment.

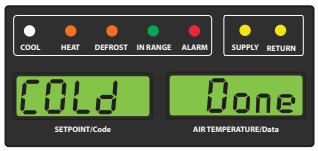
**NOTE**

Once the cold treatment process has been initiated, setpoint change via the keypad is disabled.

11. While the unit is operating in ACT mode, the left hand display will alternate between "COLd" and setpoint. The right hand display will alternate between "trEAt" and the cargo temperature. Once the treatment time has been completed, the setpoint temperature will increase to the "SPnEW" setting chosen in step 8.




12. When the cold treatment process is complete, the "SPnEW" setpoint will be displayed in the left hand display and cargo temperature in the right hand display, alternating with "COLd" "Done". "COLd" "Done" will continue to alternate with the setpoint and cargo temperature until ACT is turned off.




**Procedure to Turn ACT OFF:**

ACT will be automatically turned off with a TripStart, or if a Pretrip is initiated.

1. To manually turn ACT Off, press the CODE SELECT key.
2. Use the Arrow keys to scroll to Cd51, and then press the ENTER key.
3. Use the Arrow keys to bring up "Off" in the right display and press the ENTER key.

### 4.8.2 Automatic Setpoint Change (ASC) Cd53

Automatic Setpoint Change (ASC) allows up to 6 setpoint changes to be pre-programmed over defined periods of time using Cd53.

1. Press the CODE SELECT key.
2. Use the Arrow keys to scroll to Cd53, then press the ENTER key.
3. Use the Arrow keys to scroll to ON, then press the ENTER key. If ASC is already ON, selecting OFF will terminate ASC.

4. Select the desired number of setpoint changes (nSC) by scrolling through the available “flashing” options (1 – 6) in the right display, then press the ENTER key.
5. Select the initial setpoint: With (SP 0) in the left display, select by scrolling to the desired “flashing” setpoint in the right display and press ENTER.
6. Select the days desired for initial setpoint (SP 0): With (DAY 0) in the left display, select by scrolling to the desired “flashing” days (1 to 99) in the right display and press ENTER.
7. Select the next setpoint (SP 1): With (SP 1) in the left display, select by scrolling to the desired “flashing” setpoint in the right display and press ENTER.
8. Continue to select each additional setpoint.
9. Select a final setpoint (SP x): With (SP x) in the left display, select by scrolling to the desired “flashing” setpoint in the right display and press ENTER.

While the unit is operating in ASC mode, the left hand display will alternate between current unit setpoint and “ASC”. The right hand display will alternate between current control temperature and “ACtvE”. The user can determine the amount of time left at the current setpoint by selecting Cd53. The amount of time left will be displayed in the right display (XX (days) / XX (hours). By sequentially pressing ENTER, set parameters can be viewed.

At completion of ASC mode, the left hand display will alternate between current unit setpoint “ASC”. The right hand display will alternate between current control temperature and “Done”.

The display will remain this way until ASC is turned off. The user can determine the date of completion by selecting Cd53. With (done) in the left display, the date of completion will be displayed in the right display (Month / Day).

ASC can be manually turned off by selecting Cd53, scrolling to “Off” and pressing the ENTER key.

ACS will be automatically turned off after three days without power, or if a Pre-trip is initiated.

ACS (Cd53) will work independently of Automatic Cold Treatment (ACT) (Cd51). Setting one deactivates the other.

## 4.9 Controller Configuration Variables

**NOTE**

Configuration numbers not listed are not used in this application. These items may appear when loading configuration software to the controller but changes will not be recognized by controller programming.

**Table 4–6 Controller Configuration Variables**

| Config | Title |
|---|---|
| CnF02 | Evaporator Fan Speed |
| CnF03 | Control Sensors |
| CnF04 | Dehumidification Mode |
| CnF08 | Single Phase / 3-Phase Evaporator Fan Motor |
| CnF09 | Refrigerant Selection |
| CnF11 | Defrost “Off” Selection |
| CnF15 | Discharge Temperature Sensor |
| CnF16 | DataCORDER Present |
| CnF17 | Discharge Pressure Sensor |
| CnF18 | Heater |
| CnF20 | Suction Pressure Sensor |
| CnF22 | Economy Mode Option |
| CnF23 | Defrost Interval Timer Save Option |
| CnF24 | Advanced Pre-trip Enhanced Test Series Option |
| CnF25 | Pre-trip Test Points / Results Recording Option |
| CnF26 | Heat Lockout Change Option |
| CnF27 | Suction Temperature Display Option |
| CnF28 | Bulb Mode Option |
| CnF31 | Probe Check Option |
| CnF32 | Single Evaporator Fan Option |
| CnF33 | Snap Freeze Option |
| CnF34 | Degree Celsius Lockout Option |
| CnF37 | Electronic Temperature Recorder |
| CnF41 | Lower DTT Setting |
| CnF44 | eAutoFresh Enabled |
| CnF45 | Low Humidity Enabled |
| CnF47 | Fresh Air Vent Position Sensor |
| CnF49 | DataCORDER Configuration Restore |
| CnF50 | Enhanced Bulb Mode Selection |
| CnF51 | Timed Defrost Disable |
| CnF52 | Oil Return Algorithm |
| CnF53 | Water Cool Oil Return Logic |
| CnF55 | TXV Boost Relay |
| CnF56 | TXV Boost Circuit |
| CnF59 | Electronic Expansion Valve |
| CnF60 | Compressor-Cycle Perishable Cooling |
| CnF61 | ACT ASC Control Enable |
| CnF62 | Extended Temperature Control Enable |
| CnF63 | QUEST Pre-trip / TripWise Default State |

## 4.10 Controller Function Codes

**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| **NOTICE**<br>**If the function is not applicable, the display will read "-----"** | | |
| **Display Only Functions** | | |
| Cd01 | VFD (%) | This is the percent capacity that the VFD is currently running at ranging from 0 - 100%. Therefore, this is the speed of the compressor as a percentage. |
| Cd03 | VFD Status | This is the current feedback value from the VFD. This code will display output current (Amperes) by default.<br>Press the ENTER key to take the interface down into a selection menu.<br>The arrow keys will allow the operator to cycle forwards and backwards through the following VFD-related quantities:<br>"CUr" (current draw in amps): x.x ranging from 0 to 99.9<br>"PEr" (speed of compressor as %): x ranging from 0 to 100<br>POW (power draw displayed in kilowatts): x.x ranging from 0.0 to 99.9<br>Press the ENTER key again to cause the selected quantity to be pulled up as default, in future code select operations.<br>Press the CODE SELECT key in this selection menu to cancel the current selection activity, and ascend into the main code selection menu. |
| Cd04<br><br><br>Cd05<br><br><br>Cd06 | Line Current, Phase A<br><br><br>Line Current, Phase B<br><br><br>Line Current, Phase C | The current is measured on three legs.<br>The current measured is used for control and diagnostic purposes.<br>For control processing, the highest of the Phase A and B current values is used for current limiting purposes.<br>Phase C is used for compressor current draw measurement.<br>For diagnostic processing, the current draws are used to monitor component generalization.<br>Whenever a heater or a motor is turned ON or OFF, the current draw increase / decrease for that activity is measured.<br>The current draw is then tested to determine if it falls within the expected range of values for the component.<br>Failure of this test will result in a Pre-trip failure or a control alarm indication. |
| Cd07 | Mains Power Voltage | The main supply voltage is displayed. |
| Cd08 | Mains Power Frequency | The value of the main power frequency is displayed in Hertz. The frequency displayed will be halved if either fuse F1 or F2 is bad (alarm code AL21). |
| Cd09 | Ambient Air Temperature | The ambient sensor reading is displayed. |
| Cd10 | Evaporator Refrigerant Temperature (ETS) | The evaporator temperature of refrigerant measured leaving the evaporator. |
| Cd11 | Compressor Discharge Temperature (CPDS) | The compressor discharge temperature is displayed in °C or (°F). |
| Cd12 | Compressor Suction Port Pressure (SPT) | Bar (°C) presented with decimal. PSI (°F) no decimal. |
| Cd13 | Flash Tank Pressure (FPT) | Bar (°C) presented with decimal. PSI (°F) no decimal. |
| Cd14 | Compressor Discharge Pressure (DPT) | Bar (°C) presented with decimal. PSI (°F) no decimal. |

**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| Cd15 | Unloader | The status of the valve is displayed (“OPEn” − “CLOSE”). |
| Cd16 | Compressor Motor Hour Meter, Unit Run Time Hour Meter | This code displays the compressor motor hours. Unit run time can be viewed by pressing the ENTER key while in Cd16. Total hours are recorded in increments of 10 hours (i.e., 3000 hours is displayed as 300).<br>Compressor Motor Hour Meter display can be reset to 0 by pressing and holding the ENTER key for 5 seconds. The Unit Run Time Hour Meter cannot be reset using this code. |
| Cd17 | Relative Humidity % | Humidity Sensor (HS) reading is displayed. This code displays the relative humidity, as a percent value. |
| Cd18 | Software Revision Number | The software revision number is displayed. |
| Cd19 | Battery Check | Request battery test and display results. After selecting Cd19, press the ENTER key to run the battery test. “——“, “btESt”, “PASS”, “”LOW”, “FAIL”.<br>Press and hold the ALT key for 2 seconds, then press the ENTER key with ALT key still held down to clear the “Chargeable Battery Required” flag and then the test is run. If ENTER is not pressed in 5 seconds, the controller returns to display the setpoint. |
| Cd20 | Container Unit Model Number / Configuration | This code displays the model for which the controller is configured. (i.e., 69NT40-601-001 the display will show 01001. The model number for the unit is listed on the Unit Nameplate, see **Figure 2.1**. |
| Cd21 | Capacity Mode: Unloaded, Standard, Economized | Displays the current mode of operation “Unloaded, Standard, Economized,” the mode of operation will be displayed as (“unld”, “Std”, “Econ”). |
| Cd22 | Compressor Run State | Displays the current compressor run state (“OFF”, “ON”). |
| Cd23 | Evaporator Fan State | Displays the current evaporator fan state (“OFF”, “LO”, “HI”). |
| Cd25 | Time Remaining Until Defrost | This code displays the time remaining until the unit goes into defrost (in tenths of an hour). This value is based on actual accumulated compressor running time. |
| Cd26 | Defrost Termination Sensor Temperature | Defrost Temperature Sensor reading is displayed. |
| **Configurable Functions** | | |
| **NOTICE**<br>**Function codes Cd27 through Cd37 are user-selectable functions. The operator can change the value of these functions to meet the operational needs of the container.** | | |
| Cd27 | Defrost Interval | This is the desired period of time between defrost cycles. “AUTO”, “OFF”, 3, 6, 9, 12, 24 Hours. Factory default is “AUTO”. |
| Cd28 | Standard Temperature Unit | This parameter determines the default units (metric or British) for the system. The opposite units may be temporarily displayed with the C/F key. This function code will display “—–“ if the controller Degree Celsius Lockout option is set to F. The factory default value is Celsius units. |

**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| Cd29 | User Selectable Failure Response Code | This is the desired action to be taken should an alarm occur which severely limits the capability of the control system. Depending upon what alarm has occurred, the actual action taken may not be the same as the desired failure action.<br>The user selects one of two possible actions as follows:<br>A - Evaporator Fan Only (Evap fans on high speed, n/a with frozen setpoints.)<br>d - Full System Shutdown - Factory Default (Shut down every component in unit.) |
| Cd30 | In-Range Tolerance | The in-range tolerance will determine the band of temperatures around the setpoint which will be designated as in-range. If the control temperature is in-range, the in-range light will be illuminated. There are four possible values:<br>1 = +/- 0.5°C (+/- 0.9°F)<br>2 = +/- 1.0°C (+/- 1.8°F)<br>3 = +/- 1.5°C (+/- 2.7°F)<br>4 = +/- 2.0°C (+/- 3.6°F) - Factory Default |
| Cd32 | System Current Limit | The highest current draw of 460VAC Line Current Phase A, B, C is compared to this limit and unit capacity may be reduced to limit current draw if current limit is exceeded.<br>The five values for 460 VAC operation are: 15, 17, 19, 21, or 23 amperes. The factory default setting is 21 amperes. |
| Cd33 | Humidity Setpoint | This is the value in percent to which the system will dehumidify.<br>There are configuration variables that determine whether dehumidification is installed. In the test mode, the setpoint will be temporarily set to 1%, allowing the test of dehumidification. After 5 minutes, the normal setpoint is restored. If Pre-trip is initiated, this value will be set to “OFF” automatically. |
| Cd35 | Bulb Mode | The current state of the bulb mode option. “----“, “nOr”, “bULb” |
| Cd36 | Evaporator Fan Speed | This is the desired evaporator fan speed for use during the bulb mode option.<br>“----“, “ALt”, “LOW”, “HI” |
| Cd37 | Variable DTT Setting | This is the variable defrost termination thermostat setting to be used with the optional bulb mode functionality. “—--“, “nOr” |
| **Display Only Functions** | | |
| Cd38 | Secondary Supply | This item is only displayed if the DataCORDER is configured OFF and configured for a four probe system. Dashes are displayed otherwise. |
| Cd39 | Secondary Return | This item is only displayed if the DataCORDER is configured OFF and configured for a four probe system. Dashes are displayed otherwise. |
| Cd40 | Container ID | Cd40 is configured at commissioning to read a valid container identification number. The reading will not display alpha characters; only the numeric portion of the number will display. See **Section 7.19.3** Controller Programming Procedure for additional information. |
| Cd45 | Vent Position | This function code will be dashed out if not configured for VPS. This function code displays current vent position in units of 5 CMH (units displayed as “CM”) or closes CFM (units displayed as “CF”) depending on the selection of Cd 46 (Airflow display units), Cd 28 (Metric/Imperial) or the pressing of the deg C/F key.<br>CFM displayed as “CF”, CMH displayed as “CM”.<br>Values: 0 to 240 for UPPER / 0 to 225 for LOWER |

**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| Cd46 | Air Flow Display Units | Selects the airflow units to be displayed by Function Code 45 (Cd 45) if configured for Vent Position Sensor or displayed by “FLO” under Cd 43 if configured for Autoslide. CF= Cubic Feet per Minute, CM=Cubic Meters per Hour, bOth=Displays either CF or CM depending on the setting of Cd 28 (Metric/Imperial) or the pressing of the degree C/F key.<br>Default − “bOth” If configured for Vent Position Sensor or Autoslide |
| Cd48 | Dehumidification / Bulb Cargo Mode Parameter Selection | Initially Cd48 will display current dehumidification-mode; bUlb - bulb cargo mode, dEhUM - normal dehumidification, or OFF - off. This display is steady.<br>Press the ENTER key to take the interface down into a hierarchy of parameter selection menus (mode, setpoint, evaporator speed, DTT setting). Press the ENTER key in any parameter selection menu to commit to selection of the currently displayed parameter and cause the interface to descend into the next parameter selection menu. All parameter selection menus alternate between a blank display and the current selection in the right hand display.<br>Press the CODE SELECT key in a selection menu to cancel the current selection activity and ascend back up to the next higher selection menu (or to Cd48 display mode if that is the next higher).<br>If the operator does not press any key for five seconds, the interface reverts to normal system display and the current selection menu is canceled, but any previously committed changes are retained.<br>Available parameters and parameter ranges are a function of configuration options and previously selected parameters as indicated above.<br>Whenever any Pre-trip test is initiated, dehumidification mode goes to OFF. Whenever dehumidification mode goes to OFF:<br>• Dehumidification control setpoint goes to 0% RH internally but will then initialize to 95% RH when dehumidification mode leaves OFF.<br>• Evaporator speed select goes to Alt for units without PWM Compressor Control (Cnf57 = Out), Evaporator speed select goes to Hi for units with PWM Compressor Control (Cnf57 = In).<br>• DTT setting goes to 25.6°C or 18.0°C, depending on Cnf41.<br>Whenever dehumidification-mode is set to bUlb, DTT setting goes to 18.0°C if it had been set higher.<br>Whenever dehumidification-mode is set to dEhUM, DTT setting goes to 25.6°C or 18.0°C, depending on Cnf41.<br>For units without PWM Compressor Control (Cnf57 = Out):<br>• Whenever dehumidification control setpoint is set below 65% RH evaporator speed select goes to LO if it had been set to Hi.<br>• Whenever dehumidification control setpoint is set above 64% RH evaporator speed select goes to Alt if it had been set to LO.<br>For units with PWM Compressor Control (Cnf57 = In):<br>• Whenever dehumidification control setpoint is below 60% RH, evaporator fan speed is set to LO, the user can set evaporator fan speed to Hi via the keypad.<br>• Whenever dehumidification control setpoint is set equal to or above 60% RH, the evaporator fan speed is set to Hi, the user has the ability to set the evaporator fan speed to LO via the keypad. |

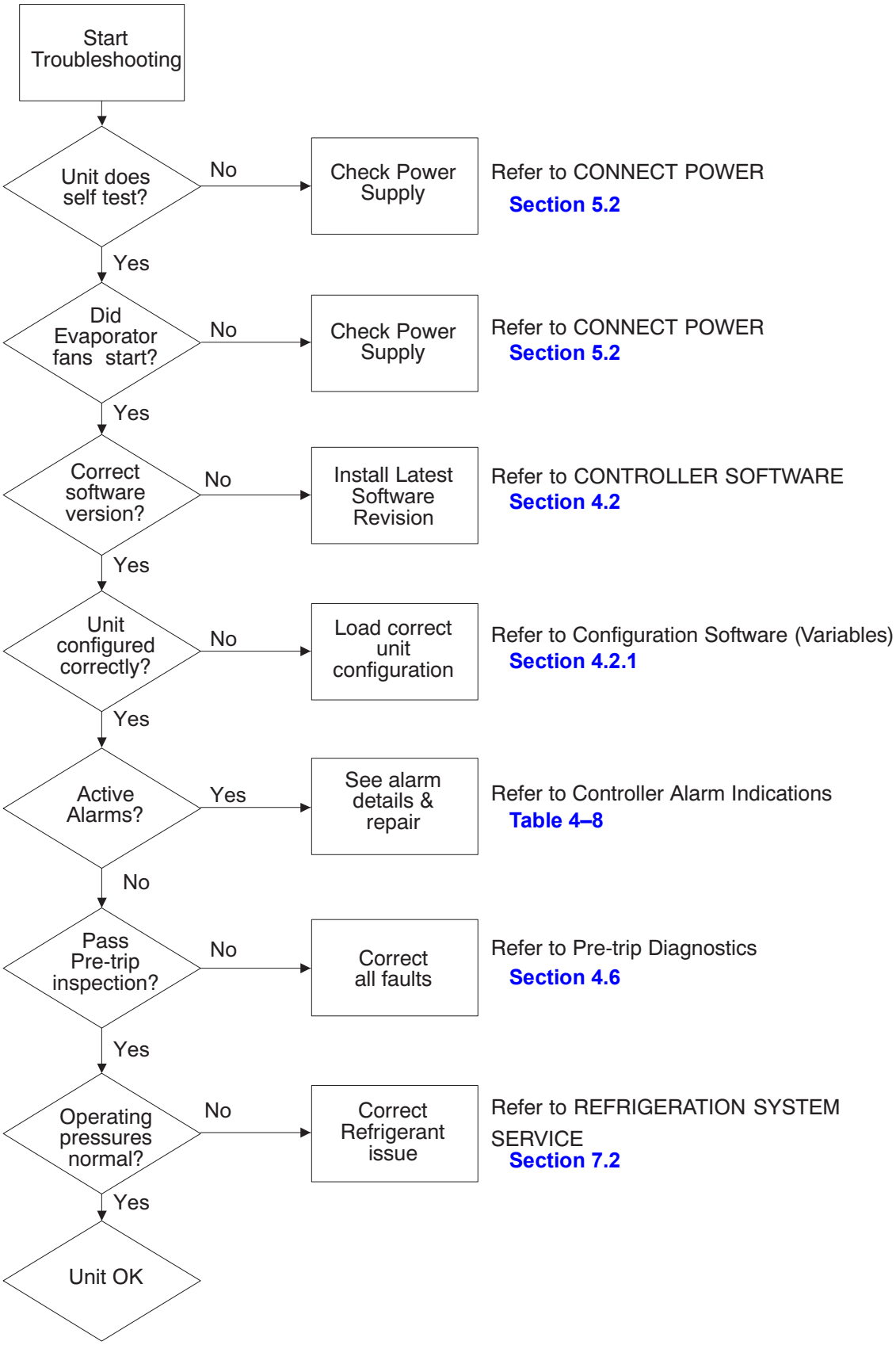
**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| Cd49 | Days Since Last Successful Pre-trip | Display number of days since last successful completion. Press the ENTER key for number of days since successful Pre-trip completion for Auto1, Auto2, and Auto3 in sequence.<br>Press the CODE SELECT key to step back through list and ultimately exit CD49 display. |
| Cd51 | Automatic Cold Treatment Parameter Selection | Automatic Cold Treatment (ACT) mode:<br>Cd51 increments of (1 day)_(1hr), Display: default “0_0 “<br>“done” mm-dd this will be display is ACT has completed<br>“ACt” value “On” “OFF” or “----“Display / Select: default “OFF“<br>“trEAt” value °C / °F on 0.1 degree increments Display / Select: default “0.0°C“<br>“DAyS” value “0-99” increments of 1 Display / Select: default “0”<br>“ProbE” value Probe positions ex ’1 2 _ 4’ ’1 _ 3 _’ Display: default “---- “<br>“SPnEW” value °C / °F on 0.1° increments Display / Select: default “10.0°C “<br>Initially Cd51 will display current countdown timer increments of (1 day)_(1hr), default “0_0”.<br>See **Section 4.8.1** for procedure to set ACT using Cd51.<br>Pressing the ENTER key will take the interface down into a hierarchy of parameter selection menus (act, treat, days, probe and spnew setting).<br>Pressing the ENTER key in any of the parameter selection menus commits to selection of the currently displayed parameter and causes the interface to descend into the next parameter selection menu. All parameter selection menus alternate between a blank display and the current selection in the right hand display.<br>Pressing the CODE SELECT key in a selection menu cancels the current selection activity and ascends back up to the next higher selection menu (or to Cd51 display mode if that is the next higher).<br>If the operator does not press any key for five seconds, the interface reverts to normal system display and the current selection menu is cancelled, but any previously committed changes are retained.<br>Parameter with the exception of “Act” may not be altered if Cd51 is re-entered if “Act” is “On”. When ACT has completed including reaching the new setpoint “done” on the left display and the MONTH DAY of completion on the right display will be displayed as the second entry in the menu. Turning ACT off clears this entry. This action also resets Cd51 to initial time remaining. ACT must then be turned on to view or modify the additional parameters.<br>Whenever any auto Pre-trip test or Trip Start is initiated, ACT mode goes to OFF. |

**Table 4–7 Controller Function Codes**

| Code | Title | Description |
|---|---|---|
| Cd53 | Automatic Setpoint Change Mode Parameter Selection | Automatic Setpoint Change (ASC) Mode:<br>Cd53 increments of (1 day)_(1hr), Display: default “0_0”<br>“done” mm-dd this will be display is ASC has completed<br>“ASC” value “On” “OFF” Display / Select: default “OFF“<br>“nSC” value “1 - 6” (This is the value “n” for the subsequent entries).<br>“SP (n-1)” value °C / °F on 0.1 degree increments Display / Select: default “10.0°C“<br>“DAY (n-1)” value “1 – 99” increments of 1 Display / Select: default “1“<br>“SP (n)” value °C / °F on 0.1 degree increments Display / Select: default “10.0°C<br>Initially Cd53 will display current countdown timer increments of (1 day)_(1hr), default “0_0”.<br>Pressing the ENTER key will take the interface down into a hierarchy of parameter selection menus, (mode, act, treat, days, probe and spnew setting).<br>Pressing the ENTER key in any of the parameter selection menus selects the currently displayed parameter and causes the interface to descend into the next parameter selection menu. All parameter selection menus alternate between a blank display and the current selection in the right hand display.<br>Pressing the CODE SELECT key in a selection menu cancels the current selection activity and ascends back up to the next higher selection menu (or to Cd53 display mode if that is the next higher).<br>If the operator does not press any key for five seconds, the interface reverts to normal system display and the current selection menu is cancelled, but any previously committed changes are retained.<br>Available parameters and parameter ranges are a function of configuration options and previously selected parameters as indicated above.<br>Parameter with the exception of “ASC” may not be altered if Cd53 is re-entered if “ASC” is “On”. When ASC has completed including reaching the last setpoint “done” on the left display and the MONTH DAY of completion on the right display will be displayed as the second entry in the menu. Turning ASC off clears this entry. This action also resets Cd53 to initial time remaining. ASC must then be turned on to view or modify the additional parameters.<br>Whenever any auto Pre-trip test or Trip Start is initiated, ASC mode goes to OFF. |
| Cd54 | Superheat Values | Evaporator superheat: Evaporator leaving temperature minus suction saturation temperature as calculated from suction pressure. |
| Cd55 | Discharge Superheat | Cd55 will display discharge superheat (discharge temperature minus discharge saturation temperature as calculated from discharge pressure) values in C / F as calculated by the discharge temperature minus the discharge saturation temperature as calculated from discharge pressure. “------” will be displayed if selection is not valid. |
| Cd58 | Water Pressure Switch State | This code is only displayed if the unit is configured for water-cooled condenser option. Values for this code are: “----”, “OPEN”, “CLOSE”. |
| Cd61 | VFD Bypass Mode | When this code is active it signifies the unit is operating in a LIMP HOME MODE Condition.<br>Cd61 is locked out, and should only be activated after the VFD bypass procedure has been completed (see **Section 7.20.2**). |
| Cd68 | EEV % Opening | Displays the current percent opening of EEV (0-100%). |
| Cd69 | HPXV % Opening | Displays the current percent opening of HPXV (0-100%). |

**Figure 4.11 Alarm Troubleshooting Sequence**



## 4.11 Controller Alarm Indications

**Table 4–8 Controller Alarm Codes**

| AL03 | Loss of Superheat Control | |
|---|---|---|
| **Cause:** | Superheat has remained below 1.66°C (3°F) degrees for five minutes continuously while the compressor is running. Compressor is drawing more than 2.0 amps, compressor pressure ratio is greater than 1.8, and Electronic Expansion Valve (EEV) is at 0% open. | |
| | **Component** | Electronic Expansion Valve (EEV) |
| | **Troubleshooting** | Allow unit to run. Monitor superheat control (Cd54) and EEV position (Cd68). Remove the service panel and inspect the EEV for icing. Stepper driver may be installed to attempt to manually control the valve driver. Check connections between the EEV and power pack and also between the power pack and controller. Check resistance of EEV coils. |
| | **Corrective Action** | If the problem may be corrected using a manual electronic stepper drive tool, replace the EEV control module. If the unit does not respond to icing on the EEV outlet (Evaporator inlet) it may indicate a physically damaged valve. Replace the EEV. |
| | **Component** | Compressor |
| | **Troubleshooting** | Check VFD Speed (Cd01), Suction Pressure (Cd12), and Flash Tank Pressure (Cd13). If the compressor speed is greater than 70% and the flash tank pressure is approximately equal to suction pressure with the HPXV controlling at less than 25% (Cd69), then there may be a compressor first stage failure. This condition will also increase compressor discharge temperature (Cd11) and may also demonstrate AL19 alarms. Heavy icing on flash tanks will also be seen. |
| | **Corrective Action** | |
| | **Component** | Evaporator Temperature Sensors (ETS and ETS1) |
| | **Troubleshooting** | Verify the accuracy of the sensors ETS and ETS1. Refer to the Sensor Checkout Procedure (**Section 7.22**). |
| | **Corrective Action** | Replace ETS or ETS1 if it is defective. |
| | **Component** | Evaporator Fans |
| | **Troubleshooting** | Confirm fans are operating properly. |
| | **Corrective Action** | Replace fan(s) if it is defective. Refer to Evaporator Fan Motor Assembly (**Section 7.13**). |

| AL05 | Manual Defrost Switch Failure | |
|---|---|---|
| **Cause:** | Controller has detected continuous Manual Defrost Switch activity for five minutes or more. | |
| | **Component** | Keypad |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | Resetting the unit may correct problem. Monitor the unit.<br>If the alarm reappears after 5 minutes, replace the keypad. |

| AL06 | Keypad or Keypad Harness Failure | |
|---|---|---|
| **Cause:** | Controller has detected continuous activity from one of the keypad keys. | |
| | **Component** | Keypad or Harness |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | Resetting the unit may correct problem. Monitor the unit.<br>If the alarm reappears, replace the keypad and harness. |

| AL07 | Fresh Air Vent Open | |
|---|---|---|
| **Cause:** | The Vent Position Sensor (VPS) is reading greater than 0 CMH while the unit is in frozen mode. | |
| | **Component** | Vent Position Sensor (VPS) |
| | **Troubleshooting** | Manually reposition the vent and confirm the position using Cd45. Refer to VPS Service (**Section 7.21**). |
| | **Corrective Action** | If unable to obtain a zero reading, replace the defective VPS. |

| AL13 | VFD Communication Alarm | |
|---|---|---|
| **Cause:** | ML3 controller loses reliable communication with the VFD (no response for 3 seconds).<br>Make sure that the latest unit software is installed and re-run the unit to see if the alarm comes back. If the alarm does not clear, then follow troubleshooting. | |
| | **Component** | VFD, VFD Bridge, Controller |
| | **Troubleshooting** | Check continuity of the KH connector. Power cycle the unit. |
| | **Corrective Action** | If the alarm immediately re-occurs after a few seconds, allow to remain active and perform the VFD Bypass procedure (**Section 7.20.2**). |
| | **Component** | Compressor IP |
| | **Troubleshooting** | Confirm motor IP and HPS is closed between KA2 and TP2. |
| | **Corrective Action** | If IP is open, replace the compressor. If HPS is open, replace the HPS. |

| AL14 | Phase Sequence Detect Fault | |
|---|---|---|
| **Cause:** | Controller is unable to determine the correct phase relationship. | |
| | **Component** | N/A |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | Resetting the unit may correct the problem. Monitor the unit. |
| | **Component** | Wiring |
| | **Troubleshooting** | Check unit wiring. |
| | **Corrective Action** | Correct wiring. |
| | **Component** | Current Sensor |
| | **Troubleshooting** | Compare function codes Cd04, Cd05, and Cd06 against manual current draw readings. |
| | **Corrective Action** | Replace the current sensor if there is discrepancy between manual and display readings. |

| AL15 | Loss of Cooling | |
|---|---|---|
| **Cause:** | Evaporator efficiency monitor has detected a loss of system capacity, likely due to a drop in refrigerant charge density. | |
| | **Component** | Refrigerant Charge |
| | **Troubleshooting** | Check units for leaks, paying careful attention to high side fittings.<br>Check Pressure Relief Valves (**Section 7.7**) to see if refrigerant has been released and replace if necessary.<br>Check for signs of unit running short of refrigerant: Codes Cd12 and Cd13 along with high superheat at Cd54 and EEV open more than standard operation, up to 100% at Cd68. |
| | **Corrective Action** | Rectify refrigerant leaks. Remove refrigerant charge (**Section 7.2.5**), evacuate the unit (**Section 7.2.7**), and recharge the unit to rated charge (**Section 7.2.8**). |
| | **Component** | Evaporator |
| | **Troubleshooting** | Check for excessive ice buildup on the coil, T-bar blockages, or fouling. |
| | **Corrective Action** | Defrost the coil. |

| AL18 | Discharge Pressure High | |
|---|---|---|
| **Cause:** | Discharge pressure is above 131 bar (1900 psig). | |
| | **Component** | High Pressure Expansion Valve (HPXV), Electronic Expansion Valve (EEV) |
| | **Troubleshooting** | Power cycle the unit.<br>Check operation of the valves during power up.<br>Verify that the HPXV coil is fully seated on the stem of the HPXV body (see **Section 7.15.2**). |
| | **Corrective Action** | Alarm will clear once pressures are within operating limits. |
| | **Component** | Refrigerant Lines |
| | **Troubleshooting** | Measure temperatures before and after all fittings and braze joints, paying careful attention to screen locations. Temperature drops may indicate internal blockages. Unit over-charge or under-charge may create pressure control problems related to charge density and compression ratio. Ensure that the unit refrigerant charge is within operational specifications for the model. |
| | **Corrective Action** | Rectify system blockages. Remove refrigerant charge (**Section 7.2.5**), evacuate the unit (**Section 7.2.7**), and recharge the unit to rated charge (**Section 7.2.8**). |
| | **Component** | Gas Cooler Fan and Motor |
| | **Troubleshooting** | Check the gas cooler fan and motor for excessive coil fouling and proper operation. |
| | **Corrective Action** | Replace the gas cooler fan motor. |

| AL19 | Discharge Temperature High | |
|---|---|---|
| **Cause:** | Discharge temperature is above 135°C (275°F). | |
| | **Component** | Restrictions in the refrigeration system |
| | **Troubleshooting** | Check the unit for air flow restrictions. |
| | **Corrective Action** | Clean or remove any debris from the coils. |
| | **Component** | Non-condensables in the refrigeration system. |
| | **Troubleshooting** | With the unit off, allow system to stabilize to ambient temperature.<br>Check system pressure against the Pressure / Temperature Chart for R744 (**Table 7–4**). Refer to function codes Cd12, Cd13 and Cd14. |
| | **Corrective Action** | Remove refrigerant charge (**Section 7.2.5**), evacuate the unit (**Section 7.2.7**), and recharge the unit (**Section 7.2.8**). |
| | **Component** | Compressor |
| | **Troubleshooting** | Check VFD Speed (Cd01), Suction Pressure (Cd12), and Flash Tank Pressure (Cd13). If the compressor speed is greater than 70% and the Flash Tank pressure is approximately equal to suction pressure with the High Pressure Expansion Valve (HPXV) controlling at less than 25% (Cd69), there may be a compressor first stage failure. This condition will also increase compressor discharge temperature (Cd11) and may also demonstrate AL03 alarms. |
| | **Corrective Action** | If the alarm persists, it may indicate a failing compressor. Replace the compressor, refer to Compressor Service (**Section 7.3**). |
| | **Component** | Refrigerant Charge |
| | **Troubleshooting** | Check unit for leaks, paying careful attention to high side fittings. Unit over-charge or under-charge may create pressure control problems related to charge density and compression ratio. Ensure the unit refrigerant charge is within operational specifications for the model.<br>Check Pressure Relief Valves (**Section 7.7**) to see if refrigerant has been released and replace if necessary.<br>Check for signs that the unit is running short of refrigerant. Check Compressor Suction Pressure (Cd12) and Flash Tank Pressure (Cd13). Check for high superheat (Cd54) and EEV open more than standard operation, up to 100% (Cd68). |
| | **Corrective Action** | Rectify refrigerant leaks, vacuum and re-charge the system to rated charge. |

| AL20 | Control Contactor Fuse (F3) | |
|---|---|---|
| **Cause:** | Control power fuse (F3A or F3B) is open. | |
| | **Component** | Fuse F3A |
| | **Troubleshooting** | If fuse F3A is open, check PA, PB, and CH coils for short to ground. If a short is found, the coil is defective. Check ESV coil resistance at TP7 to TP9, and USV coil resistance at TP1 to TP9. If short to ground, or if resistance is less than 4 ohms, the coil is defective. |
| | **Corrective Action** | Replace the defective coil.<br>Replace the fuse. |
| | **Component** | Fuse F3B |
| | **Troubleshooting** | If fuse F3B is open, check contactor coils GF, GS, ES, EF, HR, for a short to ground. If a short is found, the coil is defective. |
| | **Corrective Action** | Replace the defective coil.<br>Replace the fuse. |
| | **Component** | Controller |
| | **Troubleshooting** | Check voltage at QC1. If voltage is present, it indicates a defective microprocessor. |
| | **Corrective Action** | Refer to Controller Service (**Section 7.19**). |

| AL21 | Control Circuit Fuse (F1/F2) | |
|---|---|---|
| **Cause:** | One of the 18 VAC controller fuses (F1 / F2) is open. Refer to code Cd08. | |
| | **Component** | System Sensors |
| | **Troubleshooting** | Check system sensors for short to ground. |
| | **Corrective Action** | Replace defective sensor(s). |
| | **Component** | Wiring |
| | **Troubleshooting** | Check wiring for short to ground. |
| | **Corrective Action** | Repair as needed. |
| | **Component** | Controller |
| | **Troubleshooting** | Controller may have an internal short. |
| | **Corrective Action** | Replace controller. Refer to Controller Service (**Section 7.19**). |

| AL22 | Evaporator IP | |
|---|---|---|
| **Cause:** | Evaporator motor internal protector (IP) is open. | |
| | **Component** | Evaporator Motor |
| | **Troubleshooting** | Shut down the unit, disconnect power and check evaporator motor IP at plug connection pins 4 & 6. |
| | **Corrective Action** | Replace the defective evaporator fan motor. Refer to Evaporator Fan Motor Service (**Section 7.13**). |

| AL23 | Loss of Phase B | |
|---|---|---|
| **Cause:** | Controller fails to detect current draw. | |
| | **Component** | Incoming Power |
| | **Troubleshooting** | Check incoming power source. |
| | **Corrective Action** | Correct power source as required. |

| AL24 | Compressor IP | |
|---|---|---|
| **Cause:** | Compressor internal protector (IP) is open for greater than five seconds. | |
| | **Component** | Compressor |
| | **Troubleshooting** | Confirm motor IP is open at KA2 to KB9. Verify the High Pressure Switch (HPS) is closed. |
| | **Corrective Action** | Monitor the unit. If the alarm remains active or is repetitive, replace the compressor at the next available opportunity. Refer to Compressor Service (**Section 7.3**). |

| AL25 | Gas Cooler Motor IP | |
|---|---|---|
| **Cause:** | Gas cooler fan motor internal protector (IP) is open. | |
| | **Component** | Insufficient Air Flow |
| | **Troubleshooting** | Shut down the unit and check the gas cooler fan for obstructions. |
| | **Corrective Action** | Remove obstructions. |
| | **Component** | Gas Cooler Fan Motor |
| | **Troubleshooting** | Shut down the unit, disconnect power and check the gas cooler fan motor IP at plug connection pins 4 & 6. Or, on the controller between TP3 and TP4 if the Water Cooled Condenser is not fitted or water is disconnected. |
| | **Corrective Action** | Replace defective gas cooler fan motor. Refer to Gas Cooler Fan Motor Assembly Service (**Section 7.9**). |

| AL26 | All Sensors Failure: Supply/Return Probes | |
|---|---|---|
| **Cause:** | Sensors detected as out of range. | |
| | **Component** | Sensors |
| | **Troubleshooting** | Perform Pre-trip P5. |
| | **Corrective Action** | If P5 passes, no further action is required.<br>If P5 fails, replace the defective sensor as determined by P5. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL27 | Analog to Digital Accuracy Failure | |
|---|---|---|
| **Cause:** | Controller AD converter faulty. | |
| | **Component** | Controller |
| | **Troubleshooting** | Power cycle the unit. If the alarm persists, it indicates a defective microprocessor. |
| | **Corrective Action** | Replace the defective microprocessor. Refer to Controller Service (**Section 7.19**). |

| AL28 | Low Suction Pressure | |
|---|---|---|
| **Cause:** | Suction pressure is less than 5.5 bar (80 psi), or less than 6.2 bar (90 psi) for 300 seconds. | |
| | **Component** | Refrigerant Charge |
| | **Troubleshooting** | Check units for leaks, paying careful attention to high side fittings.<br>Check Pressure Relief Valves (**Section 7.7**) to see if refrigerant has been released and replace if necessary.<br>Check for signs that the unit is running short of refrigerant. Check Compressor Suction Pressure (Cd12) and Flash Tank Pressure (Cd13). Check for high superheat (Cd54) and Electronic Expansion Valve (EEV) open more than standard operation, up to 100% (Cd68). |
| | **Corrective Action** | Rectify refrigerant leaks, vacuum and re-charge the system to rated charge. |
| | **Component** | Suction Pressure Transducer (SPT) |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | Resetting the unit may correct the problem. Monitor the unit. |
| | **Troubleshooting** | Confirm accurate SPT pressure readings. Refer to Manifold Gauge Set procedures (**Section 7.2**). |
| | **Corrective Action** | Replace SPT if it is defective. |

| AL50 | Air Vent Position Sensor (VPS) | |
|---|---|---|
| **Cause:** | Vent Position Sensor (VPS) out of range. | |
| | **Component** | Vent Position Sensor (VPS) |
| | **Troubleshooting** | Make sure the VPS is secure. |
| | **Corrective Action** | Manually tighten the panel. |
| | **Troubleshooting** | The user is allowed five minutes to make necessary adjustments to the vent setting, and then five minutes of stability are required following the last movement to consider the vent position stable. If vent position changes are detected during the required stability period, an alarm will be generated. The alarm will also be generated if the VPS is invalid. |
| | **Corrective Action** | If the alarm persists, replace the VPS or the sensor assembly. |

| AL51 | EEPROM Failure | |
|---|---|---|
| **Cause:** | Controller Memory Failure<br>Alarm List Failure, bad queue marker, or EEPROM hardware error detected for 3 seconds. | |
| | **Component** | Controller |
| | **Troubleshooting** | Press the ENTER key when “CLEAr” is displayed to attempt to clear the alarm. |
| | **Corrective Action** | If the action to clear alarm is successful (all alarms are inactive), alarm 51 will be reset. |
| | **Troubleshooting** | Power cycle the unit. If the alarm persists, it indicates defective controller memory. |
| | **Corrective Action** | Replace the defective controller. Refer to Controller Service (**Section 7.19**). |

| AL52 | EEPROM Alarm List Full | |
|---|---|---|
| **Cause:** | Alarm list queue is full. | |
| | **Component** | Active Alarms |
| | **Troubleshooting** | Repair any alarms in the queue that are active. These are indicated by “AA”. |
| | **Corrective Action** | Clear alarms. Refer to the Controller Alarms table (**Section 4.5**). |

| AL53 | Battery Pack Failure | |
|---|---|---|
| **Cause:** | Battery voltage low. | |
| | **Component** | Battery |
| | **Troubleshooting** | If this alarm occurs on start up, allow a unit fitted with rechargeable batteries to operate for up to 24 hours to charge rechargeable batteries sufficiently. Once fully charged, the alarm will deactivate. |
| | **Corrective Action** | To clear the alarm, press the ENTER and ALT keys simultaneously at the startup of Cd19 (Battery Check).<br>If the alarm persists, replace the battery pack. Refer to Battery Replacement procedure (**Section 7.19.5**). |

| AL54 | Primary Supply Sensor (STS) | |
|---|---|---|
| **Cause:** | Invalid Supply Temperature Sensor (STS) reading. | |
| | **Component** | Supply Temperature Sensor (STS) |
| | **Troubleshooting** | Perform Pre-trip P5. |
| | **Corrective Action** | If P5 passes, no further action is required. |
| | | If P5 fails, replace the defective sensor as determined by P5. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL56 | Primary Return Sensor (RTS) | |
|---|---|---|
| **Cause:** | Invalid Return Temperature Sensor (RTS) reading. | |
| | **Component** | Return Temperature Sensor (RTS) |
| | **Troubleshooting** | Perform Pre-trip P5. |
| | **Corrective Action** | If P5 passes, no further action is required. |
| | | If P5 fails, replace the defective sensor as determined by P5. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL57 | Ambient Sensor (AMBS) | |
|---|---|---|
| **Cause:** | Invalid Ambient Temperature Sensor (AMBS) reading. | |
| | **Component** | Ambient Temperature Sensor (AMBS) |
| | **Troubleshooting** | Test the AMBS. Refer to Temperature Sensor Service (**Section 7.22**). |
| | **Corrective Action** | If AMBS is defective, replace it. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL58 | Compressor High Pressure Safety (HPS) | |
|---|---|---|
| **Cause:** | High pressure safety switch has opened and reset within five seconds, triggering a high pressure shutdown state. | |
| | **Component** | High Pressure Switch (HPS) |
| | **Troubleshooting** | Test the HPS. Refer to Checking High Pressure Switch procedure (**Section 7.5.1**). Run a P7 test to verify the operation of the HPS. |
| | **Corrective Action** | Replace the HPS if it is defective. Refer to Sensor Replacement procedure (**Section 7.5.2**). |
| | **Component** | Refrigeration System |
| | **Troubleshooting** | Measure temperatures before and after all fittings and braze joints paying careful attention to screen locations. Temperature drops may indicate internal blockages. Unit over-charge may create pressure control problems. Ensure unit refrigerant charge is within operational specifications for the model. Check unit for air flow restrictions. |
| | **Corrective Action** | Clean or remove any debris from coils. Rectify system blockages. Remove refrigerant charge (**Section 7.2.5**), evacuate the unit (**Section 7.2.7**), and recharge the unit (**Section 7.2.8**). |
| | **Component** | High Pressure Expansion Valve (HPXV) |
| | **Troubleshooting** | Verify that the HPXV coil is fully seated on the stem of the HPXV body (see **Section 7.15.2**). Attempt to manually open the valve with magnet. If this rectifies the problem, replace the stepper motor. Check resistance of HPXV coils. |
| | **Corrective Action** | Replace the HPXV. |

| AL59 | Heater Termination Thermostat (HTT) | |
|---|---|---|
| **Cause:** | Heat Termination Thermostat (HTT) is open. | |
| | **Component** | Heat Termination Thermostat (HTT) |
| | **Troubleshooting** | Check for 24 volts at test point TP10. If there is no voltage at TP10 after unit has reached setpoint, HTT is open. |
| | **Corrective Action** | Replace HTT if it is defective. |

| AL60 | Defrost Termination Sensor (DTS) | |
|---|---|---|
| **Cause:** | Failure of the Defrost Temperature Sensor (DTS) to open. This is an indication of a probable failure of the DTS. It is triggered by the opening of the HTT or the failure of the DTS to go above setpoint within two hours of defrost initiation.<br>After 1/2 hour with a frozen range setpoint, or 1/2 hour of continuous compressor run time, if return air falls below 7°C (45°F), the controller checks to ensure the DTS reading has dropped to 10°C or below. If not, a DTS failure alarm is given and defrost mode is operated using the Return Temperature Sensor (RTS). Defrost mode will be terminated after one hour by the controller. | |
| | **Component** | Defrost Termination Sensor (DTS) |
| | **Troubleshooting** | Test the DTS. Refer to Temperature Sensor Service (**Section 7.22**). |
| | **Corrective Action** | Replace the DTS if it is defective. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL61 | Heater Current Draw Fault | |
|---|---|---|
| **Cause:** | Improper current draw during heat or defrost mode. | |
| | **Component** | Heater(s) |
| | **Troubleshooting** | While in heat or defrost mode, check for proper current draw at the Heater Contactors (HR). Refer to Electrical Data (**Section 3.4**). |
| | **Corrective Action** | Replace the heater(s) if it is defective. Refer to Evaporator Coil & Heater Assembly (**Section 7.11**). |
| | **Component** | Contactor |
| | **Troubleshooting** | Check voltage at the Heater Contactor (HR) on the heater side. |
| | **Corrective Action** | If no voltage present, replace the Heater Contactor (HR) if it is defective. |

| AL63 | Current Limit | |
|---|---|---|
| **Cause:** | Unit operating above current limit. | |
| | **Component** | Refrigeration System |
| | **Troubleshooting** | Check unit for air flow restrictions. |
| | **Corrective Action** | Clean or remove any debris from coils. |
| | **Troubleshooting** | Check unit for proper operation. |
| | **Corrective Action** | Repair as needed. |
| | **Component** | Power Supply |
| | **Troubleshooting** | Confirm supply voltage / frequency is within specification and balanced according to Electrical Data (**Section 3.4**). |
| | **Corrective Action** | Correct power supply. |
| | **Troubleshooting** | Current limit set too low. Check current limit setting at Cd32. |
| | **Corrective Action** | The current limit can be raised (maximum of 23 amps) using Cd32. |

| AL64 | Discharge Temperature Sensor (CPDS) | |
|---|---|---|
| **Cause:** | Discharge Temperature Sensor (CPDS) out of range. | |
| | **Component** | Discharge Temperature Sensor (CPDS) |
| | **Troubleshooting** | Test the CPDS. Refer to Temperature Sensor Service (**Section 7.22**). Reference Cd11 for sensor values. |
| | **Corrective Action** | Replace the CPDS if it is defective. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL65 | Discharge Pressure Transducer (DPT) | |
|---|---|---|
| **Cause:** | Compressor Discharge Pressure Transducer (DPT) is out of range. | |
| | **Component** | Compressor Discharge Pressure Transducer (DPT) |
| | **Troubleshooting** | Confirm accurate DPT pressure readings. Refer to Manifold Gauge Set procedures (**Section 7.2**). Reference Cd14 for transducer values. |
| | **Corrective Action** | Replace the DPT if it is defective. |

| AL66 | Suction Pressure Transducer (SPT) | |
|---|---|---|
| **Cause:** | Suction Pressure Transducer (SPT) out of range. | |
| | **Component** | Suction Pressure Transducer (SPT) |
| | **Troubleshooting** | Confirm accurate SPT pressure readings. Refer to Manifold Gauge Set procedures (**Section 7.2**). Reference Cd12 for transducer values. |
| | **Corrective Action** | Replace SPT if it is defective. |
| | **Troubleshooting** | Monitor the unit. |
| | **Corrective Action** | If the alarm persists, it may indicate a failing compressor. Refer to Compressor Service (**Section 7.3**). |

| AL67 | Humidity Sensor (HS) | |
|---|---|---|
| **Cause:** | Humidity Sensor (HS) reading out of range.<br>Humidity Sensor (HS) below 2% or greater than four volts. | |
| | **Component** | Humidity Sensor (HS) |
| | **Troubleshooting** | Make sure HS is properly connected in the socket.<br>Make sure HS wires are not damaged.<br>Reference Cd17 for sensor values. |
| | **Corrective Action** | Monitor and replace the HS if the alarm persists. |

| AL68 | Flash Tank Pressure Transducer Alarm | |
|---|---|---|
| **Cause:** | Flash Tank Pressure Transducer (FPT) is out of range. | |
| | **Component** | Flash Tank Pressure Transducer (FPT) |
| | **Troubleshooting** | Confirm accurate FPT pressure readings. It is not possible to check FPT with gauges. Turn off the unit and let the pressure equalize, check that codes Cd12, Cd13 and Cd14 are all equal. |
| | **Corrective Action** | Replace the FPT if it is defective. |

| AL69 | Evaporator Temperature Sensor (ETS1) | |
|---|---|---|
| **Cause:** | Evaporator Temperature Sensor (ETS1) out of range. | |
| | **Component** | Evaporator Temperature Sensor (ETS1) |
| | **Troubleshooting** | Test the ETS1. Refer to Temperature Sensor Service (**Section 7.22**).<br>Refer to Cd10 for sensor values. |
| | **Corrective Action** | Replace the ETS1 if it is defective. |

| AL70 | Secondary Supply Sensor (SRS) | |
|---|---|---|
| **Cause:** | Secondary Supply Sensor (SRS) is out of range. | |
| | **Component** | Secondary Supply Sensor (SRS) |
| | **Troubleshooting** | Perform Pre-trip P5. |
| | **Corrective Action** | If P5 passes, no further action is required.<br>If P5 fails, replace the defective sensor as determined by P5. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL71 | Secondary Return Sensor (RRS) | |
|---|---|---|
| **Cause:** | Secondary Return Sensor (RRS) is out of range. | |
| | **Component** | Secondary Return Sensor (RRS) |
| | **Troubleshooting** | Perform Pre-trip P5. |
| | **Corrective Action** | If P5 passes, no further action is required.<br>If P5 fails, replace the defective sensor as determined by P5. Refer to Temperature Sensor Service (**Section 7.22**). |

| AL72 | Control Temperature Out of Range | |
|---|---|---|
| **Cause:** | After the unit goes in-range for 30 minutes then out of range for a continuous 120 minutes. | |
| | **Component** | Refrigeration System |
| | **Troubleshooting** | Ensure that the unit is operating correctly. |
| | **Corrective Action** | Power cycle the unit.<br>Control temperature is in-range.<br>Any pre-trip mode resets the timers. |

| AL92 | VFD Internal Fault | |
|---|---|---|
| **Cause:** | Internal fault occurred in the Variable Frequency Drive (VFD). | |
| | **Component** | VFD |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | If alarm cannot be reset, perform a VFD bypass procedure (**Section 7.20.2**). |

| AL93 | VFD Fan Fault | |
|---|---|---|
| **Cause:** | Variable Frequency Drive (VFD) temperature feedback exceeds 55°C (131°F).<br>Make sure that the latest unit software is installed and re-run the unit to see if the alarm comes back. If the alarm does not clear, then follow troubleshooting. | |
| | **Component** | VFD Fan |
| | **Troubleshooting** | Ensure that the fan inlet and outlets are clear and fan is free to rotate. |
| | **Corrective Action** | Remove and replace the VFD Fan (**Section 7.20.1**). |

| AL94 | VFD Trip Alarm | |
|---|---|---|
| **Cause:** | An internal Variable Frequency Drive (VFD) alarm has been detected. | |
| | **Component** | Compressor |
| | **Troubleshooting** | Verify compressor oil level and condition. |
| | **Corrective Action** | Charge compressor with oil. |
| | **Component** | VFD |
| | **Troubleshooting** | Power cycle the unit. |
| | **Corrective Action** | If alarm cannot be reset, perform a VFD bypass procedure (**Section 7.20.2**). |

| AL95 | Gas Cooler Outlet Temperature | |
|---|---|---|
| **Cause:** | Gas Cooler outlet temperature is out of range. | |
| | **Component** | Gas Cooler |
| | **Troubleshooting** | Check for dirt, debris and blockage of the Gas Cooler. Check continuity at connector KH. |
| | **Corrective Action** | Remove any blockage in the Gas Cooler coil. |
| | **Component** | Gas Cooler Temperature Sensor (GCTS) |
| | **Troubleshooting** | Check the operation of the GCTS. |
| | **Corrective Action** | Replace the GCTS if necessary. See **Section 7.8**. |

| AL97 | High Flash Tank Pressure | |
|---|---|---|
| **Cause:** | Flash tank pressure is greater than 104 bar (1508 psi). | |
| | **Component** | Electronic Expansion Valve (EEV) |
| | **Troubleshooting** | Remove the service panel and inspect the EEV for icing. Stepper driver may be installed to attempt to manually control valve driver. |
| | **Corrective Action** | If the problem may be corrected using a manual electronic stepper drive tool, replace the EEV control module. If the unit does not respond to icing on the EEV outlet (Evaporator inlet), it may indicate a physically damaged valve. Replace the EEV. Check resistance of EEV coils. |
| | **Component** | Refrigerant Charge |
| | **Troubleshooting** | High refrigerant charge will over-pressurize the flash tank and prevent economized operation. Check that Flash pressure is not higher than 69 bar (1000 psi) during operation. |
| | **Corrective Action** | Remove refrigerant charge (**Section 7.2.5**), evacuate the unit (**Section 7.2.7**), and recharge the unit (**Section 7.2.8**) to rated charge. |
| | **Component** | Gas Cooler |
| | **Troubleshooting** | Check Gas Cooler fan and motor for excessive coil fouling and proper operation. |
| | **Corrective Action** | Replace the Gas Cooler fan motor. |

**NOTICE**

**If the controller is configured for four probes without a DataCORDER, the DataCORDER alarms AL70 and AL71 will be processed as Controller alarms AL70 and AL71. Refer to Table 4–5.**

The controller performs self-check routines. If an internal failure occurs, an “ERR” alarm will appear on the display. This is an indication the controller needs to be replaced. In the event that a failure occurs and the display cannot be updated, the status LED will indicate the appropriate ERR code using Morse code as shown below.

| ERR 0 | . .–. .–. ––––– | |
|---|---|---|
| **Cause:** | RAM failure | |
| | **Description** | Indicates that the controller working memory has failed. |

| ERR 1 | . .–. .–. . ––––  | |
|---|---|---|
| **Cause:** | Program Memory failure | |
| | **Description** | Indicates a problem with the controller program. |

| ERR 2 | . .–. .–. . . ––– |
|---|---|
| **Cause:** | Watchdog time-out |
| **Description** | The controller program has entered a mode whereby the controller program has stopped executing. |

| ERR 3 | . .–. .–. . . . –– |
|---|---|
| **Cause:** | N/A |
| **Description** | N/A |

| ERR 4 | . .–. .–. . . . . – |
|---|---|
| **Cause:** | N/A |
| **Description** | N/A |

| ERR 5 | . .–. .–. . . . . |
|---|---|
| **Cause:** | A−D failure |
| **Description** | The controller's Analog to Digital (A−D) converter has failed. |

| ERR 6 | . .–. .–. –. . . . |
|---|---|
| **Cause:** | IO Board failure |
| **Description** | Internal program/update failure. |

| ERR 7 | . .–. .–. ––. . . |
|---|---|
| **Cause:** | Controller failure |
| **Description** | Internal version/firmware incompatible. |

| ERR 8 | . .–. .–. –––. . |
|---|---|
| **Cause:** | DataCORDER failure |
| **Description** | Internal DataCORDER memory failure. |

| ERR 9 | . .–. .–. ––––  . |
|---|---|
| **Cause:** | Controller failure |
| **Description** | Internal controller memory failure. |

| Entr StPt | **Enter Set point (Press Arrow & Enter)** |
|---|---|
| **Cause:** | The controller is prompting the operator to enter a setpoint. |

| LO | **Low Main Voltage (Cd27-38 disabled, NO alarm stored.)** |
|---|---|
| **Cause:** | This message will be alternately displayed with the setpoint whenever the supply voltage is less than 75% of its proper value. |

## 4.12 Controller Pre-Trip Test Codes

| Code | Title | Description |
|---|---|---|
| | | **NOTICE**<br>**"Auto" or "Auto1" menu includes the: P0, P1, P2, P3, P4, P5, P6 and rSLts.**<br>**"Auto2" menu includes P0, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10 and rSLts.**<br>**"Auto3" menu includes P0, P1, P2, P3, P4, P5, P6, P7 and P8.** |
| P0-0 | Pre-trip Initiated | **Setup:** The display shows, in sequence, Container identifier code, software revision number (Cd18), container unit model number (Cd20), and configuration database identifier CFMMYYDD.<br>Next the unit indicates the presence of an RMU according to whether any RMU inquiry messages have been received since the unit was booted.<br>Units equipped with Autoslide (Cnf44) will position the vent to closed, followed by two sequences of opening to 100% and returning to the closed position. No other Autoslide mode of operation will be available until the two cycles of opening and closing have completed.<br>**Pass / Fail Criteria:** Since the system cannot recognize lights and display failures, there are no test codes or results associated with this phase of Pre-trip.<br>To know if the test passes the operator must visually observe that the LCD display elements and the indicator lights function. |

**P1 Tests - Heaters Current Draw:** Heater is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test.

| Code | Title | Description |
|---|---|---|
| P1-0 | Heaters Turned On | **Setup:** Heater starts in the off condition, current draw is measured, and then the heater is turned on. After 15 seconds on, the current draw is measured again. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw change is within the range specified. |
| P1-1 | Heaters Turned Off | **Setup:** Heater is then turned off. After 10 seconds the current draw is measured. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw change is within the range specified. |

**P2 Tests - Gas Cooler Fan Current Draw:** Gas Cooler fan is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test. If the Water Pressure Switch is open this test will be skipped.

| Code | Title | Description |
|---|---|---|
| P2-0 | Gas Cooler Fan, Low Speed On Test | **Setup:** Gas Cooler fan starts in the off condition, current draw is measured, and Gas Cooler low speed fan is then turned on. After 10 seconds the current draw is measured again. The change in current draw is then recorded. After the current is measured the Gas Cooler fan is turned off and after 2 seconds a second off measurement is taken.<br>**Pass / Fail Criteria:** Test passes if current draw is in the specified range. |
| P2-1 | Gas Cooler Fan, High Speed On Test | **Setup:** Gas Cooler fan starts in the off condition, current draw is measured, and Gas Cooler high speed fan is then turned on. After 15 seconds the current draw is measured again. The change in current draw is then recorded. After the current is measured the Gas Cooler fan is turned off and after 15 seconds a second off measurement is taken.<br>**Pass / Fail Criteria:** Test passes if current draw is in the specified range. |

**P3 Tests - Low Speed Evaporator Fan Current Draw:** Low speed evaporator fan is turned on, then off. Current draw must fall within specified range. No other system components will change state during this test.

| Code | Title | Description |
|---|---|---|
| P3-0 | Low Speed Evaporator Fans On Test | **Setup:** Evaporator fans start in the off condition, current draw is measured, and then low speed evaporator fans will be turned on. After 10 seconds the current draw is measured again. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw is in the specified range. |
| P3-1 | Low Speed Evaporator Fans Off Test | **Setup:** Low speed evaporator fans are then turned off. After 2 seconds the current draw is measured. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw is in the specified range. |

**P4 Tests - High Speed Evaporator Fan Current Draw:** High speed evaporator fans are turned on, then off. Current draw must fall within specified range and measured current changes must exceed specified ratios. No other system components will change state during this test.

| Code | Title | Description |
|---|---|---|
| P4-0 | High Speed Evaporator Fans On Test | **Setup:** Evaporator fans start in the off condition, current draw is measured, and then high speed evaporator fans will be turned on. After 10 seconds the current draw is measured again. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw is in the range specified. |
| P4-1 | High Speed Evaporator Fans Off Test | **Setup:** High speed evaporator fans are then turned off. After 2 seconds the current draw is measured. The change in current draw is then recorded.<br>**Pass / Fail Criteria:** Test passes if current draw is in the range specified. |

**P5 Tests - Air Stream Sensor Tests:** Tests the validity of the Air Stream Temperature & Humidity Sensors (HS).

| Code | Title | Description |
|---|---|---|
| P5-0 | Supply/Return Temperature Probe Test | **Setup:** High Speed Evaporator Fan is turned on and run for eight minutes, with all other outputs de-energized.<br>**Pass / Fail Criteria:** A temperature comparison is made between the return and supply probes.<br>**NOTE:**<br>If this test fails, “P5-0” and “FAIL” will be displayed. If both Probe tests (this test and the PRIMARY/ SECONDARY) pass, display will read “P5” “PASS.” |
| P5-1 | Primary vs Secondary Supply Temperature Test | **Requirements:** For units equipped with secondary supply probe only.<br>**Pass / Fail Criteria:** The temperature difference between Supply Temperature Sensor (STS) and supply recorder sensor (SRS) probe is compared.<br>**NOTE:**<br>If this test fails, “P5-1” and “FAIL” will be displayed. If both Probe tests (this and the SUPPLY/RETURN TEST) pass, because of the multiple tests, the display will read “P 5” “PASS.” |
| P5-2 | Primary vs Secondary Return Temperature Test | **Requirements:** For units equipped with secondary return probe only.<br>**Pass / Fail Criteria:** The temperature difference between Return Temperature Sensor (RTS) and Return Recorder Sensor (RRS) probe is compared.<br>**NOTES:**<br>1. If this test fails, “P5-2” and “FAIL” will be displayed. If both Probe tests (this test and the SUPPLY/RETURN) pass, because of the multiple tests, the display will read “P 5,” “PASS.”<br>2. The results of Pre-trip tests 5-0, 5-1 and 5-2 will be used to activate or clear control probe alarms. |

| Code | Title | Description |
|---|---|---|
| P5-10 | Humidity Sensor Controller Configuration Verification Test | **Setup:** This is a Pass / Fail / Skip test of the Humidity Sensor (HS) configuration.<br>**Pass / Fail Criteria:** Test passes if the controller configuration has Humidity Sensor in. Test fails if the controller configuration has Humidity Sensor out and Humidity Sensor voltage is greater than 0. This test is skipped if the controller configuration has the Humidity Sensor out and Vout is less than 0.20 Volts. |
| P5-11 | Humidity Sensor Installation Verification Test | **Setup:** This is a Pass / Fail test of Humidity Sensor (HS) installation, humidity sensor is present. Test P5-10 must pass before this test is run.<br>**Pass / Fail Criteria:** Test passes if Humidity Sensor voltage is greater than 0.20.<br>Test fails if the voltage is less than 0.20 Volts or if the humidity sensor is configured in and is not present. |
| P5-12 | Humidity Sensor Range Check Test | **Setup:** This is a Pass / Fail test of the Humidity Sensor (HS) range. Test P5-11 must pass before this test is run.<br>**Pass / Fail Criteria:** Test passes if Humidity Sensor voltage is between 0.33 Volts and 4 Volts. Otherwise the test fails. |

**P6 Tests - Refrigerant Probes, Variable Frequency Drive, and Refrigeration Valves:** Tests the VFD, EVXV, HPXV, Unloader Solenoid Valve, Economizer Solenoid Valve, and refrigerant pressure/temperature sensors.

| Code | Title | Description |
|---|---|---|
| P6-0 | Discharge Thermistor Test | **Pass / Fail Criteria:** If AL64 (Discharge Temperature Sensor) is activate, the test fails. Otherwise the test passes. |
| P6-1 | Suction Thermistor Test | **Pass / Fail Criteria:** If the Suction Temperature Sensor (CPSS) is both configured ON and is invalid, the test fails. Otherwise the test passes. |
| P6-2 | Discharge Pressure Sensor Test | **Pass / Fail Criteria:** If AL65 (Discharge Pressure Sensor, DPT) is active any time during the first 45 second period, the test fails. Otherwise, the test passes. |
| P6-3 | Suction Pressure Sensor Test | **Pass / Fail Criteria:** If AL66 (Suction Pressure Sensor) is active the test fails. Otherwise the test passes. |
| P6-4 | Flash Tank Pressure Sensor Test | **Pass / Fail Criteria:** If AL68 (Flash Tank Pressure Transducer Alarm), is active the test fails. Otherwise the test passes.<br>**NOTE:**<br>After P6-4 is complete, the unit will establish an initial operating condition. |
| P6-5 | Unloader Valve (USV) Test | **Setup:** This test is run after P6-6. During this test, 50 seconds after the initial run condition USV will close while system pressures are checked. After meeting certain criteria the USV will be opened and system operating conditions will again be checked to confirm that USV has opened. |
| P6-6 | Variable Frequency Drive Test | **Setup:** This test is run before P6-5. During this test, the unit will establish an initial operating condition. After 20 seconds at the initial condition compressor speed will be increased and system operating conditions will be recorded after which time the compressor speed will be decreased.<br>**Pass / Fail Criteria:** Test passes when a pressure change has been detected. |
| P6-7 | High Pressure Expansion Valve (HPXV) Test | **Setup:** After P6-6 is complete, the unit will establish an initial operating condition. After the initial operating condition the controller will slowly adjust HPXV and monitor discharge pressure.<br>**Pass / Fail Criteria:** Test will pass provided an increase in discharge pressure has been detected. |

| Code | Title | Description |
|---|---|---|
| P6-8 | Evaporator Expansion Valve (EEV) Test | **Setup:** After P6-7 is complete, the unit will establish an initial operating condition. After the initial operating condition the controller will slowly adjust EEV.<br>**Pass / Fail Criteria:** Once pressure difference has been determined, the test passes. |
| P6-9 | Economizer Solenoid Valve (ESV) Test | **Setup:** Setup: After P6-8 has completed, the unit will establish an initial operating condition. The controller will then energize the Unloader Solenoid Valve (USV), followed by the economizer valve ESV. The controller will monitor system pressures<br>**Pass / Fail Criteria:** Test will pass based on the change in pressure. |
| P6-10 | Low Charge Check | **Pass / Fail Criteria:** Test will pass if the unit has adequate charge. Otherwise, test fails. |

**NOTICE**

**P7-0 & P8 are included with "Auto2 & Auto3" only. P9-0 through P10 are included with "Auto2" only.**

**P7 Tests - High Pressure Tests:** Unit is run at full capacity with low condenser fan running to make sure that the HPS opens and closes properly.

| Code | Title | Description |
|---|---|---|
| P7-0 | High Pressure Switch Opening Test | When test is running, the right display shows Discharge Pressure if the sensor is configured and valid, else Discharge Temperature.<br>**Setup:** The unit will establish an initial operating condition, then will slowly adjust VFD and HPXV and control system pressure to reach test criteria.<br>Pre-trip 7 will be skipped if any of the following conditions are met before the test:<br>Return Temperature < -17.77°C.<br>Water Pressure Switch is open (if equipped).<br>**Pass / Fail Criteria:** Test passes if HPS opens any time after the compressor starts.<br>Test fails if:<br>HPS fails to open before 900 seconds total test time. Discharge Pressure greater than 2075 psig. If greater than 2075 psig shutdown compressor, turn on fans, fail test.<br>Abort test if:<br>Evaporator IP alarm.<br>Compressor IP alarm.<br>Water Pressure Switch opens (if equipped).<br>Discharge Temperature exceeds 146.1°C<br>Both Discharge Pressure and Discharge Temperature go invalid.<br>Compressor Current exceeds operating parameters. |
| P7-1 | High Pressure Switch Close Test | **Setup:** The controller will energize the gas cooler fan, open valves, and stop the compressor.<br>**Pass / Fail Criteria:** The test passes if the high pressure switch closes within the 60 seconds. |

**P8 Tests - Perishable Mode Tests:** Pre-trip tests P7-0 and P7-1 must have passed or have been skipped for these tests to execute.

| Code | Title | Description |
|---|---|---|
| P8-0 | Perishable Mode Heat Test | **Setup:** If the control temperature is below 15.56°C, the set-point is changed to 15.56°C, and a 180 minute timer is started. The control will then be placed in the equivalent of normal heating. If the control temperature is above 15.56°C at the start of the test, then the test proceeds immediately to test 8-1. While in test 8-0 the right display will show the value of the control temperature.<br>**Pass / Fail Criteria:** The test fails if the timer expires before the control temperature reaches set-point - 0.3°C. If the test fails, it will not auto-repeat. There is no pass display for this test. Once the control temperature reaches set-point, the test proceeds to test 8-1. |
| P8-1 | Perishable Mode Pulldown Test | **Requirements:** Control temperature must be at least 15.6°C (60°F).<br>**Setup:** Setpoint is changed to 0°C. The system will attempt to pull down the control temperature to setpoint using the equivalent of normal perishable cooling. During this test, the control temperature will be displayed on the right display.<br>**Pass / Fail Criteria:** The test passes if the control temperature goes below the setpoint before the 180 minute timer expires and $CO_2$ sensor calibration passes or is skipped. Otherwise, the test fails. |
| P8-2 | Perishable Mode Maintain Temperature Test | **Requirements:** Test P8-1 must pass for this test to execute. This test is skipped if the DataCORDER is not configured or not available.<br>**Setup:** 15-minute timer is started. The unit will be required to minimize control temperature error (supply temp minus setpoint) until timer expires. Control temperature is sampled at least once each minute starting at the beginning of P8-2.<br>**Pass / Fail Criteria:** If the average recorded temperature is within +/- 1.0°C (1.8°F) of setpoint, the test passes. If the average temperature is outside of the tolerance range or if the DataCORDER supply temperature probe is invalid, the test fails and the control probe temperature will be recorded as -50.0°C. P8-2 will auto-repeat by starting P8-0 over. |

**P9 Tests - DTT Close and Open Test:** The DTT in this control is not a physical device, with actual metallic contacts, it is a software function that acts similar to a thermostat. Using various temperature inputs, the DTT function determines whether a thermostat mounted on the Evaporator Coil would have OPEN or CLOSED contacts. Primarily, the DTT function operates based on the temperature reading from the Defrost Termination Sensor.

| Code | Title | Description |
|---|---|---|
| P9-0 | DTT Closed and Open Test | **Setup:** System will run full cool for 30 minutes max while the DTT probe temperature is above 10°C. (opening threshold), allowing DTT to become considered closed. This step may not have to be executed. Once DTT is considered closed, system simulates defrost by running the heaters for up to 2 hours, or until DTT is considered open (25.6°C/18°C depending on configuration & defrost options). Successful opening of DTT causes the Defrost Interval Timer to be reset. Condenser Pressure Control logic should be used for this test if the controller is configured for it.<br>**Pass / Fail Criteria:** The test fails if: the DTT is not considered closed after the 30 minutes of full cooling, HTT opens when DTT is considered closed or if return air temperature rises above 49°C (120°F). The test passes if the DTT is considered open within the 2 hour heat cycle time limit. |

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**P10 Tests - Frozen Mode Tests:**

| Code | Title | Description |
|---|---|---|
| P10-0 | Frozen Mode Heat Test | **Setup:** If the container temperature is below 7.2°C, the setpoint is changed to 7.2°C., and a 180 Minute timer is started. The control will then be placed in the equivalent of normal heating. If the container temperature is above 7.2C. at the start of the test, then the test proceeds immediately to test 10-1. During this test, the control temperature will be shown on the right display.<br>**Pass / Fail Criteria:** The test fails if the 180 Minute timer expires before the control temperature reaches setpoint - 0.3°C. If the test fails, it will not auto-repeat. There is no pass display for this test. Once the control temperature reaches setpoint, the test proceeds to test 10-1. |
| P10-1 | Frozen Mode Pulldown Test | **Requirements:** Control temperature must be at least 7.2°C (45°F)<br>**Setup:** The setpoint is changed to -17.8°C. The system will then attempt to pull down the control temperature to setpoint using normal frozen mode cooling. During this test, the control temperature will be shown on the right display.<br>**Pass / Fail Criteria:** The test passes if the control temperature reaches setpoint minus 0.3°C before the 180 minute timer expires. Otherwise, the test fails. Upon failure and when initiated by an automatic Pre-trip sequence, P10-1 will auto-repeat once by starting P10-0 over again. |
| P10-2 | Frozen Mode Maintain Temperature Test | **Requirements:** Test P10-1 must pass for this test to execute.<br>**Setup:** Same as test 8-2 except control temperature is return probe.<br>**Pass / Fail Criteria:** The average error must be +/-1.6°C. If the DataCORDER supply temperature probe is invalid, the test fails and the control probe temperature will be recorded as -50°C. Upon failure and when initiated by an automatic Pre-trip sequence, P10-2 will auto-repeat by starting P10-0 over again. |

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**Table 4–9 DataCORDER Function Code Assignments**

| NOTE:<br>Inapplicable Functions display "-----" | | |
|---|---|---|
| To Access: Press the ALT.MODE key then CODE SELECT key | | |
| **Code** | **Title** | **Description** |
| dC1 | Recorder Supply Temperature | Current reading of the supply recorder sensor. |
| dC2 | Recorder Return Temperature | Current reading of the return recorder sensor. |
| dC3-5 | USDA 1,2,3 Temperatures | Current readings of the three USDA probes. |
| dC6-13 | Network Data Points 1-8 | Current values of the network data points, as configured. Data point 1 (code 6) is generally the Humidity Sensor (HS) and its value is obtained from the controller once every minute. |
| dC14 | Cargo Probe 4 Temperature | Current reading of the cargo probe #4. |
| dC15-19 | Future Expansion | These codes are for future expansion, and are not in use at this time. |
| dC20-24 | Temperature Sensors 1-5 Calibration | Current calibration offset values for each of the five probes: supply, return, USDA #1, #2, and #3. These values are entered via the interrogation program. |
| dC25 | Future Expansion | This code is for future expansion, and is not in use at this time. |

**Table 4–9 DataCORDER Function Code Assignments**

| NOTE:<br>Inapplicable Functions display "-----" | | |
|---|---|---|
| To Access: Press the ALT.MODE key then CODE SELECT key | | |
| **Code** | **Title** | **Description** |
| dC26,27 | S/N, Left 4, Right 4 | The DataCORDER serial number consists of eight characters. Function code dC26 contains the first four characters. Function code dC27 contains the last four characters. (This serial number is the same as the controller serial number.) |
| dC28 | Minimum Days Left | An approximation of the number of logging days remaining until the DataCORDER starts to overwrite the existing data. |
| dC29 | Days Stored | Number of days of data that are currently stored in the DataCORDER. |
| dC30 | Date of Last Trip start | The date when a Trip Start was initiated by the user. In addition, if the system goes without power for seven continuous days or longer, a trip start will automatically be generated on the next AC power up. Press and hold "ENTER" key for five seconds to initiate a "Trip Start." |
| dC31 | Battery Test | Shows the current status of the optional battery pack.<br>**PASS:** Battery pack is fully charged.<br>**FAIL:** Battery pack voltage is low. |
| dC32 | Time: Hour, Minute | Current time on the real time clock (RTC) in the DataCORDER. |
| dC33 | Date: Month, Day | Current date (month and day) on the RTC in the DataCORDER. |
| dC34 | Date: Year | Current year on the RTC in the DataCORDER. |
| dC35 | Cargo Probe 4 Calibration | Current calibration value for the Cargo Probe. This value is an input via the interrogation program. |

**Table 4–10 DataCORDER Pre-Trip Result Records**

| Test | Title | Data |
|---|---|---|
| P1-0 | Heater On | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P1-1 | Heater Off | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P2-0 | Gas Cooler Fan On | Pass / Fail / Skip Result, Water Pressure Switch (WPS) - Open / Closed.<br>Change in currents for Phase A, B and C. |
| P2-1 | Gas Cooler Fan Off | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P3-0 | Low Speed Evaporator Fan On | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P3-1 | Low Speed Evaporator Fan Off | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P4-0 | High Speed Evaporator Fan On | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P4-1 | High Speed Evaporator Fan Off | Pass / Fail / Skip Result, Change in currents for Phase A, B and C. |
| P5-0 | Supply / Return Probe Test | Pass / Fail / Skip Result, STS, RTS, SRS and RRS. |
| P5-1 | Secondary Supply Probe (SRS) Test | Pass / Fail / Skip. |
| P5-2 | Secondary Return Probe (RRS) Test | Pass / Fail / Skip. |
| P5-10 | Humidity Sensor Controller Configuration | Pass / Fail / Skip. |
| P5-11 | Humidity Sensor Installation | Pass / Fail / Skip. |

**Table 4–10 DataCORDER Pre-Trip Result Records**

| Test | Title | Data |
|---|---|---|
| P5-12 | Humidity Sensor Range | Pass / Fail / Skip. |
| P6-0 | Discharge Thermistor Test | Pass / Fail / Skip. |
| P6-1 | Suction Thermistor Test | Pass / Fail / Skip. |
| P6-2 | Discharge Pressure Sensor Test | Pass / Fail / Skip. |
| P6-3 | Suction Pressure Sensor Test | Pass / Fail / Skip. |
| P6-4 | Flash Tank Pressure Sensor Test | Pass / Fail / Skip. |
| P6-5 | USV Test | Pass / Fail / Skip. |
| P6-6 | VFD Test | Pass / Fail / Skip. |
| P6-7 | HPXV Test | Pass / Fail / Skip. |
| P6-8 | EEV Test | Pass / Fail / Skip. |
| P6-9 | ESV Test | Pass / Fail / Skip. |
| P6-10 | Low Charge Check | Pass / Fail / Skip. |
| P7-0 | High Pressure Switch Open | Pass / Fail / Skip. |
| P7-1 | High Pressure Switch Close | Pass / Fail / Skip. |
| P8-0 | Perishable Mode Heat Test | Pass / Fail / Skip Result, STS, time it takes to heat to 16°C (60°F). |
| P8-1 | Perishable Mode Pulldown Test | Pass / Fail / Skip Result, STS, time it takes to pull down to 0°C (32°F). |
| P8-2 | Perishable Mode Maintain Test | Pass / Fail / Skip Result, Averaged DataCORDER supply temperature (SRS) over last recording interval. |
| P9-0 | DTT Open / Close Test | Pass / Fail / Skip Result, DTS reading at end of test, line voltage, line frequency, time in defrost. |
| P10-0 | Frozen Mode Heat Test | Pass / Fail / Skip Result, STS, time unit is in heat. |
| P10-1 | Frozen Mode Pulldown Test | Pass / Fail / Skip Result, STS, time to pull down unit to -17.8°C (0°F). |
| P10-2 | Frozen Mode Maintain Test | Pass / Fail / Skip Result, Averaged DataCORDER return temperature (RRS) over last recording interval. |

# SECTION 5
# OPERATION

## 5.1 Introduction

**⚠ WARNING**

**Beware of unannounced starting of the evaporator and gas cooler fans. The unit may cycle the fans and compressor unexpectedly as control requirements dictate.**

1. Check inside for the following:
   a. Check channels or “T” bar floor for cleanliness. Channels must be free of debris for proper air circulation.
   b. Check container panels, insulation and door seals for damage. Effect permanent or temporary repairs.
   c. Visually check evaporator fan motor mounting bolts for proper securement (see **Section 7.13**).
   d. Check for visible corrosion on the evaporator stator and fan deck (see **Section 7.14**).
   e. Check for dirt or grease on evaporator fans or fan deck and clean if necessary.
   f. Check evaporator coil for cleanliness or obstructions. Wash with fresh water.
   g. Check defrost drain pans and drain lines for obstructions and clear if necessary. Wash with fresh water.
   h. Check panels on refrigeration unit for loose bolts and condition of panels. Make sure TIR devices are in place on access panels.
2. Check gas cooler coil for cleanliness. Wash with fresh water.
3. Open control box door. Check for loose electrical connections or hardware.

## 5.2 Connect Power

**⚠ WARNING**

**Do not attempt to remove power plug(s) before turning OFF Start-Stop switch (ST), unit circuit breaker(s) and external power source.**

**⚠ WARNING**

**Make sure the power plugs are clean and dry before connecting to power receptacle.**

### 5.2.1 Connection To 380/460 VAC Power

1. Make sure Start-Stop switch (ST), on control panel) and circuit breaker (CB-1, in the control box) are in position “0” (OFF).
2. Plug the 460 VAC (yellow) cable into a de-energized 380/460 VAC, 3-phase power source. Energize the power source. Place circuit breaker (CB-1) in position “I” (ON). Close and secure control box door.

## 5.3 Adjust Fresh Air Makeup Vent

The purpose of the fresh air makeup vent is to provide ventilation for commodities that require fresh air circulation. The vent must be closed when transporting frozen foods.

Air exchange depends on static pressure differential, which will vary depending on the container and how the container is loaded.

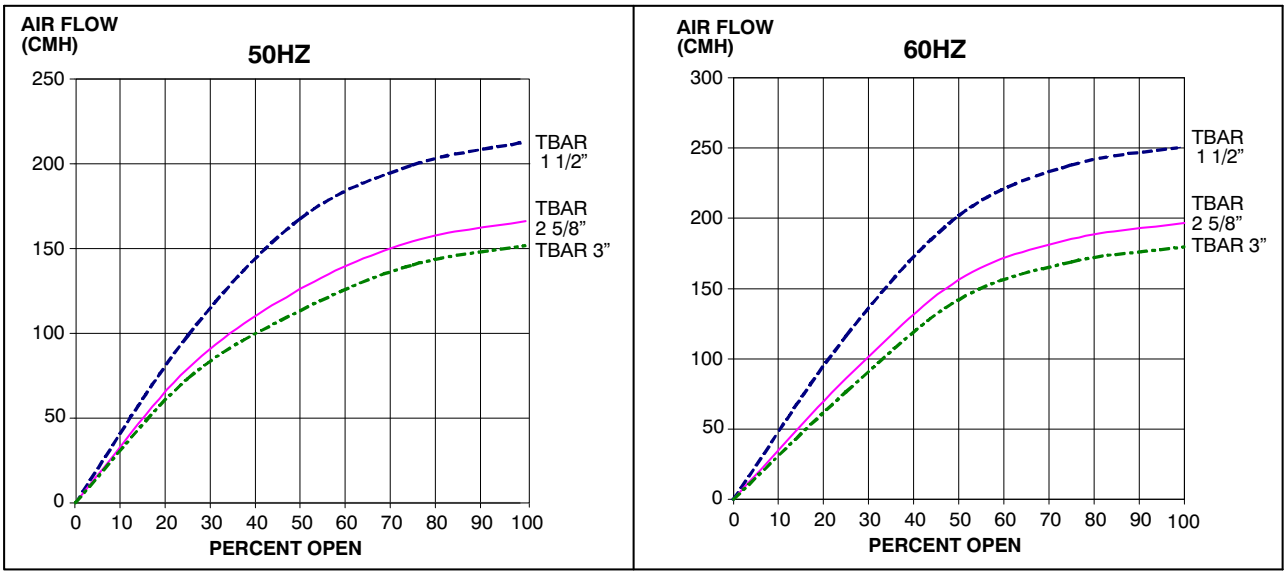
Units may be equipped with a Vent Position Sensor (VPS). The VPS determines the position of the fresh air vent and sends data to the controller display.

### 5.3.1 Upper Fresh Air Makeup Vent

Two slots and a stop are designed into the Upper Fresh Air disc for air flow adjustments. The first slot allows for a 0 to 30% air flow; the second slot allows for a 30 to 100% air flow. To adjust the percentage of air flow, loosen the wing nut and rotate the disc until the desired percentage of air flow matches with the arrow. Tighten the wing nut. To clear the gap between the slots, loosen the wing nut until the disc clears the stop.

**Figure 5.1** gives air exchange values for an empty container. Higher values can be expected for a fully loaded container.

**Figure 5.1 Upper Fresh Air Makeup Flow Chart**




### 5.3.2 Vent Position Sensor

The VPS allows the user to determine the position of the fresh air vent via Function Code Cd45. This function code is accessible via the CODE SELECT key.

The vent position will display for 30 seconds whenever motion corresponding to 5 CMH (3 CFM) or greater is detected.

It will scroll in intervals of 5 CMH (3 CFM). Scrolling to Function Code 45 will display the Fresh Air Vent Position.

The vent position will be recorded in the DataCORDER whenever the unit is running under AC power and any of the following:

Trip start

On every power cycle

Midnight

Manual changes greater than 5 CMH (3 CFM)

Vent remains in the new position for at least 4 minutes

**NOTICE**

**The user has four minutes to make necessary adjustments to the vent setting. This time calculation begins on the initial movement of the sensor. The vent can be moved to any position within the four minutes. On completion of the first four minutes, the vent is required to remain stable for the next four minutes. If vent position changes are detected during the four minute stability period, an alarm will be generated. This provides the user with the ability to change the vent setting without generating multiple events in the DataCORDER.**

**Operational Parameters**

FLO indicates the opening to which the slide will move based on the stored value in CMH (in increments of 5) or CFM depending on the selection of Cd46 (Airflow display units), Cd28 (Metric/Imperial) or the pressing of the deg C/F key. CFM is displayed as CF, CMH is displayed as CM.

tIM is the time delay prior to the door opening. The time range is from 1 to 72 hrs in 1 hr increments.

CO2LM is the maximum level of carbon dioxide that is allowed for the cargo. The range is from 0% to 19% in 1% increments, the default setting is 10.

O2LM is the minimum level of $O_2$ that is allowed for the cargo. The range is from 2% to 20% in 1% increments, the default setting is 10.

Rtn is an offset value used to expand the return air temperature value in order to compensate for fresh air entering the container. The allowable range is 0.6°C - 2.8°C or 1.0°F - 5.0°F in 0.1 degree increments, default setting is 2.8°C (5°F).

## 5.4 Connect Water Cooled Condenser

The water-cooled condenser is used when cooling water is available and heating the surrounding air is objectionable, such as in a ship's hold. If water cooled operation is desired, connect in accordance with the following procedure:

1. Connect the water supply line to the inlet/outlet couplings on the unit.
2. Maintain a flow rate of 15 to 30 liters per minute (4 to 8 gallons per minute). The water pressure switch will open to de-energize the gas cooler fan relay. The gas cooler fan motor will stop and will remain stopped until the water pressure switch closes.
3. To shift to air-cooled condenser operation, disconnect the water supply and the discharge line to the water-cooled condenser. The refrigeration unit will shift to air-cooled condenser operation when the water pressure switch closes.

## 5.5 Connect Remote Monitoring Receptacle

If remote monitoring is required, connect remote monitor plug at unit receptacle. When the remote monitor plug is connected to the remote monitoring receptacle, the following remote circuits are energized:

| Circuit | Function |
|---|---|
| Sockets B to A | Energizes remote cool light |
| Sockets C to A | Energizes remote defrost light |
| Sockets D to A | Energizes remote in-range light |

**⚠ WARNING**

**Make sure that the unit circuit breaker CB-1 and the Start-Stop switch (ST) are in the "O" (OFF) position before connecting to any electrical power source.**

### 5.5.1 Starting the Unit

1. With power properly applied and the fresh air vent position set (if required) place the Start-Stop switch (ST) to "I" (ON).

**NOTICE**

**The electronic phase detection system will check for proper phase rotation within the first 5 seconds. If rotation is not correct, the phase will be reversed.**

2. The Controller Function Codes for the container ID (Cd40), software version (Cd18) and unit model number (Cd20) will be displayed in sequence.
3. Continue with Start Up Inspection, **Section 5.6**.

### 5.5.2 Stopping the Unit

To stop the unit, place the Start-Stop switch (ST) in position "0" (OFF).

## 5.6 Start-Up Inspections

### 5.6.1 Physical Inspection

Check rotation of gas cooler and evaporator fans.

### 5.6.2 Check Controller Function Codes

Check, and if required, reset controller function codes (Cd27 through Cd39) in accordance with desired operating parameters. See **Table 4–7**.

### 5.6.3 DataCORDER Inspection

1. Check and, if required, set the DataCORDER Configuration in accordance with desired recording parameter. See **Table 4.7.3**.
2. Enter a “Trip Start.” To enter a “Trip Start,” do the following:
   a. Press the ALT MODE key. When the left display shows, dC, Press the ENTER key.
   b. Scroll to Code dC30.
   c. Press and hold the ENTER key for five seconds.
   d. The “Trip Start” event will be entered in the DataCORDER.

### 5.6.4 Complete Inspection

Allow unit to run for five minutes to stabilize conditions and perform a pre-trip diagnosis in accordance with the following paragraph.

## 5.7 Pre-Trip Diagnosis

**⚠ CAUTION**

**Pre-trip diagnostics should not be performed with critical temperature cargoes in the container.**

**⚠ CAUTION**

**When the PRE-TRIP key is pressed, economy, dehumidification and bulb mode will be deactivated. At the completion of Pre-Trip activity, economy, dehumidification and bulb mode must be reactivated.**

Pre-trip diagnosis provides automatic testing of the unit components using internal measurements and comparison logic. The program will provide a “PASS” or “FAIL” display to indicate test results.

The testing begins with access to a Pre-trip selection menu. The user may have the option of selecting one of two automatic tests. These tests will automatically perform a series of individual Pre-trip tests. The user may also scroll down to select any of the individual tests. When only the short sequence is configured, it will appear as “AUtO” in the display. Otherwise “AUtO1” will indicate the short sequence and “AUtO2” will indicate the long sequence. The test short sequence will run tests P0 through P6. The long test sequence will run tests P0 through P10.

A detailed description of the Pre-trip test codes is listed in **Section 4.12**. If no selection is made, the Pre-trip menu selection process will terminate automatically. However, dehumidification and bulb mode must be reactivated manually if required.

Scrolling down to the “r SLts” code and pressing the ENTER key will allow the user to scroll through the results of the last Pre-trip testing run. If no Pre-test has been run (or an individual test has not been run) since the unit was powered up, “----” will be displayed.

Prior to Starting a Trip Test verify the following:

- Voltage (Cd 07) is within tolerance and unit amperage draw (Cd 04, Cd 05, Cd 06) are within expected limits. Otherwise, tests may fail incorrectly.
- All alarms are rectified and cleared.

### 5.7.1 Starting a Pre-Trip

1. Press the PRE-TRIP key to access the Pre-trip test selection menu. “SELCt PrtrP” will be displayed.

**NOTE**

While making a selection, failure to press either an Arrow key or ENTER for 5 seconds will return the system to its default display, and normal operating mode.

2. To Run an Automatic Test: Scroll through the selections by pressing the Up or Down Arrow keys to display AUtO, AUtO 1, AUtO 2 or AUtO 3 as desired, then press the ENTER key.
   - The unit will execute the series of tests without any need for direct user interface. These tests vary in length, depending on the component under test.
   - While tests are running, “P#-#” will appear on the left display; the #’s indicate the test number and sub-test. The right display will show a countdown time in minutes and seconds, indicating the amount of time remaining in the test.

**⚠ CAUTION**

**When a failure occurs during automatic testing, the unit will suspend operation awaiting operator intervention.**

**⚠ CAUTION**

**When Pre-trip test Auto2 runs to completion without being interrupted, the unit will terminate Pre-trip and display “Auto2 end”. The unit will suspend operation until the user presses the ENTER key.**

When Pre-trip test Auto1 runs to completion without a failure, the unit will exit the pre-trip mode and return to normal control operation. However, dehumidification and bulb mode must be reactivated manually if required.

3. When an automatic test fails, it will be repeated once. A repeated test failure will cause “FAIL” to be shown on the right display, with the corresponding test number to the left. The user may then press the Down Arrow key to repeat the test, the Up Arrow key to skip to the next test or the PRE-TRIP key to terminate testing. The unit will wait indefinitely or until the user manually enters a command.
4. To Run an Individual Test: Scroll through the selections by pressing the Up or Down Arrow keys to display an individual test code. Press the ENTER key when the desired test code is displayed.
   - Individually selected tests, other than the LED / Display test, will perform the operations necessary to verify the operation of the component. At the conclusion, “PASS” or “FAIL” will be displayed. This message will remain displayed for up to three minutes, during which time a user may select another test. If the three minute time period expires, the unit will terminate Pre-trip and return to control mode operation.
   - While the tests are being executed, the user may terminate the Pre-trip diagnostics by pressing and holding the PRE-TRIP key. The unit will then resume normal operation. If the user decides to terminate a test but remain at the test selection menu, the user may press the Up Arrow key. When this is done, all test outputs will be de-energized and the test selection menu will be displayed.
   - Throughout the duration of any Pre-trip test (except the P-7 high pressure switch tests), the current and pressure limiting processes are active. The current limiting process only is active for P-7.

### 5.7.2 Displaying Pre-Trip Results

1. Press the PRE-TRIP key to access the Pre-trip test selection menu. “SELCt PrtrP” will be displayed.
2. Press the Arrow keys until “P rSLts” (Pre-trip results) is displayed.

**NOTE**

While making a selection, failure to press either an Arrow key or ENTER for 5 seconds will return the system to its default display, and normal operating mode.

3. Press the ENTER key. The results for all Pre-trip sub tests are available from this menu (i.e., 1-0, 1-1, etc).

   The results will be displayed as “PASS” or “FAIL” for all the tests run to completion since power up. If a test has not been run since power up, “-----” will be displayed.

   Once all Pre-test activity is completed, dehumidification and bulb mode must be reactivated manually if required.

## 5.8 Observe Unit Operation

### 5.8.1 Probe Diagnostic Logic

For units configured with four temperature probes, which include the supply and return temperature probes and the supply and return DataCORDER probes, the controller continuously performs probe diagnosis testing that compares the four probes. If the diagnosis result indicates a problem exists, the controller will perform a probe check to identify which probe or probes are in error.

a. Probe Diagnostic Logic:

   In the perishable mode of operation, both pairs of supply and return probes are monitored for probe disagreement. Probe disagreement is considered a difference of 0.5°C (0.9°F) or greater between the supply air sensors and/or a difference of 2.0°C (3.6°F) between the return air sensors. Probe disagreement found in either pair can trigger a defrost probe check.

   In the frozen mode of operation, only the controlling probes are considered. Disagreement of the controlling probes can trigger a defrost probe check, which will occur when the difference between the sensors are greater than 2.0°C (3.6°F). Normally, the controlling probes are the return probes but if both return probes are invalidated, the supply probes are used for control purposes. Probe disagreement of the non-controlling probe pair will not trigger a defrost probe check.

   If the supply probes agree and return probes agree, all supply and return sensors are valid and the unit returns to normal control.

   If supply probes disagree and the return probes agree, then invalidate the worst supply probe. If the probe check is run as part of Pre-trip P-5, an alarm will be triggered for the invalidated probe. If it is a run time defrost probe check, the invalidated probe will be passed over and no alarm will be triggered. However, if the best supply probe is greater than 1.2°C (2.2°F) difference with respect to its return probes, the best supply probe is also invalidated. If unit is in perishable operation, a probe alarm will be triggered for both supply probes.

   If the supply probes agree and return probes disagree, invalidate the worst return probe. If the probe check is being run as part of Pre-trip P-5, an alarm will be triggered for the invalidated probe. If it is a run time defrost probe check, the invalidated probe will be passed over and no alarm will be necessary. If the best return probe is greater than 1.2°C (2.2°F) difference with respect to its supply probes, then the best return probe is also invalidated. If unit is in perishable operation, a probe alarm will be triggered for both return probes.

b. Probe Check Procedure:

   A probe check diagnostic procedure is executed during Pre-trip P-5. A defrost cycle probe check may be accomplished at the end of defrost by energizing the evaporator motors for eight minutes at the end of the normal defrost. The defrost light will remain on during this period. If supply probes are within limits and return probes are within limits, the unit will return to normal control.

# SECTION 6
# TROUBLESHOOTING

| 6.1 Unit Will Not Start Or Starts Then Stops | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| No power to unit | External power source OFF | Turn On |
| | Start-Stop switch OFF or defective | Check |
| | Circuit breaker OFF or tripped | Check |
| Loss of control power | Circuit breaker OFF or defective | Check |
| | Control transformer defective | Check |
| | Fuse (F3A / F3B) blown | Check |
| | Start-Stop switch OFF or defective | Check |
| Component(s) not operating | Evaporator fan motor internal protector open | **Section 7.13** |
| | Gas Cooler fan motor internal protector open | **Section 7.9** |
| | Compressor internal protector open | **Section 7.3** |
| | High Pressure Switch (HPS) open | **Section 5.8** |
| | Heat Termination Thermostat (HTT) open | Replace |
| | Current sensor malfunction | Replace |

| 6.2 Unit Operates Long Or Continuously In Cooling | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Container | Hot load | Normal |
| | Box insulation defective or air leak | Repair |
| Refrigeration system | Refrigerant shortage | **Section 7.2.6** |
| | Evaporator coil covered with ice | **Section 6.6** |
| | Evaporator coil plugged with debris | **Section 7.11** |
| | Evaporator coil has air bypass around it | Check |
| | Controller set too low | Reset |
| | Coil dirty | **Section 7.8** |
| | Current limit (Cd32) set to wrong value | **Section 4.4.3** |
| | Economizer Solenoid Valve (ESV) malfunction | **Section 7.17** |
| | Electronic Expansion Valve (EEV) | Replace |

| 6.3 Unit Runs But Has Insufficient Cooling | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Refrigeration system | Pressures abnormal | **Section 6.7** |
| | Temperatures abnormal | **Section 6.13** |
| | Currents abnormal | **Section 6.14** |
| | Controller malfunction | **Section 6.9** |
| | Evaporator fan or motor defective | **Section 7.13** |
| | Electronic Expansion Valve (EEV) | Replace |

| 6.4 Unit Will Not Heat Or Has Insufficient Heating | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| No operation of any kind | Start-Stop switch OFF or defective | Check |
| | Circuit breaker OFF or defective | Check |
| | External power source OFF | ON |
| No control power | Circuit breaker or fuse defective | Replace |
| | Control Transformer defective | Replace |
| | Evaporator fan internal motor protector open | **Section 7.13** |
| | Heat relay defective | Check |
| | Heat Termination Thermostat (HTT) open | **Section 7.11** |
| Unit will not heat or has insufficient heat | Heater(s) defective | **Section 7.11** |
| | Heater contactor or coil defective | Replace |
| | Evaporator fan motor(s) defective | **Section 7.11** / **Section 7.13** |
| | Evaporator fan motor contactor defective | Replace |
| | Controller malfunction | **Section 6.9** |
| | Wiring defective | Replace |
| | Terminal connections loose | Tighten |
| | Line voltage low | **Section 3.4** |

| 6.5 Unit Will Not Terminate Heating | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Unit fails to stop heating | Controller improperly set | Reset |
| | Controller malfunction | **Section 6.9** |
| | Heat Termination Thermostat (HTT) remains closed along with the heat relay | **Section 7.11** |

| 6.6 Unit Will Not Defrost Properly | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Will not initiate defrost automatically | Defrost timer malfunction (Cd27) | **Table 4–7** |
| | Terminal connections loose | Tighten |
| | Wiring defective | Replace |
| | Defrost Temperature Sensor (DTS) defective or Heat Termination Thermostat (HTT) open | Replace |
| | Heater contactor or coil defective | Replace |
| Will not initiate defrost manually | Manual defrost switch defective | Replace |
| | Keypad defective | Replace |
| | Defrost Temperature Sensor (DTS) open | Replace |
| Initiates but relay DR drops out | Low line voltage | **Section 3.4** |
| Initiates but does not defrost | Heater contactor or coil defective | Replace |
| | Heater(s) burned out | **Section 7.11** |

| 6.7 Abnormal Pressures | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| High discharge pressure | Gas Cooler coil dirty | **Section 7.8** |
| | Gas Cooler fan rotating backwards | **Section 7.9** |
| | Gas Cooler fan inoperative | **Section 7.9** |
| | Refrigerant overcharge or non-condensibles | **Section 7.2.6** |
| | High Pressure Expansion Valve (HPXV) control malfunction | Replace |
| Low suction pressure | Software incorrect and/or controller configuration incorrect | Check |
| | Suction Pressure Transducer (SPT) failed | Replace |
| | Evaporator air flow not present or restricted | **Section 7.11** |
| | Electronic Expansion Valve (EEV) control malfunction | Replace |

| 6.8 Abnormal Noise Or Vibrations | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Compressor | Mounting bolts loose | Tighten / Replace |
| | Liquid slugging | **Section 7.15** |
| Gas Cooler or Evaporator Fan | Bent, loose or striking venturi | Check |
| | Motor bearings worn | **Section 7.9** / **Section 7.13** |
| | Motor shaft bent | **Section 7.9** / **Section 7.13** |

| 6.9 Microprocessor Malfunction | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Will not control | Software incorrect and/or controller configuration incorrect | Check |
| | Sensor defective | **Section 7.22** |
| | Wiring defective | Check |
| | Refrigerant charge low | **Section 7.2.6** |

| 6.10 No Evaporator Air Flow Or Restricted Air Flow | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Evaporator coil blocked | Coil has frost | **Section 6.6** |
| | Coil dirty | **Section 7.11** |
| No or partial evaporator air flow | Evaporator fan motor internal protector open | **Section 7.13** |
| | Evaporator fan motor(s) defective | **Section 7.13** |
| | Evaporator fan(s) loose or defective | **Section 7.13** |
| | Evaporator fan contactor defective | Replace |

| 6.11 Electronic Expansion Valve (EEV) Malfunction | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Low suction pressure | Software incorrect and/or controller configuration incorrect. | Check |
| | Suction Pressure Transducer (SPT) failed | Replace |
| | Evaporator air flow not present or restricted | **Section 7.11** |
| | Evaporator coil has excessive frost | **Section 6.6** |
| | Electronic Expansion Valve (EEV) control malfunction | **Section 7.15** |
| | Evaporator Temperature Sensor (ETS) loose or insufficiently clamped | Replace |
| High suction pressure with low superheat | Valve contains foreign material | **Section 6.11** |
| | Suction Pressure Transducer (SPT) failed | Replace |
| | Electronic Expansion Valve (EEV) control malfunction | Replace |
| Liquid slugging in compressor | Suction Pressure Transducer (SPT) failed | Replace |
| | Electronic Expansion Valve (EEV) failed | Replace |

| 6.12 High Pressure Expansion Valve (HPXV) Malfunction | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| High discharge pressure | High Pressure Expansion Valve (HPXV) coil not seated properly, loose, or not fully engaged. | **Section 7.15.2** |
| | Software incorrect or controller configuration incorrect | Check |
| | Discharge Pressure Transducer (DPT) failed | Replace |
| | Filter drier restriction | **Section 7.10** |
| | Gas Cooler Temperature Sensor (GCTS) loose or insufficiently clamped | Check |
| | Gas cooler coil dirty | **Section 7.8** |
| | Gas cooler fan rotating backwards | **Section 7.9** |
| | Gas cooler fan inoperative | **Section 7.9** |
| | HPXV control malfunction | Replace |
| | HPXV failed | Replace |

| 6.13 Abnormal Temperatures | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| High discharge temperature | Gas cooler coil dirty | **Section 7.8** |
| | Gas cooler fan rotating backwards | **Section 7.9** |
| | Gas cooler fan inoperative | **Section 7.9** |
| | Refrigerant overcharge or non-condensibles | **Section 7.2.6** |
| | Electronic Expansion Valve (EEV) control malfunction | Replace |
| | Suction Pressure Transducer (SPT) failed | Replace |
| | Discharge Temperature Sensor drifting high | Replace |
| | Sensor loose or insufficiently clamped | Replace |
| | Electronic Solenoid Valve (ESV) coil not fully engaged | **Section 7.17.2** |
| | ESV or ESV coil malfunction | Replace |

| 6.14 Abnormal Currents | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Unit reads abnormal currents | Current sensor wiring | Check |
| | Component is defective | Check current draw / Replace as needed. |

| 6.15 Fuse F1 or F2 Blown | | |
|---|---|---|
| **Condition** | **Possible Cause** | **Remedy / Reference** |
| Fuse F1 or F2 Blown | Electronic Expansion Valve (EEV) drive module wires were grounded. | Check EEV drive module by unplugging it, replacing the fuse(s) and turning the unit back on. |

# SECTION 7
# SERVICE

**⚠ CAUTION**

**Never use air or gases containing oxygen for leak testing or operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to explosion.**

## 7.1 Annual Maintenance Procedures

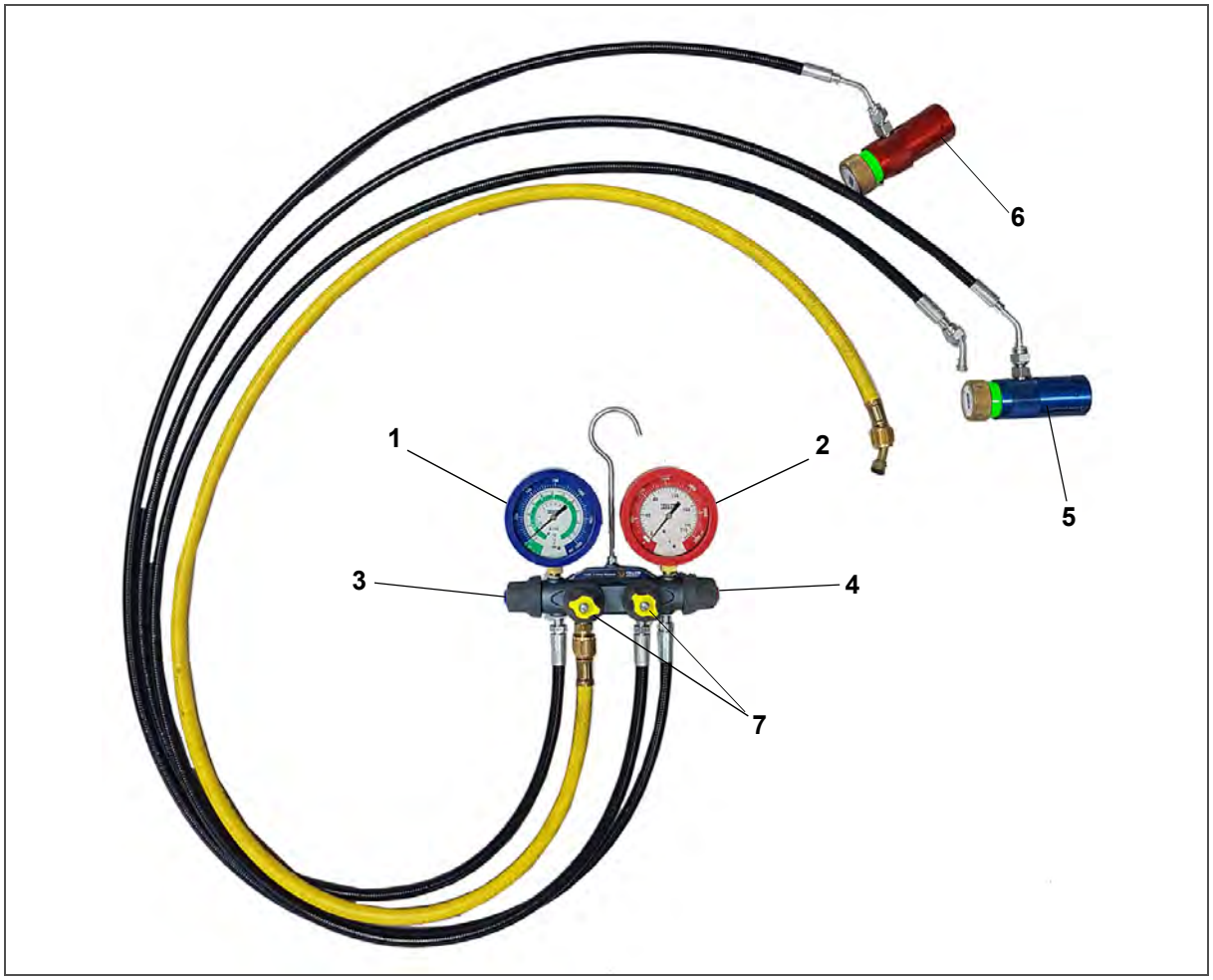
**NOTE**

Annual maintenance procedures for NaturaLINE units 69NT40-601 can be found in the 62-12119 Annual Inspection manual, located in the Literature section of the Container Refrigeration website. To find the manual from the Literature section, click on Container Units > NaturaLINE > Operation.

## 7.2 Service Gauge Set

The service gauge set (part # 07-00582-00) is used to determine system operating pressure, add refrigerant charge, and to equalize or evacuate the system. See **Figure 7.1**.

**Figure 7.1 Service Gauge Set**




1) Suction Gauge (low side)
2) Discharge Gauge (high side)
3) Suction Hand Valve (low side)
4) Discharge Hand Valve (high side)
5) Suction Coupling (low side)
6) Discharge Coupling (high side)
7) Utility hoses:
   - yellow 3/8” (faster evacuation)
   - black 1/4”

- - - - -

**⚠ DANGER**

**Only use manifold gauge sets designed and manufactured for R-744 ($CO_2$) on these units.**

### 7.2.1 Service Connections

There are two service connections on the NaturaLINE unit. See **Section 3.1.4** for component locations.

- For PIDs lower than NT5010, the connections are service fittings. The suction (low side) service fitting is located on the bell housing of the compressor, the discharge (high side) service fitting is located under the Filter Drier.
- For PIDs NT5010 and higher, the connections are service valves. The suction (low side) service valve is mounted on a bracket above the compressor, the discharge (high side) service valve is located under the Filter Drier.

**NOTE**

To completely open the system the Economizer Solenoid Valve (ESV), Unloader Solenoid Valve (USV), and High Pressure Expansion Valve (HPXV) must be opened. See **Section 7.2.4** for procedure.

### 7.2.2 Connecting Service Gauges

**Procedure for Units with Service Fitting:**

1. Verify that the discharge and suction hand valves on the gauge set are fully closed by turning the knobs clockwise.
2. Before starting to attach the gauge set, check that the coupling connectors are clean and that both O-ring seals are correctly seated into their grooves at the bottom of the connector.
3. Remove the suction service connection access cap.
4. Connect the blue field service coupling (low side) to the suction service fitting. Check that the coupling is locked into place by lightly pulling back on it.
5. Turn the blue coupling knob clockwise to read (low side) system pressure on the gauge.
6. Remove the discharge service fitting access cap.
7. Connect the red field service coupling (high side) to the discharge service fitting. Check that the coupling is locked into place by lightly pulling back on it.
8. Turn the red coupling knob clockwise to read (high side) system pressure on the gauge.
9. Perform any required maintenance.
10. If any component changes are required, the system must first be evacuated. See **Section 7.2.4**.

**Procedure for Units with Service Valves:**

1. Verify that the discharge and suction hand valves on the gauge set are fully closed by turning the knobs clockwise.
2. Remove the suction service valve stem cap and check that the valve is backseated.
3. Remove the access valve cap.
4. Connect the blue hose (low side) to the access valve.
5. Slightly mid-seat the suction service valve to read (low side) system pressure on the gauge.
6. Remove the discharge service valve stem cap and check that the valve is backseated.
7. Remove the access valve cap.
8. Connect the red hose (high side) to the access valve.
9. Slightly mid-seat the discharge service valve to read (high side) system pressure on the gauge.
10. Perform any required maintenance.
11. If any component changes are required, the system must first be evacuated. See **Section 7.2.4**.

### 7.2.3 Removing Service Gauges

**Procedure for Units with Service Fittings:**

1. If the unit is running, turn it off by moving the Start-Stop switch (ST) to the OFF position.
2. Turn the low side field service coupling knob counterclockwise to close the system off to the gauges.
3. Turn the high side field service coupling knobs counterclockwise to close the system off to the gauges. If the high side coupling is closed first, then the contents of the high side hose can be dumped into the low side until the pressures equalize. After that, the low side can be closed from the system.

**NOTE**

As the coupling knobs of the connector valves are being closed, a small pocket of $CO_2$ refrigerant is isolated inside the connector which makes it difficult to remove. On the last turn of the valve, a vent opens which releases this trapped refrigerant.

4. With both service couplings closed, connect a hose to the center port of the manifold gauge set.
5. Make sure the open end of the hose is pointed in a safe direction, and slowly open the manifold gauge set high and low side hand valves to allow the hose pressure to be released.

**Procedure for Units with Service Valves:**

1. While the compressor is still ON, backseat the discharge (high side) service valve.
2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to drawn down to low side pressure. This returns any liquid that may be in the high side hose to the system.
3. Backseat the suction (low side) service valve.
4. Backseat both field service couplings and frontseat both manifold hand valves.
5. Remove hoses / couplings from the access valves.
6. Install both service valve stem caps and service port caps (finger-tight only).

### 7.2.4 Manually Opening Solenoid Valves and High Pressure Expansion Valve

During system evacuation and refrigerant charging, both solenoid valves (ESV, USV) and the High Pressure Expansion Valve (HPXV) must be open. This ensures the removal of pockets of refrigerant throughout the system, and allows a complete system evacuation and dehydration. All valves will be reset upon system start up.

For location of the ESV, USV, and HPXV, see **Section 3.1.4**.

**Opening the Economizer Solenoid Valve / Unloader Solenoid Valve**

1. Obtain a magnet tool (Carrier Transicold part # 07-00512-00) to assist in this procedure.
2. Remove the coil from the valve body.
3. Place the magnet over the valve stem, an audible click will be heard when the valve opens.

**Opening the High Pressure Expansion Valve**

1. Obtain a magnet tool (Carrier Transicold part # 14-00396-20) to assist in this procedure.
2. Remove the power head from the expansion valve body.
3. Place the magnet tool over the valve body and rotate the tool counter-clockwise. When the tool begins to chatter during rotation, it means that the valve is fully open.
4. After the valve has been opened, replace the power head. Make sure the power head is sitting on the stem correctly, the dimples on the stem need to be engaged.

### 7.2.5 Removing Refrigerant Charge

**⚠ CAUTION**

**Opening the Manifold Gauge Valve wide open quickly can cause excessive noise and possible loss of the system oil charge.**

To service any component that is part of the pressurized system, it is required to first remove the refrigerant charge.

To completely open the system the Economizer Solenoid Valve (ESV), Unloader Solenoid Valve (USV), and High Pressure Expansion Valve (HPXV) must be opened. See **Section 7.2.4**.

1. Connect the service gauge, by following the procedure for Connecting Service Gauges. See **Section 7.2.2**. The gauge will show the system pressure.
2. Once the manifold gauge set is properly connected and open to the system, connect the utility hose to the center port of the manifold gauge set if not already connected.
3. Secure the utility hose and point in a safe direction.
4. Slowly open the low side and high side of the gauge set to release the refrigerant through the utility hose.
5. After all of the R-744 refrigerant charge has been released from the system and the gauges read 0 psi, close the manifold gauge set hand valves.

### 7.2.6 Refrigerant Leak (Tightness) Test

**⚠ WARNING**

**Never use air or gases containing oxygen for leak testing or operating refrigerant compressors. Pressurized mixtures of air or gases containing oxygen can lead to explosion.**

**NOTICE**

**Use only R-744 refrigerant to pressurize the system. Any other gas or vapor will contaminate the system, and require additional purging and evacuation of the system.**

1. If the system is without refrigerant, charge the system with R-744 to full charge on the nameplate. See **Section 7.2.8** for adding refrigerant.
2. Leak-check connections using an R-744 electronic leak detector (part # 07-00529-00). If AR-GLO dye has been added to the system, a UV torch can also be used to check for signs of leaks.
3. After identifying the leak location, remove the refrigerant charge. See **Section 7.2.5**.
4. Repair any leaks that were found.
5. Evacuate and dehydrate the unit. See **Section 7.2.7**. If the unit fails to pull down or maintain a vacuum, inspect the repair again.
6. Charge the unit. See **Section 7.2.8**.
7. After the repair is made to the unit (threaded joint or brazed), the joint **MUST** be leak tested using the R-744 electronic leak tester.

### 7.2.7 Evacuation and Dehydration

The presence of moisture is detrimental to a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices by free water, and formation of acids resulting in metal corrosion.

To completely open the system the Economizer Solenoid Valve (ESV), Unloader Solenoid Valve (USV), and High Pressure Expansion Valve (HPXV) must be opened. See **Section 7.2.4**.

1. Evacuate and dehydrate only after a refrigerant leak check has been performed and all leaks have been repaired.
2. Essential tools to properly evacuate and dehydrate the system include high side and low side manifold gauges, a vacuum pump (part # 07-00176-11) and an electronic vacuum gauge. Vacuum pump should be 8 cfm volume displacement (14 m/hr). If using the gauge set with a 3/8” yellow utility hose, it is faster to use the 3/8” hose if the pump is equipped with a 3/8” connection.
3. If possible, keep the ambient temperature above 15.6°C (60°F) to speed evaporation of moisture. If the ambient temperature is lower than 15.6°C (60°F), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise the system temperature.
4. Remove all R-744 refrigerant from the system. See **Section 7.2.5**.
5. Connect both low side and high side manifold gauges to the vacuum pump and electronic vacuum gauge. See **Figure 7.2**, **Figure 7.3** for evacuation diagram.

6. Test the evacuation setup for any connection leaks by closing the low side and high side service fittings and drawing a deep vacuum with the vacuum pump and gauge valves open. Shut off the pump and check to see if the vacuum holds. Repair leaks if necessary.
7. Open the low side and high side service fittings.
8. Start the vacuum pump. Evacuate the unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.
9. Break the vacuum with clean dry $CO_2$ (R-744) refrigerant. Raise system pressure to roughly 0.14 bar (2 psig), monitoring it with the compound gauge.
10. Evacuate unit to 500 microns.
11. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait five minutes to see if vacuum holds. This procedure checks for residual moisture and/or leaks.
12. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on a weight scale.

### 7.2.8 Charging, Vapor Method

**NOTICE**

**Only use Refrigerant R-744 with a Purity level of 99.9% $CO_2$. Refer to nameplate for required charge.**

**NOTE**

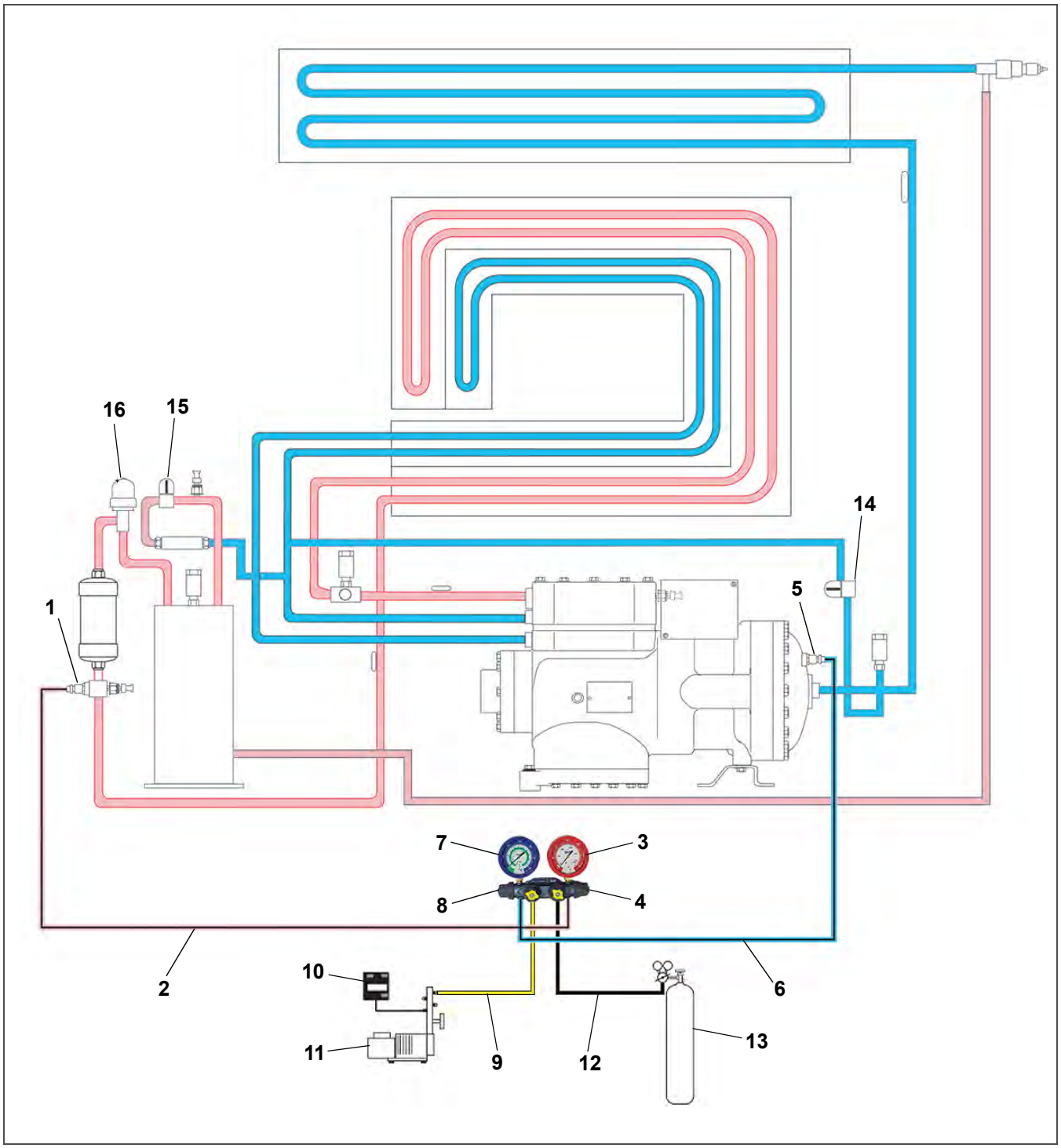
In cold ambient temperatures it may be necessary to raise the bottle pressure by warming the cylinder. This is accomplished by using a cylinder warmer or by moving the cylinder into warm ambient conditions.

**NOTE**

To completely open the system the Economizer Solenoid Valve (ESV), Unloader Solenoid Valve (USV), and High Pressure Expansion Valve (HPXV) must be opened. See **Section 7.2.4**.

1. Evacuate the unit and leave in a deep vacuum. See **Section 7.2.7**.
2. Place the R-744 cylinder on a scale and connect the utility hose from the service gauge to the pressure regulator. See **Figure 7.2**, **Figure 7.3** for Evacuation diagram.
3. With the supply valve closed on the regulator, open the valve on the cylinder. The gauge on the regulator will now show the R-744 cylinder pressure.
4. Purge the utility hose by partially unthreading the hose on the manifold gauge set and opening the supply on the regulator. Tighten the hose on the gauge and close the supply line.
5. Zero out the scale or note the starting weight.
6. Open the low side and high side hand valves by turning the knobs counterclockwise. See **Figure 7.2**, **Figure 7.3** for evacuation diagram.
7. Allow the R-744 refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by the scale.
8. If you are unable to get the full charge into the unit based on ambient conditions, the following additional steps should be taken:
   a. Remove magnets and refit coils to ESV, USV and HPXV.
   b. Close the high side hand valve on the manifold gauge set.
   c. Turn the unit on. The suction side pressure will reduce and the unit will start to draw the remaining refrigerant into the system.
9. Close the low side service connection by turning the knob clockwise once desired charge is reached.
10. Close the valve on the R-744 cylinder and bleed out remaining pressure in the utility line by partially unthreading the hose.
11. Start the unit in cooling mode. Run for approximately 10 minutes to make sure the unit is cooling properly.
12. Remove the gauge set. See **Section 7.2.3**.

**Figure 7.2 Refrigeration Evacuation & Charging Diagram - PIDs lower than NT5010**




1) Discharge Service Fitting (high side)
2) Discharge Hose (high side)
3) Discharge Gauge (high side)
4) Discharge Hand Valve (high side)
5) Suction Service Fitting (low side)
6) Suction Hose (low side)
7) Suction Gauge (low side)
8) Suction Hand Valve (low side)
9) Utility Hose to Vacuum Pump
10) Electronic Vacuum Gauge
11) Vacuum Pump
12) Utility Hose to R-744 Bottle
13) R-744 Bottle
14) Unloader Solenoid Valve (USV)
15) Economizer Solenoid Valve (ESV)
16) High Pressure Expansion Valve (HPXV)

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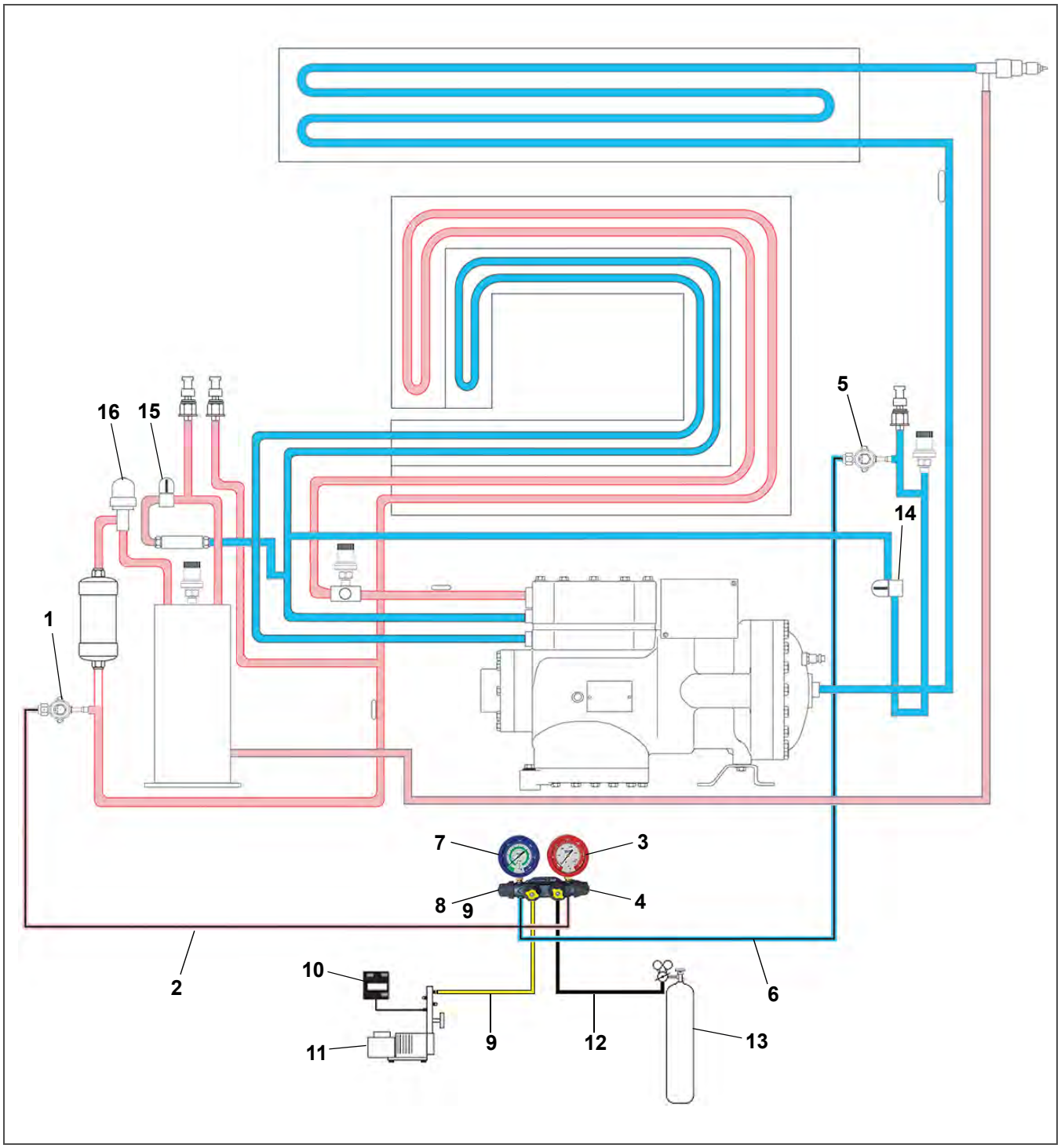
**Figure 7.3 Refrigeration Evacuation & Charging Diagram - PIDs NT5010 and higher**




1) Discharge Service Valve (high side)
2) Discharge Hose (high side)
3) Discharge Gauge (high side)
4) Discharge Hand Valve (high side)
5) Suction Service Valve (low side)
6) Suction Hose (low side)
7) Suction Gauge (low side)
8) Suction Hand Valve (low side)
9) Utility Hose to Vacuum Pump
10) Electronic Vacuum Gauge
11) Vacuum Pump
12) Utility Hose to R-744 Bottle
13) R-744 Bottle
14) Unloader Solenoid Valve (USV)
15) Economizer Solenoid Valve (ESV)
16) High Pressure Expansion Valve (HPXV)

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## 7.3 Compressor

**⚠ WARNING**

**Make sure power to the unit is OFF and power plug disconnected before replacing the compressor.**

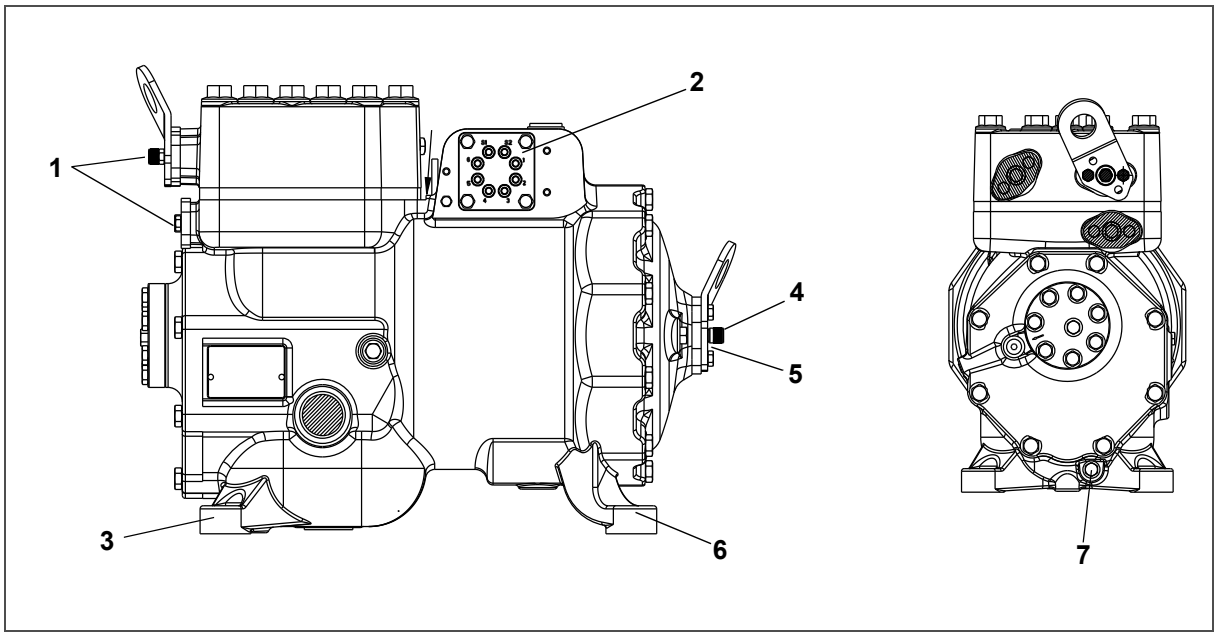
**⚠ WARNING**

**Before disassembly of the compressor, be sure to relieve the internal pressure very carefully by slightly loosening the couplings to break the seal.**

**NOTICE**

**Compressor is shipped without oil in the compressor.**

**Figure 7.4 Compressor**




1) Flange Bolts
2) Terminal Block / Plate
3) Mounting Bolts
4) Flange Bolt
5) Suction Flange
6) Mounting Bolts
7) Oil Drain

- - - - -

### 7.3.1 Removal and Replacement of Compressor

**NOTE**

The service replacement of the compressor is sold without terminal box and cover, service connection, and Suction Pressure Transducer. The customer should retain these components for use on replacement compressor.

1. Turn the unit Start-Stop switch (ST) and unit Circuit Breaker (CB-1) Off.
2. Disconnect power to the unit.
3. Remove all refrigerant from the unit. See **Section 7.2.5**.
4. Locate the compressor terminal box. Tag and disconnect the wiring from the compressor terminals and remove the compressor terminal box. The terminal box will be used on the new compressor.
5. Loosen the compressor flange mounting bolts, break the seal and then remove the bolts.
6. Remove the compressor mounting bolts.

7. Remove the compressor and mounting plate (if compressor has a plate). See **Section 3.2** for weight of compressor.
8. Remove the Suction Pressure Transducer (SPT) from compressor and check operation of switch. See **Section 7.5.1**. The SPT will be used on the new compressor.
9. Remove service fittings from the compressor. The service fittings will be used on the new compressor.
10. Place the compressor in a position where it will be convenient to drain the oil. Remove the oil drain plug (see **Figure 7.4**) and allow the oil to drain out slowly. The compressor will need to be angled to remove all the oil.
11. Measure the amount of oil drained from the compressor.
12. Add four mls. of AR-GLO 5E dye to the new replacement compressor oil.
13. Pour the equivalent amount of new oil into the suction side flange of the new compressor. See **Figure 7.4**. The compressor suction side may need to be elevated for better angle to pour oil in.

**NOTICE**

**When installing service fittings and the Suction Pressure Transducer, a new O-ring must be installed with each. See Section 7.4 for instructions on installing the O-rings.**

14. Install the service fittings with new O-rings on the replacement compressor and torque to 27 Nm (20 ft-lb).
15. Install the SPT with a new O-ring on the replacement compressor and torque to 27 Nm (20 ft-lb).
16. Install the replacement compressor in the unit.
17. Install the compressor mounting bolts and torque to 22.6 Nm (16.67 ft-lb).
18. If replacement compressor has mounting plate, install the compressor plate mounting bolts and torque to 22.6 Nm (16.67 ft-lb).
19. Connect the junction box to the replacement compressor and use the terminal wiring kit to rewire the compressor. Follow the instructions included with the kit.
20. Install the junction box cover.
21. Install the compressor flanges with new metal gaskets.
22. Install the flange mounting bolts and torque to 36.61 Nm (27 ft-lb).
23. Connect the high side and low side service gauges to the discharge and suction service fittings. See **Section 7.2.2**.
24. Dehydrate and evacuate the system to 500 microns (75.9 cm Hg vacuum = 29.90 inches Hg vacuum). See **Section 7.2.7**.
25. Charge the unit with refrigerant. See **Section 7.2.8**.
26. After the unit has been fully charged, remove the service gauges. See **Section 7.2.3**.
27. Start the unit and check operation.
28. If the compressor is equipped with a sight glass, the oil level should be between 1/4 and 3/4 of the sight glass while operating.
29. Clean the area below the foot of the compressor with local cleaner and install the icing label on the frame in front of the compressor (part # 62-66170-00).

## 7.4 O-Ring Installation

### 7.4.1 Installation

This procedure is intended for all O-ring installations for this unit. A Pressure Relief Valve (PRV) is used for illustration purposes in this procedure.

1. Place electrical tape around the threads of the component to protect the O-ring from damage during installation. See **Figure 7.5**.
2. Apply a small amount of Super O-lube to the O-ring, making sure to coat the entire surface. See **Figure 7.6**.
3. Slide the O-ring over the tape and onto the component. See **Figure 7.7**.
4. Remove electrical tape. See **Figure 7.8**.

**Figure 7.5 O-Ring - Electrical Tape**

**Figure 7.6 O-Ring - Apply Super O-lube**

**Figure 7.7 O-Ring - Slide On O-Ring**

**Figure 7.8 O-Ring - Remove Electrical Tape**

### 7.4.2 Adding Loctite 55 Thread Sealing Cord

On completion of the O-ring installation for components: Flash Tank Pressure Transducer (FPT), Discharge Pressure Transducer (DPT) and the high side coupling, add Loctite 55 thread sealing cord by following the procedure below.

1. Cut 7.5 cm (3 inch) of cord length from the Loctite 55 tube.
2. Twist the cord between the fingers to prevent fraying, rotate fingers in opposite directions. See **Figure 7.9**.
3. Locate the 3rd and 6th thread on the fitting. See **Figure 7.10**.
4. Wrap Loctite 55 cord around the transducer starting on the 3rd thread and end at the 6th thread in clockwise direction, overlap is not necessary but two full threads need to be covered and seated within the threads. See **Figure 7.11**, **Figure 7.12**.
5. The cord should be in contact with the threads without any loose ends, trimming off any excess. See **Figure 7.13**.
6. Hand tighten the transducer until the cord is fully rolled in the fitting. No part of the cord should be seen pushed out of the fitting thread. See **Figure 7.14**.
7. Torque to 9.5Nm - 10.8Nm (7 - 8 ft-lb).

Figure 7.9 Loctite 55 - Twist Cord

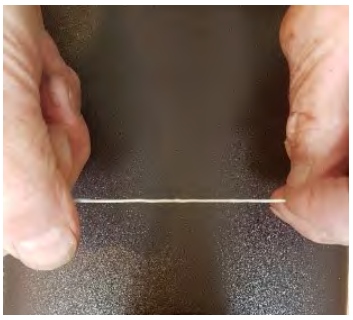


Figure 7.10 Loctite 55 - Locate Threads

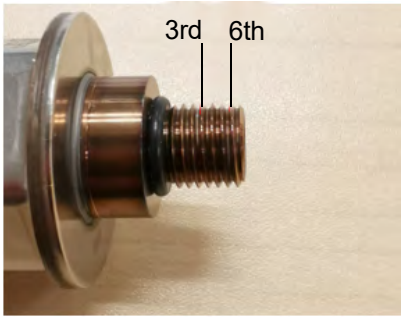



Figure 7.11 Loctite 55 - Wrap Cord

Figure 7.12 Loctite 55 - Wrap Cord

Figure 7.13 Loctite 55 - Trim Excess Cord

Figure 7.14 Loctite 55 - Tighten Transducer

## 7.5 High Pressure Switch

### 7.5.1 Checking a High Pressure Switch

1. Connect a set of gauges to the unit or read the unit pressure at code Cd14. If the pressure is below 100.6 bars (1430 psig), the switch should be closed. See **Section 7.5.2**.
2. Using an Ohm meter check the continuity of the switch. The ohm meter will indicate no resistance or the continuity light will be illuminated. If the switch is open, it should be replaced. See **Section 7.5.2**.

### 7.5.2 Replacing a High Pressure Switch

The High Pressure Switch (HPS) is located on the 2nd stage discharge connection. See **Figure 3.5**.

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Disconnect wiring from the switch to be replaced.
3. Remove the High Pressure Switch (HPS) by turning the assembly counterclockwise.
4. See **Section 7.4** for installation of O-ring on High Pressure Switch (HPS).
5. Install a new High Pressure Switch (HPS) and then run P-7 to confirm the settings for the switch are correct.
6. Evacuate and dehydrate the system. See **Section 7.2.7**.
7. Recharge the system. See **Section 7.2.8**.
8. Start the unit, and then verify refrigeration charge.

## 7.6 Pressure Transducer

### 7.6.1 Replacing a Pressure Transducer

For location of the pressure transducers, see **Section 3.1.4**.

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Disconnect wiring from the pressure transducer.
3. Remove the pressure transducer by turning the assembly counterclockwise.
4. See **Section 7.4** for installation of the O-ring on the pressure transducer.
5. Install a new pressure transducer.
6. Evacuate and dehydrate the system. See **Section 7.2.7**.
7. Recharge the system. See **Section 7.2.8**.
8. Start the unit, and then verify refrigeration charge.

**NOTE**

The transducer should be used within 48 hours after cord wrapping.

## 7.7 Pressure Relief Valve

There are three Pressure Relief Valves (PRV) located in the NaturaLINE unit. See **Section 3.1.4** for location.

### 7.7.1 Replacing a Pressure Relief Valve

**⚠ DANGER**

**There are no serviceable parts on a pressure relief valve (PRV). Attempting to repair or alter the PRV is not permitted. If the PRV has released pressure, the entire PRV must be replaced.**

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Remove the pressure relief valve.
3. Verify no contaminants have entered into the orifice.
4. See **Section 7.4** for installation of an O-ring on the pressure relief valve.
5. Install a new pressure relief valve using correct torque. Wrench on 1-1/8” hexagon flats only, do not wrench on round surfaces. See **Section 3.3** for torque requirements.
6. Evacuate and dehydrate the system. See **Section 7.2.7**.
7. Recharge the system. See **Section 7.2.8**.
8. Start the unit, and then verify refrigeration charge.

## 7.8 Gas Cooler / Intercooler Coil

The Gas Cooler consists of the Gas Cooler and the Intercooler sections.

### 7.8.1 Gas Cooler Coil Cleaning

Keep the coil clean to maximize air flow and maintain proper heat transfer. If cleaning is required, use fresh water.

**NOTE**

Use low water pressure when cleaning coils to avoid damage.

### 7.8.2 Gas Cooler Coil Replacement

**⚠ WARNING**

**Do not open the Gas Cooler fan grille before turning power OFF and disconnecting power plug.**

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Remove the Gas Cooler fan grille and side panels.

3. Unsolder the (2) Intercooler and (2) Gas Cooler lines.
4. Remove the coil mounting hardware and remove the coil assembly.
5. Install the replacement coil and mounting hardware.
6. Solder the Intercooler and Gas Cooler connections.
7. Leak-check the unit coil connections. See **Section 7.2.6**.
8. Evacuate and dehydrate the system. See **Section 7.2.7**.
9. Recharge the system. See **Section 7.2.8**.
10. Secure fan grille and any panels that may have been removed.

## 7.9 Gas Cooler Fan and Motor Assembly

**⚠ WARNING**

**Do not open Gas Cooler fan grille before turning power OFF and disconnecting power plug**

The Gas Cooler fan rotates counterclockwise as viewed from front of unit. The fan pulls air through the coil, and discharges air horizontally through the front of the unit. To replace the motor assembly:

1. Remove the Gas Cooler fan grille.
2. Loosen the two set screws on fan. (Thread sealer has been applied to set screws at installation.)

***NOTICE***

**Do not pull or pry from the outer edge of the fan as this may damage the fan.**

3. Remove the fan assembly.
4. Unplug the wiring connector.
5. Mark the location of the fan motor and keep the hardware in the same location for reassembly.
6. Remove motor mounting hardware and replace the motor. It is recommended that new locknuts be used when replacing the motor.
7. Connect the wiring connector.
8. Install the fan loosely on the motor shaft (hub side in). DO NOT USE FORCE. If necessary, tap the hub only, not the hub nuts or bolts. Apply “Loctite H” to the (2) fan set screws. Adjust the fan within the venturi so that the outer edge of the fan is within 2.0 +/- 0.07 mm (0.08” +/- 0.03”) from the outside of the orifice opening. Spin the fan by hand to check clearance.
9. Secure the fan grille and any panels that may have been removed.

## 7.10 Filter Drier

**⚠ CAUTION**

**Do not touch the Filter Drier to check for temperature difference while the unit is operating. Refer to troubleshooting for when to replace the Filter Drier due to restriction.**

**NOTE**

The Filter Drier should be replaced any time the system is opened up for service.

**Replacing the Filter Drier:**

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Remove Filter Drier by loosening the compression fittings.
3. Install the new Filter Drier and tighten the compression fittings.Torque to 18.4-22.1 Nm (25-30 ft-lb).
4. Evacuate and dehydrate the system. See **Section 7.2.7**.
5. Recharge the system. See **Section 7.2.8**.

## 7.11 Evaporator Coil Assembly

The evaporator section, including the coil, should be cleaned regularly. Restrictions in the evaporator coil restrict air flow through the coil and reduce heat transfer. The preferred cleaning fluid is fresh water or steam. Another recommended cleaner is Oakite 202 or similar, following manufacturer's instructions.

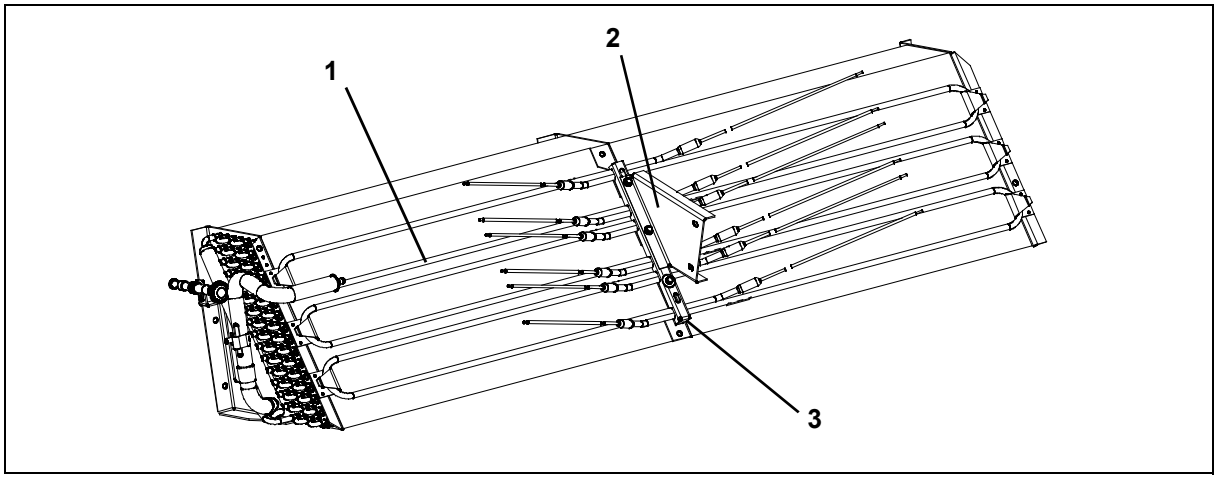
The two drain pan hoses are routed behind the Gas Cooler fan motor and compressor. The drain pan line(s) must be open to ensure adequate drainage.

### 7.11.1 Evaporator Coil Replacement

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. With power OFF and power plug removed, remove the screws securing the panel covering the evaporator section (upper panel).
3. Disconnect the defrost heater wiring.
4. Remove the mounting hardware from the coil.
5. Unsolder the two coil connections, one at the distributor and the other at the coil header.
6. Disconnect the Defrost Temperature Sensor (DTS), the Heat Termination Thermostat (HTT) and ground wire from the center tube sheet. See **Figure 3.2**.
7. Remove middle coil support.
8. After defective coil is removed from unit, remove defrost heaters and install on replacement coil.
9. Install coil assembly by reversing above steps.
10. Leak check evaporator coil connections.
11. Evacuate and dehydrate the system. See **Section 7.2.7**.
12. Recharge the system. See **Section 7.2.8**.

## 7.12 Evaporator Heater

**Figure 7.15 Heater Arrangement**




1) Heater Element
2) Bracket
3) Retainer

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### 7.12.1 Evaporator Heater Removal and Replacement

The heaters are wired directly back to the contactor and if a heater failure occurs during a trip, the heater set containing that heater may be disconnected at the contactor.

The next Pre-trip will detect that a heater set has been disconnected and indicate that the failed heater should be replaced.

### 7.12.2 Megger Testing the Heaters

**⚠ WARNING**

**Always turn OFF the unit circuit breakers, disconnect the main power supply, and perform Lock Out / Tag Out before working on moving parts.**

All of the checks performed during this procedure should be carried out using a 500v Meg-ohm tester.

1. Connect the ground wire from the insulation tester to a fixed ground point, preferably the ground plate in the control box.
2. At the load side of the heater contactor, check the insulation resistance to ground.

   If readings are > 2 Mohm, then the heaters are operating properly and no action is needed.

   If readings are < 1 Mohm, then the faulty heater needs to be identified. Proceed to step 3 for units *with* a heater access panel or step 4 for units *without* a heater access panel.

   If readings are between 1 and 2 Mohm, then the heaters need to be re-tested with the following steps:

   a. Reconnect the unit to power and power the unit on.

   b. Set the unit set point to a minimum of 10°C higher than the current temperature of the container. Allow the unit to go into heat mode, reach the temperature set point and maintain for 10-15 minutes.

   c. Power the unit off. Allow the unit to cool to ambient temperature.

   d. Connect the ground wire from the insulation tester to a fixed ground point, preferably the ground plate in the control box.

   e. At the load side of the heater contactor, check the insulation resistance to ground.

   If readings are > 1 Mohm, then the heaters are operating properly and no action is needed.

   If readings are < 1 Mohm, then the faulty heater needs to be identified. Proceed to step 3 for units with a heater access panel or step 4 for units without a heater access panel.
3. Identify the faulty heater(s) for units with a heater access panel:

   a. Open the access panel and cut out all wire splices to isolate all heaters inside of the unit.

   b. Repeat the Megger test on each individual heater. Connect the ground clip to the outer metal sheath of the heater and the test clip to one of the wires from the same heater.

   c. Replace any heater where the readings are < 1 Mohm.
4. Identify the faulty heater(s) for units without a heater access panel:

   a. Remove all six connections from the Heater (HR) contactor load side, which splits the six heaters into three separate pairs.

   b. Identify the following three wires: DHTL, DHML, DHBL. There is one from each load connection.

   c. Repeat the Megger test on each pair of heaters to identify the faulty heater pair. Connect the ground clip from the insulation tester to a fixed ground point on the unit, preferably the ground plate in the control box. Connect the test clip to one of the wires stated above.

   d. Test all three wires and replace any heater pair that has readings < 1 Mohm.
5. If the unit is loaded, and the heater can not be immediately replaced, perform the following steps:

   a. Identify the wire at the opposite end of the faulty heater pair: DHTL - DHTR, DHML - DHMR, DHBL - DHBR.

   b. Isolate the two wires.

   c. Reconnect the remaining good wiring pairs to their original connections.

   d. The unit will fail the PTI test P1-0 at the next pre-trip inspection. Repair action can be taken at that time.
6. If the unit is empty, replace the faulty heater:

**⚠ WARNING**

**Always turn OFF the unit circuit breakers, disconnect the main power supply, and perform Lock Out / Tag Out before working on moving parts.**

a. With the heater pair identified, remove the upper back panel inside the container.

b. Identify the center point connection for the heater pair (black wiring from heaters) either against the unit back wall or in the wiring loom.

c. Cut the splice to separate the two heaters.

d. Carry out a Megger check on the two heaters in the same way as for units with heater panel. Replace any heater where the Megger readings are < 1 Mohms.

**NOTE**

If all heaters are above the acceptable limit with the wiring disconnected, then this indicates that the fault was in one or more of the wire splices that were removed.

e. Remove the hold-down clamp securing the heater(s) to the coil.

f. Verify that the heaters are not hot before handling them.

g. Lift the bent end of the heater (with the opposite end down and away from the coil). Move the heater to the side enough to clear the heater end support and remove.

h. To install heater, reverse steps.

i. Reconnect all wiring using new splices and heat shrink where needed. The heat shrink MUST have a 'melt-able' liner to ensure that the connections are properly sealed when shrunk. This can be seen as a 'Ring' of melt liner pushed from under the heat shrink at each end of the shrink tube.

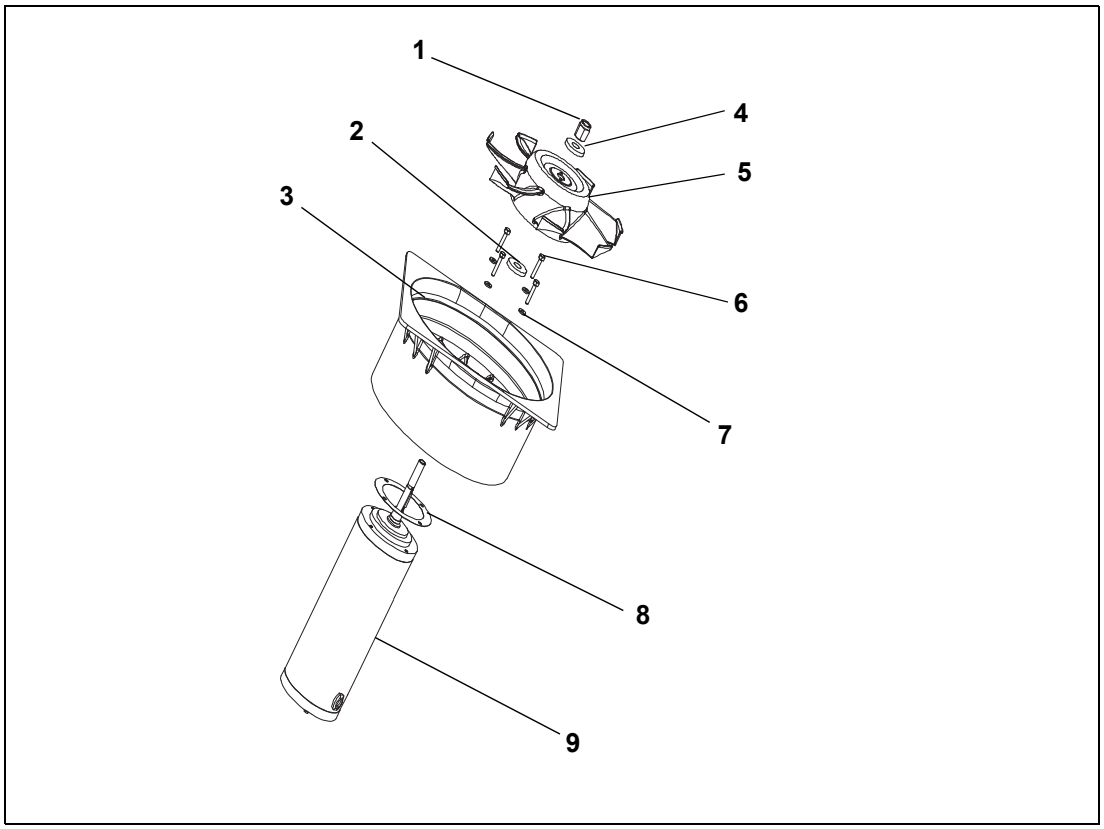
**NOTE**

Failure to use melt liner heat shrink allows moisture to 'wick' up under the heat shrink and cause a leakage path.

## 7.13 Evaporator Fan And Motor Assembly

The evaporator fans circulate air throughout the container by pulling air in the top of the unit. The air is forced through the evaporator coil where it is either heated or cooled and then discharged out the bottom of the refrigeration unit into the container. The fan motor bearings are factory lubricated and do not require additional grease.

**Figure 7.16 Evaporator Fan Assembly**




1) Locknut, 5/8-18
2) Flat Washer, 5/8
3) Stator
4) Flat Washer, 5/8
5) Impeller Fan
6) Screw, 1/4
7) Flat Washer, 1/4
8) Mylar Protector
9) Evaporator Motor

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### 7.13.1 Replacing the Evaporator Fan Assembly

**⚠ WARNING**

**Always turn OFF the unit circuit breakers, disconnect the main power supply, and perform Lock Out / Tag Out before working on moving parts.**

1. Remove the upper access panel (see **Figure 3.2**) by removing mounting bolts and TIR locking device. Reach inside of unit and remove the Ty-Rap securing the wire harness loop. Disconnect the connector by twisting to unlock and pulling to separate.
2. Loosen four 1/4-20 clamp bolts that are located on the underside of the fan deck at the sides of the fan assembly. Slide the loosened clamps back from the fan assembly.
3. Slide the fan assembly out from the unit and place on a sturdy work surface.

### 7.13.2 Disassemble the Evaporator Fan Assembly

1. Secure the fan blade so that it cannot turn. Then, loosen the 5/8-18 shaft nut by turning the 5/8-18 nut counter-clockwise. See **Figure 7.16**.
2. Use a universal wheel puller and remove the fan from the shaft.
3. Remove the washers and key.
4. Remove the four 1/4-20 x 3/4 long bolts that are located under the fan that support the motor and stator housing.
5. Remove the motor and plastic spacer.

### 7.13.3 Assemble the Evaporator Fan Assembly

1. Assemble the motor and plastic spacer onto the stator.

**NOTICE**

**When removing the black nylon evaporator fan blade, care must be taken to assure that the blade is not damaged. In the past, it was a common practice to insert a screwdriver between the fan blades to keep it from turning. This practice can no longer be used, as the blade is made up of a material that will be damaged. It is recommended that an impact wrench be used when removing the blade. Do not use the impact wrench when reinstalling, as galling of the stainless steel shaft can occur.**

2. Apply Loctite to the 1/4-20 x 3/4 long bolts and torque to 7.9Nm (70 in-lb).
3. Place one 5/8 flat washer on the shoulder of the fan motor shaft. Insert the key in the keyway and lubricate the fan motor shaft and threads with a graphite-oil solution (such as Never-seez).
4. Install the fan onto the motor shaft. Place one 5/8 flat washer with a 5/8-18 locknut onto the motor shaft and torque to 40 foot-pounds.
5. Install the evaporator fan assembly in reverse order of removal. Torque the four 1/4-20 clamp bolts to 7.9Nm (70 in-lb). Connect the wiring connector.
6. Replace access panel making sure that panel does not leak. Make sure that the TIR locking device is lockwired.

## 7.14 Evaporator Section Cleaning

Containers and Container units that are exposed to certain fumigants may develop visible surface corrosion. This corrosion will show up as a white powder found on the inside of the container and on the reefer unit evaporator stator and fan deck.

Analyses by Carrier Transicold environmental specialists have identified the white powder as consisting predominantly of aluminum oxide. Aluminum oxide is a coarse crystalline deposit most likely the result of surface corrosion on the aluminum parts within the container. If left untreated over time, it may build up in thickness and eventually flake as a lightweight white powder.

The surface corrosion of aluminum is brought about by exposure to chemicals such as sulfur dioxide and possibly other fumigants that are commonly used for fumigation and protection of some perishable cargo such as grapes, for example. Fumigation is the process by which a chemical is released into an enclosed area to eliminate infestations of insects, termites, rodents, weeds and soil-born disease.

Typically any aluminum oxide that becomes detached from evaporator fan stators will be blown into the wet evaporator coil where it will be caught and then flushed out of the unit during routine defrost cycles.

However, it is still highly recommended that after carrying cargo subject to fumigation procedures, that the inside of the unit be thoroughly cleansed prior to reuse.

Carrier Transicold has identified a fully biodegradable and environmentally safe alkaline cleaning agent (Tri-Pow'r® HD) for the unit. This will assist in helping to remove the corrosive fumigation chemicals and dislodging of the corrosive elements.

This cleaner is available from the Carrier Transicold Performance Parts Group (PPG) and can be ordered through any of the PPG locations; Part Number NU4371-88.

As a general safety precaution, before using this product, refer to and retain the Material Safety Data (MSDS) sheet.

**Cleaning Guidelines:**

- Use low water pressure when cleaning coils to avoid damage.
- Always wear goggles, gloves and work boots.
- Avoid contact with skin and clothing, and avoid breathing mists.
- When mixing, add water to the sprayer first, then the cleaner.
- ALWAYS provide for proper ventilation when cleaning indoor evaporator coils (rear doors must be open).
- Be aware of surroundings - food, plants, etc., and the potential for human exposure.
- Always read directions and follow recommended dilution ratios. More is not always better. Using non-diluted cleaner is not recommended.

**Cleaning Procedure:**

1. Remove the upper evaporator access panel inside of the unit.
2. Spray the surface with water before applying the cleaning solution. This helps the cleaner work better.
3. Liberally apply the prepared cleaner solution (5 parts water and 1 part cleaner).
4. Allow the cleaner to soak in for 5 to 7 minutes.
5. Assess area for rinsing. Follow all local regulations regarding disposal of waste water.
6. Thoroughly rinse the cleaner and surrounding area, floor, etc. When rinsing where heavy foaming solution is present, it is very important to take the time to thoroughly rinse the equipment and surroundings.
7. Always rinse the empty coil cleaner bottle, cap tightly and dispose of properly.

## 7.15 Electronic Expansion Valve (EEV)

The Electronic Expansion Valve (EEV) is an automatic device which maintains required superheat of the refrigerant gas leaving the evaporator. For location of the Electronic Expansion Valve, see **Figure 3.2**.

The valve functions are:

a. Automatic response of refrigerant flow to match the evaporator load.

b. Prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.

### 7.15.1 Removing an EEV or HPXV:

1. Turn unit power off and remove power from the unit.
2. Remove the coil (applies only to the HPXV).
3. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
4. The preferred method of removing the valve is to cut the connection between the brazed section and the valve, using a small tube cutter. The valve can also be removed by un-brazing the connection. Remove valve.

### 7.15.2 Installing an EEV or HPXV:

1. Make sure that there is no brazing material in the lines, and install the new valve.
2. When brazing in the new valve, the power head should be cooled with wet cloth.
3. Make sure that the HPXV coil is snapped down fully, and the coil retention tab is properly seated in one of the valve body dimples.

   Important Notes:

   - Retention tab is not visible with the coil boot fitted as shown in **Figure 7.17**.
   - For better visualization, see **Figure 7.18** for correct position of the coil with the retention tab sited in one of the valve body dimples.
   - Do not remove the coil boot from the valve.
4. Grab and rotate the coil for approximately 1/4 turn in either direction (see **Figure 7.17**) and make sure that you can feel the clicking as the coil retention tab is moving from dimple to dimple.

**Figure 7.17 HPXV Coil Boot**

**Figure 7.18 HPXV Valve Body Dimples**

5. Apply the blue dot on the unit side wall next to the coil indicating that the coil has been inspected and is seated correctly on the valve body.
6. If a coil is seated incorrectly on a loaded unit once it has been seated properly, power cycle the unit. This enables the controller to reset the valve to 0% to ensure proper operation going forward.
7. Replace the Filter Drier. See **Section 7.10**.
8. Evacuate and dehydrate the system. See **Section 7.2.7**.
9. Recharge the system. See **Section 7.2.8**.
10. Check unit operation by running Pre-trip. See **Section 4.7**.

## 7.16 Humidity Sensor (HS)

The humidity sensor is an optional component that allows setting of a humidity setpoint in the controller. In dehumidification mode, the controller will operate to reduce internal container moisture level.

### 7.16.1 Checking the Operation of the Humidity Sensor

This procedure is to be performed in an effort to ease the troubleshooting of the humidity sensor. When performing this procedure and while working on the unit, always follow the proper lockout/tagout procedures.

**Items Required:**

- One 7/16” socket wrench or nut driver.
- One 1/4” socket wrench or nut driver.
- One clean, clear water bottle with a minimum 6 cm (2.5 in) opening and capacity to hold 500 ml (16.9 oz).
- 100 ml (3.4 oz) of fresh water - distilled if available.
- 50 gm of Salt (NaCl).

**Procedure:**

1. Remove the left Upper Fresh Air Makeup Vent panel.
2. Remove the humidity sensor from the mounting hardware and bring to the front of the access panel.
3. Disconnect the humidity sensor from the harness.
4. Drill a 3 cm (1.25 in) hole in the cap of a bottle.
5. Pour approximately 100 ml (3.4 oz) of water into the empty clean bottle.
6. Add salt to the water until it is present at the bottom of the bottle.
7. Cap the bottle and tape over the drilled hole.
8. Shake the bottle until the salt dissolves and water is saturated.

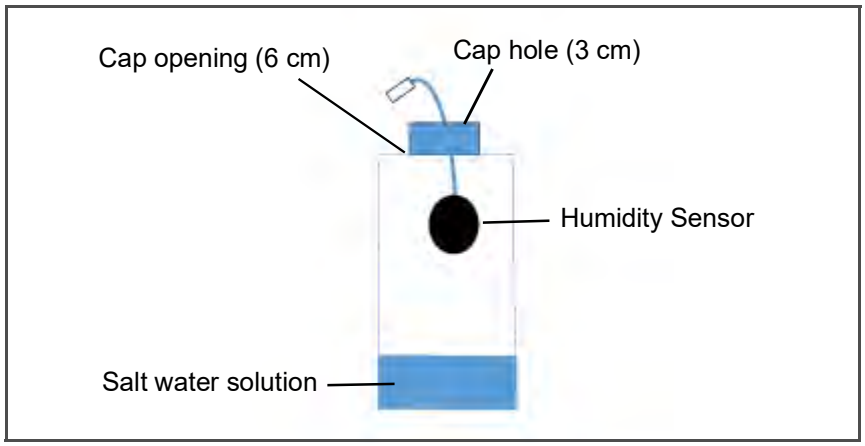
**NOTE**

To ensure saturation, add additional salt until it settles at the bottom without dissolving while shaking.

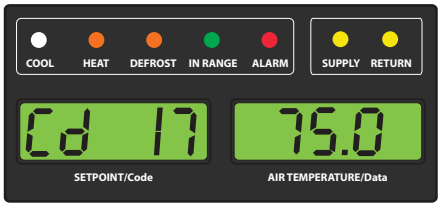
9. Remove the cap and insert the humidity sensor into the bottle through the bottle opening and pull the connector back through the drilled hole in the cap. Then, secure the cap and seal the wire going through the cap.

**NOTE**

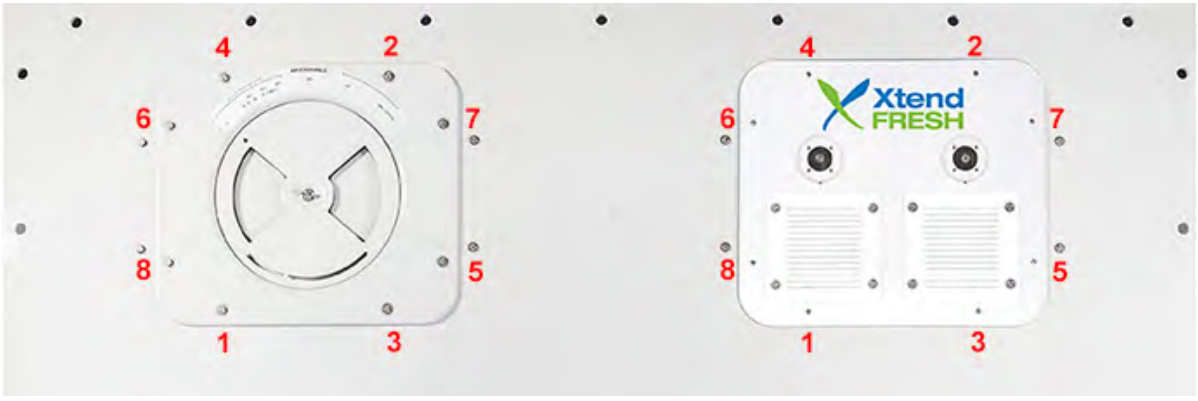
Make sure that the sensor is not at all in contact with the salt water.




10. Allow the saturated salt mixture to settle for approximately ten minutes.
11. Reconnect the humidity sensor to the harness and power the reefer unit on.
12. Press the CODE SELECT key on the keypad.
13. Use the Arrow keys until “Cd17” is displayed then press the ENTER key.




14. This displays the humidity sensor reading. Verify the reading is between 60% and 85% relative humidity.
15. If the humidity sensor display is outside of this range, reconfirm the salt mixture and retest. If not in range, replace the sensor at the next opportunity.
16. Wipe clean and reinstall the humidity sensor and access panel. Torque the access panel hardware to 69 kg-cm (60 in.-lbs.) using a crossing pattern similar to the numbering below.




17. If the panel gasket is damaged and needs to be replaced, use the following part numbers:
    - 42-00296-01: Standard Panel Gasket
    - 42-00823-00: XtendFRESH Panel Gasket

## 7.17 Economizer Solenoid Valve, Unloader Solenoid Valve

The procedures for removing / replacing the ESV and removing / replacing the USV are the same.

For location of the Economizer Solenoid Valve and the Unloader Solenoid Valve, see **Figure 3.3**.

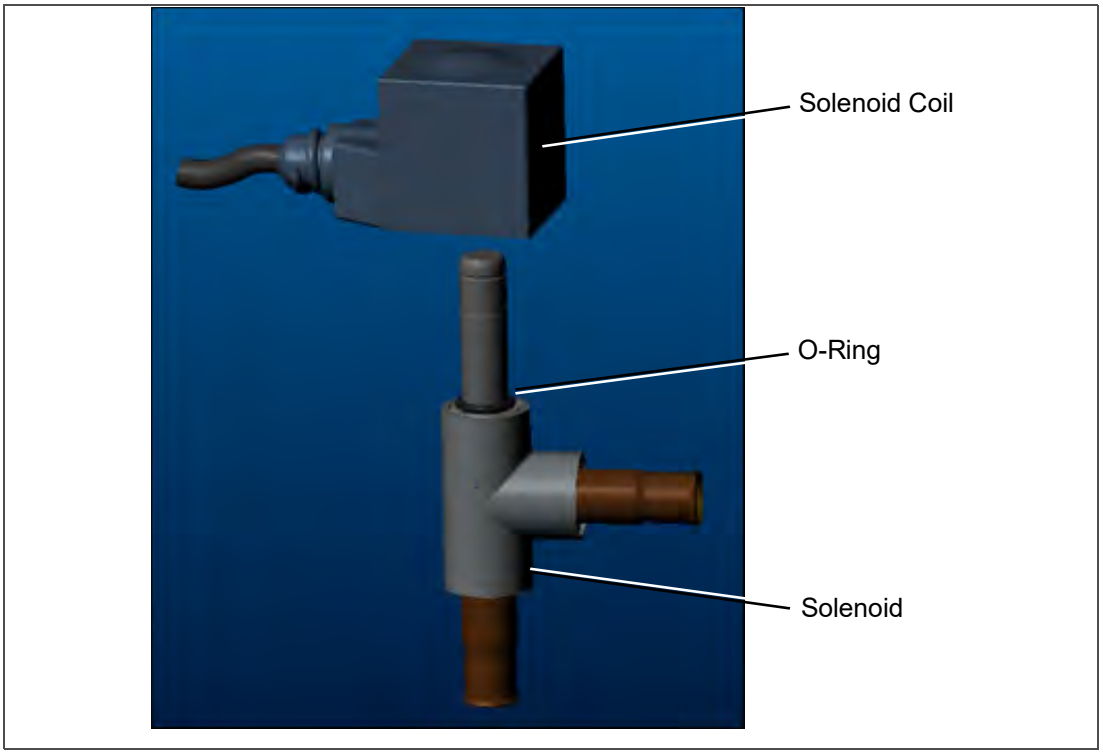
### 7.17.1 Removing / Replacing the ESV or USV Coil

1. Remove the valve coil from the valve. See **Figure 7.19**.
2. Cut the cable approximately 3 inches (75 mm) from the coil.
3. Connect the new coil wires using butt-splices and heat-shrink tubing.
4. Replace the coil on the valve, make sure that the coil is fully seated.

### 7.17.2 Removing / Replacing the ESV or USV

1. Turn unit power off and remove power from the unit.
2. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
3. Remove the valve coil from the valve. See **Figure 7.19**.

**Figure 7.19 Coil View of Economizer Solenoid Valve (ESV)**




4. **VALVE REMOVAL:** The preferred method of removing the solenoid valve is to cut the connection between the brazed section and the valve, using a small tube cutter. The valve can also be removed by un-brazing the connection. Then remove the valve. Remove valve.
5. Fit the new solenoid valve into position and braze. Use a wet rag to keep valve cool whenever brazing.
6. Install the O-ring on the valve stem (provided). See **Figure 7.19**.
7. Press the coil onto the valve stem ensuring that it is pressed all the way down, engaging with the O-ring.

## 7.18 Removing / Replacing the Flash Tank

The NaturaLINE unit is equipped with a flash tank. See **Figure 3.3** for location.

**⚠ DANGER**

**There are no serviceable parts on the flash tank. Attempting to repair the flash tank or welding on the flash tank vessel is not permitted. If the flash tank should be damaged in any way the entire flash tank must be replaced.**

**Removing the Flash Tank:**

1. Turn unit power off and remove power from the unit.
2. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
3. Remove flash tank pressure relief valve.
4. Un-braze the tube connections.
5. Remove the bolts securing the flash tank to the unit (4 places).
6. Take out flash tank.

**Installing the Flash Tank:**

1. Bolt flash tank to the unit (4 places).
2. Braze only at the tube connections.
3. Install pressure relief valve with new O-ring onto flash tank. See **Section 7.4**.
4. Replace Filter Drier. See **Section 7.10**.
5. Evacuate and dehydrate the system. See **Section 7.2.7**.
6. Recharge the system. See **Section 7.2.8**.
7. Check unit operation by running Pre-trip. See **Section 4.6**.

## 7.19 Controller

**NOTICE**

**The NaturaLINE platform must use the green label controller only (part number 12-55011).**

### 7.19.1 Handling Modules

**⚠ CAUTION**

**Do not remove wire harnesses from module unless you are grounded to the unit frame with a static safe wrist strap.**

**⚠ CAUTION**

**Unplug all module connectors before performing arc welding on any part of the container.**

The guidelines and cautions provided herein should be followed when handling the modules. These precautions and procedures should be implemented when replacing a module, when doing any arc welding on the unit, or when service to the refrigeration unit requires handling and removal of a module.

1. Obtain a grounding wrist strap (Carrier Transicold part number 07-00304-00) and a static dissipation mat (Carrier Transicold part number 07-00277-00). The wrist strap, when properly grounded, will dissipate any potential buildup on the body. The dissipation mat will provide a static-free work surface on which to place and/or service the modules.
2. Disconnect and secure power to the unit.
3. Place strap on wrist and attach the ground end to any exposed unpainted metal area on the refrigeration unit frame (bolts, screws, etc.).
4. Carefully remove the module. Do not touch any of the electrical connections if possible. Place the module on the static mat.
5. The strap should be worn during any service work on a module, even when it is placed on the mat.

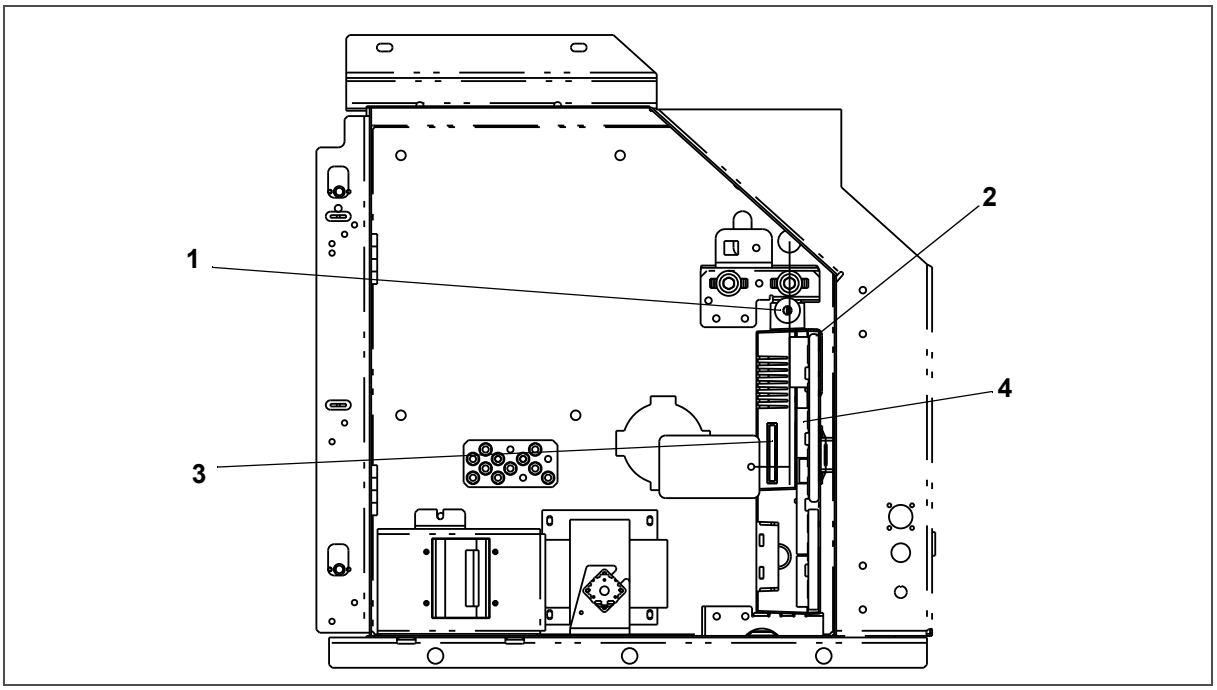
### 7.19.2 Controller Troubleshooting

A group of test points, TP1 - TP10, are provided on the controller for troubleshooting electrical circuits. See **Figure 7.20** and schematic diagram in **Section 8**.

**NOTICE**

**Use a digital voltmeter to measure AC voltage between TP's and ground (TP9), except for TP8.**

**Figure 7.20 Controller Section of the Control Box**




1) Mounting Screw
2) Controller
3) Controller Software Programming Port
4) Test Points

**Table 7–1 Test Point Descriptions**

| Test Point | Description |
|---|---|
| TP1 | Check if the controller unloader valve relay (TU) is open or closed. |
| TP2 | Check if the High Pressure Switch (HPS) is open or closed. |
| TP3 | Test point is not used in this application. |
| TP4 | Check whether the internal protector for the Gas Cooler fan (IP-GM) is open or closed. |
| TP5 | Check whether the internal protectors for the evaporator fan motors (IP-EM1 or IPEM2) are open or closed. |
| TP6 | Test point is not used in this application. |
| TP7 | Check whether the controller Economizer Solenoid Valve relay (TS) is open or closed. |
| TP8 | Test point is not used in this application. |
| TP9 | Chassis (unit frame) ground connection. |
| TP10 | Check whether the heat termination thermostat (HTT) contact is open or closed. |

### 7.19.3 Controller Programming Procedure

**⚠ CAUTION**

**The unit must be OFF whenever a programming card is inserted or removed from the controller programming port.**

**Procedure for Loading Operational Software:**

1. Place the Start-Stop switch (ST) to “0” to turn power off.
2. Insert the software / programming PCMCIA card into the programming port on the controller (see **Figure 7.20**). The PCMCIA card will contain the following (example) files:
   - *menuDDMM.ml3*, this file allows the user to select a file/program to upload into the controller.
   - *cfYYMMDD.ml3*, multi-configuration file.
3. Place the Start-Stop switch (ST) to “I” to turn unit power on.
4. The display will display the message “SEt UP”.
5. Press the Up or Down Arrow keys until the display reads “LOAd 57XX”. The XX represents the software revision.
6. Press the ENTER key.
7. The display will alternate between the messages “PrESS EntR” and “rEV 57XX”.
8. Press the ENTER key.
9. The display will show the message “Pro SoFt”. This message will last for up to one minute as the new software is loading.When software loading is complete, the display will show the message “Pro donE”.

   If a problem occurs while loading the software, the display will blink the message “Pro FAIL” or “bad 12V”. Place the Start-Stop switch (ST) to “0” and remove the card.
10. Place the Start-Stop switch (ST) to “0” to turn unit power off.
11. Remove the PCMCIA card from the programming slot.
12. Place the Start-Stop switch (ST) to “I” to return the unit to normal operation.
13. On power up, the status LED will flash quickly and the display will remain blank as the controller loads the new software. This takes about 15 seconds. When complete, the controller will reset and power up normally.
14. Wait for the default display to appear: setpoint on the left, and control temperature on the right.
15. To confirm the correct software loaded, use the keypad to bring up function code Cd18.

**Procedure for Loading Configuration Software:**

1. Place the Start-Stop switch (ST) to “0” to turn power off.
2. Insert the software / programming PCMCIA card into the programming port on the controller (see **Figure 7.20**). The PCMCIA card will contain the following (example) files:
   - *menuDDMM.ml3*, this file allows the user to select a file/program to upload into the controller.
   - *cfYYMMDD.ml3*, multi-configuration file.
3. Place the Start-Stop switch (ST) to “I” to turn unit power on.
4. The display will display the message “SEt UP”.
5. Press the ENTER key on the keypad.
6. The display will read “ruN COnFG”.

   If the display has blinking message “bAd CArd”, then the card is defective. Place the Start-Stop switch (ST) to “0” to turn power off and remove the card
7. Press the ENTER key.
8. The display module will go blank briefly and then display “6XX XXX”, based on the current operational software installed.

9. Press the Up or Down Arrow key until the display reads the desired model number.
10. Press the ENTER key.
11. When software loading has successfully completed, the display will show the message “COnFG donE”.

    If the display has blinking message “Pro FAIL” or “bad 12V”, then a problem has occurred while loading the software. Place the Start-Stop switch (ST) to “0” to turn unit power off and remove the card.
12. Place the Start-Stop switch (ST) to “0” to turn unit power off.
13. Remove the PCMCIA card from the programming slot.
14. Place the Start-Stop switch (ST) to “I” to return the unit to normal operation.
15. To confirm the correct model configuration was loaded, use the keypad to bring up function code Cd20. The model displayed should match the last five digits of the model number listed on the unit nameplate (see **Figure 2.1**).

**Procedure for Setting the Date and Time:**

1. Place the Start-Stop switch (ST) to “0” to turn power off.
2. Insert the software / programming PCMCIA card into the programming port on the controller (see **Figure 7.20**). The PCMCIA card will contain the following (example) files:
   - *menuDDMM.ml3*, this file allows the user to select a file/program to upload into the controller.
   - *cfYYMMDD.ml3*, multi-configuration file.
3. Place the Start-Stop switch (ST) to “I” to turn unit power on.
4. The display will display the message “SEt UP”.
5. Press the ENTER key on the keypad.
6. The display will read “ruN COnFG”.
7. Press the Up or Down Arrow key until the display reads “SEt tIM”.
8. Press the ENTER key.
9. The display will show the date in YYYY MM-DD format. The day value will be blinking.
10. The date values are modified from right to left. Press the Up or Down Arrow key to increase or decrease the values. Press the ENTER key to confirm the value for the current field and move to the next value. Press the CODE SELECT key to modify the previous value.
11. After pressing ENTER to confirm the year value, the time will be displayed in HH MM format with the hours being in a 24 hour format. The minutes will be blinking.
12. The time values are modified from right to left. Press the Up or Down Arrow key to change the values. Press the ENTER key to confirm the value for the current field and move to the next value. Press the CODE SELECT key to modify the previous value.
13. . After pressing ENTER to confirm the hour value, the display will return to “SEt tIM”.
14. Place the Start-Stop switch (ST) to “0” to turn power off.
15. Remove the PCMCIA card from the programming slot.
16. Place the Start-Stop switch (ST) to “I” to return the unit to normal operation.

**Procedure for Setting the Container ID:**

**NOTE**

The characters will be preset to the container ID already on the controller. If none exist, the default will be AAAA0000000.

1. Place the Start-Stop switch (ST) to “0” to turn power off.
2. Insert the software / programming PCMCIA card into the programming port on the controller (see **Figure 7.20**). The PCMCIA card will contain the following (example) files:
   - *menuDDMM.ml3*, this file allows the user to select a file/program to upload into the controller.
   - *cfYYMMDD.ml3*, multi-configuration file.

3. Place the Start-Stop switch (ST) to “I” to turn unit power on.
4. The display will display the message “SEt UP”.
5. Press the ENTER key on the keypad.
6. The display will read “ruN COnFG”.
7. Press the Up or Down Arrow key until display reads “SEt Id”.
8. Press the ENTER key.
9. The display will show the first letter of the container ID.
10. Press the Up or Down Arrow key to increase or decrease the values. Press ENTER to confirm a value for the current field and move to the next value. Press CODE SELECT to modify a previous value.
11. When the last value is entered, press the ENTER key to enter the information to the controller. The display will return to “SEt Id”.
12. Place the Start-Stop switch (ST) to “0” to turn power off.
13. Remove the PCMCIA card from the programming slot.
14. Place the Start-Stop switch (ST) to “I” to return the unit to normal operation.
15. To confirm that the correct container ID was loaded, use the keypad to bring up function code Cd40.

### 7.19.4 Removing and Installing a Module

**Removal:**

1. Disconnect all front wire harness connectors and move wiring out of way.
2. Remove the VIM module from the right side of the controller.
3. The lower controller mounting is slotted, loosen the top mounting screw and lift up and out. See **Figure 7.20**.
4. Disconnect the back connectors and remove module.
5. When removing the replacement module from its packaging, note how it is packaged. When returning the old module for service, place it in the packaging in the same manner as the replacement. The packaging has been designed to protect the module from both physical and electrostatic discharge damage during storage and transit.

**Installation:**

1. Install the module by reversing the removal steps.
2. Torque values for mounting screws are 2.26 Nm (20 in-lb). See **Figure 7.20**, item 2. Torque value for the connectors is 1.13 Nm (10 in-lb).

### 7.19.5 Battery Replacement

**Standard Battery Location (Standard Cells):**

1. Turn unit power OFF and disconnect power supply.
2. Slide bracket out and remove old batteries. See **Figure 3.5**, Item 8.
3. Install new batteries and slide bracket into control box slot.

**⚠ CAUTION**

**Use care when cutting wire ties to avoid nicking or cutting wires.**

**Standard Battery Location (Rechargeable Cells):**

1. Turn unit power OFF and disconnect power supply.
2. Disconnect battery wire connector from control box.
3. Slide out and remove old battery and bracket. See **Figure 3.5**, Item 8.
4. Slide new battery pack and bracket into the control box slot.
5. Reconnect battery wire connector to control box and replace wire ties that were removed.

**Secure Battery Option (Rechargeable Cells Only):**

1. Turn unit power OFF and disconnect power supply.
2. Open control box door and remove both the high voltage shield and clear plastic rain shield (if installed).
3. Disconnect the battery wires from the “KA” plug positions 14, 13, 11.
4. Using Driver Bit, Carrier Transicold part number 07-00418-00, remove the 4 screws securing the display module to the control box. Disconnect the ribbon cable and set the display module aside.

**NOTICE**

**The battery wires must face toward the right.**

5. Remove the old battery from the bracket and clean bracket surface. Remove the protective backing from the new battery and assemble to the bracket. Secure battery by inserting the wire tie from the back of the bracket around the battery, and back through the bracket.
6. Reconnect the ribbon cable to display and re-install the display.
7. Route the battery wires from the battery along the display harness and connect the red battery wire and one end of the red jumper to “KA14,” the other end of the red jumper wire to “KA11,” and the black wire to “KA13.”
8. Replace wire ties that were removed.

## 7.20 Variable Frequency Drive

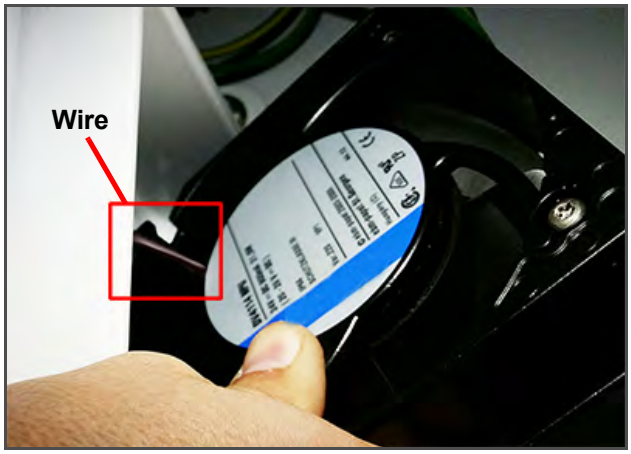
### 7.20.1 Remove and Replace Variable Frequency Drive Cooling Fan

**VFD Fan Removal:**

1. Turn unit off and disconnect power cord.
2. Remove the (8) screws that secure the VFD cover and remove the cover.
3. The VFD cooling fan is located on the right side of the VFD. Remove the (4) mounting screws that secure the fan assembly and grille to the VFD. See **Figure 7.21**.

**Figure 7.21 VFD Fan Screws**

**Figure 7.22 VFD Fan Removal**




4. Remove the grille and fan assembly. While removing, rotate the fan assembly to in order to expose the wires. See **Figure 7.22**.
5. Cut the exposed VFD fan wires and remove the fan assembly.
6. Feed the cut wires through the opening at the back of the fan housing, this is where the new fan wires will be spliced to the existing wires.

**VFD Fan Replacement:**

1. Feed the new VFD fan wires through the opening at the back of the fan housing.
2. Butt splice and heat shrink the new fan wires and the existing wires.

3. Rotate the fan assembly and place it back into the fan housing so that the wires are located on top and completely tucked in behind the fan housing.
4. Place the grille over the fan and secure the fan assembly and grille with the (4) mounting screws.
5. Replace the VFD cover and secure in place with the (8) mounting screws.
6. Restore power to the unit and check the operation of the VFD fan.

### 7.20.2 Variable Frequency Drive (VFD) Bypass

**⚠ CAUTION**

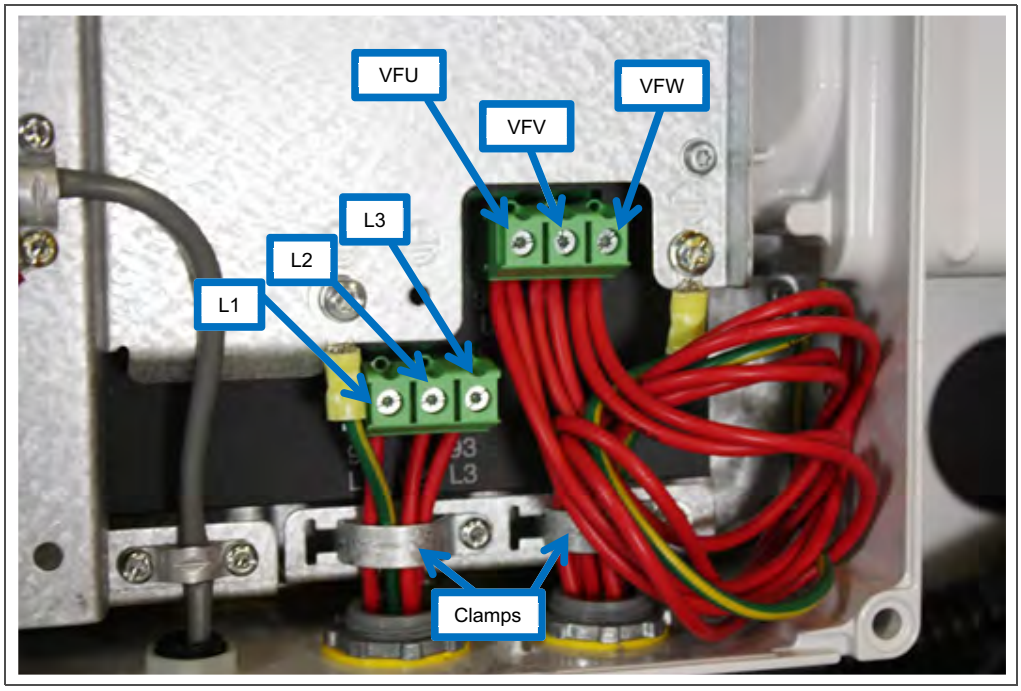
**Variable Frequency Drive Electrical Hazard. After disconnecting from power supply, wait seven (7) minutes before servicing to allow capacitors to completely discharge.**

*Video available in the Mobile Version*

If the VFD fails, the following procedure will bypass VFD control allowing the compressor to operate at one speed. This will restore limited unit functionality until the VFD can be repaired or replaced.

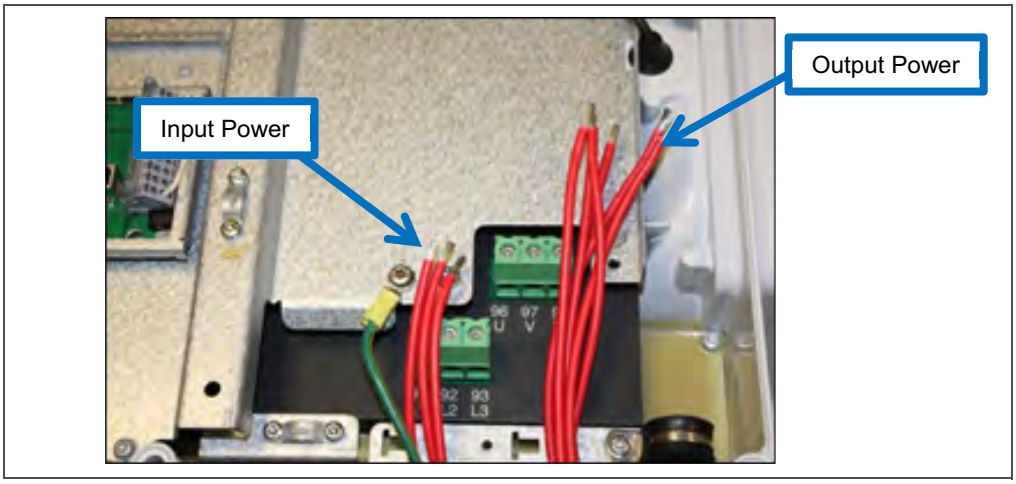
1. Turn the unit off and disconnect the power cord.
2. Wait a minimum of 7 minutes before servicing the VFD.
3. Remove the (8) screws that secure the VFD cover and remove the cover. The VFD Phase wiring will be visible in the lower right corner of the box. See **Figure 7.23**.

**Figure 7.23 VFD Phase Wiring**

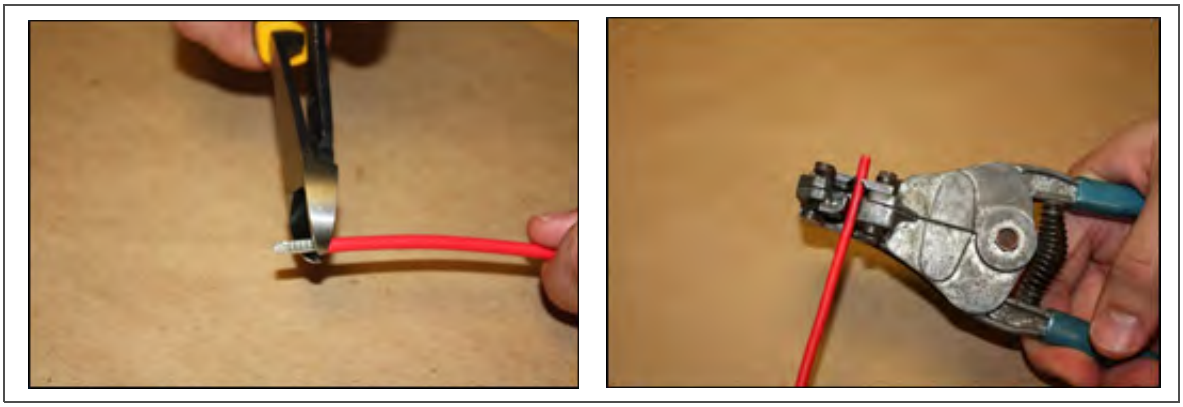



4. Remove wire harness clamps to allow wires to be worked on.

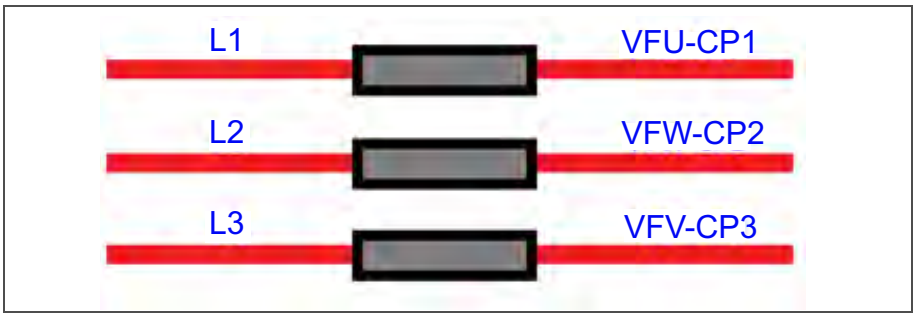
5. Disconnect the VFD input and output phase wires, leaving the ground wire attached.



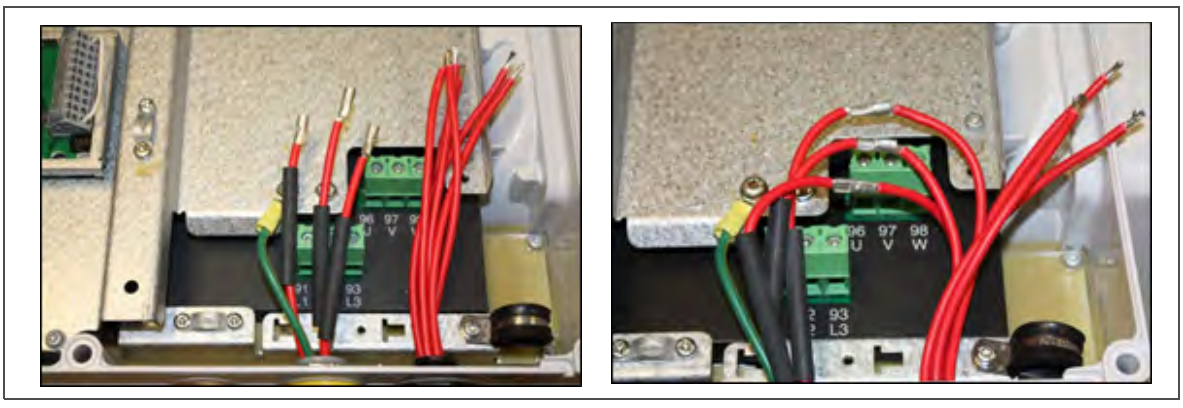

6. Cut the barrels off of the wires using wire cutters and strip back the insulation approximately 0.25” (6.35mm).



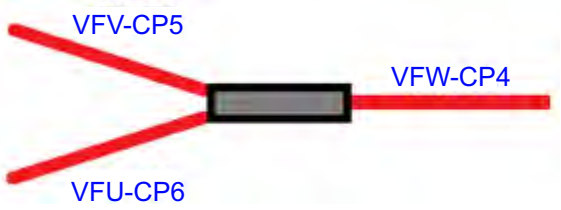
7. Locate the following wires to prepare for a butt splice connection.




8. Position the heat shrink and crimp the electrical splice connector for all 6 wires mentioned above.



9. Locate the following wires to prepare for a two-to-one butt splice electrical connection.





10. Using a hot air gun, shrink the heat shrink tube to insulate all of the electrical butt splice joints.


11. While heating the heat shrink tube for a two-to-one butt splice electrical connection, use a needle-nosed plier to crimp the heat shrink tube while heating.

The finished wires should look like the image below:

12. Install wire harness clamps and secure the wires using best practice to prevent damage.
13. Be sure that all the wires are within the VFD and replace the cover and secure with the eight (8) screws.
14. Power up the unit and go to Cd61 to activate the VFD Bypass mode.
15. While Cd61 is visible on the display, press and hold the ALT key for 2 seconds, then press ENTER with the ALT key still held down. This will lock the code. Press an arrow key to change from 'OFF' to 'Act iV' and press ENTER. Press ENTER a second time to lock and activate the limp home mode. Power cycle the unit to engage limp home mode. To unlock or reset to normal operation the same procedure must be followed. Cd61 will remain on the display until a valid selection is made, or is manually exited. If the state of limp home mode is modified, Cd61 will restart the unit after a 30 second hold off.

## 7.21 Vent Position Sensor Service

### 7.21.1 Upper VPS Service

The fresh air vent position sensor alarm (AL50) will occur if the sensor reading is not stable for four minutes or if the sensor is outside of its valid range (shorted or open). This can occur if the vent is loose or the panel is defective. To confirm a defective panel, assure that the wing nut is secure and then power cycle the unit. If the alarm immediately reappears as active, the panel should be replaced.

The alarm should immediately go inactive, check the 4-minute stability requirement. If the alarm reoccurs after the four minutes and the panel was known to have been stable, then the sensor should be replaced. In order to replace the Upper VPS, the panel must be removed and replaced with another upper fresh air panel equipped with VPS. If sensor is found to be defective then replace the panel or replace the VPS with kit number 74-66615-00.

Upon installation, a new Vent Position Sensor assembly requires calibration as follows:

1. Rotate the vent to the 0 CMH/ CFM position. Cd45 will automatically display.
2. Press the Enter key and hold for five seconds. After the enter key has been pressed the display will read "CAL" (for calibration).
3. Press the ALT MODE key and hold for five seconds. After the calibration has been completed, Cd45 will display 0 CMH / CFM.

## 7.22 Temperature Sensor Service

Service procedures for the return recorder (RRS), return temperature (RTS), supply recorder (SRS), supply temperature (STS), ambient temperature (AMBS), defrost temperature (DTS), evaporator temperature (ETS), and compressor discharge temperature (CPDS) sensors are provided here.

### 7.22.1 Ice Bath Preparation

The ice-water bath is a method for testing the accuracy of sensors by submerging the sensors in an insulated container with ice cubes or chipped ice, then filling voids between ice with water and agitating until the mixture reaches 0°C (32°F) measured on a laboratory thermometer.

**Notes:**

- Wherever possible, use a thermometer that is regularly calibrated by an accredited test lab. Contact your instrument representative if the reference thermometer is not showing correct readings.
- Always use a temperature measurement reference instrument which is of higher accuracy than the device checked – for example, a thermometer with a rated accuracy of +/- 0.2 °C should be used to check a device with a rated accuracy +/- 0.3 °C.
- A thermally insulated container, tub open to atmosphere and large enough to contain crushed ice and water should be used. The tub should be large enough to contain the unit's sensor and the reference thermometer.
- Enough distilled water should be available to make ice cubes and to set up a proper and stable ice-water triple-point mixture. Prepare ice using distilled water.
- Pre-cool distilled water for testing.

**Procedure:**

1. Prepare a mixture of clean ice using distilled water in a clean insulated container. If possible, the person handling should be wearing latex gloves.
   a. Crush or chip the ice to completely fill the container. The finer the ice particles, the more accurate the mixture.
   b. Add enough pre-cooled distilled water to fill the container.
   c. Stir the mixture for a minimum of 2 minutes to ensure water is completely cooled and good mixing has occurred.
   d. The mixture should generally contain about 85% ice with the distilled water occupying the rest of the space.
   e. Add more ice as the ice melts.
2. Stir the ice water slurry mixture to maintain a temperature of 0°C (32°F).
3. Constantly monitor the temperature of the ice water slurry with your reference thermometer. Ensure that the temperature of the bath has stabilized. The criterion for stability generally is to take two readings at 1 minute intervals, and the two readings should be 0°C (32°F).

### 7.22.2 Sensor Checkout Procedure

This procedure is performed to verify the accuracy of a temperature sensor.

1. Remove the sensor and place it in a 0°C (32°F) ice-water bath. Refer to **Ice Bath Preparation** procedure.
2. Start the unit and check the sensor reading on the control panel. The reading should be 0°C (32°F). If the reading is correct, reinstall the sensor; if it's not, continue with the next step.
3. Turn the unit OFF and disconnect the power supply.
4. Remove the controller to gain access to the sensor plugs. See **Section 7.19**.
5. Using the plug connector marked "EC" that is connected to the back of the controller, locate the sensor wires (RRS, RTS, SRS, STS, AMBS, DTS, or CPDS as required). Follow those wires to the connector and using the pins of the plug, measure the resistance. Values are provided in **Table 7–2**, **Table 7–3**.

   Due to the variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is defective, the resistance reading will usually be much higher or lower than the resistance values given.

**Table 7–2 Sensor Resistance - AMBS, DTS, ETS, RRS, RTS, SRS, STS**

| °C | °F | OHMS | | °C | °F | OHMS |
|---|---|---|---|---|---|---|
| -40 | -40 | 336,500 | | 6 | 42.8 | 24,173 |
| -39 | -38.2 | 314,773 | | 7 | 44.6 | 23,017 |
| -38 | -36.4 | 294,600 | | 8 | 46.4 | 21,922 |
| -37 | -34.6 | 275,836 | | 9 | 48.2 | 20,886 |
| -36 | -32.8 | 258,336 | | 10 | 50 | 19,900 |
| -35 | -31 | 242,850 | | 11 | 51.8 | 18,975 |
| -34 | -29.2 | 228,382 | | 12 | 53.6 | 18,093 |
| -33 | -27.4 | 214,164 | | 13 | 55.4 | 17,258 |
| -32 | -25.6 | 200,909 | | 14 | 57.2 | 16,466 |
| -31 | -23.8 | 188,545 | | 15 | 59 | 15,715 |
| -30 | -22.0 | 177,000 | | 16 | 60.8 | 15,002 |
| -29 | -20.2 | 166,360 | | 17 | 62.6 | 14,325 |
| -28 | -18.4 | 156,426 | | 18 | 64.4 | 13,683 |
| -27 | -16.6 | 147,148 | | 19 | 66.2 | 13,073 |
| -26 | -14.8 | 138,478 | | 20 | 68 | 12,494 |
| -25 | -13 | 130,374 | | 21 | 69.8 | 11,944 |
| -24 | -11.2 | 122,794 | | 22 | 71.6 | 11,420 |
| -23 | -9.4 | 115,702 | | 23 | 73.4 | 10,923 |
| -22 | -7.6 | 109,063 | | 24 | 75.2 | 10,450 |
| -21 | -5.8 | 102,846 | | **25** | **77** | **10,000** |
| -20 | -4 | 97,022 | | 26 | 78.8 | 9,572 |
| -19 | -2.2 | 91,563 | | 27 | 80.6 | 9,164 |
| -18 | -0.4 | 86,445 | | 28 | 82.4 | 8,777 |
| -17 | 1.4 | 81,644 | | 29 | 84.2 | 8,407 |
| -16 | 3.2 | 77,139 | | 30 | 86 | 8,055 |
| -15 | 5 | 72,910 | | 31 | 87.8 | 7,720 |
| -14 | 6.8 | 68,938 | | 32 | 89.6 | 7,401 |
| -13 | 8.6 | 65,206 | | 33 | 91.4 | 7,096 |
| -12 | 10.4 | 61,699 | | 34 | 93.2 | 6,806 |
| -11 | 12.2 | 58,401 | | 35 | 95 | 6,529 |
| -10 | 14 | 55,330 | | 36 | 96.8 | 6,265 |
| -9 | 15.8 | 52,381 | | 37 | 98.6 | 6,013 |
| -8 | 17.6 | 49,634 | | 38 | 100.4 | 5,772 |
| -7 | 19.4 | 47,047 | | 39 | 102.2 | 5,543 |
| -6 | 21.2 | 44,610 | | 40 | 104.0 | 5,323 |
| -5 | 23 | 42,314 | | 41 | 105.8 | 5,114 |
| -4 | 24.8 | 40,149 | | 42 | 107.6 | 4,914 |
| -3 | 26.6 | 38,108 | | 43 | 109.4 | 4,723 |
| -2 | 28.4 | 36,182 | | 44 | 111.2 | 4,540 |
| -1 | 30.2 | 34,365 | | 45 | 113 | 4,365 |
| **0** | **32** | **32,650** | | 46 | 114.8 | 4,198 |
| 1 | 33.8 | 31,030 | | 47 | 116.6 | 4,038 |
| 2 | 35.6 | 29,500 | | 48 | 118.4 | 3,885 |
| 3 | 37.4 | 28,054 | | 49 | 120.2 | 3,739 |
| 4 | 39.2 | 26,688 | | 50 | 122 | 3,599 |
| 5 | 41 | 25,396 | | | | |

**Table 7–3 Sensor Resistance - CPDS**

| °C | °F | OHMS | | °C | °F | OHMS |
|---|---|---|---|---|---|---|
| -40 | -40 | 849,822 | | 18 | 64.4 | 136,705 |
| -38 | -36.4 | 834,450 | | 20 | 68.0 | 124,876 |
| -36 | -32.8 | 819,079 | | 22 | 71.6 | 114,101 |
| -34 | -29.2 | 803,707 | | 24 | 75.2 | 104,352 |
| -32 | -25.6 | 788,336 | | **25** | **77** | **100,000** |
| -30 | -22.0 | 772,964 | | 26 | 78.8 | 95,585 |
| -28 | -18.4 | 757,593 | | 28 | 82.4 | 87,619 |
| -26 | -14.8 | 742,221 | | 30 | 83.0 | 80,447 |
| -24 | -11.2 | 726,849 | | 32 | 89.6 | 73,931 |
| -22 | -7.6 | 711,478 | | 34 | 93.2 | 68,000 |
| -20 | -4.0 | 696,106 | | 36 | 96.8 | 62,599 |
| -18 | -0.4 | 680,735 | | 38 | 100.4 | 57,657 |
| -16 | 3.2 | 665,363 | | 40 | 104.0 | 53,200 |
| -14 | 6.8 | 649,992 | | 42 | 107.6 | 49,117 |
| -12 | 10.4 | 620,224 | | 44 | 111.2 | 45,367 |
| -10 | 14.0 | 563,722 | | 46 | 114.8 | 41,965 |
| -8 | 17.6 | 507,219 | | 48 | 118.4 | 38,840 |
| -6 | 21.2 | 450,717 | | 50 | 122.0 | 35,991 |
| -4 | 24.8 | 403,140 | | 52 | 125.6 | 33,369 |
| -2 | 28.4 | 365,427 | | 54 | 129.2 | 30,967 |
| **0** | **32.0** | **327,715** | | 56 | 132.8 | 28,753 |
| 2 | 35.6 | 295,834 | | 58 | 136.4 | 26,733 |
| 4 | 39.2 | 267,922 | | 60 | 140.0 | 24,867 |
| 6 | 42.8 | 241,618 | | 62 | 143.6 | 23,152 |
| 8 | 46.4 | 219,659 | | 64 | 147.2 | 21,570 |
| 10 | 50.0 | 198,927 | | 66 | 150.8 | 20,827 |
| 12 | 53.6 | 180,987 | | 68 | 154.4 | 20,112 |
| 14 | 57.2 | 164,687 | | 70 | 158.0 | 18,768 |
| 16 | 60.8 | 149,680 | | 72 | 161.6 | 16,375 |

### 7.22.3 GDP Supply and Return Sensor Calibration

European Commission GDP (Good Distribution Practices) guidelines, which are used worldwide, call for the equipment used to control or monitor environments where medicinal products are stored or transported be calibrated in accordance with pharmaceutical shipper specifications, typically every six months or annually.

This procedure explains how to perform a GDP calibration of the supply (STS/SRS) and return (RTS/RRS) sensors using DataLINE software version 3.1 or higher. The calibration procedure should be conducted in pairs (STS/SRS, or RTS/RRS) and it is recommended to calibrate before the full pre-trip inspection.

**⚠ WARNING**

**Before removing the Supply or Return air sensors from the unit, turn the ON/OFF switch and circuit breaker to the OFF position. Disconnect the power plug from the unit. Follow proper lockout/tagout procedures to ensure the power cannot inadvertently be energized. It is important that all dismantling work is done and tools and personnel are away from the unit before powering on the unit for calibration.**

**⚠ WARNING**

**When performing the Return Air Sensor calibration, disconnect both evaporator motors.**

**NOTE**

Before proceeding with the calibration procedure, ensure that controller software version is up to date (57xx) and DataLINE version 3.1 or higher is installed onto the download device. Only the latest DataLINE and controller software will allow users to carry out Good Distribution Practice (GDP) calibration. Do not downgrade the software after installing the latest software.

**NOTE**

Before proceeding with the calibration procedure, it is recommended to check the sensors by running pre-trip P5-0. This test checks the sensor values. If the test fails, identify and correct the faulty sensor and rerun the test.

**Tools Required:**

- Socket screwdrivers set
- Phillips screwdriver
- Standard hand tools
- Interrogator cable
- Laptop with DataLINE 3.1 or above installed
- Clean insulated container for distilled water and ice
- A regularly calibrated reference thermometer, recommended to be of accuracy up to 2 decimal places

**GDP Calibration, Removing Supply Sensors (STS/SRS) from Unit:**

1. Locate the supply sensors cover assembly on the suction side of the compressor. Remove the two fasteners securing the cover of the sensors.
2. Remove the cover and rotate the supply air sensors, STS/SRS, in a clockwise direction and remove the sensors from the sensor housing.

**GDP Calibration, Removing Return Sensors (RTS/RRS) from Unit:**

1. Remove both front access panels from the unit by removing 8 fasteners from each panel. Save all hardware for re-installation.
2. On the right side, disconnect the fan motor wiring, loosen the fastener and remove (slide) the evaporator motor from the unit.
3. Loosen the fastener on the sensor bracket.
4. Cut all wire ties that are securing the sensors to the harness and remove sensor.

**GDP Calibration, Perform Calibration:**

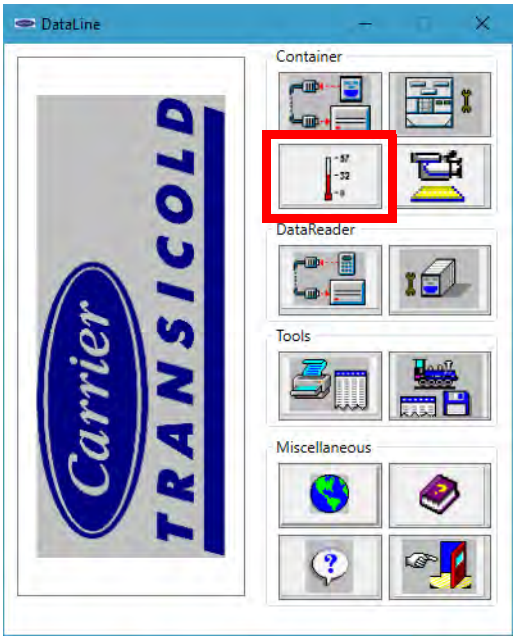
1. Connect the interrogator cable to the interrogator port. Then, power on the unit.

**⚠ WARNING**

**Before powering on the unit, it is important to ensure that all dismantling work is done and tools are away and service personnel are not working on the unit at the time of power on.**

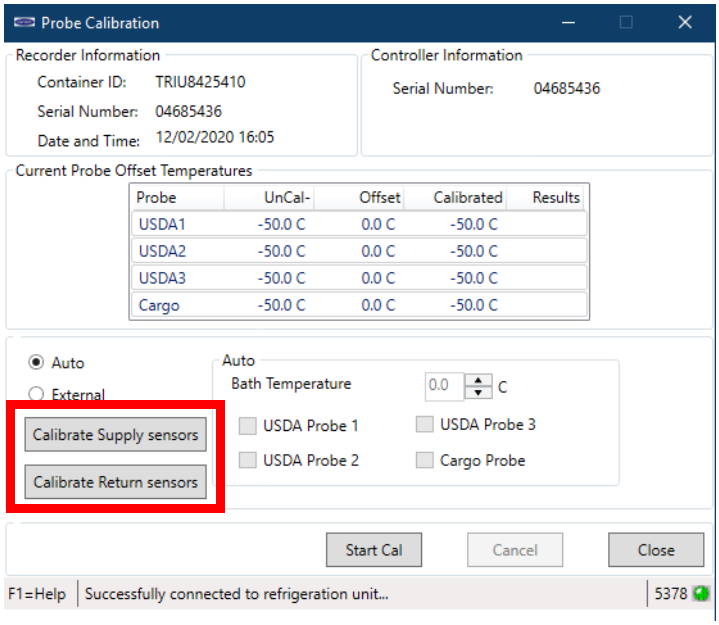
2. Open DataLINE version 3.1 or above. From the DataLINE launch pad, click on the Probe Calibration button to go to the Probe Calibration screen. A pop-up window will appear reminding the user to ensure proper ice bath temperature. Click OK to acknowledge.

**Figure 7.24 DataLINE - Probe Calibration**



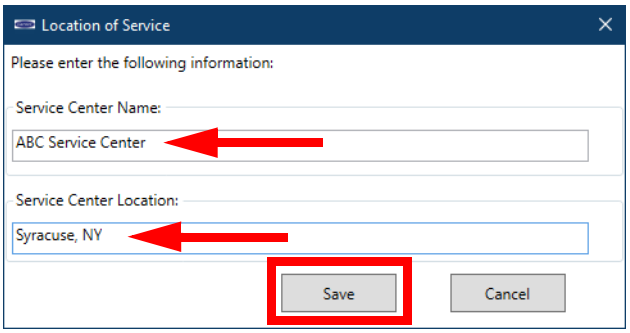

3. On the Probe Calibration screen, click on the Calibrate Supply sensors or Calibrate Return sensors button.

**Figure 7.25 DataLINE - Calibrate Sensors Button**




4. A Location of Service pop-up window will appear. In the appropriate fields, enter the Service Center Name and Service Center Location where the calibration is being performed. Then, click the Save button. A pop-up window will appear reminding the user to ensure proper ice bath temperature. Click OK to acknowledge and remember to maintain the Ice bath at 0°C (32°F).

**Figure 7.26 DataLINE - Enter Service Information**

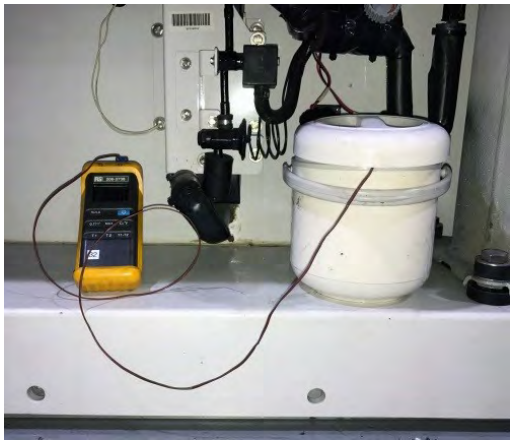



5. Prepare the ice bath. Refer to the **Ice Bath Preparation** procedure.

   Ensure that the set-up (i.e. ice bath, sensors, reference thermometer) has reached a stable state before beginning the calibration process. Ensure that the set-up is clean and the reference thermometer is regularly maintained and calibrated.

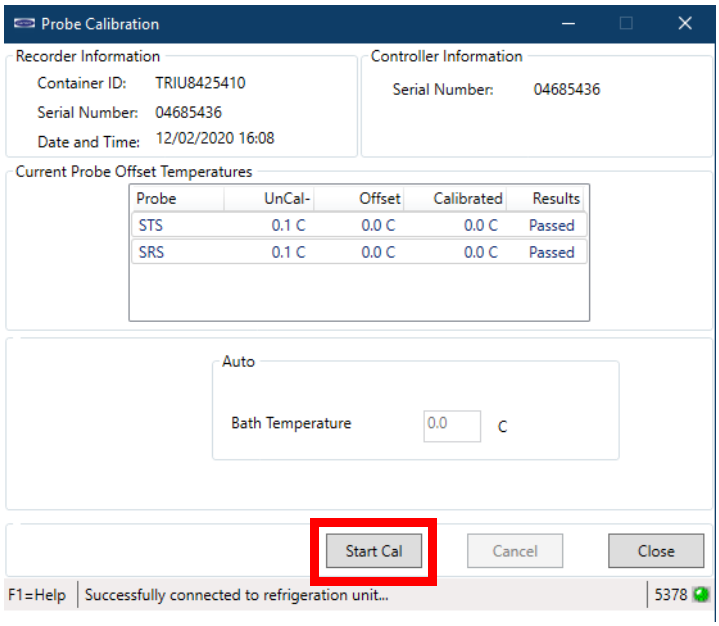
6. Place the ice bath in a location near sensors. For Return Sensors, place the ice bath on an elevated platform (ladder) of appropriate height.

**Figure 7.27 Ice Bath**



7. Once temperature stability is ensured, submerge the sensors in the ice water slurry. Make certain that the sensors do not contact the container sides or bottom, or each other. Continuously stir the slurry mixture during calibration.
8. Ensure that the Ice bath is at 0°C (32°F) using the calibrated reference thermometer. Confirm that the sensor readings have stabilized and the sensors are within +/- 0.3°C (0.5°F). The readings can be taken from the Uncal column in the Current Probe Offset Temperatures table.
9. Then, after confirming the sensor readings have stabilized, click on the Start Cal button. After clicking Start Cal, the process begins automatically and will complete in less than 5 minutes. Continue to stir the ice bath during testing. Calibration will fail if the stability cannot be achieved or the sensor offset is greater than 0.3°C (0.5°F).

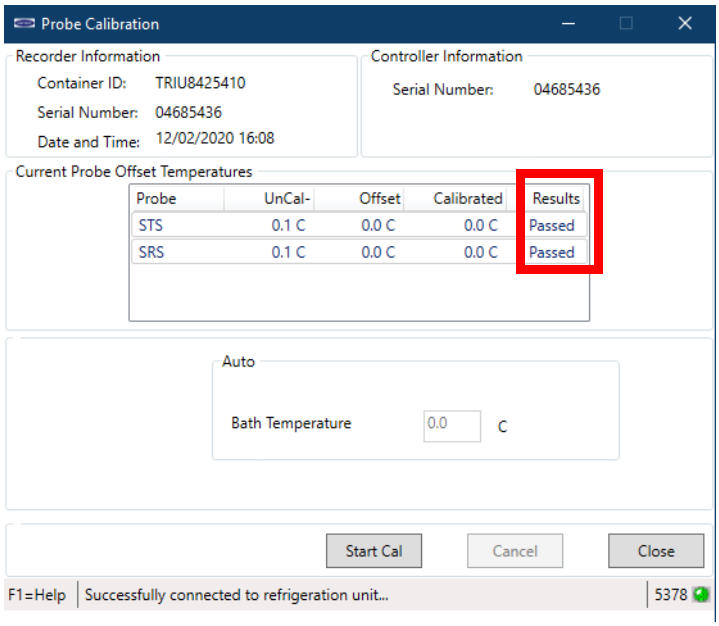
**Figure 7.28 DataLINE - Start Cal Button**




10. Once the calibration has completed, a pop-up will appear with the message Calibrate Complete. Click OK to acknowledge and the results will then be displayed on the screen in the Results column.

    Calibration will fail if the stability cannot be achieved or the sensor offset is greater than 0.3°C (0.5°F). The validity of a sensor can be checked by hand warming the sensors to see if there are changes in the readings on the DataLINE screen. If calibration will not complete, replace and recalibrate the sensors. Refer to the Sensor Replacement procedure.

**Figure 7.29 DataLINE - Calibration Results**




11. After completing the calibration event, download a DCX file and check that all of the following information is captured: service center name, location, the results of the calibration and the offset applied. Ensure that all the information is captured and the event is considered a success when all the intended sensors in calibration have passed.

**NOTE**

If there is “uncal” in the download, it means that the calibration process was not completed.

12. After the completion of the calibration, restore the unit to its original state.

### 7.22.4 Sensor Replacement

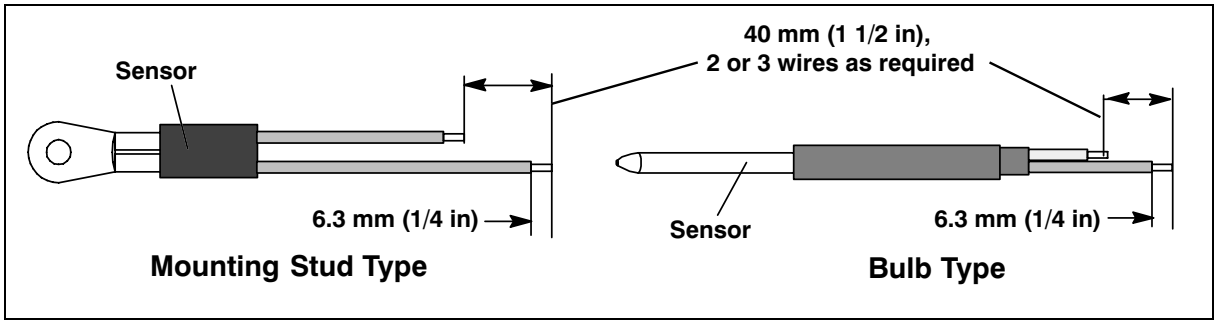
1. Turn unit power OFF and disconnect power supply.

**NOTICE**

**Include white date code label when cutting out and removing defective sensors. The label could be required for warranty returns.**

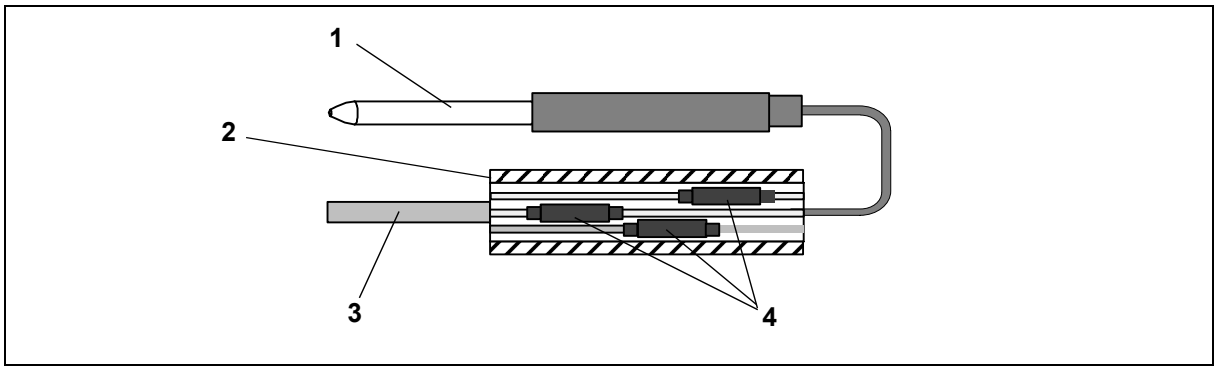
2. Cut cable. Slide the cap and grommet off a bulb type sensor and save for reuse. Do not cut the grommet.
3. Cut one wire of existing cable 40 mm (1-1/2 inches) shorter than the other wire.
4. Cut replacement sensor wires (opposite colors) back 40 mm (1-1/2 inches). See **Figure 7.30**.
5. Strip back insulation on all wiring 6.3 mm (1/4 inch).

**Figure 7.30 Sensor Types**




6. Slide a large piece of heat shrink tubing over the cable, and place the two small pieces of heat shrink tubing, one over each wire, before adding crimp fittings as shown in **Figure 7.31**.

**Figure 7.31 Sensor and Cable Splice**




1) Sensor (typical)
2) Large Heat Shrink Tubing (1)
3) Cable
4) Heat Shrink Tubing (2 or 3 as required)

- - - - -

7. If required, slide the cap and grommet assembly onto the replacement sensor.
8. Slip crimp fittings over dressed wires (keeping wire colors together). Make sure wires are pushed into crimp fittings as far as possible and crimp with crimping tool.
9. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
10. Slide heat shrink tubing over each splice so that ends of tubing cover both ends of crimp as shown in **Figure 7.30**.
11. Heat tubing to shrink over splice. Make sure all seams are sealed tightly against wiring to prevent moisture seepage.

**⚠ CAUTION**

**Do not allow moisture to enter wire splice area as this may affect the sensor resistance.**

12. Slide large heat shrink tubing over both splices and shrink.
13. Position the sensor in unit as shown in **Figure 7.31** and re-check sensor resistance.
14. Reinstall the sensor. See **Section 7.22.5**.

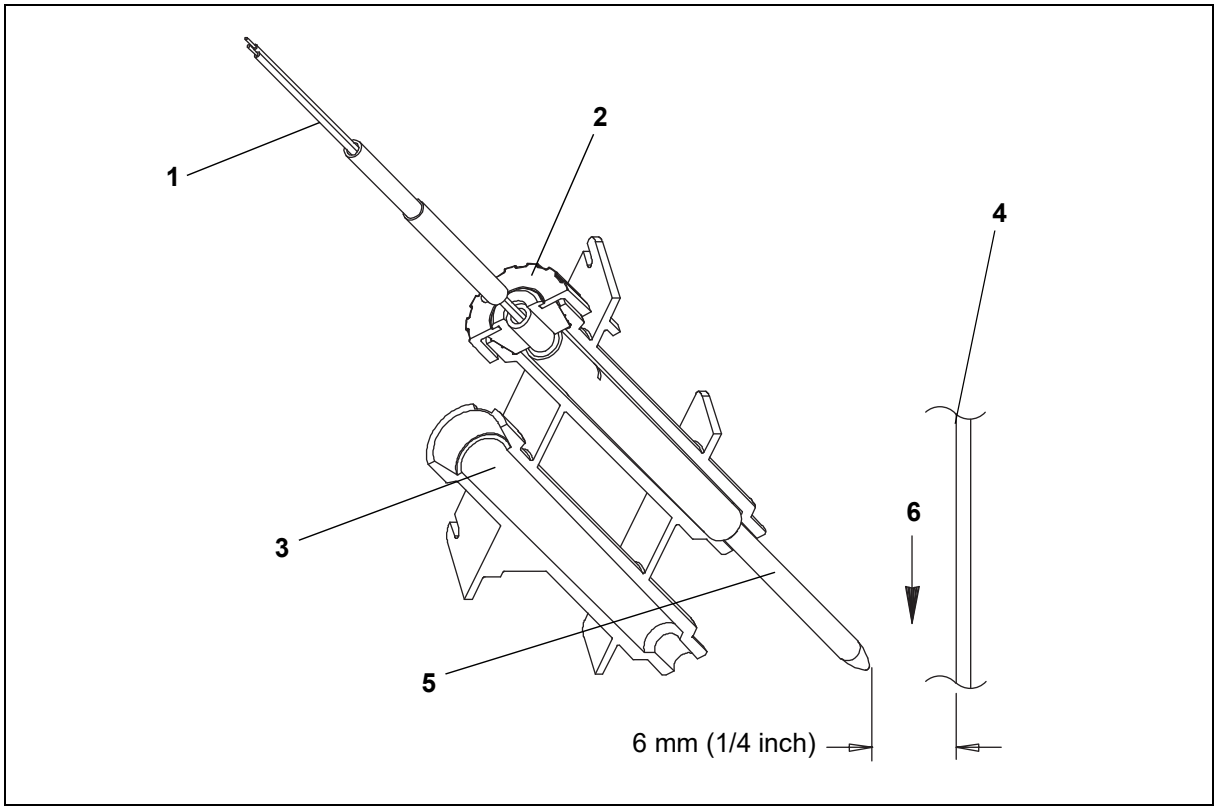
**NOTICE**

**The P5 Pre-Trip test must be run to inactivate probe alarms. See Section 5.8.**

### 7.22.5 Sensor STS and SRS Re-Installation

To properly position a supply sensor, the sensor must be fully inserted into the probe holder. See **Figure 7.32**. Do not allow heat shrink covering to contact the probe holder. For proper placement of the sensor, be sure to position the enlarged positioning section of the sensor against the side of the mounting clamp. This positioning will give the sensor the optimum amount of exposure to the supply air stream, and will allow the controller to operate correctly.

**Figure 7.32 Supply Sensor Positioning**



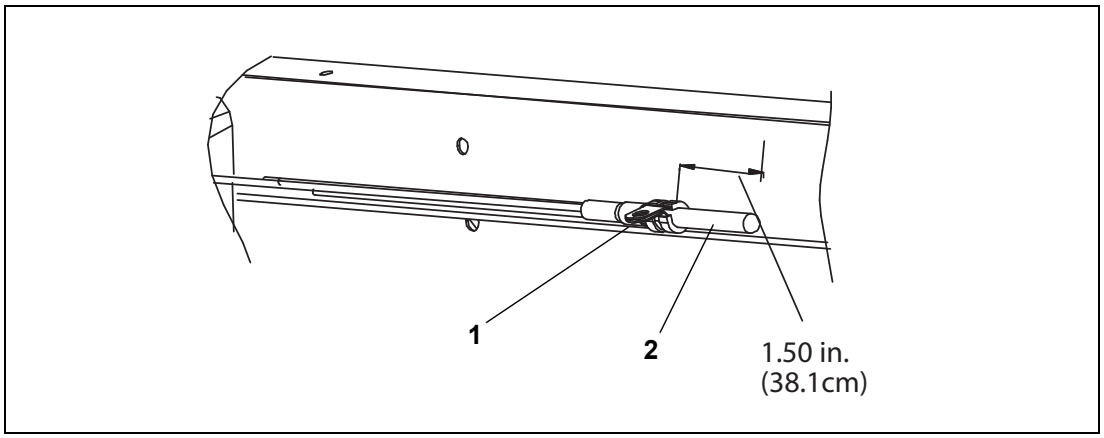

1) Sensor Wires
2) Cap and Grommet Assembly
3) Probe Holder
4) Evaporator Back Panel
5) Supply Sensor
6) Supply Air Stream

- - - - -

### 7.22.6 Sensors RRS and RTS Re-Installation

Reinstall the return sensor as shown in **Figure 7.33**. For proper placement of the return sensor, be sure to position the enlarged positioning section of the sensor against the side of the mounting clamp.

**Figure 7.33 Return Sensor Positioning**




1) Mounting Clamp 2) Return Sensor

- - - - -

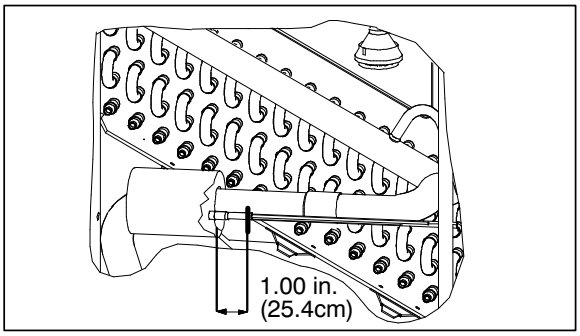
### 7.22.7 Sensor DTS Re-Installation

The DTS sensor must be installed with the long, flat edge against the coil center tube sheet in order to accurately measure the coil temperature.

### 7.22.8 Sensors ETS1 Re-Installation

The ETS1 sensor is located in a tube holder under insulation, as shown in **Figure 7.34**. When the combo sensor is removed and reinstalled, it must be placed in a tube holder by applying thermal grease. Insulating material must completely cover the sensor to ensure the correct temperature is sensed.

**Figure 7.34 Evaporator Temperature Sensor Positioning**




### 7.22.9 Sensor, CPDS Re-Installation

To replace the Compressor Discharge Sensor perform the following:

1. Ensure the unit is disconnected from the power source and that ST is in OFF position.
2. Remove the existing sensor. Clean all silicone sealer and dielectric compound from the sensor well. Ensure well is clean and dry. Top of compressor, where the sensor seals, must also be clean and dry.
3. Using the syringe supplied with the replacement sensor, squeeze all of the dielectric compound into the sensor well.
4. Place a bead of the silicone sealer supplied with the replacement sensor around the sensor sealing ring. Insert sensor into the well with the leads parallel to the suction fitting.
5. Reconnect sensor and run a Pre-trip to test. See **Figure 7.30**.

## 7.23 Transducer Service

The location of the Discharge Pressure Transducer (DPT), Suction Pressure Transducer (SPT), and Flash Tank Pressure Transducer (FPT) can be found in **Figure 3.3** and **Figure 3.4**.

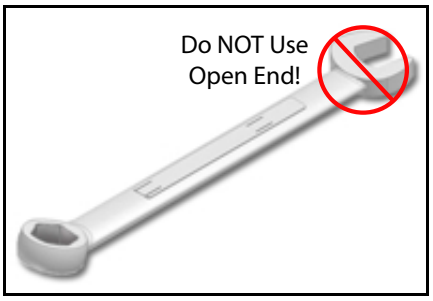
Remove and replace transducers using the following procedure:

1. Remove the refrigerant charge from the unit. See **Section 7.2.5**.
2. Disconnect wiring from defective transducer.

**NOTICE**

**When removing or installing a transducer from the unit, always use a deep well socket or box end wrench to prevent crushing of the transducer. Never use an open end wrench (see Figure 7.35). Using an open end wrench will concentrate pressure on only two sides of the transducer housing which can potentially crush the transducer.**

**Figure 7.35 Open End Wrench**




3. Using a deep well socket or box end wrench, turn the transducer assembly counterclockwise to loosen and remove the defective transducer.
4. Using a deep well socket or box end wrench, install the new transducer. The torque values for each transducer are listed below:
   - SPT: 25.7-28.5 Nm (19-21 ft-lb)
   - DPT and FPT: 9.5-12.2 Nm (7-8 ft-lb)
5. Reconnect the wiring to the new Transducer.
6. Evacuate and dehydrate the system. See **Section 7.2.7**.
7. Recharge the system. See **Section 7.2.8**.
8. Start the unit, verify refrigeration charge. See **Section 3.6**.

## 7.24 Communications Interface Module Installation

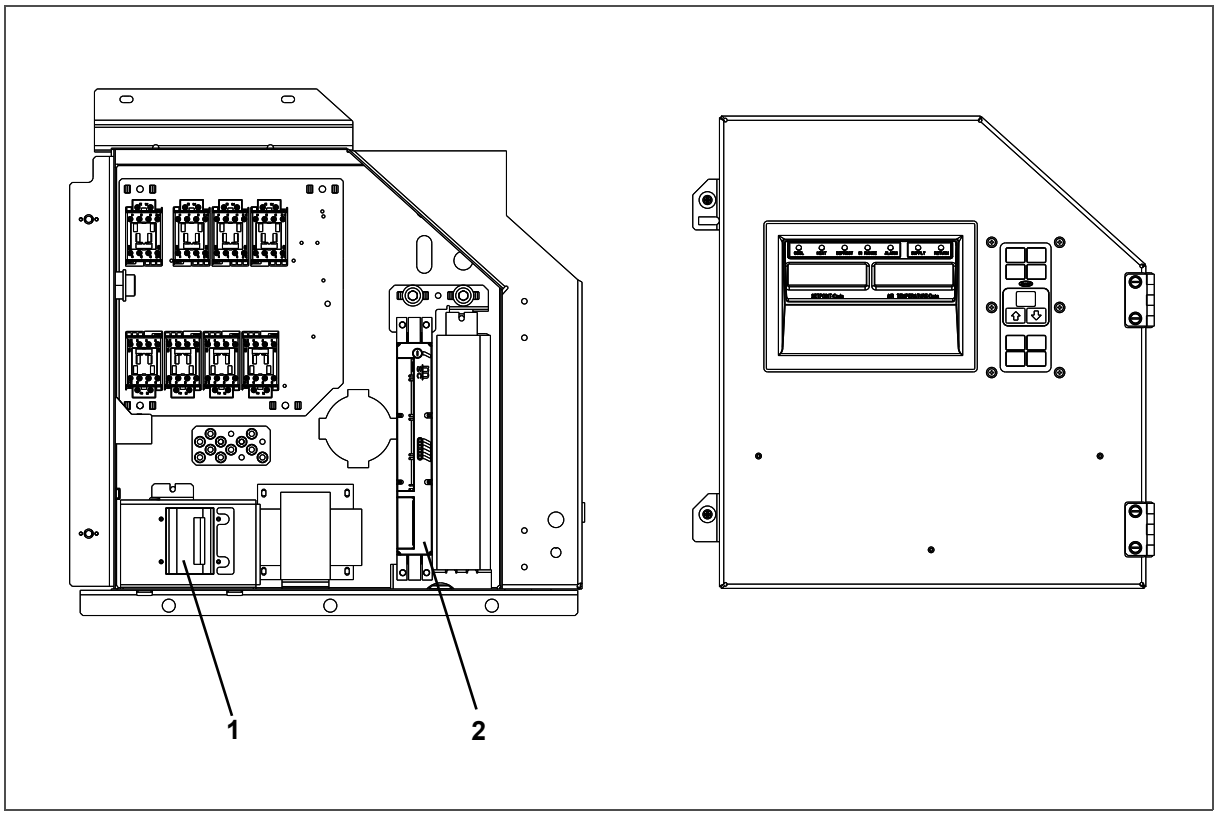
Units that have been factory provisioned for installation of a communication interface module (CIM) have the required wiring installed. If the unit is not factory provisioned, a provision wiring kit (Carrier Transicold part number 76-00685-00) must be installed. Installation instructions are packaged with the kit. To install the module, do the following:

**⚠ WARNING**

**Installation requires wiring to the main unit circuit breaker, CB-1. Make sure the power to the unit is off and power plug disconnected before beginning installation.**

1. CB-1 is connected to the power system, see wiring schematic. Ensure that the unit power is off AND that the unit power plug is disconnected.
2. Open control box and remove low voltage shield. See **Figure 7.36**. Open the high voltage shield.
3. If using factory provisioned wiring, remove the circuit breaker panel, with circuit breaker, from the control box. Locate, wires CB21/CIA3, CB22/CIA5 and CB23/CIA7 that have been tied back in the wire harness. Remove the protective heat shrink from the ends of the wires.
4. Refit the circuit breaker panel.
5. Fit the new CIM into the unit.
6. Attach three wires CB21/CIA3, CB22/CIA5 and CB23/CIA7 to the CIM at connection CIA.
7. Locate connectors CIA and CIB, remove plugs if required, and attach to the module.
8. Replace the low voltage shield.

**Figure 7.36 Communications Interface Installation**




1) Circuit Breaker (CB1)

2) Communications Interface Module

- - - - -

## 7.25 Maintenance Of Painted Surfaces

The refrigeration unit is protected by a special paint system against the corrosive atmosphere in which it normally operates. However, should the paint system be damaged, the base metal can corrode. In order to protect the refrigeration unit from the highly corrosive sea atmosphere, or if the protective paint system is scratched or damaged, clean area to bare metal using a wire brush, emery paper or equivalent cleaning method. Immediately following cleaning, apply two-part epoxy paint to the area. and allow to dry. After the first coat dries, apply a second coat.

## 7.26 Temperature / Pressure Chart

**Table 7–4 R-744 Temperature - Pressure Chart**

| Temp | | Pressure | | Temp | | Pressure |
|---|---|---|---|---|---|---|
| °F | °C | psig | | °C | °F | bar |
| -40 | -40.0 | 131.0 | | -40 | -40.0 | 9.05 |
| -38 | -38.9 | 137.0 | | -39 | -38.2 | 9.42 |
| -36 | -37.8 | 143.3 | | -38 | -36.4 | 9.81 |
| -34 | -36.7 | 149.7 | | -37 | -34.6 | 10.20 |
| -32 | -35.6 | 156.3 | | -36 | -32.8 | 10.61 |
| -30 | -34.4 | 163.1 | | -35 | -31.0 | 11.02 |
| -28 | -33.3 | 170.1 | | -34 | -29.2 | 11.45 |
| -26 | -32.2 | 177.3 | | -33 | -27.4 | 11.89 |
| -24 | -31.1 | 184.8 | | -32 | -25.6 | 12.34 |
| -22 | -30.0 | 192.4 | | -31 | -23.8 | 12.80 |
| -20 | -28.9 | 200.2 | | -30 | -22.0 | 13.28 |

**Table 7–4 R-744 Temperature - Pressure Chart**

| Temp | | Pressure | | Temp | | Pressure |
|---|---|---|---|---|---|---|
| °F | °C | psig | | °C | °F | bar |
| -18 | -27.8 | 208.3 | | -29 | -20.2 | 13.76 |
| -16 | -26.7 | 216.5 | | -28 | -18.4 | 14.26 |
| -14 | -25.6 | 225.0 | | -27 | -16.6 | 14.77 |
| -12 | -24.4 | 233.8 | | -26 | -14.8 | 15.29 |
| -10 | -23.3 | 242.7 | | -25 | -13.0 | 15.83 |
| -8 | -22.2 | 251.9 | | -24 | -11.2 | 16.38 |
| -6 | -21.1 | 261.3 | | -23 | -9.4 | 16.94 |
| -4 | -20.0 | 271.0 | | -22 | -7.6 | 17.51 |
| -2 | -18.9 | 280.9 | | -21 | -5.8 | 18.10 |
| 0 | -17.8 | 291.0 | | -20 | -4.0 | 18.70 |
| 2 | -16.7 | 301.5 | | -19 | -2.2 | 19.31 |
| 4 | -15.6 | 312.1 | | -18 | -0.4 | 19.94 |
| 6 | -14.4 | 323.1 | | -17 | 1.4 | 20.58 |
| 8 | -13.3 | 334.2 | | -16 | 3.2 | 21.24 |
| 10 | -12.2 | 345.7 | | -15 | 5.0 | 21.91 |
| 12 | -11.1 | 357.4 | | -14 | 6.8 | 22.59 |
| 14 | -10.0 | 369.5 | | -13 | 8.6 | 23.29 |
| 16 | -8.9 | 381.8 | | -12 | 10.4 | 24.01 |
| 18 | -7.8 | 394.3 | | -11 | 12.2 | 24.74 |
| 20 | -6.7 | 407.2 | | -10 | 14.0 | 25.49 |
| 22 | -5.6 | 420.4 | | -9 | 15.8 | 26.25 |
| 24 | -4.4 | 433.8 | | -8 | 17.6 | 27.03 |
| 26 | -3.3 | 447.6 | | -7 | 19.4 | 27.82 |
| 28 | -2.2 | 461.7 | | -6 | 21.2 | 28.63 |
| 30 | -1.1 | 476.1 | | -5 | 23.0 | 29.46 |
| 32 | 0.0 | 490.8 | | -4 | 24.8 | 30.30 |
| 34 | 1.1 | 505.8 | | -3 | 26.6 | 31.16 |
| 36 | 2.2 | 521.2 | | -2 | 28.4 | 32.04 |
| 38 | 3.3 | 536.9 | | -1 | 30.2 | 32.94 |
| 40 | 4.4 | 552.9 | | 0 | 32.0 | 33.85 |
| 42 | 5.6 | 569.3 | | 1 | 33.8 | 34.78 |
| 44 | 6.7 | 586.0 | | 2 | 35.6 | 35.73 |
| 46 | 7.8 | 603.1 | | 3 | 37.4 | 36.70 |
| 48 | 8.9 | 620.5 | | 4 | 39.2 | 37.69 |
| 50 | 10.0 | 638.3 | | 5 | 41.0 | 38.70 |
| 52 | 11.1 | 656.5 | | 6 | 42.8 | 39.72 |
| 54 | 12.2 | 675.0 | | 7 | 44.6 | 40.77 |
| 56 | 13.3 | 694.0 | | 8 | 46.4 | 41.83 |
| 58 | 14.4 | 713.3 | | 9 | 48.2 | 42.92 |

**Table 7–4 R-744 Temperature - Pressure Chart**

| Temp | | Pressure | | Temp | | Pressure |
|---|---|---|---|---|---|---|
| °F | °C | psig | | °C | °F | bar |
| 60 | 15.6 | 733.1 | | 10 | 50.0 | 44.02 |
| 62 | 16.7 | 753.2 | | 11 | 51.8 | 45.15 |
| 64 | 17.8 | 773.8 | | 12 | 53.6 | 46.30 |
| 66 | 18.9 | 794.8 | | 13 | 55.4 | 47.47 |
| 68 | 20.0 | 816.2 | | 14 | 57.2 | 48.66 |
| 70 | 21.1 | 838.1 | | 15 | 59.0 | 49.87 |
| 72 | 22.2 | 860.5 | | 16 | 60.8 | 51.11 |
| 74 | 23.3 | 883.3 | | 17 | 62.6 | 52.37 |
| 76 | 24.4 | 906.7 | | 18 | 64.4 | 53.65 |
| 78 | 25.6 | 930.5 | | 19 | 66.2 | 54.96 |
| 80 | 26.7 | 954.9 | | 20 | 68.0 | 56.29 |
| 82 | 27.8 | 979.8 | | 21 | 69.8 | 57.65 |
| 84 | 28.9 | 1005.4 | | 22 | 71.6 | 59.03 |
| 86 | 30.0 | 1031.6 | | 23 | 73.4 | 60.44 |
| 88 | 31.1 | ** | | 24 | 75.2 | 61.88 |
| | | | | 25 | 77.0 | 63.34 |
| | | | | 26 | 78.8 | 64.84 |
| | | | | 27 | 80.6 | 66.36 |
| | | | | 28 | 82.4 | 67.92 |
| | | | | 29 | 84.2 | 69.51 |
| | | | | 30 | 86.0 | 71.14 |
| | | | | 31 | 87.8 | 71.80 |
| | | | | 32 | 89.6 | **** |

** 87.8°F is the Critical point of CO2, Pressure 1056.2psig. Distinct liquid and vapor states do not exist.

**** 31.1°C is the Critical point of CO2, Pressure 72.82Bar. Distinct liquid and vapor states do not exist.

## 7.27 Bolt Torque Values

**Table 7–5 Recommended Bolt Torque Values (Dry, Non-Lubricated for 18-8 Stainless Steel)**

| Bolt Diameter | Threads | In-Lb | Ft-Lb | Nm |
|---|---|---|---|---|
| **Free Spinning** | | | | |
| #4 | 40 | 5.2 | 0.4 | 0.6 |
| #6 | 32 | 9.6 | 0.8 | 1.1 |
| #8 | 32 | 20 | 1.7 | 2.3 |
| #10 | 24 | 23 | 1.9 | 2.6 |
| 1/4 | 20 | 75 | 6.3 | 8.5 |
| 5/16 | 18 | 132 | 11 | 14.9 |
| 3/8 | 16 | 240 | 20 | 27.1 |
| 7/16 | 14 | 372 | 31 | 42 |
| 1/2 | 13 | 516 | 43 | 58.3 |
| 9/16 | 12 | 684 | 57 | 77.3 |
| 5/8 | 11 | 1104 | 92 | 124.7 |
| 3/4 | 10 | 1488 | 124 | 168.1 |
| **Non Free Spinning (Locknuts etc.)** | | | | |
| 1/4 | 20 | 82.5 | 6.9 | 9.3 |
| 5/16 | 18 | 145.2 | 12.1 | 16.4 |
| 3/8 | 16 | 264 | 22.0 | 29.8 |
| 7/16 | 14 | 409.2 | 34.1 | 46.2 |
| 1/2 | 13 | 567.6 | 47.3 | 64.1 |
| 9/16 | 12 | 752.4 | 62.7 | 85 |
| 5/8 | 11 | 1214.4 | 101.2 | 137.2 |
| 3/4 | 10 | 1636.8 | 136.4 | 184.9 |

# SECTION 8
# ELECTRICAL WIRING SCHEMATIC AND DIAGRAMS

**Figure 8.1 Schematic Legend**

| ZONE | SYMBOL | | DESCRIPTION |
|---|---|---|---|
| C21 | AMBS | — | AMBIENT SENSOR |
| J19,J28 | C | — | CONTROLLER |
| F1 | CB1 | — | CIRCUIT BREAKER 460V |
| L1,M7 | CH | — | COMPRESSOR CONTACTOR |
| A3 | CI | — | COMMUNICATIONS INTERFACE MODULE (OPTION) |
| T1,F7 | CP | — | COMPRESSOR MOTOR |
| A21 | CPDS | — | DISCHARGE TEMPERATURE SENSOR |
| J2 | CS | — | CURRENT SENSOR |
| R4 | DHBL | — | DEFROST HEATER – BOTTOM LEFT |
| T3 | DHBR | — | DEFROST HEATER – BOTTOM RIGHT |
| R3 | DHML | — | DEFROST HEATER – MIDDLE LEFT |
| T3 | DHMR | — | DEFROST HEATER – MIDDLE RIGHT |
| R3 | DHTL | — | DEFROST HEATER – TOP LEFT |
| T4 | DHTR | — | DEFROST HEATER – TOP RIGHT |
| J21 | DPT | — | DISCHARGE PRESSURE TRANSDUCER |
| C21 | DTS | — | DEFROST TEMPERATURE SENSOR |
| A23 | EEV | — | EVAPORATOR EXPANSION VALVE (EVXV) |
| N11,M12,L12 | EF | — | EVAPORATOR FAN CONTACTOR (HIGH SPEED) |
| E12,H12,T11,T13 | EM | — | EVAPORATOR FAN MOTOR |
| M12,P10 | ES | — | EVAPORATOR FAN CONTACTOR (LOW SPEED) |
| D21 | ETS | — | EVAPORATOR TEMPERATURE SENSOR (SUCTION) |
| K9 | ESV | — | ECONOMIZER SOLENOID VALVE |
| C6,D6,D18, E18,D28,E28 | F | — | FUSE |
| G21 | FPT | — | FLASH TANK PRESSURE TRANSDUCER |
| D16 | GCTS | — | GAS COOLER TEMPERATURE SENSOR |
| E11,T9 | GM | — | GAS COOLER FAN MOTOR |
| P6,M11,L10 | GF | — | GAS COOLER FAN CONTACTOR (HIGH SPEED) |
| P8,M10 | GS | — | GAS COOLER FAN CONTACTOR (LOW SPEED) |
| J7 | HPS | — | HIGH PRESSURE SWITCH |
| R15 | HPXV | — | HIGH PRESSURE EXPANSION VALVE |
| P3,M13 | HR | — | HEATER CONTACTOR |
| F13 | HTT | — | HEAT TERMINATION THERMOSTAT |
| T21 | ICF | — | INTERROGATOR CONNECTOR FRONT |
| T22 | ICR | — | INTERROGATOR CONNECTOR REAR |
| E7,E11,E12,H12 | IP | — | INTERNAL PROTECTOR |
| L7,M6,P5 | PA | — | UNIT PHASE CONTACTOR |
| L6,M7,P6 | PB | — | UNIT PHASE CONTACTOR |
| P19 | PTC1 | — | PTC FOR VENT POSITION SENSOR (UPPER) |
| E21,K22,L22,M22 | PR | — | PROBE RECEPTACLE (USDA) (OPTION) |
| B21 | RRS | — | RETURN RECORDER SENSOR |
| B21 | RTS | — | RETURN TEMPERATURE SENSOR |
| C23 | SD | — | STEPPER MOTOR DRIVE |
| H21 | SPT | — | SUCTION PRESSURE TRANSDUCER |
| K21 | SRS | — | SUPPLY RECORDER SENSOR |
| F5 | ST | — | START–STOP SWITCH |
| A21 | STS | — | SUPPLY TEMPERATURE SENSOR |
| L7 | TC | — | CONTROLLER RELAY (COOLING) |
| K6,K7 | TCP | — | CONTROLLER RELAY (PHASE SEQUENCING) |
| K12 | TE | — | CONTROLLER RELAY (HIGH SPEED EVAPORATOR FANS) |
| K10,K11 | TG | — | CONTROLLER RELAY (HIGH & LOW SPEED GAS COOLER FANS) |
| K13 | TH | — | CONTROLLER RELAY (HEATING) |
| H11 | TN | — | CONTROLLER RELAY (GAS COOLER FAN) |
| E13,F8,F9,G11, K7,M15,J12,J13 | TP | — | TEST POINT |
| H3 | TR | — | TRANSFORMER |
| E9 | TS | — | CONTROLLER RELAY (ECONOMIZER SOLENOID VALVE) |
| E8 | TU | — | CONTROLLER RELAY (UNLOADER) |
| K11 | TV | — | CONTROLLER RELAY (LOW SPEED EVAPORATOR FANS) |
| K8 | USV | — | UNLOADER SOLENOID VALVE |
| R1 | VFD | — | VARIABLE FREQUENCY DRIVE |
| P1 | VIM | — | VFD INTERFACE MODULE |
| H12 | WCR | — | WETTING CURRENT SENSOR (OPTION) |
| D12 | WP | — | WATER PRESSURE SWITCH (OPTION) |

## Figure 8.2 Schematic Diagram - Standard Unit Configuration

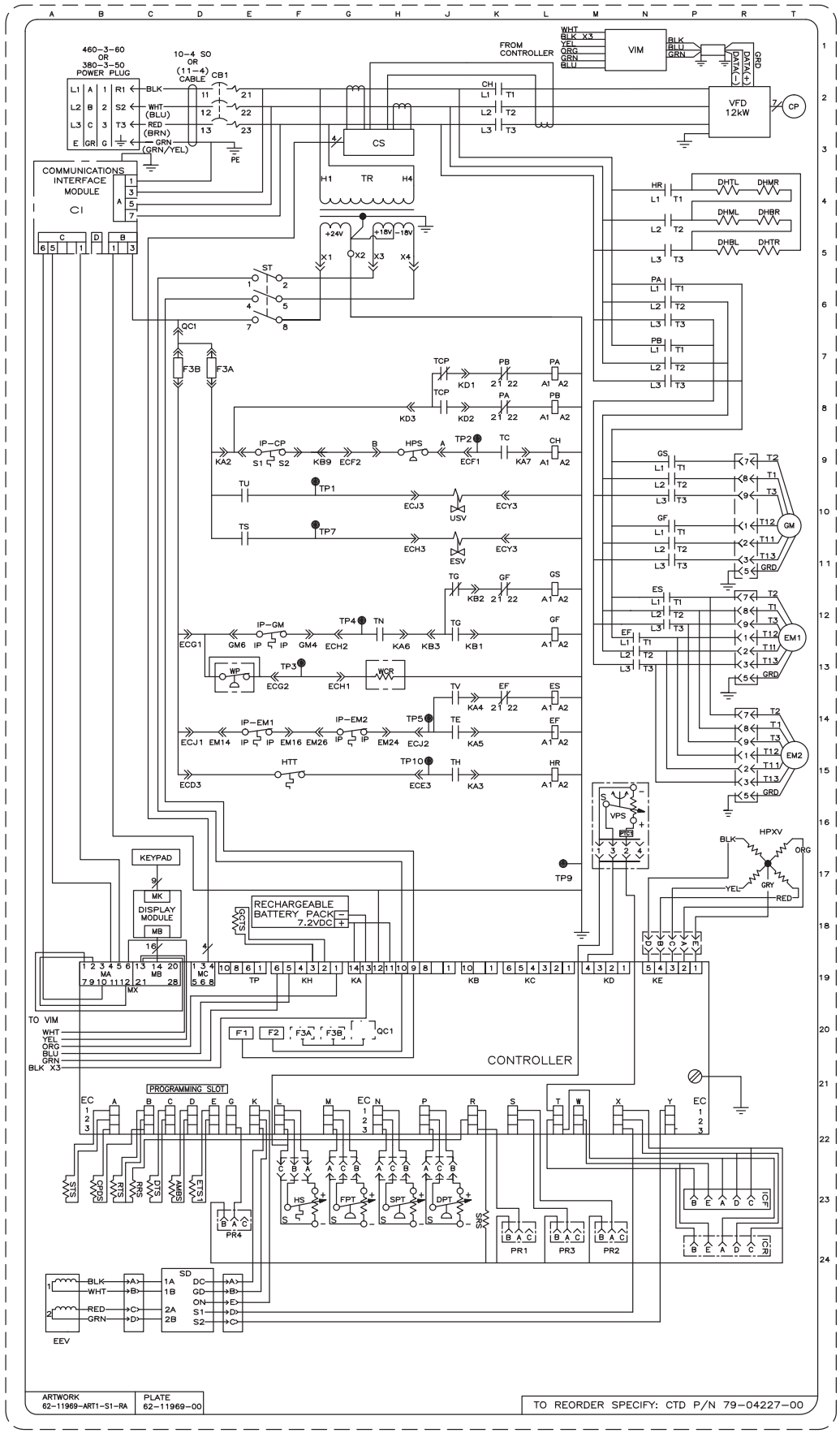


**Figure 8.3 Unit Wiring Diagram - Standard Unit Configuration Sheet 1 of 2**

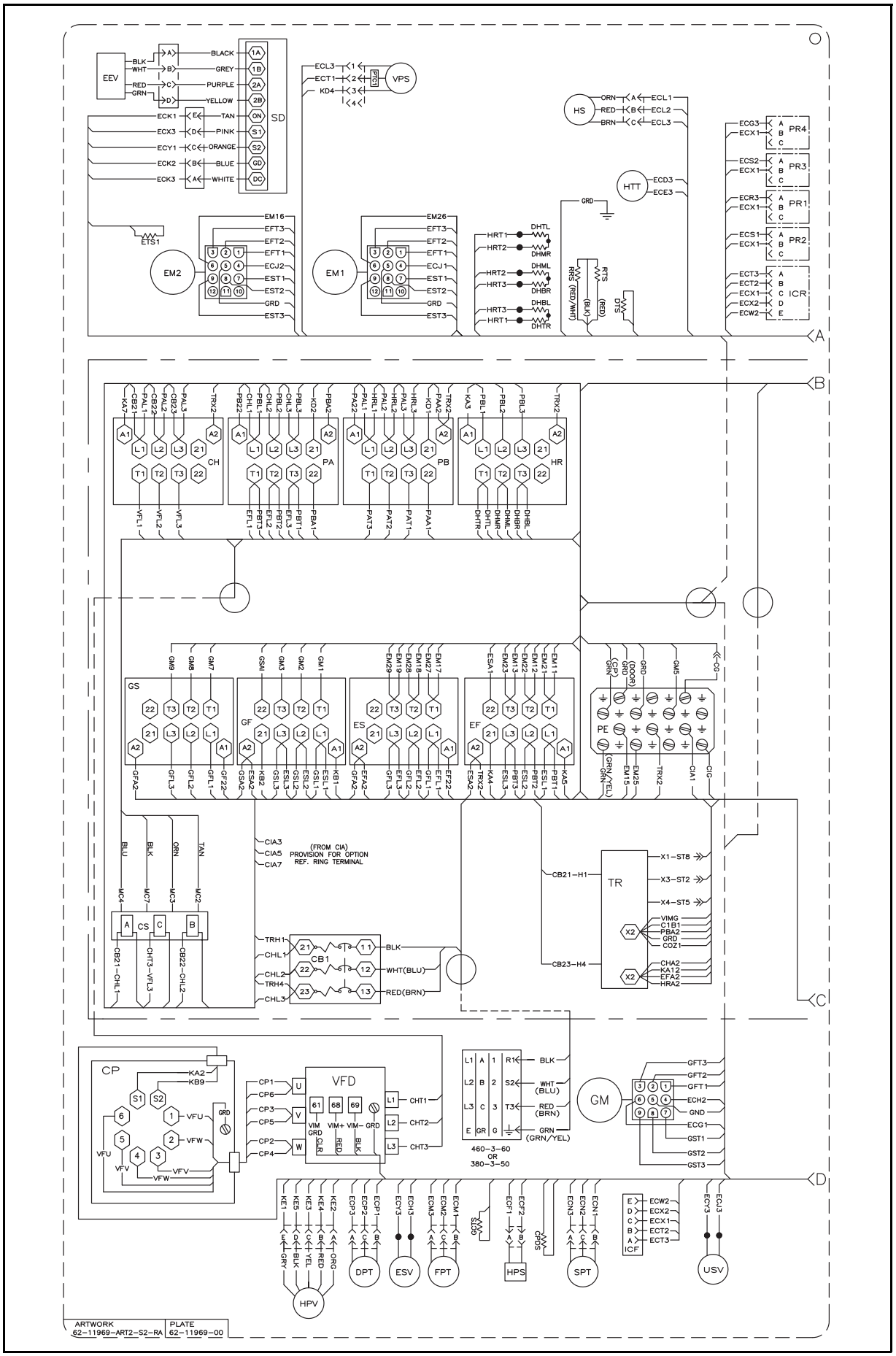
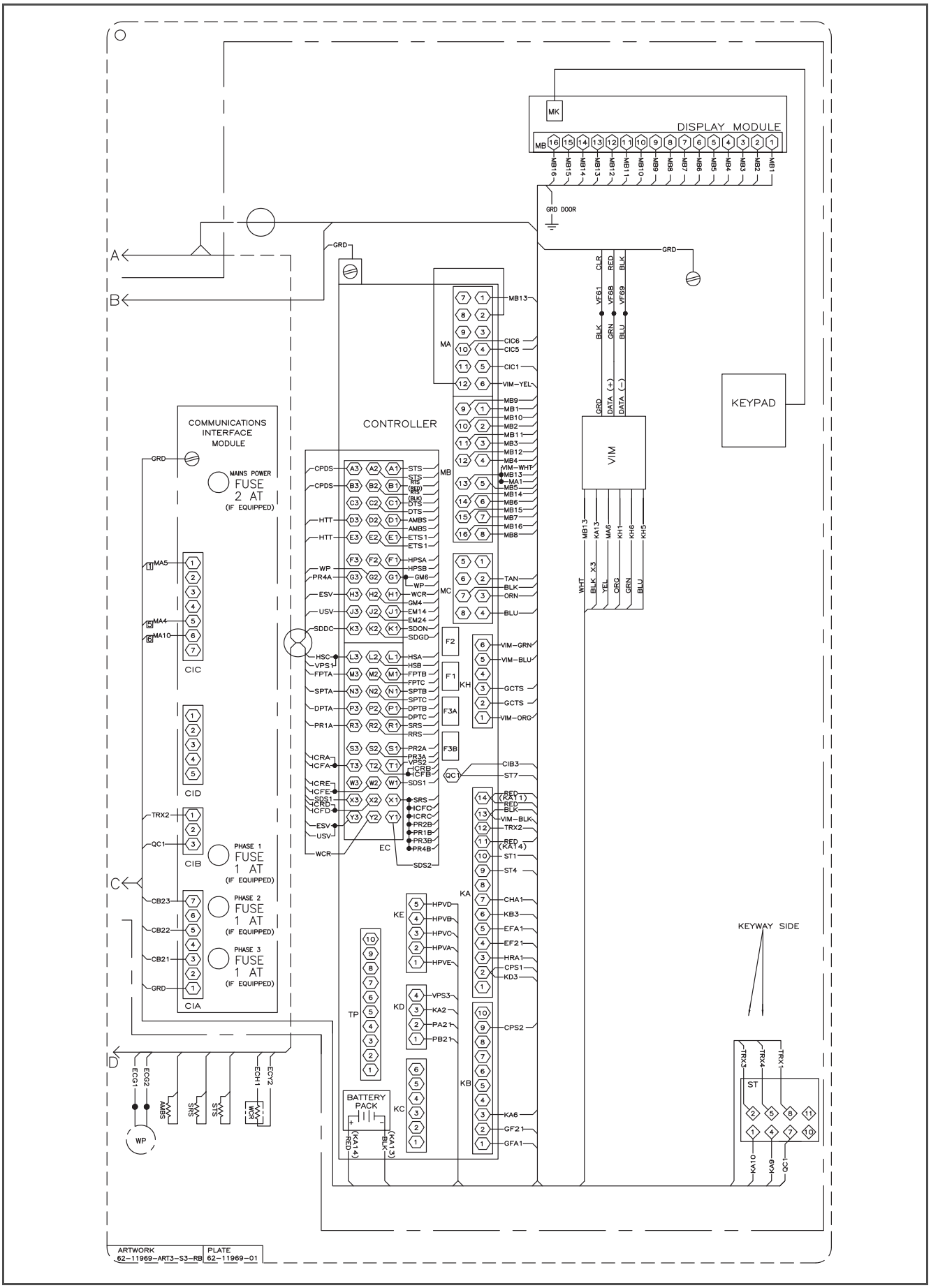


**Figure 8.4 Unit Wiring Diagram -Standard Unit Configuration - Sheet 2 of 2**



# SECTION 9
# EU DECLARATION OF CONFORMITY

Serial Number / *Seriennummer* / *Serienummer*:
_____ - _____
Manufacturing Date/ *Herstellungsdatum* / *Fremstillingsdato*:
_____

## EU Declaration of Conformity
## EU-Konformitätserklärung / EU Overensstemmelseserklæring

We, manufacturer:
*Wir, der Hersteller* / *Vi, fabrikant*:
Carrier Transicold Pte Ltd
251 Jalan Ahmad Ibrahim
Singapore 629146

Declare, under our sole responsibility, that the NaturaLINE Container Unit:

*Erklären, eigenverantwortlich, dass die NaturaLINE Container-Einheit / Erklærer, som eneansvarlige, at NaturaLINE Container enhed*:

Models (*Modelle / Modellerne*): 69NT40-601 - 100 to (*bis / til*) 199

are in conformity with the provisions of the following European Directives:

*in Übereinstimmung mit den Bestimmungen der folgenden europäischen Richtlinien ist /er i overensstemmelse med bestemmelserne i følgende europæiske direktiver*:

- Machinery Directive 2006/42/EC following Annex VIII
  *Maschinenrichtlinie 2006/42/EC, folgender Anhang VIII / Maskindirektiv 2006/42/EF, tillæg VIII*
- Electromagnetic Compatibility Directive 2014/30/EU following Annex II
  *Richtlinie zur elektromagnetischen Verträglichkeit 2014/30/EU, folgender Anhang II / Elektromagnetisk Kompatibilitetsdirektiv 2014/30/EU, tillæg II*
- Pressure Equipment Directive 2014/68/EU following Module A2.
  *Druckgeräte-Richtlinie (PED) 2014/68/EU, folgendes Modul A2./ Direktiv 2014/68/EU, Modul A2 om trykbærende udstyr*.
  - PED Notified Body / *PED Dafür benannte Stelle / bemyndigende organ*:
    Bureau Veritas Services SAS nr 0062 8 Cours du Triangle, 92800 Puteaux, France
    Certification Number / *Zertifizierungsnummer* / *Certificeringsnummer*: CE-0062-PED-A2-CPG001-20-SGP-Rev-B
- Radio Equipment Directive 2014/53/EU Annex II (with select options)
  *Funkanlagenrichtlinie (RED) 2014/53/EU Anhang II / Radio udstyrs direktiv 2014/53/EU, tillæg II (med valgmuligheder)*

This PED assembly contains the following equipment which was subject to its own CE Marking:
*Diese PED-Baugruppe enthält die folgenden Geräte, die ihrer eigenen CE-Kennzeichnung unterliegen / Denne PED-montering indeholder følgende udstyr, der er underkastet egen CE-mærkning*:

| Component<br>*Komponente / Komponent* | Conformity Procedure<br>*Konformitätsverfahren / Overensstemmelsesprocedure* |
|---|---|
| Flash Tank / *Entspanner / Ekspansionstank* | Module A2 / *Modul* A2 |
| Pressure Relief Valves / *Ueberdruckventil / Overtryksventiler* | Module A2 / *Modul* A2 |
| High Pressure Switch / *Hochdruckschalter / Højtrykskontakt* | Module B+D / *Modul* B + D |

The following Harmonized Standards were applied for this equipment:
*Folgende harmonisierte Normen wurden für diese Geräte angewendet/ Følgende harmoniserede standarder blev anvendt til dette udstyr*:

| Machinery Directive *Maschinenrichtlinie / Maskindirektiv* | EMC Directive *EMV Richtlinie / EMC direktiv* | RED Directive / *RED Richtlinie* (with select options / *Mit bestimmten Auswahlmoeglichkeiten // med valgmuligheder*) | PED Directive *Druckgeräte-Richtlinie / PED-direktiv* |
|---|---|---|---|
| EN ISO 12100:2010<br>EN 60204-1:2006<br>EN 13857:2008 | EN 61000-6-4:2007<br>EN 61000-6-2:2005<br>EN 55011:2009 | EN/IEC 60950:2011, EN 62311:2008<br>EN 300 328 v2.1.1, EN 300 440 v2.1.1<br>EN 301 511 v12.5.1, EN 301 908-1 v11.1.1<br>EN 301 489-1 v2.1.1, EN 301 489-3 v2.1.1<br>EN 301 489-17 v3.1.1, EN 301 489-52 v1.1.0 | EN 378-2:2016 |

The following technical standard was applied for this equipment / *Folgende technische Norm wurde für diese Geräte angewendet// Følgende Tekniske standarder blev anvendt til dette udstyr*: ISO 1496-2:2008

Person established in Europe authorized to compile a copy of the Technical File:
*In Europa ansässige Person, die berechtigt ist, eine Kopie der technischen Dokumentation zu erstellen/ Ansvarlig person i Europa udpeget til at udarbejde en kopi af den tekniske fil*:

Shaun Bretherton
Service Engineering Manager of CTL Rotterdam
Pittsburgstraat 21 3047 BL Rotterdam, Netherlands

DocuSigned by:
Nader Awwad
1B83EFEDEAAD48A...

14-Jul-21 | 7:18 PM SGT

Nader Awwad, Engineering Director
Carrier Transicold
P.O. Box 4805
Syracuse, New York 13221, USA
(Authorized person to sign declaration on behalf of the manufacturer)
(*Person, die zur Unterzeichnung der Erklärung im Namen des Herstellers berechtigt ist / Bemyndiget person skal underskrive på vejne af fabrikanten*)

# China RoHS per SJ/T 11364-2014

## 产品中有害物质的名称及含量

| 部件名称 | 有害物质 | | | | | |
|---|---|---|---|---|---|---|
| | 铅 (Pb) | 汞 (Hg) | 镉 (Cd) | 六价铬 (Cr (VI)) | 多溴联苯 (PBB) | 多溴二苯醚 (PBDE) |
| 金属板部件 | O | O | O | O | O | O |
| 塑料部件 | O | O | O | O | O | O |
| 盘管组件 | X | O | O | O | O | O |
| 加热部件 | O | O | O | O | O | O |
| 马达，压缩机与风扇组件 | O | O | O | O | O | O |
| 温度控制微处理器系统 | X | O | O | O | O | O |
| 断路器与接触器 | O | O | O | O | O | O |
| 变压器 | O | O | O | O | O | O |
| 传感器 | X | O | O | O | O | O |
| 通讯组件 | O | O | O | O | O | O |
| 阀组件 | X | O | O | O | O | O |
| 电缆线/电源 | O | O | O | O | O | O |
| 电池 | O | O | X | O | O | O |
| 标签与绝缘材料 | O | O | O | O | O | O |
| 玻璃部件 | X | O | O | O | O | O |

本表格依据 SJ/T 11364 的规定编制。
O：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
X：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

62-66122-00, Rev A

# INDEX

## E



## F



## G



## H

## I



## K



## L



## M



## O



## P



## R



## S

## T



## U



## V



## W


Carrier Transicold Division,
Carrier Corporation
P.O. Box 4805
Syracuse, NY 13221 USA

https://www.carrier.com/container-refrigeration