



**TRANSICOLD**

# Container Refrigeration Unit

Models  
69NT40-511-1  
to  
69NT40-511-199  
and  
69NT40-521

**DUE TO THE LARGE NUMBER OF SCHEMATIC  
DIAGRAMS CONTAINED IN THIS BOOK, THE  
BOOK IS PRESENTED AS TWO FILES.  
REFER TO FILE T268-DIAGRAMS FOR THE  
CHAPTER 7 ELECTRICAL DIAGRAMS AND  
SCHEMATICS**

**OPERATION  
AND SERVICE**



**TRANSCOLD**

**OPERATION AND  
SERVICE MANUAL**

**CONTAINER REFRIGERATION UNIT**

**MODELS  
69NT40-511-1  
to  
69NT40-511-199  
and  
69NT40-521**

Carrier Transicold Division, Carrier Corporation, P.O. Box 4805, Syracuse, N.Y. 13221

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**Carrier**

A United Technologies Company

# SAFETY SUMMARY

## GENERAL SAFETY NOTICES

The following general safety notices supplement the 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.

## FIRST AID

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

## OPERATING PRECAUTIONS

Always wear safety glasses.

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

No work should be performed on the unit until all circuit breakers and start-stop switches are turned off, and power supply is disconnected.

Always work in pairs. Never work on the equipment alone.

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

## MAINTENANCE PRECAUTIONS

Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille or evaporator access panels before turning power off, and disconnecting and securing the power plug.

Be sure power is turned off before working on motors, controllers, solenoid valves and electrical control switches. Tag 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 the control box. 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<sub>2</sub> (never use water).

## **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 which **WILL** result in severe personal injury or death.

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

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

*The statements listed below 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.*

### **WARNING**

**When servicing the unit, use caution when handling R-134a. The refrigerant when in contact with high temperatures (about 1000°F) will decompose into highly corrosive and toxic compounds.**

### **WARNING**

**Be sure to avoid refrigerant coming in contact with the eyes. Should refrigerant come in contact with the eyes, wash eyes for a minimum of 15 minutes with potable water only. THE USE OF MINERAL OIL OR REFRIGERANT OILS IS NOT RECOMMENDED.**

### **WARNING**

**Be sure to avoid refrigerant coming in contact with the skin. Should refrigerant come in contact with the skin, it should be treated as if the skin had been frostbitten or frozen.**

### **WARNING**

**Be sure ventilation in the workspace is adequate to keep the concentration of refrigerant below 1000 parts per million. If necessary, use portable blowers.**

### **WARNING**

**Beware of rotating fan blades and unannounced starting of fans.**

### **WARNING**

**Do not use a nitrogen cylinder without a pressure regulator. Never mix refrigerants with air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.**

### **WARNING**

**Never fill a refrigerant cylinder beyond its rated capacity. Cylinder may rupture due to excessive pressure when exposed to high temperatures.**

### **WARNING**

**When starting the unit, be sure that all manual refrigerant valves in the discharge line are open. Severe damage could occur from extremely high refrigerant pressures.**



## TABLE OF CONTENTS (CONTINUED)

| Section                                                                                 | Page       |
|-----------------------------------------------------------------------------------------|------------|
| 3.3.1 Brief Description .....                                                           | 3-24       |
| 3.3.2 DataCORDER Configuration .....                                                    | 3-25       |
| 3.3.3 DataCORDER Function Codes .....                                                   | 3-26       |
| 3.3.4 DataCORDER Alarms .....                                                           | 3-27       |
| 3.3.5 Access to DataCORDER Functions .....                                              | 3-29       |
| 3.3.6 USDA/ Message Trip Comment .....                                                  | 3-31       |
| 3.3.7 USDA Recording .....                                                              | 3-31       |
| 3.3.8 Pre-Trip Data Recording .....                                                     | 3-31       |
| 3.3.9 DataCORDER Communications .....                                                   | 3-31       |
| 3.3.10 DataCORDER Scrollback .....                                                      | 3-32       |
| 3.4 USDA COLD TREATMENT PROCEDURE .....                                                 | 3-32       |
| <b>OPERATION</b> .....                                                                  | <b>4-1</b> |
| 4.1 PRE-TRIP INSPECTION (Before Starting) .....                                         | 4-1        |
| 4.2 STARTING AND STOPPING INSTRUCTIONS .....                                            | 4-2        |
| 4.3 AFTER STARTING INSPECTION .....                                                     | 4-2        |
| 4.4 UNIT OPERATION .....                                                                | 4-2        |
| 4.4.1 Crankcase Heater .....                                                            | 4-2        |
| 4.4.2 Probe Check Initiation .....                                                      | 4-2        |
| 4.4.3 Cooling - Controller Set BELOW -10°C (+14°F), or<br>-5°C (+23°F) optionally ..... | 4-3        |
| 4.4.4 Controller Set ABOVE -10°C (+14°F), or -5°C (+23°F) optionally .....              | 4-3        |
| 4.4.5 Heating (See Figure 4-4.) .....                                                   | 4-10       |
| 4.4.6 Defrost .....                                                                     | 4-12       |
| 4.4.7 Arctic .....                                                                      | 4-12       |
| <b>TROUBLESHOOTING</b> .....                                                            | <b>5-1</b> |
| 5.1 UNIT WILL NOT START OR STARTS THEN STOPS .....                                      | 5-1        |
| 5.2 UNIT RUNS BUT HAS INSUFFICIENT COOLING .....                                        | 5-1        |
| 5.3 UNIT OPERATES LONG OR CONTINUOUSLY IN COOLING .....                                 | 5-1        |
| 5.4 UNIT WILL NOT HEAT OR HAS INSUFFICIENT HEATING .....                                | 5-2        |
| 5.5 UNIT WILL NOT TERMINATE HEATING .....                                               | 5-2        |
| 5.6 UNIT WILL NOT DEFROST PROPERLY .....                                                | 5-2        |
| 5.7 ABNORMAL PRESSURES (COOLING) .....                                                  | 5-3        |
| 5.8 ABNORMAL NOISE OR VIBRATIONS .....                                                  | 5-3        |
| 5.9 TEMPERATURE CONTROLLER MALFUNCTION .....                                            | 5-3        |
| 5.10 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW .....                                | 5-3        |
| 5.11 THERMOSTATIC EXPANSION VALVE MALFUNCTION .....                                     | 5-4        |
| 5.12 POWER AUTOTRANSFORMER MALFUNCTION .....                                            | 5-4        |
| 5.13 WATER-COOLED CONDENSER OR WATER PRESSURE SWITCH .....                              | 5-4        |

## TABLE OF CONTENTS (CONTINUED)

| Section                                                         | Page       |
|-----------------------------------------------------------------|------------|
| <b>SERVICE</b> .....                                            | <b>6-1</b> |
| 6.1 MANIFOLD GAUGE SET .....                                    | 6-1        |
| 6.2 SUCTION AND DISCHARGE SERVICE VALVES .....                  | 6-4        |
| 6.3 PUMPING THE UNIT DOWN .....                                 | 6-4        |
| 6.4 REFRIGERANT LEAK CHECKING .....                             | 6-4        |
| 6.5 EVACUATION AND DEHYDRATION .....                            | 6-5        |
| 6.5.1 General .....                                             | 6-5        |
| 6.5.2 Preparation .....                                         | 6-5        |
| 6.5.3 Procedure .....                                           | 6-5        |
| 6.6 REFRIGERANT CHARGE .....                                    | 6-5        |
| 6.6.1 Checking the Refrigerant Charge .....                     | 6-5        |
| 6.6.2 Adding Refrigerant to System (Full Charge) .....          | 6-8        |
| 6.6.3 Adding Refrigerant to System (Partial Charge) .....       | 6-8        |
| 6.7 COMPRESSOR - MODEL 06DR .....                               | 6-8        |
| 6.7.1 Removal and Replacement of Compressor .....               | 6-9        |
| 6.8 COMPRESSOR DISASSEMBLY .....                                | 6-9        |
| 6.9 COMPRESSOR REASSEMBLY .....                                 | 6-13       |
| 6.10 COMPRESSOR OIL LEVEL .....                                 | 6-14       |
| 6.11 FILTER-DRIER .....                                         | 6-15       |
| 6.12 HIGH PRESSURE SWITCH .....                                 | 6-15       |
| 6.12.1 Replacing High Pressure Switch .....                     | 6-15       |
| 6.12.2 Checking High Pressure Switch .....                      | 6-15       |
| 6.13 EVAPORATOR COIL AND HEATER ASSEMBLY .....                  | 6-16       |
| 6.14 EVAPORATOR COIL HEATERS .....                              | 6-16       |
| 6.15 EVAPORATOR FAN AND MOTOR ASSEMBLY .....                    | 6-16       |
| 6.16 EVAPORATOR FAN MOTOR CAPACITORS .....                      | 6-17       |
| 6.17 CONDENSER COIL .....                                       | 6-18       |
| 6.18 CONDENSER FAN AND MOTOR ASSEMBLY .....                     | 6-18       |
| 6.19 PARTLOW RECORDING THERMOMETER .....                        | 6-18       |
| 6.20 SAGINOMIYA RECORDING THERMOMETER .....                     | 6-20       |
| 6.21 MAINTENANCE OF PAINTED SURFACES .....                      | 6-21       |
| 6.22 POWER AUTOTRANSFORMER (OPTIONAL) .....                     | 6-21       |
| 6.23 SENSOR CHECKOUT PROCEDURE (AMBS, DTS, RRS, RTS, SRS & STS) | 6-21       |
| 6.23.1 Checking Sensor (RRS, RTS, SRS or STS) .....             | 6-21       |
| 6.23.2 Replacing Sensor (STS and SRS) .....                     | 6-22       |
| 6.23.3 Replacing Sensor (RRS and RTS) .....                     | 6-23       |
| 6.23.4 Checking Sensor (AMBS or DTS) .....                      | 6-24       |
| 6.23.5 Replacing Sensor (AMBS or DTS) .....                     | 6-24       |
| 6.24 SUCTION SOLENOID VALVE (SSV) .....                         | 6-25       |
| 6.25 SUCTION MODULATION VALVE (SMV) .....                       | 6-25       |

## TABLE OF CONTENTS (CONTINUED)

| Section                                                  | Page           |
|----------------------------------------------------------|----------------|
| 6.26 THERMOSTATIC EXPANSION VALVE .....                  | 6-26           |
| 6.27 CONTROLLER/DATACORDER .....                         | 6-28           |
| 6.27.1 Controller/DataCORDER Programming Procedure ..... | 6-29           |
| 6.27.2 Controller Trouble-Shooting .....                 | 6-29           |
| 6.28 WATER-COOLED CONDENSER .....                        | 6-30           |
| <b>ELECTRICAL WIRING SCHEMATIC AND DIAGRAMS .....</b>    | <b>7-1</b>     |
| 7.1 INTRODUCTION .....                                   | 7-1            |
| <b>INDEX .....</b>                                       | <b>Index-1</b> |

## LIST OF ILLUSTRATIONS

| Figure                                                                                   | Page |
|------------------------------------------------------------------------------------------|------|
| Figure 2-1 Refrigeration Unit - Front .....                                              | 2-1  |
| Figure 2-2 Refrigeration Unit - Rear (Panels Removed) .....                              | 2-3  |
| Figure 2-3 Compressor Section .....                                                      | 2-4  |
| Figure 2-4 Condenser Section .....                                                       | 2-5  |
| Figure 2-5 Units with Receiver .....                                                     | 2-6  |
| Figure 2-6 Units with Water-Cooled Condenser .....                                       | 2-7  |
| Figure 2-7 Control Box on Units with a Single-Speed Compressor .....                     | 2-8  |
| Figure 2-8 Control Box on Units with a Two-Speed Compressor (Optional) .....             | 2-9  |
| Figure 2-9 Power Autotransformer (Optional) .....                                        | 2-12 |
| Figure 2-10 Refrigeration Circuit with Receiver .....                                    | 2-15 |
| Figure 2-11 Refrigeration Circuit with Water-Cooled Condenser (Optional) .....           | 2-17 |
| <br>                                                                                     |      |
| Figure 3-1 Micro-Link 2i Controller/DataCORDER Module .....                              | 3-1  |
| Figure 3-1 Key Pad .....                                                                 | 3-4  |
| Figure 3-2 Display Module .....                                                          | 3-5  |
| Figure 3-3 Standard Configuration Report Sample .....                                    | 3-34 |
| Figure 3-4 Controller Set Point BELOW -10°C (+14°F), or<br>-5°C (+23°F) optionally ..... | 3-35 |
| Figure 3-5 Controller Set Point ABOVE -10°C (+14°F), or<br>-5°C (+23°F) optionally ..... | 3-35 |
| Figure 3-6 Two-Speed Compressor Speed Change Logic - Perishable Range Only               | 3-36 |
| Figure 3-7 Two-Speed Compressor Speed Change Logic - Frozen Range Only .                 | 3-37 |
| <br>                                                                                     |      |
| Figure 4-1 Cooling in High Speed with Two-Speed Compressor .....                         | 4-5  |
| Figure 4-2 Cooling in Low Speed with Two-Speed Compressor .....                          | 4-7  |
| Figure 4-3 Cooling with Single-Speed Compressor .....                                    | 4-9  |
| Figure 4-4 Heating Mode .....                                                            | 4-11 |
| Figure 4-5 Defrost .....                                                                 | 4-13 |



## LIST OF ILLUSTRATIONS (CONTINUED)

| Figure                                                                                              | Page      |
|-----------------------------------------------------------------------------------------------------|-----------|
| Figure 6-1 Manifold Gauge Set .....                                                                 | 6-1       |
| Figure 6-2 R-134a Manifold Gauge Set Connection .....                                               | 6-3       |
| Figure 6-3 Suction or Discharge Service Valve .....                                                 | 6-4       |
| Figure 6-4 Vacuum Pump Connections .....                                                            | 6-7       |
| Figure 6-5 Compressor – Model 06DR .....                                                            | 6-9       |
| Figure 6-6 Exploded View of Valve Plate .....                                                       | 6-10      |
| Figure 6-7 Bottom Plate Removed .....                                                               | 6-10      |
| Figure 6-8 Oil Pump and Bearing Head .....                                                          | 6-11      |
| Figure 6-9 Low Profile Gear Oil Pump .....                                                          | 6-11      |
| Figure 6-10 Motor End Cover .....                                                                   | 6-11      |
| Figure 6-11 Crankshaft Assembly .....                                                               | 6-12      |
| Figure 6-12 Removing Equalizing Tube and Lock Screw Assembly .....                                  | 6-12      |
| Figure 6-13 Terminal Mounting Assembly .....                                                        | 6-12      |
| Figure 6-14 Suction Valve & Positioning Springs .....                                               | 6-13      |
| Figure 6-15 Piston Rings .....                                                                      | 6-13      |
| Figure 6-16 Compressor Oil Pump End View .....                                                      | 6-14      |
| Figure 6-17 Typical Setup for Testing High Pressure Switch .....                                    | 6-15      |
| Figure 6-18 Evaporator Fan Assembly .....                                                           | 6-17      |
| Figure 6-19 Partlow Recording Thermometer .....                                                     | 6-20      |
| Figure 6-20 Saginomiya Recording Thermometer .....                                                  | 6-21      |
| Figure 6-21 Supply Sensor Positioning .....                                                         | 6-22      |
| Figure 6-22 Sensor (RRS, RTS, SRS or STS) .....                                                     | 6-23      |
| Figure 6-23 Sensor and Cable Assembly (RRS, RTS, SRS or STS) .....                                  | 6-23      |
| Figure 6-24 Return Sensor Positioning .....                                                         | 6-24      |
| Figure 6-25 Sensor (AMBS or DTS) .....                                                              | 6-24      |
| Figure 6-26 Sensor and Wire Assembly (AMBS or DTS) .....                                            | 6-24      |
| Figure 6-27 Suction Solenoid Valve (SSV) – Alco .....                                               | 6-25      |
| Figure 6-28 Suction Modulation Valve (SMV) .....                                                    | 6-26      |
| Figure 6-29 Thermostatic Expansion Valve – Alco .....                                               | 6-27      |
| Figure 6-30 Thermostatic Expansion Valve Bulb .....                                                 | 6-27      |
| Figure 6-31 Controller side of the Control Box .....                                                | 6-28      |
| Figure 6-32 Water-Cooled Condenser Cleaning – Forced Circulation .....                              | 6-31      |
| Figure 6-33 Water-Cooled Condenser Cleaning – Gravity Circulation .....                             | 6-32      |
| Figure 6-34 R-134a Compressor Pressure and Motor Current Curves Versus<br>Ambient Temperature ..... | 6-37      |
| Figures 7-1/7-68 Electrical Schematic – <b>See Model Chart</b> .....                                | 7-2/7-137 |

TABLE OF CONTENTS

## LIST OF TABLES

| <b>Table</b> |                                                                                         | <b>Page</b> |
|--------------|-----------------------------------------------------------------------------------------|-------------|
| Table 1-1    | Model Chart .....                                                                       | 1-2         |
| Table 2-1    | Safety and Protective Devices .....                                                     | 2-19        |
| Table 3-1    | Controller Configuration Variables .....                                                | 3-3         |
| Table 3-2    | Key Pad Function .....                                                                  | 3-4         |
| Table 3-3    | Controller Function Code Assignments .....                                              | 3-6         |
| Table 3-4    | Controller Alarm Indications .....                                                      | 3-11        |
| Table 3-5    | Pre-Trip Test Codes .....                                                               | 3-19        |
| Table 3-6    | DataCORDER Function Code Assignments .....                                              | 3-26        |
| Table 3-7    | DataCORDER Alarm Indications .....                                                      | 3-28        |
| Table 3-8    | DataCORDER Alarm Configurations .....                                                   | 3-29        |
| Table 3-9    | DataCorder Standard Configuration .....                                                 | 3-30        |
| Table 3-10   | DataCORDER Pre-Trip Data .....                                                          | 3-33        |
| Table 4-1    | Electrical Control Positions - BELOW -10°C (+14°F), or<br>-5°C (+23°F) optionally ..... | 4-14        |
| Table 4-2    | Electrical Control Positions - ABOVE -10°C (+14°F), or<br>-5°C (+23°F) optionally ..... | 4-15        |
| Table 6-1    | AMBS, DTS, RRS, RTS, SRS and STS Temperature-Resistance Chart                           | 6-32        |
| Table 6-2    | Partlow Bulb Temperature-Resistance Chart .....                                         | 6-32        |
| Table 6-3    | Recommended Bolt Torque Values .....                                                    | 6-33        |
| Table 6-4    | Wear Limits For Compressors .....                                                       | 6-33        |
| Table 6-5    | Compressor Torque Values .....                                                          | 6-34        |
| Table 6-6    | Temperature-Pressure Chart - R-134a .....                                               | 6-35        |

# SECTION 1

## INTRODUCTION

### 1.1 INTRODUCTION

#### WARNING

**It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.**

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 1-1. Also, Table 1-1 charts some significant differences between these models.

#### NOTE

Beginning with early 1995 production, in addition to a model number, Carrier Transicold began using a parts identification (PID) number in the format NT0000. In the parts manual, the PID number is shown in boldface to point out parts variations within models. The PID number must be included when ordering and inquiring about your unit.

The unit, of lightweight aluminum frame construction, is an all electric, one piece, self-contained cooling and heating refrigeration unit. The unit is designed to fit in the front of a container and to serve as the container front wall. Forklift pockets are provided for installation and removal of the unit.

The unit is complete with a charge of R-134a, compressor lubricating oil (approved POE SW20 compressor oil for R-134a only), mode indicating lights, and temperature controller, and is ready for operation upon installation.

Some units are equipped with a two-speed compressor that is used to enhance power saving.

Some units are dual voltage units designed to operate on 190/230 or 380/460 volts AC, 3-phase, 50-60 hertz power (refer to section 2.4). Other units are designed to operate on 380/460 volts AC, 3-phase 50/60 hertz power only. An external autotransformer is required for 190/230 vac operation (refer to Figure 2-9 and section 2.4).

Operating control power is provided by a control transformer which steps down the AC supply power source to 18 and 24 volts AC, single phase control power.

The temperature Controller/DataCORDER (Micro-Link 2i) is a microprocessor-based controller and a integrated electronic data logging device. Refer to sections 3.1 and 3.3. Once the temperature controller is set at a desired container temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects cooling, holding or heating as necessary to maintain the desired temperature within the container.

#### WARNING

**Beware of unannounced starting of the evaporator and condenser fans. Do not open the condenser fan grille before turning power OFF and disconnecting power plug.**

Some units are equipped with a mechanical temperature recorder.

Some units may have a TransFRESH controlled atmosphere system added. Contact TransFRESH Corporation, P.O. Box 1788, Salinas, CA 93902 for information on their system.

| Table 1-1. Model Chart |        |                     |             |                      |                        |                |       |                                     |                 |            |                                      |                              |                                 |                                           |
|------------------------|--------|---------------------|-------------|----------------------|------------------------|----------------|-------|-------------------------------------|-----------------|------------|--------------------------------------|------------------------------|---------------------------------|-------------------------------------------|
| MODEL                  | PID    | USDA Cold Treatment | Transformer | Two-Speed Compressor | Water-Cooled Condenser | Condenser Coil |       | Suction & Discharge Pressure Option | Humidity Sensor | TransFresh | Communications Interface Module (CI) | Partlow Temperature Recorder | Saginomiya Temperature Recorder | Electrical Wiring Schematics and Diagrams |
|                        |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-1           | NT0001 | X                   | P           | X                    | P                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               | Figure 7-1 & Figure 7-2                   |
|                        | NT0062 | X                   | P           | X                    | P                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
| 69NT40-511-2           | NT0002 | X                   | P           | X                    | X                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
|                        | NT0017 | X                   | P           | X                    | X                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
| 69NT40-511-3           | NT0007 | P                   | P           | -                    | -                      | X              | -     | -                                   | X               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-4           | NT0037 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-5           | NT0011 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
|                        | NT0038 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
|                        | NT0099 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-6           | NT0013 | P                   | P           | -                    | -                      | X              | -     | -                                   | X               | -          | -                                    | -                            | Figure 7-3 & Figure 7-4         |                                           |
| 69NT40-511-7           | NT0014 | X                   | P           | -                    | -                      | X              | -     | -                                   | X               | -          | -                                    | -                            |                                 |                                           |
| 69NT40-511-8           | NT0005 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            |                                 | -                                         |
|                        | NT0037 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
|                        | NT0094 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-9           | NT0064 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|                        | NT0089 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
|                        | NT0152 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-10          | NT0024 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|                        | NT0027 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               |                                           |
|                        | NT0040 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               |                                           |
|                        | NT0041 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               |                                           |
|                        | NT0104 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               |                                           |
|                        | NT0112 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|                        | NT0173 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
| NT0209                 | P      | X                   | -           | P                    | X                      | -              | -     | P                                   | X               | P          | X                                    | -                            |                                 |                                           |
| 69NT40-511-11          | NT0008 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-12          | NT0076 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | P                            | -                               |                                           |
|                        | NT0082 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | P                            | -                               |                                           |
| 69NT40-511-13          | NT0015 | X                   | P           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-5 & Figure 7-6                   |
|                        | NT0022 | X                   | P           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
| 69NT40-511-14          | NT0018 | X                   | P           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
| 69NT40-511-15          | NT0029 | P                   | X           | -                    | X                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|                        | NT0044 | P                   | X           | -                    | X                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-16          | NT0028 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
|                        | NT0054 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|                        | NT0070 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| NT0083                 | P      | P                   | -           | P                    | X                      | -              | -     | P                                   | -               | P          | X                                    | -                            |                                 |                                           |
| 69NT40-511-17          | NT0043 | X                   | P           | X                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-1 & Figure 7-2                   |

| MODEL         | PID    | USDA Cold Treatment | Transformer | Two-Speed Compressor | Water-Cooled Condenser | Condenser Coil |       | Suction & Discharge Pressure Option | Humidity Sensor | TransFresh | Communications Interface Module (CI) | Partlow Temperature Recorder | Saginomiya Temperature Recorder | Electrical Wiring Schematics and Diagrams |
|---------------|--------|---------------------|-------------|----------------------|------------------------|----------------|-------|-------------------------------------|-----------------|------------|--------------------------------------|------------------------------|---------------------------------|-------------------------------------------|
|               |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-18 | NT0035 | P                   | X           | -                    | P                      | X              | -     | A                                   | P               | -          | X                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-19 | NT0037 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-21 | NT0055 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               |                                           |
| 69NT40-511-22 | NT0046 | P                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0121 | P                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               |                                           |
|               | NT0139 | P                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-23 | NT0252 | P                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0050 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-24 | NT0069 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-25 | NT0051 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |
| 69NT40-511-26 | NT0053 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-1 & Figure 7-2                   |
| 69NT40-511-26 | NT0047 | P                   | P           | X                    | P                      | X              | -     | -                                   | P               | P          | P                                    | P                            | -                               |                                           |
|               | NT0175 | P                   | P           | X                    | P                      | X              | -     | -                                   | P               | P          | P                                    | P                            | -                               | Figure 7-21 & Figure 7-22                 |
| 69NT40-511-27 | NT0056 | X                   | X           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-28 | NT0057 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | X                            | -                               |                                           |
|               | NT0132 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-29 | NT0059 | P                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0219 | P                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | -                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0343 | P                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-30 | NT0060 | X                   | -           | X                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-7 & Figure 7-8                   |
| 69NT40-511-31 | NT0061 | P                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-32 | NT0067 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |
|               | NT0097 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-33 | NT0068 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | -                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0239 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | P                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-34 | NT0065 | P                   | P           | -                    | P                      | X              | -     | B                                   | P               | -          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-35 | NT0071 | X                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-36 | NT0072 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-5 & Figure 7-6                   |
| 69NT40-511-37 | NT0073 | X                   | -           | -                    | P                      | X              | -     | B                                   | X               | X          | -                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |

| MODEL         | PID    | USDA Cold Treatment | Transformer | Two-Speed Compressor | Water-Cooled Condenser | Condenser Coil |       | Suction & Discharge Pressure Option | Humidity Sensor | TransFresh | Communications Interface Module (CI) | Partlow Temperature Recorder | Saginomiya Temperature Recorder | Electrical Wiring Schematics and Diagrams |
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|               |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-38 | NT0074 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-11 & Figure 7-12                 |
|               | NT0135 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
|               | NT0208 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-31 & Figure 7-32                 |
|               | NT0246 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-47 & Figure 7-48                 |
|               | NT0253 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
|               | NT0267 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
|               | NT0307 | X                   | -           | -                    | -                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-63 & Figure 7-64                 |
| 69NT40-511-39 | NT0078 | X                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0084 | X                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
|               | NT0095 | X                   | P           | -                    | X                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-40 | NT0079 | X                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0085 | X                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
|               | NT0096 | X                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-41 | NT0080 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0090 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-65 & Figure 7-66                 |
| 69NT40-511-42 | NT0088 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | P                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-43 | NT0081 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | -                            | -                               |                                           |
| 69NT40-511-44 | NT0091 | X                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0102 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               |                                           |
|               | NT0137 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               |                                           |
|               | NT0185 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0213 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | -                            | X                               | Figure 7-41 & Figure 7-42                 |
|               | NT0244 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | -                            | X                               |                                           |
|               | NT0266 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | -          | P                                    | -                            | X                               |                                           |
| 69NT40-511-45 | NT0092 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | -                                    | P                            | -                               | Figure 7-3 & Figure 7-4                   |
| 69NT40-511-46 | NT0110 | P                   | X           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-47 | NT0098 | P                   | X           | -                    | X                      | X              | -     | B                                   | P               | -          | P                                    | -                            | X                               |                                           |
|               | NT0124 | P                   | X           | -                    | X                      | X              | -     | B                                   | P               | -          | P                                    | -                            | X                               |                                           |
|               | NT0146 | P                   | X           | -                    | X                      | X              | -     | B                                   | P               | -          | P                                    | -                            | X                               | Figure 7-23 & Figure 7-24                 |
| NT0186        | P      | X                   | -           | X                    | X                      | -              | B     | P                                   | -               | P          | -                                    | X                            | Figure 7-19 & Figure 7-20       |                                           |
| 69NT40-511-48 | NT0101 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |

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|               |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-49 | NT0103 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0134 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0184 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0216 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0268 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0282 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0283 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | -                            | X                               |                                           |
|               | NT0303 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | -                            | X                               |                                           |
|               | NT0308 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|               | NT0341 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | -                            | X                               |                                           |
| NT0345        | P      | P                   | -           | P                    | -                      | X              | -     | P                                   | -               | P          | X                                    | -                            |                                 |                                           |
| 69NT40-511-50 | NT0106 | X                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | -                            | X                               | Figure 7-9 & Figure 7-10                  |
|               | NT0178 | X                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | -                            | X                               |                                           |
| 69NT40-511-51 | NT0107 | X                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-13 & Figure 7-14                 |
|               | NT0207 | X                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-45 & Figure 7-46                 |
|               | NT0417 | X                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-67 & Figure 7-68                 |
| 69NT40-511-52 | NT0109 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0111 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-3 & Figure 7-4                   |
|               | NT0133 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0162 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0225 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-53 | NT0113 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | -                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-54 | NT0118 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0136 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-55 | NT0215 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0120 | P                   | -           | -                    | -                      | -              | X     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-56 | NT0188 | P                   | -           | -                    | -                      | -              | X     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0242 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-57 | NT0156 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |

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|               |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-58 | NT0105 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0122 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0138 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0141 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0160 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0161 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0189 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0240 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0269 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|               | NT0309 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0340 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | P                            | -                               |                                           |
|               | NT0386 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               |                                           |
|               | NT0418 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| NT0428        | P      | X                   | -           | P                    | X                      | -              | -     | P                                   | -               | P          | -                                    | X                            |                                 |                                           |
| 69NT40-511-59 | NT0167 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0174 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0211 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0272 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0312 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-60 | NT0125 | X                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0153 | X                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-61 | NT0126 | X                   | X           | -                    | P                      | X              | -     | A                                   | P               | -          | -                                    | X                            | -                               |                                           |
|               | NT0154 | X                   | X           | -                    | P                      | X              | -     | A                                   | P               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-62 | NT0127 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | X                                    | X                            | -                               | Figure 7-17 & Figure 7-18                 |
| 69NT40-511-63 | NT0140 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | X          | X                                    | -                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0192 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | X          | X                                    | -                            | -                               | Figure 7-19 & Figure 7-20                 |
| 69NT40-511-64 | NT0131 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | X          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-65 | NT0119 | P                   | X           | -                    | X                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-66 | NT0129 | P                   | X           | -                    | X                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0147 | P                   | X           | -                    | X                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-67 | NT0143 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | P                            | -                               |                                           |
| 69NT40-511-69 | NT0177 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |
| 69NT40-511-70 | NT0241 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0271 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
|               | NT0311 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|               | NT0353 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |



| MODEL         | PID    | USDA Cold Treatment | Transformer | Two-Speed Compressor | Water-Cooled Condenser | Condenser Coil |       | Suction & Discharge Pressure Option | Humidity Sensor | TransFresh | Communications Interface Module (CI) | Partlow Temperature Recorder | Saginomiya Temperature Recorder | Electrical Wiring Schematics and Diagrams |
|---------------|--------|---------------------|-------------|----------------------|------------------------|----------------|-------|-------------------------------------|-----------------|------------|--------------------------------------|------------------------------|---------------------------------|-------------------------------------------|
|               |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-71 | NT0166 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0235 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-72 | NT0157 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-25 & Figure 7-26                 |
|               | NT0200 | P                   | X           | -                    | -                      | X              | -     | -                                   | P               | X          | P                                    | X                            | -                               | Figure 7-33 & Figure 7-34                 |
| 69NT40-511-73 | NT0158 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-74 | NT0159 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-74 | NT0223 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
| 69NT40-511-75 | NT0163 | X                   | P           | -                    | P                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-76 | NT0169 | P                   | X           | X                    | P                      | X              | -     | B                                   | P               | -          | P                                    | -                            | X                               | Figure 7-15 & Figure 7-16                 |
| 69NT40-511-77 | NT0176 | P                   | X           | -                    | P                      | X              | -     | B                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-78 | NT0182 | P                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-79 | NT0190 | -                   | X           | -                    | P                      | X              | -     | B                                   | P               | -          | -                                    | -                            | X                               | Figure 7-39 & Figure 7-40                 |
| 69NT40-511-80 | NT0165 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               | Figure 7-9 & Figure 7-10                  |
| 69NT40-511-81 | NT0151 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|               | NT0168 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0180 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-9 & Figure 7-10                  |
|               | NT0236 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0258 | P                   | X           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-82 | NT0187 | P                   | X           | -                    | P                      | X              | -     | A                                   | P               | X          | P                                    | X                            | -                               | Figure 7-31 & Figure 7-32                 |
|               | NT0198 | P                   | X           | -                    | P                      | X              | -     | A                                   | P               | X          | P                                    | X                            | -                               | Figure 7-27 & Figure 7-28                 |
|               | NT0199 | P                   | X           | -                    | P                      | X              | -     | A                                   | X               | X          | P                                    | X                            | -                               | Figure 7-35 & Figure 7-36                 |
| 69NT40-511-83 | NT0210 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               | Figure 7-43 & Figure 7-44                 |
| 69NT40-511-84 | NT0191 | -                   | -           | -                    | X                      | -              | X     | -                                   | P               | -          | P                                    | P                            | -                               | Figure 7-19 & Figure 7-20                 |
|               | NT0201 | -                   | -           | -                    | X                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-41 & Figure 7-42                 |
|               | NT0334 | -                   | -           | -                    | X                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-85 | NT0183 | X                   | -           | -                    | X                      | -              | X     | A                                   | P               | -          | X                                    | -                            | -                               | Figure 7-31 & Figure 7-32                 |
|               | NT0226 | X                   | -           | -                    | X                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
|               | NT0280 | X                   | -           | -                    | X                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               |                                           |
|               | NT0317 | X                   | -           | -                    | X                      | -              | X     | A                                   | X               | -          | X                                    | -                            | -                               | Figure 7-55 & Figure 7-56                 |
| 69NT40-511-87 | NT0214 | P                   | P           | -                    | P                      | X              | -     | B                                   | P               | X          | P                                    | -                            | X                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-89 | NT0212 | X                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |
|               | NT0243 | X                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |

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|----------------|--------|---------------------|-------------|----------------------|------------------------|----------------|-------|-------------------------------------|-----------------|------------|--------------------------------------|------------------------------|---------------------------------|-------------------------------------------|
|                |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-90  | NT0222 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-19 & Figure 7-20                 |
| 69NT40-511-91  | NT0202 | -                   | -           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-37 & Figure 7-38                 |
|                | NT0238 | -                   | -           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-51 & Figure 7-52                 |
|                | NT0278 | -                   | -           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-61 & Figure 7-62                 |
|                | NT0318 | -                   | -           | -                    | X                      | -              | X     | -                                   | P               | -          | P                                    | -                            | -                               | Figure 7-61 & Figure 7-62                 |
| 69NT40-511-92  | NT0218 | P                   | X           | -                    | -                      | -              | X     | A                                   | X               | X          | P                                    | -                            | X                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-93  | NT0197 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | X          | X                                    | -                            | -                               | Figure 7-29 & Figure 7-30                 |
| 69NT40-511-94  | NT0204 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | X          | X                                    | -                            | -                               |                                           |
|                | NT0262 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | -          | X                                    | -                            | -                               |                                           |
|                | NT0265 | X                   | -           | -                    | P                      | -              | X     | -                                   | X               | -          | X                                    | -                            | -                               |                                           |
| 69NT40-511-95  | NT0220 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | P                            | -                               | Figure 7-19 & Figure 7-20                 |
|                | NT0322 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|                | NT0344 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|                | NT0365 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | X                                    | P                            | -                               |                                           |
| 69NT40-511-96  | NT0224 | P                   | X           | -                    | P                      | -              | X     | B                                   | P               | -          | -                                    | -                            | X                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-97  | NT0228 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|                | NT0285 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
|                | NT0322 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-98  | NT0297 | P                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | P                                    | -                            | X                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-99  | NT0245 | X                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | -                            | X                               |                                           |
| 69NT40-511-100 | NT0247 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-101 | NT0250 | -                   | X           | -                    | P                      | X              | -     | B                                   | P               | -          | -                                    | -                            | X                               |                                           |
|                | NT0298 | -                   | X           | -                    | P                      | X              | -     | B                                   | P               | -          | -                                    | -                            | X                               |                                           |
|                | NT0333 | -                   | X           | -                    | P                      | X              | -     | B                                   | P               | -          | -                                    | -                            | X                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-102 | NT0251 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               | Figure 7-41 & Figure 7-42                 |
|                | NT0254 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | P                            | -                               |                                           |
| 69NT40-511-103 | NT0259 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | P                            | -                               |                                           |
| 69NT40-511-104 | NT0260 | P                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | -                                    | X                            | -                               |                                           |
| 69NT40-511-105 | NT0274 | X                   | X           | -                    | P                      | -              | X     | A                                   | P               | -          | -                                    | X                            | -                               | Figure 7-53 & Figure 7-54                 |
| 69NT40-511-106 | NT0263 | X                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|                | NT0414 | X                   | P           | -                    | P                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|                | NT0415 | X                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |

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|----------------|--------|---------------------|-------------|----------------------|------------------------|----------------|-------|-------------------------------------|-----------------|------------|--------------------------------------|------------------------------|---------------------------------|-------------------------------------------|
|                |        |                     |             |                      |                        | 2 Row          | 4 Row |                                     |                 |            |                                      |                              |                                 |                                           |
| 69NT40-511-107 | NT0275 | P                   | X           | -                    | P                      | -              | X     | A                                   | X               | X          | P                                    | X                            | -                               | Figure 7-49 & Figure 7-50                 |
|                | NT0277 | P                   | X           | -                    | P                      | -              | X     | A                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0315 | P                   | X           | -                    | P                      | -              | X     | A                                   | X               | X          | P                                    | X                            | -                               | Figure 7-59 & Figure 7-60                 |
|                | NT0354 | P                   | X           | -                    | P                      | -              | X     | A                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0381 | P                   | X           | -                    | P                      | -              | X     | X                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0385 | P                   | X           | -                    | P                      | -              | X     | X                                   | X               | X          | P                                    | X                            | -                               |                                           |
| 69NT40-511-108 | NT0264 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-109 | NT0284 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
| 69NT40-511-110 | NT0288 | X                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|                | NT0296 | X                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | -                            | X                               |                                           |
|                | NT0347 | X                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0349 | X                   | X           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
| 69NT40-511-111 | NT0286 | X                   | X           | -                    | X                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0295 | X                   | X           | -                    | X                      | -              | X     | -                                   | X               | X          | P                                    | -                            | X                               |                                           |
|                | NT0429 | X                   | P           | -                    | X                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-112 | NT0289 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|                | NT0325 | P                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | -                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
| 69NT40-511-113 | NT0294 | P                   | X           | -                    | X                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
| 69NT40-511-114 | NT0290 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|                | NT0326 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
|                | NT0335 | P                   | -           | -                    | -                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               |                                           |
|                | NT0336 | P                   | -           | -                    | -                      | -              | X     | -                                   | X               | -          | X                                    | X                            | -                               |                                           |
|                | NT0358 | P                   | P           | -                    | P                      | -              | X     | -                                   | X               | X          | P                                    | X                            | -                               |                                           |
| 69NT40-511-115 | NT0299 | P                   | X           | -                    | P                      | -              | X     | A                                   | X               | -          | P                                    | X                            | -                               | Figure 7-41 & Figure 7-42                 |
|                | NT0300 | P                   | X           | -                    | P                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-116 | NT0302 | X                   | P           | -                    | P                      | X              | -     | -                                   | P               | -          | P                                    | -                            | -                               |                                           |
| 69NT40-511-117 | NT0348 | X                   | P           | -                    | P                      | -              | X     | -                                   | X               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-118 | NT0387 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               | Figure 7-57 & Figure 7-58                 |
|                | NT0388 | P                   | P           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-119 | NT0389 | P                   | X           | -                    | P                      | -              | X     | -                                   | P               | -          | P                                    | X                            | -                               |                                           |
| 69NT40-511-120 | NT0410 | -                   | P           | -                    | P                      | X              | -     | -                                   | X               | -          | -                                    | -                            | -                               |                                           |
| 69NT40-521-10  | NT0108 | X                   | X           | -                    | P                      | X              | -     | -                                   | X               | -          | X                                    | -                            | X                               | Figure 7-9 & Figure 7-10                  |

- A - Factory Installed Pressure Gauges
- B - Factory Installed Pressure Transducers.
- P - Provision.
- X - Features that apply to model.

## SECTION 2

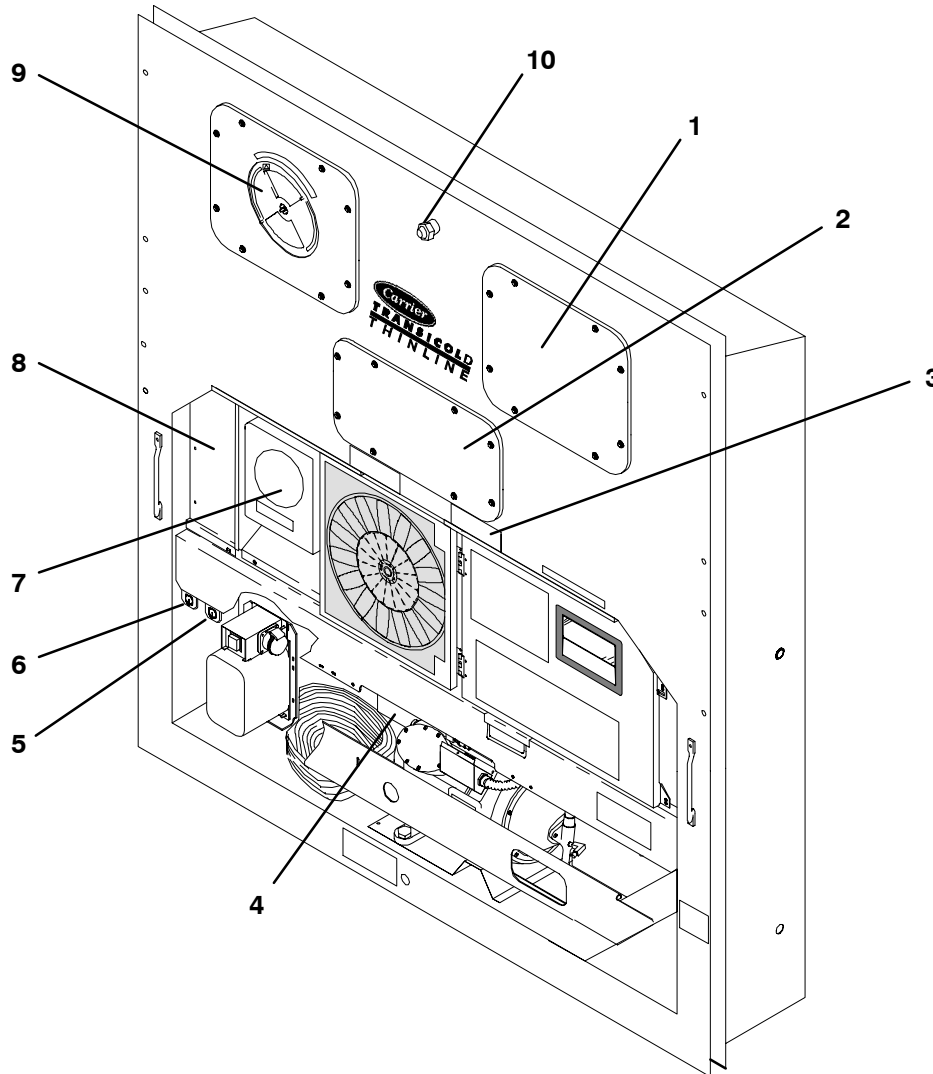
### DESCRIPTION

#### 2.1 GENERAL DESCRIPTION

##### a. Refrigeration Unit - Front Section

The front section of the refrigeration unit shows access to most parts of the unit (i.e., compressor, condenser, receiver, etc.), which will be discussed in more detail of the following sections in 2.1. The upper access panels

allow front entry into the evaporator section, and the center access panel allows access to the thermostatic expansion valve and evaporator coil heaters. The unit model number, serial number and parts identification number will be found on the front of the unit to the left of the compressor.



1. Access Panel (For Evap. Fan Motor #1)
2. Access Panel (For Heater & Thermostatic Expansion Valve)
3. Fork Lift Pockets
4. Unit Serial Number, Model Number and Parts Identification Number (PID) Plate
5. TransFRESH Communications Connector (TCC)  
- Optional

6. Interrogator Connector (Also see Figure 2-7)
7. Mechanical Recording Thermometer - Optional - (Partlow or Saginomiya)
8. Lower Fresh Air Makeup Vent or Blank Plate - Optional
9. Upper Fresh Air Makeup Vent and Access Panel (For Evap. Fan Motor #2)
10. Return Air Thermometer Port - Optional

Figure 2-1. Refrigeration Unit - Front

## **b. Evaporator Section**

The evaporator section contains the optional mechanical temperature recording bulb, return recorder sensor (RRS), return temperature sensor (RTS), thermostatic expansion valve, dual-speed evaporator fan motors and fans (2), evaporator coil and heaters, drain pan and heater, defrost termination sensor, heat termination thermostat, and heat exchanger. See Figure 2-2 and Figure 2-5 for sensor locations.

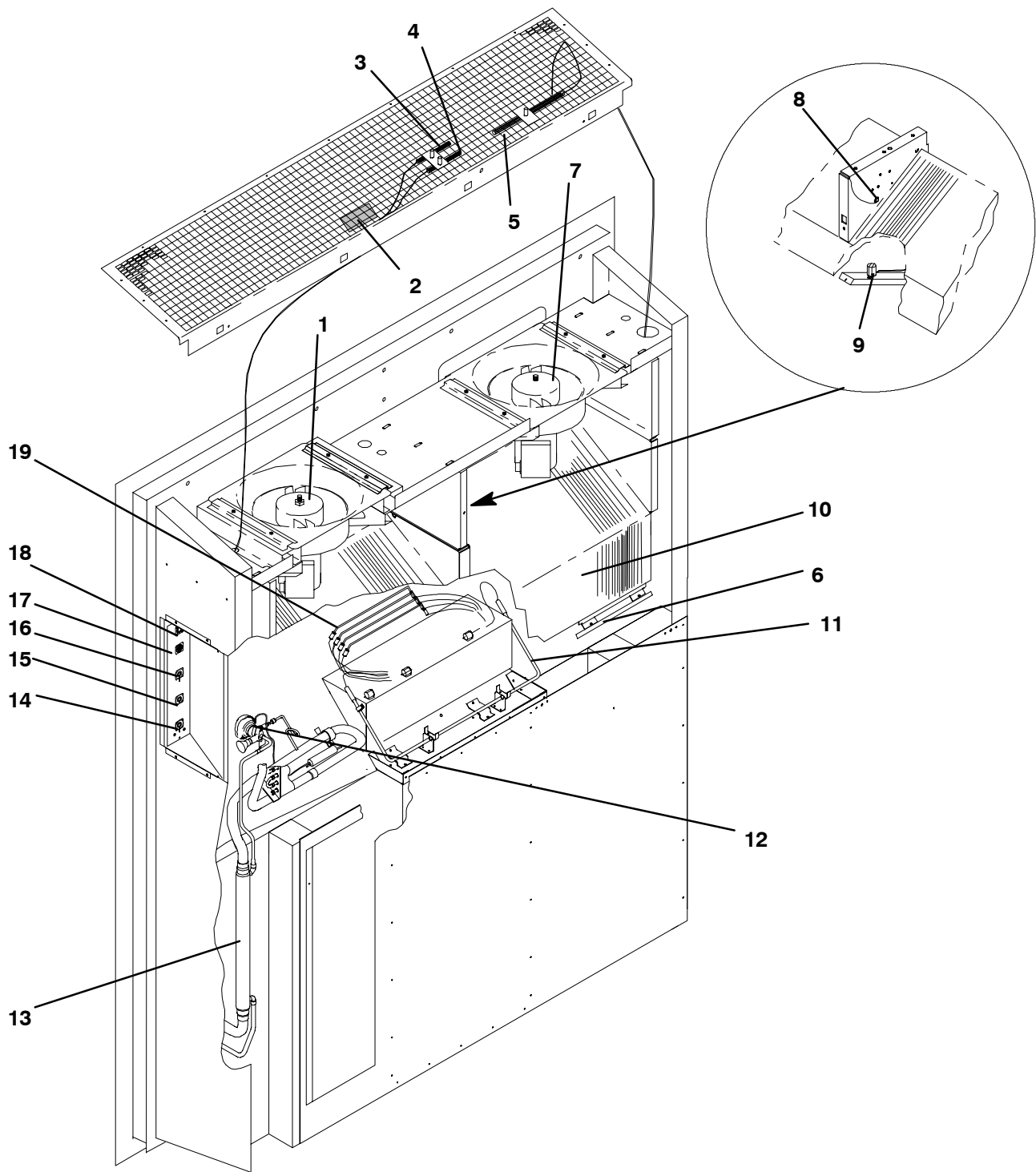
The evaporator fans circulate air throughout the container by pulling air in the top of the refrigeration unit, directing the air through the evaporator coil where it is either heated or cooled, and discharging the air through the bottom of the refrigeration unit into the container.

When transporting perishable (chilled) commodities, the fan motors will normally be in high speed above  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally.

The evaporator coil heaters are accessible by removing the front lower access panel. The defrost termination sensor (DTS) is located on the coil center tube sheet and may be serviced by removing the upper rear panel, or by removing the left front upper access panel, disconnecting the evaporator fan connector and reaching through the access panel opening.

### **WARNING**

**Before servicing unit, make sure the unit circuit breakers (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position. Also disconnect power plug and cable.**



- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>1. Evaporator Fan Motor #1 (EM1)</li> <li>2. Humidity Sensor (HS) - Optional</li> <li>3. Return Recorder Sensor (RRS)</li> <li>4. Return Temperature Sensor (RTS)</li> <li>5. Mechanical Recording Thermometer Bulb</li> <li>6. Mechanical Recording Thermometer Bulb -<br/>Used on PID <b>NT0073</b></li> <li>7. Evaporator Fan Motor #2 (EM2)</li> <li>8. Defrost Termination Sensor (DTS)</li> <li>9. Heater Termination Thermostat (HTT)</li> </ul> | <ul style="list-style-type: none"> <li>10. Evaporator Coil</li> <li>11. Drain Pan Heater (DPH)</li> <li>12. Thermostatic Expansion Valve</li> <li>13. Heat Exchanger</li> <li>14. Interrogator Receptacle (IC) - Optional</li> <li>15. USDA Probe Receptacle (PR2) - Optional</li> <li>16. USDA Probe Receptacle (PR1) - Optional</li> <li>17. USDA Probe Receptacle (PR3) - Optional</li> <li>18. Cargo Probe Receptacle (PR4) - Optional</li> <li>19. Evaporator Coil Heaters</li> </ul> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

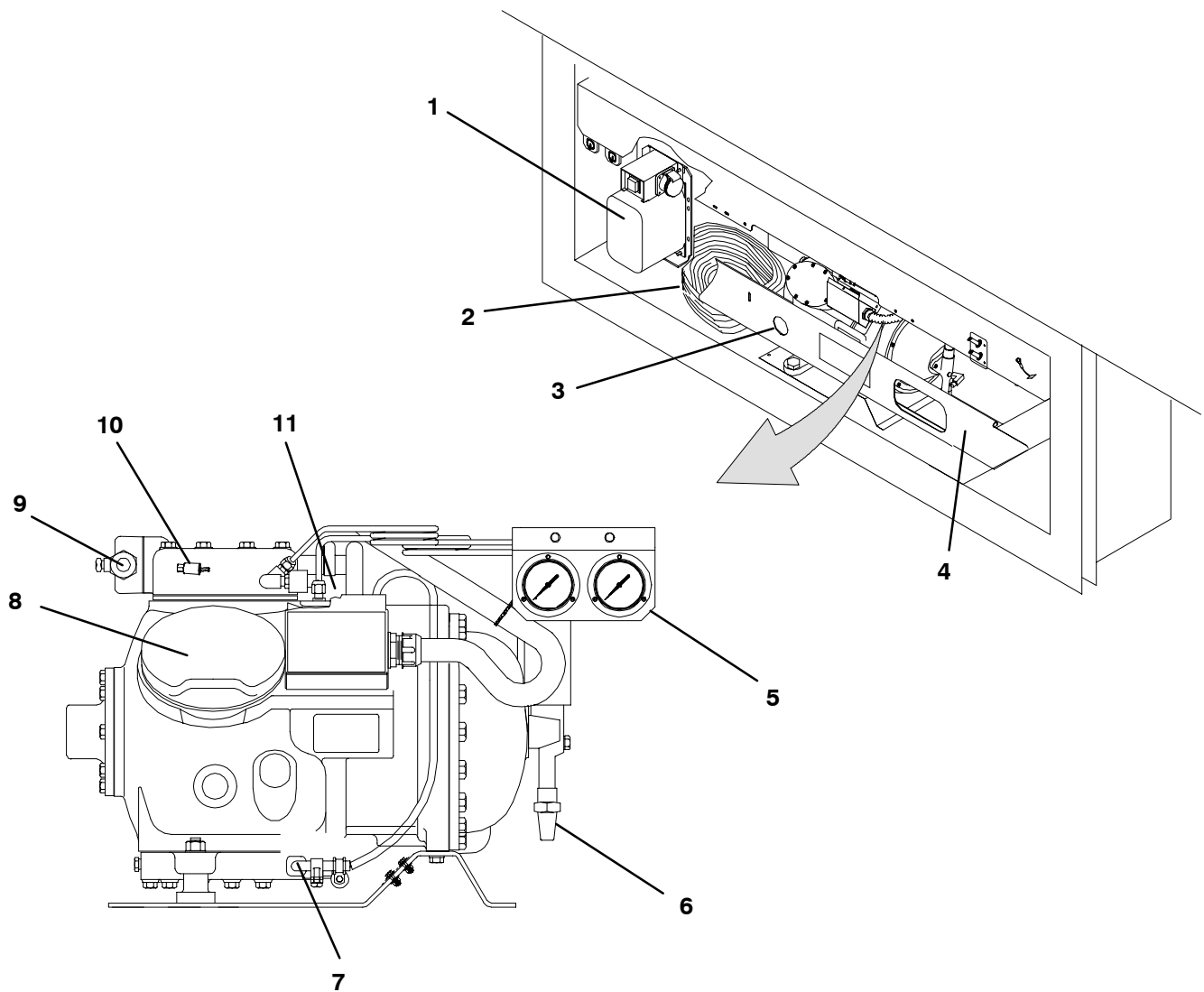
**Figure 2-2. Refrigeration Unit - Rear (Panels Removed)**

### c. Compressor Section

The compressor section includes the compressor, power cable storage compartment, and an optional transformer (refer to Table 1-1 and Figure 2-9), which is located to

the left of the compressor.

This section also contains the optional discharge/suction pressure transducers.



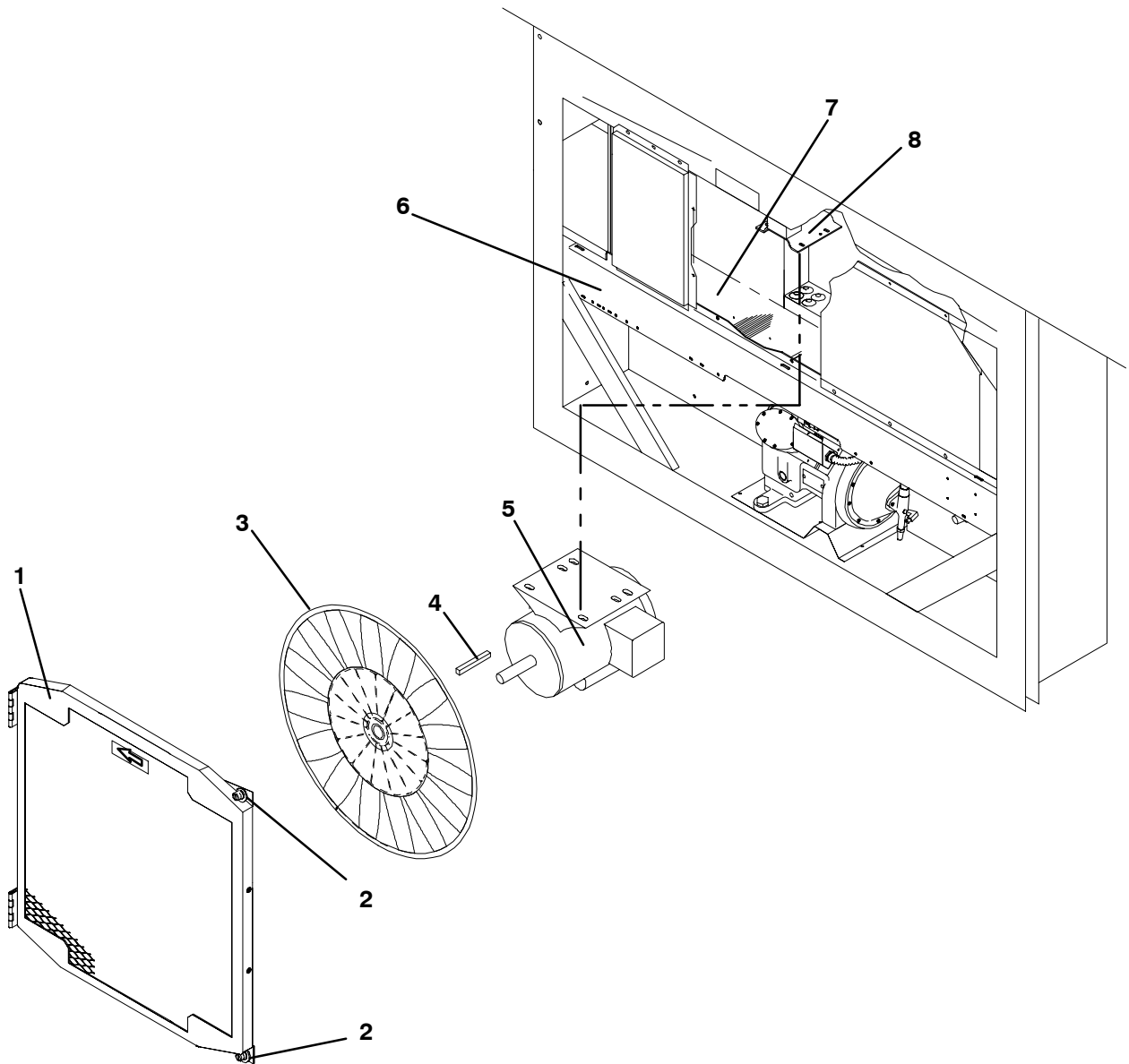
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|-------------------------------------------------|----------------------------------------------------|
| 1. Power Autotransformer - Optional             | 7. Compressor Crankcase Heater (CCH) - Optional    |
| 2. Power Cables and Plug                        | 8. Compressor Motor (CP)                           |
| 3. Compressor Sight Glass View Port             | 9. Discharge Service Valve                         |
| 4. Compressor Guard                             | 10. Discharge Pressure Transducer (DPT) - Optional |
| 5. Suction/Discharge Pressure Gauges - Optional | 11. Suction Pressure Transducer (SPT) - Optional   |
| 6. Suction Service Valve                        |                                                    |

**Figure 2-3. Compressor Section**

#### d. Condenser Section

The condensing section consists of a condenser fan motor, a condenser fan and an air-cooled condenser coil.

When the unit is operating, air is pulled in the bottom of the coil and discharged horizontally out through the front of the condenser fan grille.



1. Grille and Venturi Assembly
2. Retaining Screw
3. Condenser Fan
4. Key

5. Condenser Fan Motor (CM)
6. Condenser Coil Cover
7. Condenser Coil
8. Condenser Motor Mount Bracket

**Figure 2-4. Condenser Section**

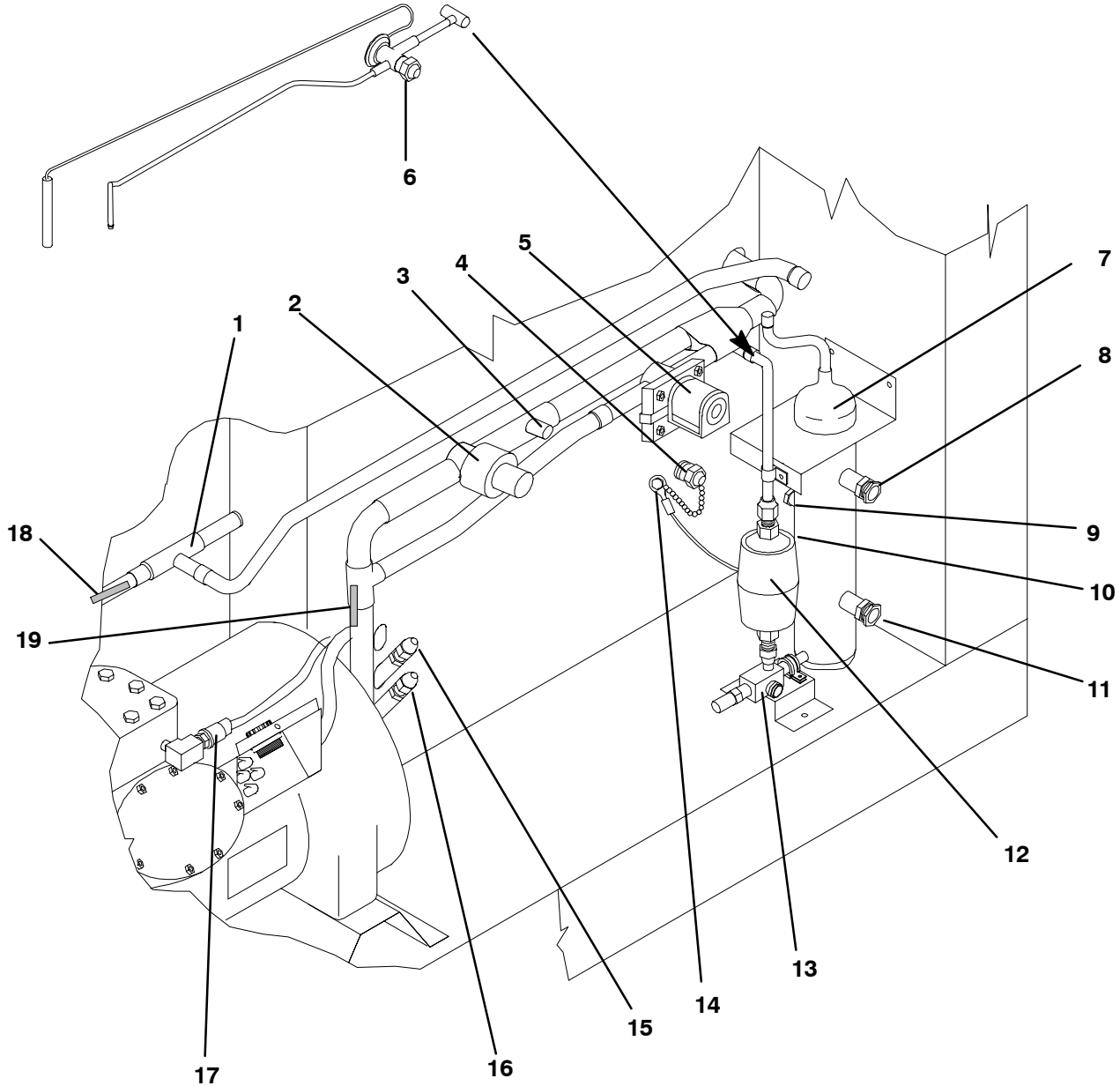


### e. Receiver Section

The receiver section consists of quench expansion valve, manual liquid line valve, filter-drier, receiver with sight glass/moisture-liquid indicator, condenser pressure transducer (CPT), fusible plug, suction modulation valve, suction solenoid valve, and

discharge pressure regulator valve.

The supply temperature sensor (STS), supply recorder sensor (SRS) and ambient sensor (AMBS) are located at the right side of the compressor.



- |                                           |                                     |
|-------------------------------------------|-------------------------------------|
| 1. Discharge Pressure Regulator Valve     | Located on back side of Receiver)   |
| 2. Suction Modulation Valve (SMV)         | 11. Sight Glass/Moisture Indicator  |
| 3. Schrader Valve                         | 12. Filter-Drier                    |
| 4. Supply Air Thermometer Port - Optional | 13. Manual Liquid Line Valve        |
| 5. Suction Solenoid Valve (SSV)           | 14. Ambient Sensor (AMBS)           |
| 6. Quench Expansion Valve                 | 15. Supply Temperature Sensor (STS) |
| 7. Electro-Coated Modular Receiver        | 16. Supply Recorder Sensor (SRS)    |
| 8. Sight Glass                            | 17. High Pressure Switch (HPS)      |
| 9. Fusible Plug                           | 18. Thermistor Sensor (CPDS)        |
| 10. Condenser Pressure Transducer (CPT) - | 19. Thermistor Sensor (CPSS)        |

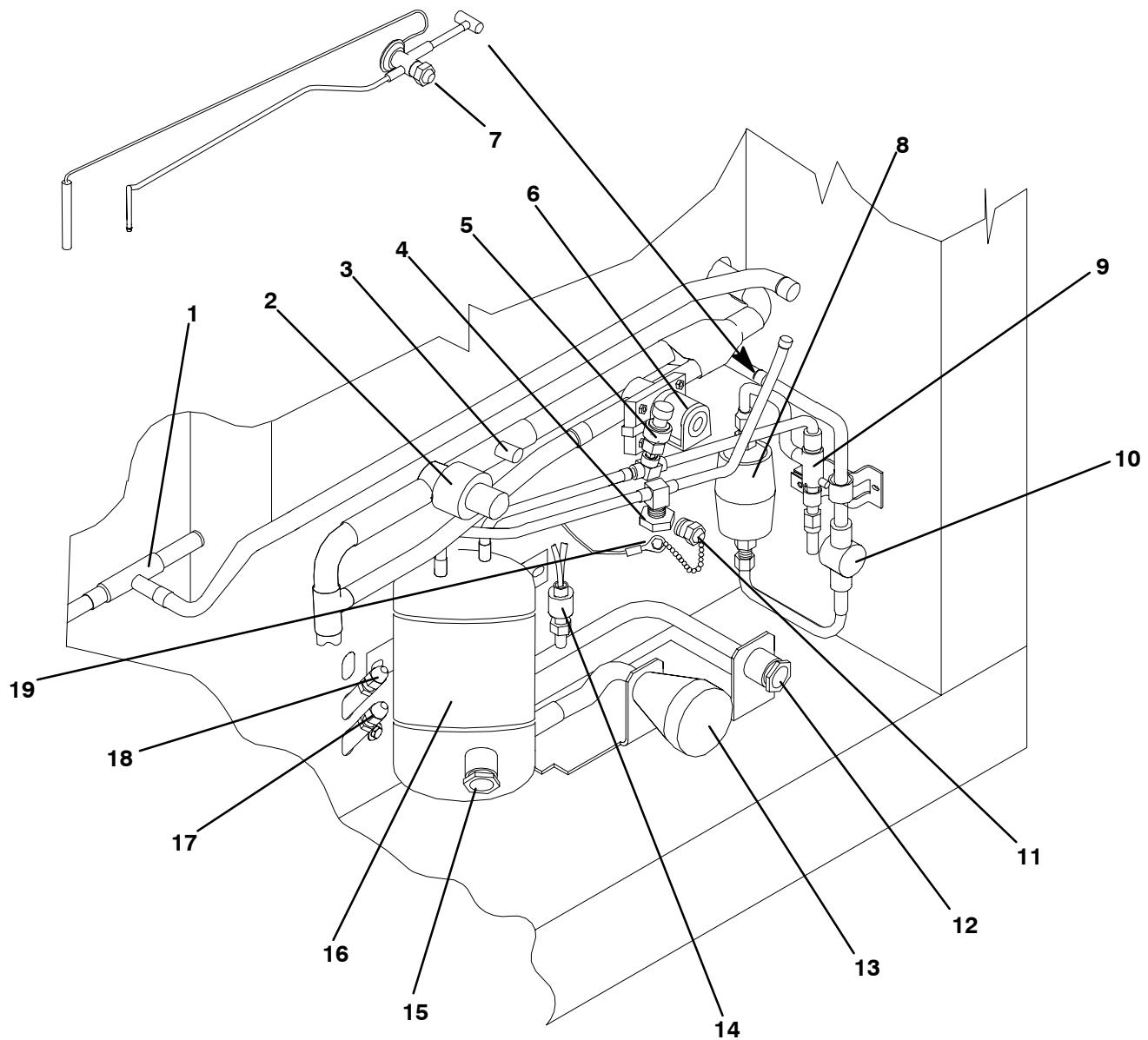
**Figure 2-5. Units with Receiver**

#### f. Water-Cooled Condenser Section (Optional)

The water-cooled condenser section consists of water-cooled condenser, sight glass, moisture-liquid indicator, quench expansion valve, rupture disc, condenser pressure transducer (CPT), filter-drier, suction modulation valve, suction solenoid valve,

discharge pressure regulator valve, water hook-up couplings and water pressure switch.

The supply temperature sensor (STS), supply recorder sensor (SRS) and ambient sensor (AMBS) are located at the right side of the compressor.



- |                                        |                                             |
|----------------------------------------|---------------------------------------------|
| 1. Discharge Pressure Regulator Valve  | 11. Supply Air Thermometer Port - Optional  |
| 2. Suction Modulation Valve (SMV)      | 12. Coupling (Water In)                     |
| 3. Schrader Valve                      | 13. Self Draining Coupling (Water Out)      |
| 4. Rupture Disc                        | 14. Water Pressure Switch (WPS)             |
| 5. Condenser Pressure Transducer (CPT) | 15. Sight Glass                             |
| 6. Suction Solenoid Valve (SSV)        | 16. Water-Cooled Condenser                  |
| 7. Quench Expansion Valve              | 17. Supply Recorder Sensor (SRS) - Optional |
| 8. Filter-Drier                        | 18. Supply Temperature Sensor (STS)         |
| 9. Manual Liquid Line Valve            | 19. Ambient Sensor (AMBS)                   |
| 10. Moisture-Liquid Indicator          |                                             |

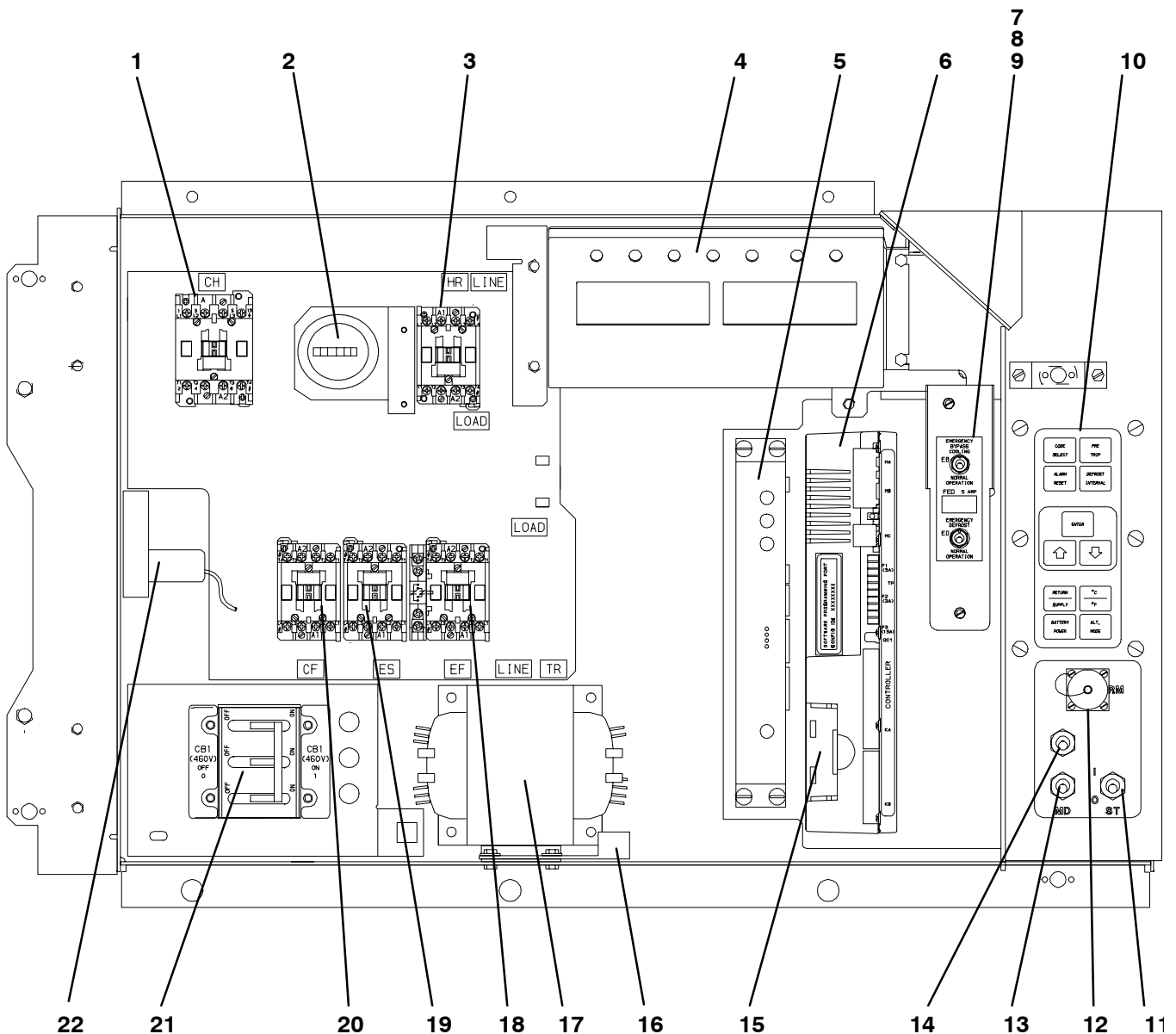
**Figure 2-6. Units with Water-Cooled Condenser**

**SECTION 2**

### g. Control Box with a Single-Speed Compressor

The control box includes the manual switches, circuit breaker(s), contactors, transformer, fuses, key pad, display module, current sensor module,

Controller/DataCORDER module (See Figure 2-7), an optional remote monitoring unit (CI), and an optional emergency bypass cooling switch (EB), emergency defrost switch (ED) and emergency defrost fuse (FED).



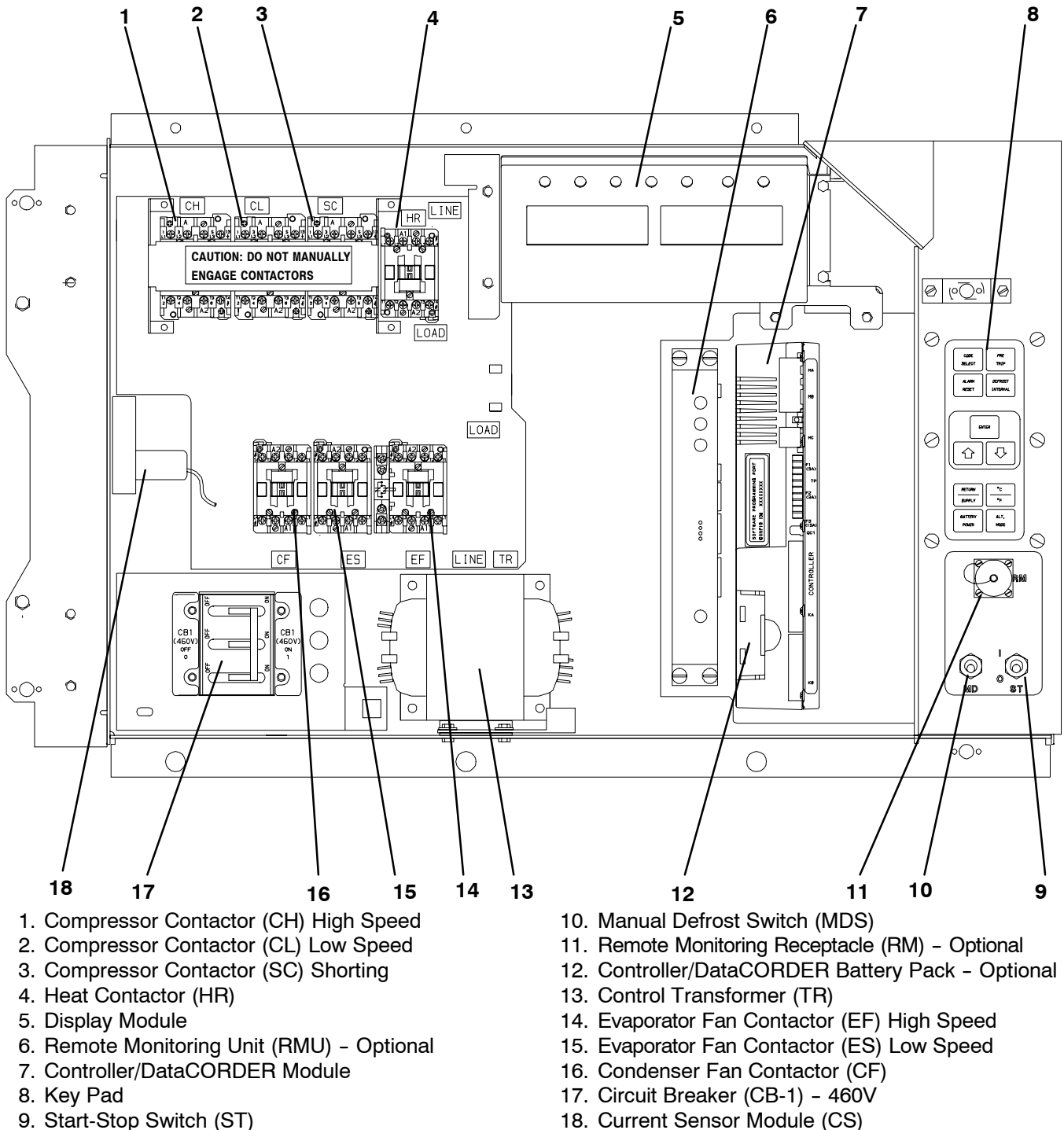
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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Compressor Contactor (CH)</li> <li>2. Hour Meter (HM) - Optional</li> <li>3. Heat Contactor (HR)</li> <li>4. Display Module</li> <li>5. Remote Monitoring Unit (RMU) - Optional</li> <li>6. Controller/DataCORDER Module</li> <li>7. Emergency Bypass Cooling Switch (EB)-Optional</li> <li>8. Emergency Defrost Fuse (FED) - Optional</li> <li>9. Emergency Defrost Switch (ED) - Optional</li> <li>10. Key Pad</li> <li>11. Start-Stop Switch (ST)</li> <li>12. Remote Monitoring Receptacle (RM) - Optional</li> </ol> | <ol style="list-style-type: none"> <li>13. Manual Defrost Switch (MDS)</li> <li>14. Condenser Fan Switch (CFS) - Optional</li> <li>15. Controller/DataCORDER Battery Pack - Optional</li> <li>16. Interrogator Connector - Optional location for some models</li> <li>17. Control Transformer (TR)</li> <li>18. Evaporator Fan Contactor (EF) High Speed</li> <li>19. Evaporator Fan Contactor (ES) Low Speed</li> <li>20. Condenser Fan Contactor (CF)</li> <li>21. Circuit Breaker (CB-1) - 460V</li> <li>22. Current Sensor Module (CS)</li> </ol> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Figure 2-7. Control Box on Units with a Single-Speed Compressor**

### h. Control Box with a Two-Speed Compressor (Optional)

The control box includes the manual switches, circuit breaker(s), contactors, transformer, fuses, key pad,

display module, current sensor module, Controller/DataCORDER module (See Figure 2-8), and an optional remote monitoring unit (CI).



**Figure 2-8. Control Box on Units with a Two-Speed Compressor (Optional)**

**SECTION 2**

## 2.2 REFRIGERATION SYSTEM DATA

|                                                                                                                                                                         |                                                                                                                                     |                                                                                                                                                                  |                         |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--|
| <b>i. Compressor/Motor Assembly</b>                                                                                                                                     | Number of Cylinders                                                                                                                 | 6                                                                                                                                                                |                         |  |
|                                                                                                                                                                         | Model                                                                                                                               | 06DR                                                                                                                                                             |                         |  |
|                                                                                                                                                                         | CFM                                                                                                                                 | 41                                                                                                                                                               |                         |  |
|                                                                                                                                                                         | Weight (Dry)                                                                                                                        | 118 kg (260 lb) - Single-Speed                                                                                                                                   |                         |  |
|                                                                                                                                                                         |                                                                                                                                     | 129.39 kg (285.25 lb) - Two-Speed                                                                                                                                |                         |  |
|                                                                                                                                                                         | Approved Oil                                                                                                                        | Castrol Icematic - SW20                                                                                                                                          |                         |  |
|                                                                                                                                                                         | Oil Charge                                                                                                                          | 3.6 liters (7.6 U.S. pints)                                                                                                                                      |                         |  |
| Oil Sight Glass                                                                                                                                                         | The oil level range, with the compressor off, should be between the bottom and one-eighth level of the capacity of the sight glass. |                                                                                                                                                                  |                         |  |
| <b>j. Expansion Valve Superheat</b>                                                                                                                                     | Verify at -18 °C (0 °F) container box temperature                                                                                   | 4.48 to 6.67 °C (8 to 12 °F)                                                                                                                                     |                         |  |
| <b>k. Heater Termination Thermostat</b>                                                                                                                                 | Opens                                                                                                                               | 54 (± 3) °C = 130 (± 5) °F                                                                                                                                       |                         |  |
|                                                                                                                                                                         | Closes                                                                                                                              | 38 (± 4) °C = 100 (± 7) °F                                                                                                                                       |                         |  |
| <b>l. High Pressure Switch</b>                                                                                                                                          | Cutout                                                                                                                              | 25 (± 1.0) kg/cm <sup>2</sup> = 350 (± 10) psig                                                                                                                  |                         |  |
|                                                                                                                                                                         | Cut-In                                                                                                                              | 18 (± 0.7) kg/cm <sup>2</sup> = 250 (± 10) psig                                                                                                                  |                         |  |
| <b>m. Refrigerant Charge</b>                                                                                                                                            | <b>Unit Configuration</b>                                                                                                           | <b>Charge Requirements - R-134a</b>                                                                                                                              |                         |  |
|                                                                                                                                                                         |                                                                                                                                     | <b>2* row condenser</b>                                                                                                                                          | <b>4* row condenser</b> |  |
|                                                                                                                                                                         | Water-Cooled Condenser                                                                                                              | 4.5 kg (9.0 lbs)                                                                                                                                                 | 5.22 kg (11.5 lbs)      |  |
|                                                                                                                                                                         | Receiver                                                                                                                            | 3.74 kg (8.25 lbs)                                                                                                                                               | 4.88 kg (10.75 lbs)     |  |
| * Refer to Table 1-1.                                                                                                                                                   |                                                                                                                                     |                                                                                                                                                                  |                         |  |
| <b>NOTE</b>                                                                                                                                                             |                                                                                                                                     |                                                                                                                                                                  |                         |  |
| When replacing the components (n.), (o.) and (p.) in section 2.2, refer to the installation instructions included with the ordered new part for additional information. |                                                                                                                                     |                                                                                                                                                                  |                         |  |
| <b>n. Fusible Plug</b>                                                                                                                                                  | Melting point                                                                                                                       | 99 °C = (210 °F)                                                                                                                                                 |                         |  |
|                                                                                                                                                                         | Torque                                                                                                                              | 6.2 to 6.9 mkg (45 to 50 ft-lbs)                                                                                                                                 |                         |  |
| <b>o. Sight Glass/Moisture Indicator</b>                                                                                                                                | Torque                                                                                                                              | 8.9 to 9.7 mkg (65 to 70 ft-lbs)                                                                                                                                 |                         |  |
| <b>p. Rupture Disc</b>                                                                                                                                                  | Bursts at                                                                                                                           | 35 ±5% kg/cm <sup>2</sup> = (500 ±5% psig)                                                                                                                       |                         |  |
|                                                                                                                                                                         | Torque (P/N 14-00215-03)                                                                                                            | 1.4 to 2 mkg (10 to 15 ft-lbs)                                                                                                                                   |                         |  |
|                                                                                                                                                                         | Torque (P/N 14-00215-04)                                                                                                            | 6.2 to 6.9 mkg (45 to 50 ft-lbs)                                                                                                                                 |                         |  |
| <b>q. Condenser Pressure Transducer (CPT)</b>                                                                                                                           | Condenser Fan Starts                                                                                                                | The condenser fan will start if the condenser pressure is greater than 14.06 kg/cm <sup>2</sup> (200 psig) OR the condenser fan is OFF for more than 60 seconds. |                         |  |
|                                                                                                                                                                         | Condenser Fan Stops                                                                                                                 | The condenser fan will stop if the condenser pressure is less than 9.14 kg/cm <sup>2</sup> (130 psig) AND the condenser fan remains ON for at least 30 seconds.  |                         |  |
| <b>r. Unit Weight</b>                                                                                                                                                   | Refer to unit model number plate, see Figure 2-1 for location of plate.                                                             |                                                                                                                                                                  |                         |  |
| <b>s. Water Pressure Switch (Optional)</b>                                                                                                                              | Cut-In                                                                                                                              | 0.5 ± 0.2 kg/cm <sup>2</sup> (7 ± 3 psig)                                                                                                                        |                         |  |
|                                                                                                                                                                         | Cutout                                                                                                                              | 1.6 ± 0.4 kg/cm <sup>2</sup> (22 ± 5 psig)                                                                                                                       |                         |  |

### 2.3 ELECTRICAL DATA

|                                                        |                                                   |                                                               |                                |
|--------------------------------------------------------|---------------------------------------------------|---------------------------------------------------------------|--------------------------------|
| <b>a. Circuit Breaker</b>                              | CB-1 Trips at                                     | 29 amps                                                       |                                |
|                                                        | CB-2 ( <b>50 amp</b> ) Trips at                   | 62.5 amps                                                     |                                |
|                                                        | CB-2 ( <b>70 amp</b> ) Trips at                   | 87.5 amps                                                     |                                |
| <b>b. Compressor Motor</b>                             | Full Load Amps (FLA)                              | 17.6 amps @ 460 vac<br>(with current limiting set at 21 amps) |                                |
| <b>c. Condenser Fan Motor</b>                          |                                                   | <b>380 vac, 3 Phase, 50 hz</b>                                | <b>460 vac, 3 Phase, 60 hz</b> |
|                                                        | Full Load Amps                                    | 1.3 amps                                                      | 1.6 amps                       |
|                                                        | Horsepower                                        | 0.43 hp                                                       | 0.75 hp                        |
|                                                        | Rotations Per Minute                              | 1425 rpm                                                      | 1725 rpm                       |
|                                                        | Voltage and Frequency                             | 360 - 460 vac $\pm$ 1.25 hz                                   | 400 - 500 vac $\pm$ 1.5 hz     |
|                                                        | Bearing Lubrication                               | Factory lubricated, additional grease not required.           |                                |
|                                                        | Rotation                                          | Counter-clockwise when viewed from shaft end.                 |                                |
| <b>d. Drain Pan Heaters</b>                            | Number of Heaters                                 | 1                                                             |                                |
|                                                        | Rating                                            | 750 watts +5 /-10 % @ 460 vac                                 |                                |
|                                                        | Resistance (cold)                                 | 285 $\pm$ 7.5% ohms nominal                                   |                                |
|                                                        | Type                                              | Sheath                                                        |                                |
| <b>e. Evaporator Coil Heaters</b>                      | Number of Heaters                                 | 4                                                             |                                |
|                                                        | Rating                                            | 750 watts +5/-10% each @ 230 vac                              |                                |
|                                                        | Resistance (cold)                                 | 66.8 to 77.2 ohms                                             |                                |
|                                                        | Ambient                                           | @ 20 °C (68 °F)                                               |                                |
|                                                        | Type                                              | Sheath                                                        |                                |
| <b>f. Evaporator Fan Motor(s)</b>                      |                                                   | <b>380 vac, 3 Phase, 50 hz</b>                                | <b>460 vac, 3 Phase, 60 hz</b> |
|                                                        | Full Load Amps - High Speed                       | 1.6 amps                                                      | 2.0 amps                       |
|                                                        | Full Load Amps - Low Speed                        | 0.8 amps                                                      | 1.0 amps                       |
|                                                        | Nominal Horsepower - High Speed                   | 0.70 hp                                                       | 0.84 hp                        |
|                                                        | Nominal Horsepower - Low Speed                    | 0.09 hp                                                       | 0.11 hp                        |
|                                                        | Rotations Per Minute - High Speed                 | 2850 rpm                                                      | 3450 rpm                       |
|                                                        | Rotations Per Minute - Low Speed                  | 1425 rpm                                                      | 1750 rpm                       |
|                                                        | Voltage and Frequency                             | 360 - 460 vac $\pm$ 1.25 hz                                   | 400 - 500 vac $\pm$ 1.5 hz     |
|                                                        | Voltage and Frequency - using modular transformer | 180 - 230 vac $\pm$ 1.25 hz                                   | 200 - 250 vac $\pm$ 1.5 hz     |
|                                                        | Bearing Lubrication                               | Factory lubricated, additional grease not required            |                                |
|                                                        | Rotation                                          | Clockwise when viewed from shaft end.                         |                                |
| <b>g. Fuses</b>                                        | Control Circuit                                   | 15 amps (F3)                                                  |                                |
|                                                        | Controller/DataCORDER                             | 5 amps (F1 & F2)                                              |                                |
| <b>h. Compressor Crankcase Heater (CCH) - Optional</b> |                                                   | 180 watts @ 460 vac                                           |                                |

|                                    |                                                                          |              |
|------------------------------------|--------------------------------------------------------------------------|--------------|
| i. Humidity Sensor (HS) - Optional | Orange wire                                                              | Power        |
|                                    | Red wire                                                                 | Output       |
|                                    | Brown wire                                                               | Ground       |
|                                    | Input voltage                                                            | 5 vdc        |
|                                    | Output voltage                                                           | 0 to 3.3 vdc |
|                                    | <b>Output voltage readings verses relative humidity (RH) percentage:</b> |              |
|                                    | 30%                                                                      | 0.99 V       |
|                                    | 50%                                                                      | 1.65 V       |
|                                    | 70%                                                                      | 2.31 V       |
|                                    | 90%                                                                      | 2.97 V       |

## 2.4 POWER AUTOTRANSFORMER (Optional)

### WARNING

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

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

#### a. Step-Up Power Autotransformer

The modular transformer (if equipped) is located under the condenser coil on the left-hand side of the unit (see Figure 2-9).

The modular transformer (item 1, Figure 2-9) provides 380/460 vac, 3-phase, 50/60 hertz power to the unit when the 230 vac (black) power cable is connected to a 190/230 vac, 3-phase power source. The module, in addition to the transformer, includes a 230 vac cable and a receptacle to accept the unit 460 vac power plug. The modular transformer may be equipped with an optional circuit breaker (CB-2).

### WARNING

**Do not attempt to unplug the power cable connected to the autotransformer before performing the following operations: Move the start-stop switch (ST), the unit circuit breaker(s), CB-1 and CB-2 (if equipped) and any external power source to their OFF positions.**

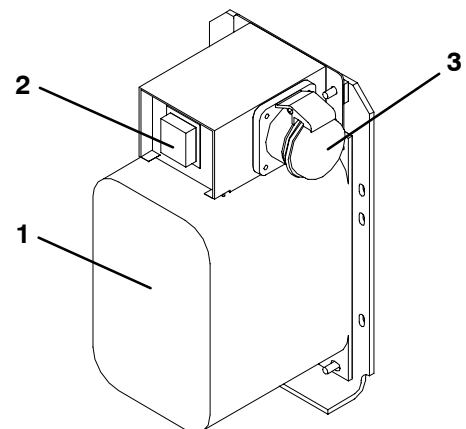
#### b. To Operate Unit on 190/230 vac Power Supply

1. Make sure that the start-stop switch (ST, on control panel) and circuit breaker (CB-2 if equipped, on the modular transformer) are in position "0" (OFF). Make sure the 460 vac power plug is locked into the receptacle on the modular transformer and circuit breaker (CB-1, in the control box) is in position "1" (ON).

2. Plug the 230 vac (black) cable into a de-energized 190/230 vac, 3-phase power source. Energize the power source. Set circuit breaker (CB-2 if equipped) to position "1" (ON). Close and secure control box door and place the start-stop switch (ST) in position "1" (ON) to start the unit.

#### c. To Operate Unit on 380/460 vac Power Supply

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 "1" (ON). Close and secure control box door and then place the start-stop switch (ST) in position "1" (ON) to start the unit.



1. Dual Voltage Modular Transformer
2. Circuit Breaker (CB-2) 230V (Optional)
3. 460 vac Power Receptacle

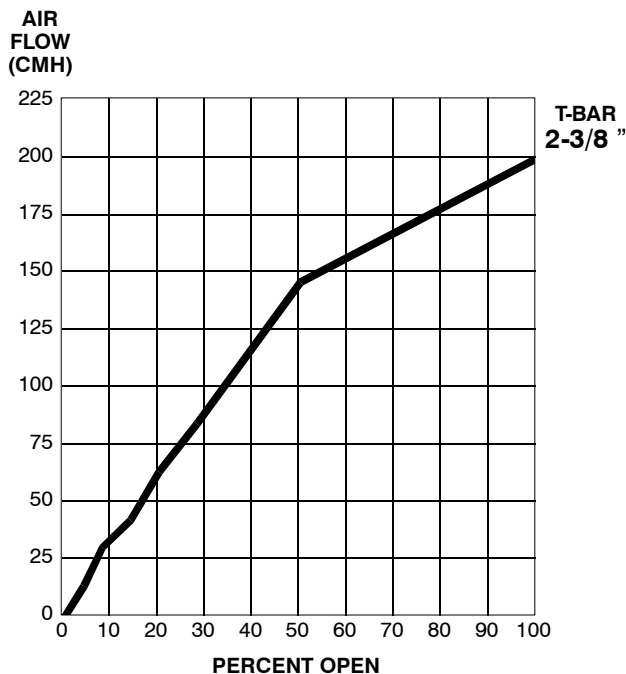
**Figure 2-9. Power Autotransformer (Optional)**

## 2.5 UPPER 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 or controlled atmosphere loads.

Air exchange depends on static pressure differential, which will vary depending on the container and how the container is loaded. The chart below gives air exchange values for an empty container. Higher values can be expected for a fully loaded container.

ZERO EXTERNAL STATIC PRESSURE, 50HZ POWER



For 60HZ operation multiply air flow values from curve by 1.2

### a. Full Open or Closed Positions

Maximum air flow is achieved by loosening the wing nut and rotating the disc to the maximum open position (100% open). The closed position is 0% air flow.

Two slots and a stop are designed into the disc for air flow adjustments. The first slot allows for a 0 to 30% air flow, and the second slot allows for a 30 to 100% air flow. To increase the percentage of air flow, the wing nut must be loosened, and the disc rotated until the desired percentage of air flow matches with the arrow on the disc. Tighten the wing nut. To clear the gap between the slots, loosen the wing nut until the disc clears the stop, and rotate the disc for the second slot.

The operator may also increase or decrease the air flow volume to meet the required air flow by aligning the

arrow on the disc with the percentage of desired air flow marked on the supplied label (see Figure 2-1).

## 2.6 LOWER FRESH AIR MAKEUP VENT (Optional)

The purpose of the lower 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. The chart across gives air exchange values for an empty container. Higher values can be expected for a fully loaded container.

### a. Full Open or Closed Positions

The air slide is supplied with two adjustable air control discs. The fresh air makeup can be adjusted for 15, 35, 50 and 75 cubic meters per hour (CFM). The air flow has been established at 60 Hz power, and a 2 1/2 inch T bar, with 15 mm (0.6 inch) H<sub>2</sub>O external static above free blow.

Maximum air flow is achieved by loosening the hex nuts and rotating each disc to the maximum open position (100% open). The closed position is 0% air flow.

The operator may also adjust the openings to increase or decrease the air flow volume to meet the required air flow.

### NOTE

The main air slide is in the fully closed position during reduced air flow operation.

### a. Air Sampling for Carbon Dioxide (CO<sub>2</sub>) Level

Loosen hex nuts and move the cover until the arrow on the cover is aligned with the “atmosphere sampling port” label. Tighten the hex nuts and attach a 3/8 hose to the sampling port.

If the internal atmosphere content has reached an unacceptable level, the operator may adjust the disc opening to meet the required air flow volume to ventilate the container.



## 2.7 REFRIGERATION CIRCUIT WITH RECEIVER

Starting at the compressor, the suction gas is compressed to a higher temperature and pressure.

When operating with the *air-cooled condenser*, the gas flows through the discharge service valve into the pressure regulator valve that is normally open. The pressure regulator valve restricts the flow of refrigerant to maintain a minimum discharge pressure of 5 kg/cm<sup>2</sup> (70 psig). Refrigerant gas then moves into the air-cooled condenser. Air flowing across the coil fins and tubes cools the gas to saturation temperature. By removing latent heat, the gas condenses to a high pressure/high temperature liquid and flows to the receiver which stores the additional charge necessary for low temperature operation.

From the receiver, the liquid refrigerant continues through the manual liquid line valve, the filter-drier (which keeps refrigerant clean and dry), and a heat exchanger that increases subcooling of liquid refrigerant to the thermostatic expansion valve. As the liquid refrigerant passes through the orifice of the expansion valve, some of it vaporizes into a gas (flash gas). Heat is absorbed from the return air by the balance of the liquid, causing it to vaporize in the evaporator coil. The vapor then flows through the suction modulation valve (and suction solenoid valve under some conditions) to the compressor.

The thermostatic expansion valve bulb on the suction line near the evaporator coil outlet controls the thermostatic expansion valve, maintaining a constant

superheat at the coil outlet regardless of load conditions, except at abnormally high container temperatures such as during pulldown (valve at maximum operating pressure condition).

### NOTE

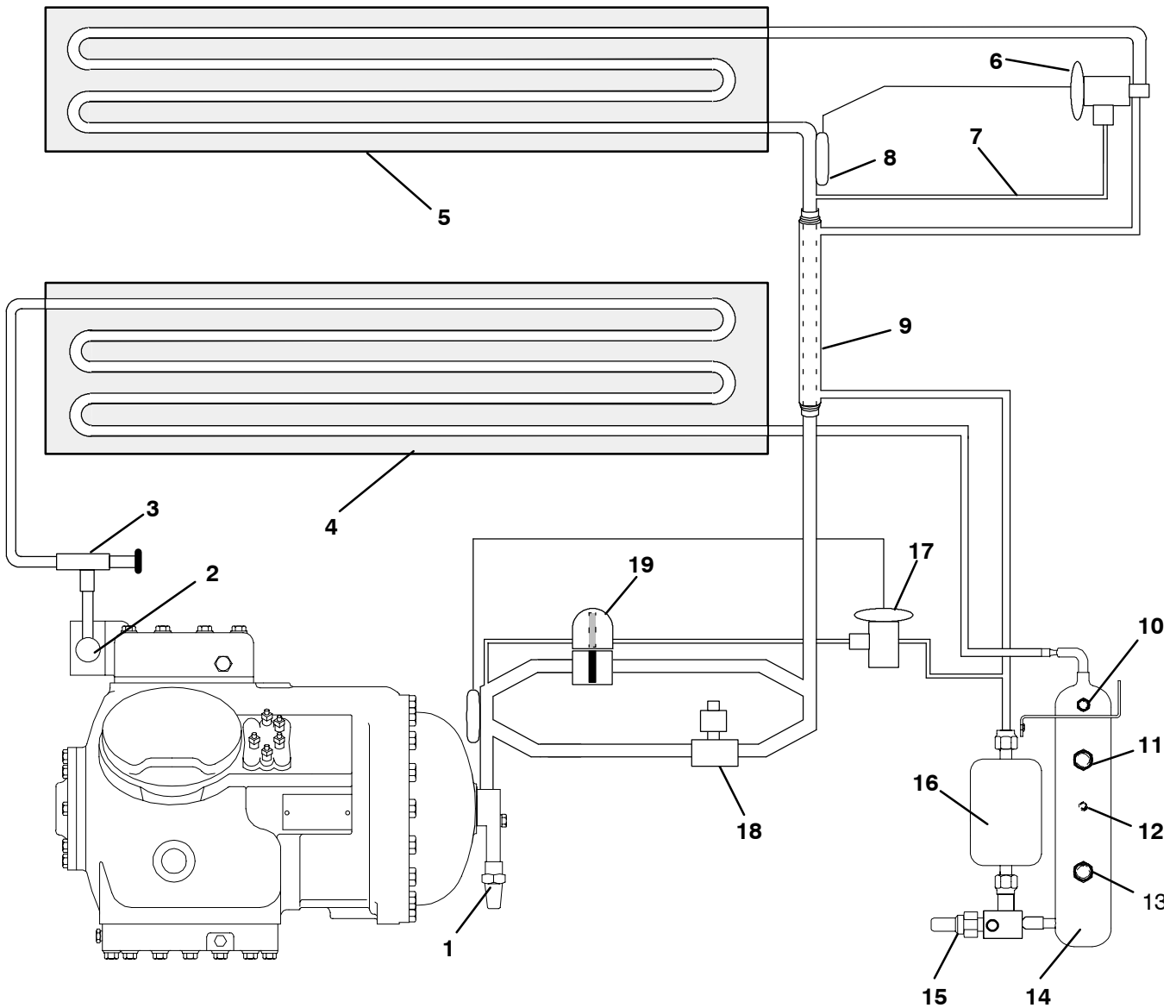
A pressure control system has been incorporated by means of a condenser pressure transducer (CPT) and condenser pressure control (CPC) logic to maintain discharge pressures above 130 psig in low ambients.

Regardless of pressure, CPC will be disabled at every compressor start-up, 15 seconds before the compressor is energized and 30 seconds after. An exception, for two-speed compressor units, is the low speed to high speed switching sequence, where CPC will be disabled while SMV is at 0% during the entire switching sequence for a total of 47 seconds.

**a. At ambients below 27°C (80°F), the condenser fan will cycle on/off depending on condenser pressure and on/off times.**

1. The condenser fan will start if the condenser pressure is greater than 200 psig OR the condenser fan is OFF for more than 60 seconds.
2. The condenser fan will stop if the condenser pressure is less than 130 psig AND the condenser fan remains ON for at least 30 seconds.

**b. At ambients above 27°C (80°F), condenser pressure control (CPC) is disabled and the condenser fan runs continuously.**



- |                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>1. Suction Service Valve</li> <li>2. Discharge Service Valve</li> <li>3. Discharge Pressure Regulator Valve</li> <li>4. Air-Cooled Condenser</li> <li>5. Evaporator</li> <li>6. Thermostatic Expansion Valve</li> <li>7. External Equalizer Line</li> <li>8. Thermostatic Expansion Valve Bulb</li> <li>9. Heat Exchanger</li> <li>10. Fusible Plug (Located on back of receiver)</li> </ul> | <ul style="list-style-type: none"> <li>11. Sightglass</li> <li>12. Condenser Pressure Transducer (CPT)<br/>(Located on the back-side of the receiver)</li> <li>13. Sight Glass/Moisture Indicator</li> <li>14. Electro-Coated Modular Receiver</li> <li>15. Manual Liquid Line Valve</li> <li>16. Filter-Drier</li> <li>17. Quench Expansion Valve</li> <li>18. Suction Solenoid Valve</li> <li>19. Suction Modulation Valve</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Figure 2-10. Refrigeration Circuit with Receiver**

**SECTION 2**

## 2.8 REFRIGERATION CIRCUIT WITH THE WATER-COOLED CONDENSER (Optional)

Starting at the compressor, the suction gas is compressed to a higher temperature and pressure.

When operating with the water-cooled condenser, the gas flows through the discharge service valve into the pressure regulator valve that is normally open. The pressure regulator valve may restrict the flow of refrigerant to maintain a minimum discharge pressure of 5 kg/cm<sup>2</sup> (70 psig).

Refrigerant gas then moves through the air-cooled coil to the water-cooled condenser. As the refrigerant flows across the water chilled coiled tube bundle, it is cooled to saturation temperature and exits the condenser as a high pressure/saturated liquid.

From the water-cooled condenser, the liquid refrigerant continues through the manual liquid line valve, the filter-drier (which keeps refrigerant clean and dry), a moisture-liquid indicator, and a heat exchanger that increases subcooling of liquid refrigerant to the thermostatic expansion valve. As the liquid refrigerant passes through the orifice of the expansion valve, some of it vaporizes into a gas (flash gas). Heat is absorbed from the return air by the balance of the liquid, causing it to vaporize in the evaporator coil. The vapor then flows through the suction modulation valve (and suction solenoid valve under some conditions) to the compressor.

The thermostatic expansion valve bulb (on the suction line near the evaporator coil outlet) controls the thermostatic expansion valve, maintaining a constant superheat at the coil outlet regardless of load conditions except at abnormally high container temperatures such as during pull-down (valve at maximum operating pressure condition).

## 2.9 WATER-COOLED CONDENSER (Optional)

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.

The water-cooled condenser is of the shell and coil type, with water circulating through the cupro-nickel coil. The refrigerant vapor is admitted to the shell side and is condensed on the outer surface of the coil.

### 2.9.1 Water-Cooled Condenser with Water Pressure Switch (WP)

*For operation of the refrigeration unit with the water-cooled condenser, do the following:*

- Connect the water supply line to the inlet side of condenser and the discharge line to the outlet side of the condenser.

- Maintain a flow rate of 11 to 26 liters per minute (3 to 7 gallons per minute). The water pressure switch will open to de-energize the condenser fan relay. The condenser fan motor will stop and will remain stopped until the water pressure switch closes.

The refrigeration unit operating with the water-cooled condenser will perform as outlined in section 4.4 except that the condenser fan motor is stopped in all modes.

*To shift to air-cooled condenser operation, do the following:*

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. (Refer to section 2.2.)

### 2.9.2 Water-Cooled Condenser with Condenser Fan Switch (CFS)

*For operation of the refrigeration unit with the water-cooled condenser with (CFS), do the following:*

- Connect the water supply line to the inlet side of condenser and the discharge line to the outlet side of the condenser.
- Maintain a flow rate of 11 to 26 lpm (3 to 7 gpm).
- Set CFS switch to position "O" when water is supplied to the water-cooled condenser. This will de-energize the condenser fan relay. The condenser fan motor will stop and will remain stopped until the CFS switch is set to position "1."

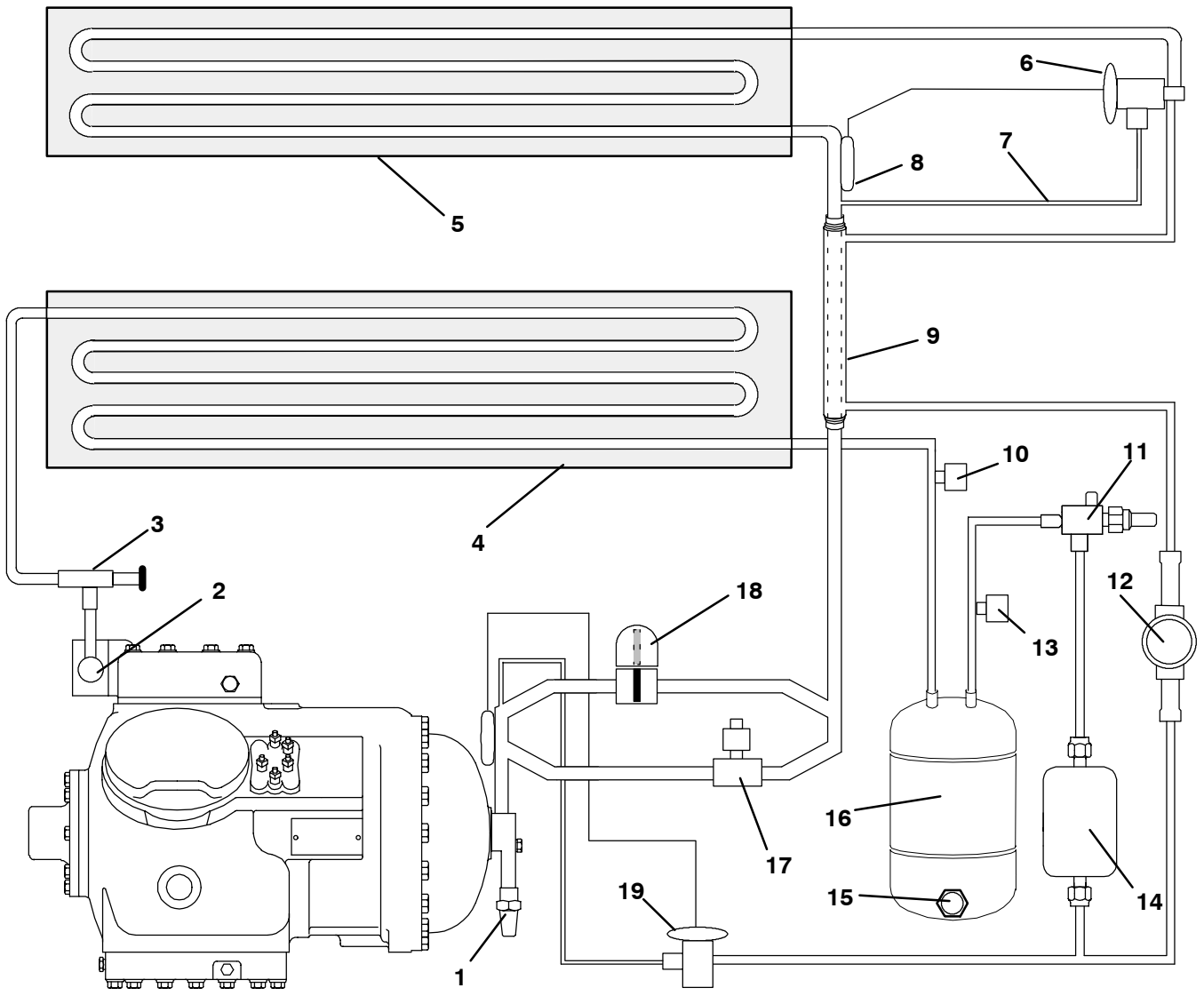
The refrigeration unit operating with the water-cooled condenser and the CFS switch in position "O," will perform as outlined in section 4.4 except that the condenser fan motor is stopped in all modes.

### WARNING

**When water flow is below 11 lpm (3 gpm) or when water-cooled operation is not in use, the CFS switch MUST be set to position "1" or the unit will not operate properly.**

*To shift to air-cooled condenser operation, do the following:*

Turn the unit OFF and set the CFS switch to position "1." Disconnect the water supply and the discharge line to the water-cooled condenser. The unit should now perform as outlined in section 4.4.



**SECTION 2**

- |                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>1. Suction Service Valve</li> <li>2. Discharge Service Valve</li> <li>3. Discharge Pressure Regulator Valve</li> <li>4. Air-Cooled Condenser</li> <li>5. Evaporator</li> <li>6. Thermostatic Expansion Valve</li> <li>7. External Equalizer Line</li> <li>8. Thermostatic Expansion Valve Bulb</li> <li>9. Heat Exchanger</li> <li>10. Rupture Disc</li> </ul> | <ul style="list-style-type: none"> <li>11. Manual Liquid Line Valve</li> <li>12. Moisture-Liquid Indicator</li> <li>13. Condenser Pressure Transducer (CPT)</li> <li>14. Filter-Drier</li> <li>15. Sight Glass</li> <li>16. Water-Cooled Condenser</li> <li>17. Suction Solenoid Valve</li> <li>18. Suction Modulation Valve</li> <li>19. Quench Expansion Valve</li> </ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Figure 2-11. Refrigeration Circuit with Water-Cooled Condenser (Optional)**

## 2.10 SUCTION SOLENOID VALVE

The suction solenoid valve, shown in Figure 2-5, is controlled by the Controller relay (TS).

### a. Operation

If set point is below  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, and the suction solenoid valve override is not activated, Controller relay (TS) closes to energize the suction solenoid valve (SSV). Once opened, the refrigerant flow rate and unit cooling capacity is increased.

If set point is above  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, the suction solenoid valve opens during the temperature pulldown period unless the current limiting suction solenoid overrides or compressor reliability enhancement logic restricts its use. A pulldown period begins when the control temperature is more than  $5^{\circ}\text{C}$  ( $+9^{\circ}\text{F}$ ) above set point, and ends as soon as the control temperature equals set point.

For both conditions above, at the instant when the SSV opens, the SMV will drop to 20% open, then gradually increase to 100% open. Unless the current limiting suction solenoid overrides or compressor reliability enhancement logic (CREL) restricts its use.

### b. Suction Solenoid Override

The suction solenoid override function restricts the opening of the suction solenoid valve (SSV) under certain high ambient and/or box temperature conditions to prevent compressor overload under these high capacity conditions. If the primary return sensor (RTS) fails (alarm code AL56), the suction solenoid valve will not open unless the ambient temperature is less than  $10^{\circ}\text{C}$  ( $50^{\circ}\text{F}$ ). If the ambient sensor fails (AL57), the suction solenoid valve will not be allowed to open until the return air temperature is less than  $1.67^{\circ}\text{C}$  ( $35^{\circ}\text{F}$ ). If both the ambient and return air (RTS) sensors fail, the suction solenoid valve will not be allowed to open until at least one of the sensors is repaired.

## 2.11 REMOTE MONITORING (Optional)

### NOTE

The in-range light will be illuminated if the container control air temperature is within the tolerance selected. Refer to section 3.1.4 (Code 30).

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 |

## 2.12 SAFETY AND PROTECTIVE DEVICES

Unit components are protected from damage by safety and protective devices listed in Table 2-1. 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 condenser fan motor.

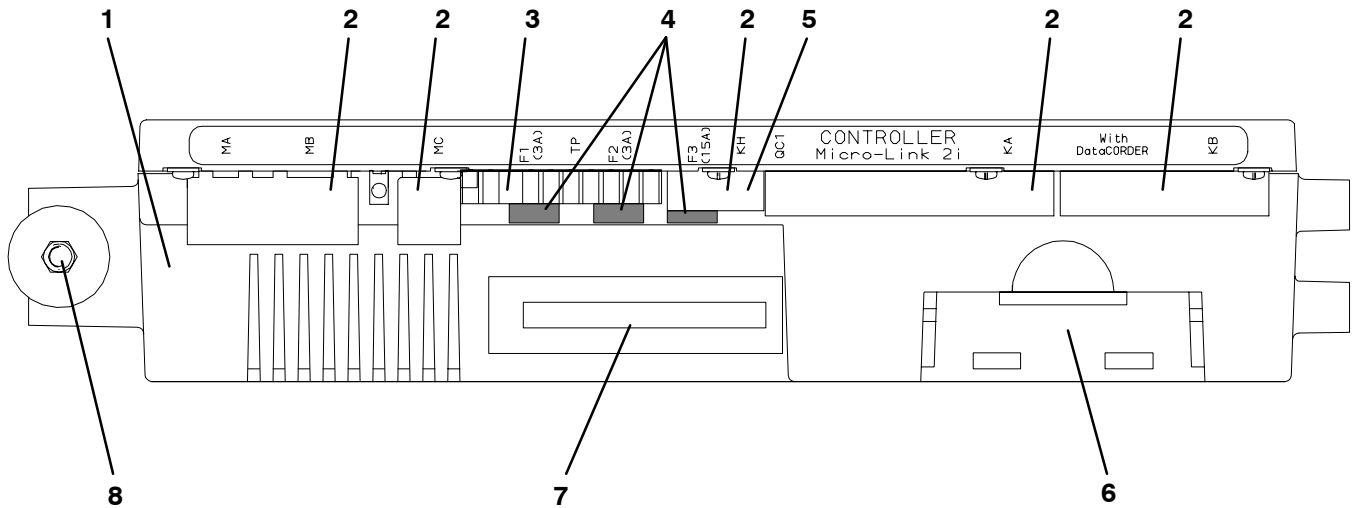
The entire refrigeration unit will shut down if one of the following safety devices open: (a) Circuit Breaker(s); (b) Fuse (F3/15A); or (c) Evaporator Fan Motor Internal Protector(s) - (IP-EM).

| Table 2-1. Safety and Protective Devices                     |                                                      |                                           |
|--------------------------------------------------------------|------------------------------------------------------|-------------------------------------------|
| UNSAFE CONDITION                                             | SAFETY DEVICE                                        | DEVICE SETTING                            |
| Excessive current draw                                       | Circuit Breaker (CB-1) - Manual Reset                | Trips at 29 amps <b>(460 vac)</b>         |
|                                                              | Circuit Breaker (CB-2, <b>50 amp</b> ) -Manual Reset | Trips at 62.5 amps <b>(230 vac)</b>       |
|                                                              | Circuit Breaker (CB-2, <b>70 amp</b> ) -Manual Reset | Trips at 87.5 amps <b>(230 vac)</b>       |
| Excessive current draw on the control circuit                | Fuse (F3)                                            | 15 amp rating                             |
| Excessive current draw by the Controller/DataCORDER          | Fuse (F1 & F2)                                       | 5 amp rating                              |
| Excessive condenser 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/temperatures in the high refrigerant side | Fusible Plug - Used on the Receiver                  | 93 °C = (200 °F)                          |
|                                                              | Rupture Disc - Used on the Water-Cooled Condenser    | 35 kg/cm <sup>2</sup> = (500 psig)        |
| Abnormally high discharge pressure                           | High Pressure Switch (HPS)                           | Opens at 25 kg/cm <sup>2</sup> (350 psig) |

## SECTION 3

### MICROPROCESSOR

#### 3.1 MICRO-LINK 2i CONTROLLER MODULE



1. Micro-Link 2i Controller/DataCORDER Module
2. Connectors
3. Test Points
4. Fuses

5. Control Circuit Power Connection  
(Location: In back of connector)
6. Battery Pack (Optional)
7. Software Programming Port
8. Mounting Screw

Figure 3-1. Micro-Link 2i Controller/DataCORDER Module

##### 3.1.1 Brief Description

###### NOTE

Some units are equipped with an optional emergency bypass switch (EB), which permits manually overriding a malfunctioning Controller by locking the unit into a continuous full cooling mode (see Figure 2-7).

###### WARNING

**Do not attempt to service the Controller/DataCORDER module. Breaking the warranty seal will void the warranty.**

###### CAUTION

**Remove the Controller/DataCORDER module and unplug all wire harness connectors before performing any arc welding on any part of the container.**

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

The Carrier Transicold Micro-Link 2i Controller/DataCORDER is a custom-designed microprocessor-based module which incorporates embedded software to:

- a. Control supply or return air temperature to extremely tight limits by providing modulated refrigeration control, electric heat control and defrost to ensure continuous conditioned air delivery to the load.
- b. Provide dual independent readouts of set point and supply or return air temperatures.
- c. Provide digital readout and ability to select data. Refer to Table 3-3 for Controller Function Codes. For Controller alarm digital display identification refer to Table 3-4.
- d. 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 and current limiting. Refer to section 3.2.
- e. Provide the ability to select or change Codes 27 to 37 and set point without AC power being hooked up. Refer to section 3.1.4.

- f. Provide reprogrammability and configuration through a memory card. The memory card automatically downloads new software to the Controller when inserted, and controls output to the display for status information.
- g. Provide electronic data storage.

**NOTE**

For the benefit of the reader the remaining parts of section 3.1 will devote themselves to the temperature controller portion of the module. For the integrated DataCORDER refer to section 3.3.

**3.1.2 Controller Programming (Memory) Cards**

The programming cards are used for loading software into the Controller. This is the same concept as using a floppy diskette to load software into a personal computer.

The software that can be loaded into the Controller module comes in one of two forms: "Operational Software" or "Configuration Software."

*Procedure for loading software:*

Refer to section 6.27.1.

*Operational Software:*

This software operates the Controller module, which turns fans on and off, turns the compressor on and off, etc.

*Configuration Software:*

This software tells the Operational Software what physical components are built into the container unit. Refer to Table 3-1.

Programming cards with either Operational Software or Configuration Software are available through CTD Replacement Components Group.

The use of a configuration program card in the field should only occur under unusual circumstances. Some of these circumstances may include:

- a. A Controller module that has an older version of Operational Software, when the need exists to upgrade to a newer version of the software.
- b. A physical component in the container unit is changed to a different component, resulting in a new configuration for the unit.
- c. A Controller module was damaged in such a way that the integrity or existence of software within the module is questionable.



**Table 3-1. Controller Configuration Variables**

| CONFIGURATION NUMBER | TITLE                                  | DEFAULT        | OPTION          |
|----------------------|----------------------------------------|----------------|-----------------|
| 1                    | Bypass Valve Enable                    | In             | Out             |
| 2                    | Evaporator Fan Speed                   | dS (Dual)      | SS (Single)     |
| 3                    | Number of Sensor Probes                | FoUR           | dUAL            |
| 4                    | Dehumidification Mode                  | On             | Off             |
| 5                    | Probe Calibration                      | noCal          | CAL             |
| 6                    | Condenser Fan Speed Select             | Off (Single)   | On (Variable)   |
| 7                    | Unit Selection, 20FT/ 40FT/45FT        | 40ft           | 20ft,45         |
| 8                    | Single Phase/Three Phase Motor         | 1Ph            | 3Ph             |
| 9                    | Refrigerant Selection                  | r134a          | r12, r22, bLEnd |
| 10                   | Compressor Speed                       | Out (Single)   | In (Dual)       |
| 11                   | Defrost "Off" Selection                | noOFF          | OFF             |
| 12                   | TXV/Solenoid Quench Valve              | Out (TXV)      | In (Solenoid)   |
| 13                   | Unloader                               | Out            | In              |
| 14                   | Condenser Pressure Control (CPC)       | In             | Out             |
| 15                   | Discharge Temperature Sensor           | Out            | In              |
| 16                   | DataCORDER Option                      | On (Yes)       | Off (No)        |
| 17                   | Discharge Pressure Sensor              | Out (No)       | In (Yes)        |
| 18                   | Heater                                 | Old (Low Watt) | nEW (High Watt) |
| 19                   | Controlled Atmosphere                  | Out (No)       | In (Yes)        |
| 20                   | Pressure Sensor (Suction)              | Out (No)       | In (Yes)        |
| 21                   | Auto-Transformer                       | Std            | -               |
| 22                   | Economy Mode Option                    | Off            | Std, Full       |
| 23                   | Defrost Interval Timer Save Option     | noSAV          | SAV             |
| 24                   | Advanced Pre-Trip Enhanced Test        | Off            | On              |
| 25                   | Pre-Trip Test Points/Results Recording | rSLts          | data            |
| 26                   | Heat Lockout                           | Set to -10°C   | Set to-5°C      |
| 27                   | Suction Temperature Display            | Out            | In              |
| 28                   | Bulb Mode                              | Nor            | bulb            |
| 29                   | Arctic Mode                            | Out            | In              |
| 30                   | Compressor Size                        | 41 CFM         | 37 CFM          |
| 31                   | Probe Check Logic                      | Std            | SPEC            |
| 32                   | Single Evaporator Fan Option           | 2EF0           | 1EF0            |
| 33                   | Snap Freeze Option                     | Off            | SnAP            |
| 34                   | Degree Celsius Lockout Option          | bOth           | °F              |
| 35                   | Humidification Mode                    | Off            | On              |
| 36                   | Modulation Valve Type                  | 1              | 2, 3            |
| 37                   | Electronic Partlow                     | rEtur          | SuPPL, bOth     |
| 38                   | Quench Bypass Valve                    | Out            | In              |
| 39                   | Current Limit Range                    | Out            | In              |
| 40                   | Demand Defrost                         | Out            | In              |

**SECTION 3**

### 3.1.3 General Layout of the Controller Section

The Micro-Link 2i Controller/DataCORDER consists of a key pad, display module and Controller module. Connectors are used to attach the wiring of the unit to the Controller module. The Controller module is designed to permit ease of installation and removal.

All control functions are accessed by key pad selections and viewed on the display module which are designed for optimum user friendliness and convenience.

The key pad (see Figure 3-1) is mounted on the right-hand side of the control box. The key pad consists of eleven push-energized membrane switches that act as the user's interface with the Controller and the optional DataCORDER. Refer to Table 3-2.

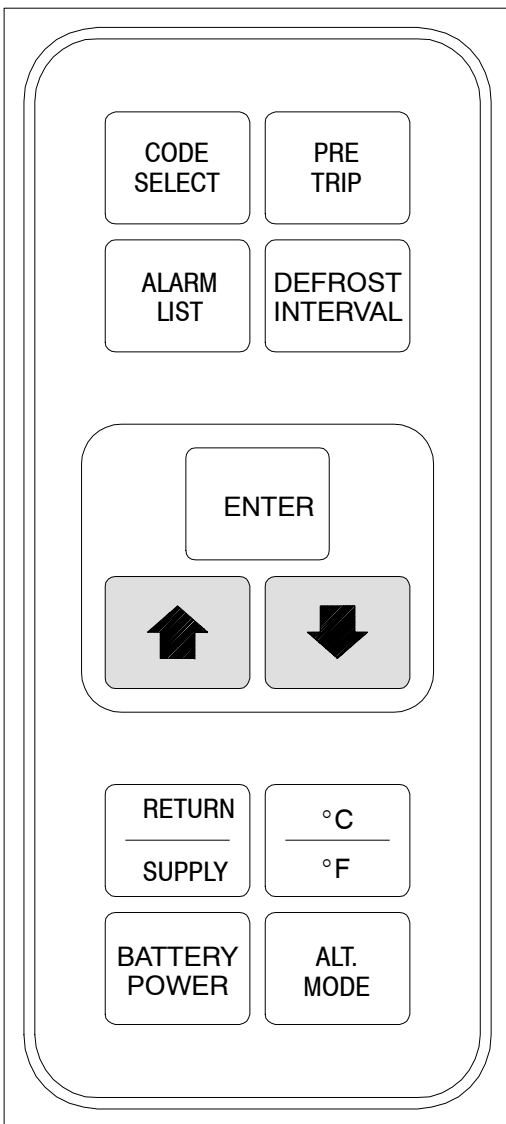
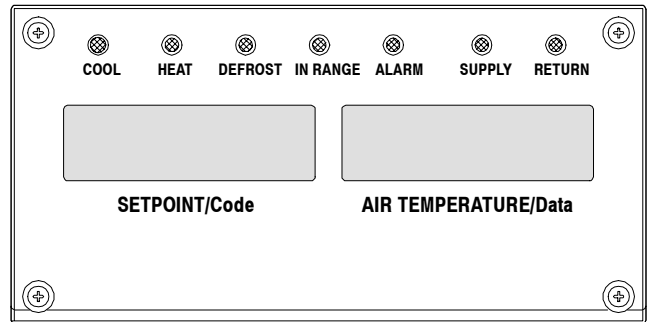


Figure 3-1. Key Pad

| Table 3-2. Key Pad Function |                                                                                                                                                                                                                                                                                         |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| KEY                         | FUNCTION                                                                                                                                                                                                                                                                                |
| Arrow Up                    | Change set point upward. Change codes upward. Scan alarm list upward. Change user selectable features upward. Pre-trip advance forward. Pre-trip test interruption. DataCORDER Function and Alarm Codes are scrolled upward after the ALT. MODE key is depressed.                       |
| Arrow Down                  | Change set point downward. Change codes downward. Scan alarm list downward. Change user selectable features downward. Pre-trip repeat backward. DataCORDER Function and Alarm Codes are scrolled downward after the ALT. MODE key is depressed.                                         |
| Return/Supply               | Displays non-controlling probe temperature (momentary display).                                                                                                                                                                                                                         |
| °C/°F                       | Displays alternate temperature scale (momentary display).                                                                                                                                                                                                                               |
| Alarm List                  | Displays alarm list and clearing of the alarm queue (when followed by <i>Enter</i> key) for the Controller, and also for the DataCORDER after the ALT. MODE key is depressed.                                                                                                           |
| Code Select                 | Access function codes (see arrow up and arrow down) for the Controller, and also for the DataCORDER after the ALT. MODE key is depressed.                                                                                                                                               |
| Defrost Interval            | Displays selected defrost interval.                                                                                                                                                                                                                                                     |
| Pre-Trip                    | Displays a pre-trip selection menu. Discontinues pre-trip in progress.                                                                                                                                                                                                                  |
| Battery Power               | If the unit is equipped with the optional battery pack, initiate the battery backup mode to allow set point and function code selection if no mains power is present.                                                                                                                   |
| Enter                       | Entering a set point change. Extending to 30 seconds the time a chosen data function code is displayed. Entering the value of a user selectable mode. Clearing the alarm list and initiating pre-trip. Also used for various DataCORDER functions after the ALT. MODE key is depressed. |
| ALT. Mode                   | Allows access to DataCORDER function codes, alarm codes, DataCORDER configuration and scrollbar.                                                                                                                                                                                        |

The display module (see Figure 3-2) is mounted at a 20 degree downward tilt to aid in visibility. The display module consists of:

- a. Two 25mm (1 inch) high, five digit LCD displays which are easily viewed in direct sunlight and backlighted for superior low-light visibility.
- b. Seven Indicators:
  - Cool - White Lamp: Energized when the refrigerant compressor is energized.
  - Heat - Orange LED: Energized when the heaters are on, and the unit is in the heat or defrost mode.
  - Defrost - Orange LED: Energized when the heaters are on, and the unit is in the defrost mode.
  - In-Range - Green LED: Energized when the controlling temperature probe is in range. (Supply air probe will be used for control in the perishable ranges and the return air probe is used for control in the frozen ranges.)
  - Alarm - Red LED: Energized when there is an active or an inactive shutdown alarm (AL20 to AL27) in the alarm queue.
  - Supply - Yellow LED: Energized when supply temperature and set point are displayed. Flashes if dehumidification or humidification is enabled on units so equipped.
  - Return - Yellow LED: Energized when return temperature and set point are displayed.



**Figure 3-2. Display Module**

**NOTE**

The default display mode will show the set point temperature (on the left display) and controlling probe temperature (on the right display). The controlling probe in the perishable range will be the SUPPLY air probe and the controlling probe in the frozen range will be the RETURN air probe.

### 3.1.4 Controller Function Codes

There are thirty-nine functions which the operator may access to examine the operating status of the unit. To access these functions, perform the following steps: Press the CODE SELECT key, then press an arrow key until the left window displays the desired code number

(see Table 3-3). For the display only function codes, the right window will display the value of this item for five seconds before returning to the normal display mode. If a longer time is desired, pressing the ENTER key will extend the time to 30 seconds after the last pressing of the ENTER key. Function codes are explained in Table 3-3.

| <b>Table 3-3. Controller Function Code Assignments</b> |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CODE #</b>                                          | <b>TITLE</b>                                                            | <b>DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Inapplicable Functions Display -----</b>            |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Display Only Functions</b>                          |                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Cd01                                                   | Modulation Valve Opening (%)                                            | The suction modulation valve (SMV) is a normally open valve which restricts flow of refrigerant to the compressor when energized by a pulse width modulated (PWM) output. The amount of valve closure is proportional to the applied current over the range of 0.2 to 1.3 A. The valve is completely open (right display reads 100%) below 0.2 amps and is completely closed (right display reads 0%) at 1.3 amps.                                                                                                                                                                                                                                                                                                        |
| Cd02                                                   | Quench Valve (Open-Closed)                                              | Shows state of the solenoid quench valve, if so equipped (open or closed).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Cd03                                                   | Suction Solenoid Valve (Open-Closed)                                    | The suction solenoid valve (SSV) provides maximum refrigerant flow to the refrigeration unit. This valve will always be open for set points at or below -10°C (+14°F), or -5°C (+23°F) optionally, and during temperature pulldown periods unless suction solenoid override or current limiting restricts its use.                                                                                                                                                                                                                                                                                                                                                                                                        |
| Cd04<br>Cd05<br>Cd06                                   | Line Current, Phase A<br>Line Current, Phase B<br>Line Current, Phase C | Unit current is monitored by two current sensors. The current measured is used for control and diagnostic purposes. For control processing, the highest of the Phase A and B current values is used for current limiting purposes. The third unmeasured leg is calculated based on a current algorithm. For diagnostic processing, the current draws are used to determine control unit operations. Whenever a heater or a motor is turned ON or OFF, the current draw increase/reduction for that activity is measured. The current draw is then tested to determine if it falls within the expected range of values for the unit. Failure of this test will result in a pre-trip failure or a control alarm indication. |
| Cd07                                                   | Main 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 and alarm code AL21 is active.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Cd09                                                   | Ambient Temperature                                                     | The ambient sensor (AMBS) measures the temperature outside the container. For location of the sensor, see Figure 2-5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Cd10                                                   | Compressor Suction Temperature (Optional)                               | Compressor suction temperature is measured just prior to the compressor suction service valve, and is a display-only temperature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Cd11                                                   | Compressor Discharge Temperature (Optional)                             | The compressor discharge temperature is measured near the compressor discharge valve and is display only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Cd12                                                   | Compressor Suction Pressure (Optional)                                  | Compressor suction pressure is displayed using a pressure transducer. Pressure is displayed in units of psig when code 28 is set to °F and units of bars when code 28 is set to °C. "P" appears after the value to indicate psig, "b" appears after the value to indicate bars and "i" appears after the value for inches of mercury.                                                                                                                                                                                                                                                                                                                                                                                     |

| CODE #                                      | TITLE                                           | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inapplicable Functions Display -----</b> |                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Cd13                                        | Condenser Pressure (CPC)                        | Condenser pressure is displayed using a pressure transducer. Pressure is displayed in units of psig when code 28 is set to °F and units of bars when function code Cd28 is set to °C. "P" is displayed after the value to indicate psig, "b" appears after the value to indicate bars and "i" appears after the value for inches of mercury.                                                                                                                                                                                                                                              |
| Cd14                                        | Compressor Discharge Pressure (Optional)        | Compressor discharge pressure is displayed using a pressure transducer. Pressure is displayed in units of psig when function code Cd28 is set to °F and units of bars when Cd28 is set to °C. "P" is displayed after the value to indicate psig, "b" appears after the value to indicate bars and "i" appears after the value for inches of mercury.                                                                                                                                                                                                                                      |
| Cd15                                        | Unloader Valve (On-Off)                         | The status of the unloader valve (if present) is displayed (on or off).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Cd16                                        | Compressor Motor Hour Meter                     | Records total hours of compressor run time. Total hours are recorded in increments of 10 hours (i.e., 3000 hours displayed as 300).                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Cd17                                        | Relative Humidity (%) (Optional)                | This code is only applicable to units with a humidity sensor (HS). This code displays, as a percent value, the relative humidity at that time.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Cd18                                        | Software Revision #                             | The software revision number is displayed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Cd19                                        | Battery Check                                   | This code checks the Controller/DataCORDER battery pack. While the test is running, "btest" will flash on the right display, followed by the result. "PASS" will be displayed for battery voltages greater than 7.0 volts and for alkaline batteries with voltages greater than 7.5 volts, "FAIL" will be displayed for battery voltages between 4.5 and 7.0 volts, and "---" will be displayed for battery voltages less than 4.5 volts. After the result is displayed for four seconds, "btest" will again be displayed, and the user may continue to scroll through the various codes. |
| Cd20                                        | Config/Model #                                  | This code indicates the dash number of the model for which the Controller is configured (i.e., if the unit is a 69NT40-511-105, the display will show 11105).                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Cd21                                        | Future Expansion                                | This code is for future expansion, and is not in use at this time.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Cd22                                        | Compressor Speed (High-Low-Off)                 | The status of the compressor is displayed (high, low or off).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Cd23                                        | Evaporator Fan Speed (High-Low-Off)             | Displays the current evaporator fan state (high, low or off).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Cd24                                        | Controlled Atmosphere State (On-Off) (Optional) | This code shows the state of Controlled Atmosphere (enabled or disabled), if equipped.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Cd25                                        | Compressor Run 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 the actual accumulated compressor running time.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Cd26                                        | Defrost Termination Sensor Temperature          | The defrost termination sensor (DTS) is located immediately above the evaporator coil. It is used by the Controller for defrost initiation and termination. (See Figure 2-2.)                                                                                                                                                                                                                                                                                                                                                                                                             |

| CODE #                                                                                                                                                               | TITLE                               | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inapplicable Functions Display -----</b>                                                                                                                          |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Display Only Functions</b>                                                                                                                                        |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>NOTE</b>                                                                                                                                                          |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 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 (Hours)            | <p>The defrost interval is the time interval between defrost cycles. Five selectable values are available: 3, 6, 9, 12 or 24 hours. The factory default value is 12 hours. The time interval of the first defrost will not begin counting down until defrost termination sensor (DTS) is below 10°C (50°F). The time interval to the next defrost cycle is entered into the Controller at the time DTS is below 10°C (50°F) or at power-up. (See code Cd37 for deviations.) If DTS reaches 25.6°C (78°F) at any time during the timer count down, the interval is reset and the countdown begins over. If DTS has failed (i.e., alarm code AL60 is active) and the primary return sensor temperature is less than 10°C, the interval timer countdown begins. The interval timer is reset if the return sensor temperature rises above 25.6°C. (See section 4.4.6.)</p> <p><i>Defrost Interval Timer Value Option:</i> If the software is configured to “ON” for this option, 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.</p> <p style="text-align: center;"><b>NOTE</b></p> <p style="text-align: center;">The defrost interval timer counts only during compressor run time.</p> |
| Cd28                                                                                                                                                                 | Temperature Units (°C or °F)        | <p>This code determines the temperature units (°C or °F) which will be used for all temperature displays. The user selects °C or °F by selecting function code Cd28 and pushing the ENTER key. The factory default value is Celsius units.</p> <p style="text-align: center;"><b>NOTE</b></p> <p style="text-align: center;">This function code will display “-----” if the Controller configuration variable option 34 is set to °F (refer to Table 3-1).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Cd29                                                                                                                                                                 | Failure Action (Mode)               | <p>If all of the control sensors are out of range (alarm code AL26) or there is an alarm code AL27 failure, the unit will enter the shutdown state defined by the failure action. The user selects one of four possible actions as designated by a selection code:</p> <ul style="list-style-type: none"> <li>A - Full Cooling (SMV 100%)</li> <li>B - Partial Cooling (SMV 50% open)</li> <li>C - Evaporator Fan Only</li> <li>D - Full System Shutdown - Factory Default</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Cd30                                                                                                                                                                 | In-Range Tolerance                  | <p>The in-range tolerance will determine the band of temperatures around the set point 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:</p> <ol style="list-style-type: none"> <li>1. ± 0.5°C (± 0.9°F)</li> <li>2. ± 1.0°C (± 1.8°F)</li> <li>3. ± 1.5°C (± 2.7°F)</li> <li>4. ± 2.0°C (± 3.6°F) - Factory Default</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Cd31                                                                                                                                                                 | Stagger Start Offset Time (Seconds) | <p>The stagger start offset time is the amount of time that the unit will delay at start-up, thus allowing multiple units to stagger their control initiation when all units are powered up together. The eight possible offset values are:<br/>0 (Factory Default), 3, 6, 9, 12, 15, 18 or 21 seconds</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

| CODE #                                                                                                          | TITLE                                            | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inapplicable Functions Display -----</b>                                                                     |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Cd32                                                                                                            | Current Limit (Amperes)                          | The current limit is the maximum current demand allowed on any phase at any time. Limiting the unit's current (amperage) reduces the load on the main power and lowers the compressor discharge pressure. When desirable, the limit can be lowered. Note, however, that capacity is also reduced. The five values for 460vac operation are:<br>15, 17, 19, 21 (Factory Default), 23                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Cd33                                                                                                            | Dehumidification Control (% RH) (Optional)       | This code is only applicable to units with a humidity sensor (HS). Relative humidity set point is available only on units configured for dehumidification. When the mode is activated, the control probe LED flashes on and off every second to alert the user. If not configured, the mode is permanently deactivated and Cd33 will display "-----." When set point is available, it can be set to "OFF," "TEST," or 65 to 95% relative humidity in increments of 1%. If bulb mode is active (code Cd35) and "Lo" speed evaporator motors are selected (code Cd36) then set point ranges from 60 to 95%. When "TEST" is selected or test set point is entered, the heaters should be turned on, indicating that dehumidification mode is activated. After a period of five minutes has elapsed in this mode, the previously selected mode is reinstated. |
| Cd34                                                                                                            | Economy Mode (On-Off) (Optional)                 | Economy mode is a user selectable mode of operation provided for power saving purposes. Refer to sections 3.1.7.1 and 3.1.7.2 for a more detailed description of economy mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Cd35                                                                                                            | Bulb Mode (Normal-Bulb) (Optional)               | Bulb mode is a user selectable mode of operation that is an extension of normal dehumidification. If dehumidification is set to "Off," code Cd35 will display "Nor" and the user will be unable to change it. After a dehumidification set point has been selected and entered for code Cd33, the user may then change code Cd35 to "bulb." After bulb has been selected and entered, the user may then utilize function codes Cd36 and Cd37 to make the desired changes.                                                                                                                                                                                                                                                                                                                                                                                 |
| Cd36                                                                                                            | Evaporator Speed Select (Cd35 must be in "Bulb") | This code is enabled only if a dehumidification set point has been selected using function code Cd33 and "bulb" has been selected using function code Cd35. If these conditions are not met, "alt" will be displayed indicating that the evaporator fans will alternate their speed whenever a dehumidification set point is selected. This display cannot be changed by the user. If a dehumidification set point has been selected along with bulb mode then "alt" may be selected for alternating speed, "Lo" for low speed evaporator fan only, or "Hi" for high speed evaporator fan only. If a setting other than "alt" has been selected and bulb mode is deactivated in any manner, then selection reverts back to "alt."                                                                                                                         |
| Cd37                                                                                                            | Defrost Temperature Sensor Setting (Optional)    | This code, as with function code Cd36, is used in conjunction with bulb mode and dehumidification. If bulb mode is active, this code allows the user to change the temperature above which the defrost termination sensor (DTS) temperature must go to terminate defrost. It allows the user to change the setting from 4°C to 25.6°C in 0.1°C (0.2°F) increments. This value is changed using the UP/DOWN ARROW keys, followed by the ENTER key when the desired value is displayed. If bulb mode is deactivated in any manner, the DTS setting above which defrost terminates defaults to the normal 25.6°C (78°F) setting.                                                                                                                                                                                                                             |
| <b>NOTE</b>                                                                                                     |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| In the unlikely event that AL55 activates, Function Codes Cd38 and Cd39 will display SRS and RRS, respectively. |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Cd38                                                                                                            | Secondary Supply Air Temperature (Optional)      | This code is only applicable to units without a DataCORDER that are configured to have four probes. If this is true, it will then display the current secondary supply air temperature. If the unit is configured with a DataCORDER, the Controller function code Cd38 will display "-----." and the display values for SRS will appear on the DataCORDER function code dC1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| CODE #                                      | TITLE                                       | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inapplicable Functions Display -----</b> |                                             |                                                                                                                                                                                                                                                                                                                                                                               |
| Cd39                                        | Secondary Return Air Temperature (Optional) | This code is only applicable to units without a DataCORDER, that are configured to have four probes. If this is true, it will then display the current secondary return air temperature. If the unit is configured with a DataCORDER, the Controller function code Cd39 will display "-----," and the display values for RRS will appear on the DataCORDER function code dC2. |

### 3.1.5 Controller Alarms

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 a low mains voltage, when the voltage drops over 25%, an indication is given on the display, but the unit will continue to run.

An alarm (See Table 3-4) is indicated by flashing an alarm code on the display panel, and for some alarms, by the alarm light illuminating.

When an Alarm Occurs:

- The red alarm light will illuminate for "20 series" alarms only.
- If a detectable problem is found to exist, its alarm code will be alternately displayed with the set point 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.

To Display Alarm Codes:

While in Set Point Selection or Default Display mode, press the ALARM LIST key. This accesses the Alarm List Display Mode, which displays any alarms archived in the Alarm Queue. The alarm list stores up to 16 alarms in the sequence in which they occurred. The user may scroll through the list by depressing the UP ARROW key. Depressing the DOWN ARROW key allows the user to scroll backward through the list.

The left display will show "AL#," where # is the alarm number sequentially in the queue.

The right display will show:

- "AAXX" for an active alarm, where "XX" is the alarm code. See Table 3-4, Controller Alarm Indications.
- "IAXX" for an inactive alarm.

"END" is displayed to indicate the end of the alarm list if any alarms are active. "CLEAR" is displayed if all alarms are inactive.

- The alarm queue may only be cleared if no alarms are active, other than alarm code AL51, and "CLEAR" is displayed.

To Clear the Alarm List:

If all above conditions have been satisfied, e.g. no alarms are active other than AL51, the alarm queue may be cleared.

- Press the ENTER key. The alarm list will clear and "-----" will be displayed.

#### NOTE

If the unit is configured for single evaporator fan operation (refer to Table 3-1), and troubleshooting alarms AL11 and AL12, be aware that the presence of 24 vac on the evaporator fan motor internal protector safety sense lines (MC6 and KB10) will indicate a failure condition. This differs from most other circumstances, whereby the absence of 24 vac usually means an alarm condition is present.



**Table 3-4. Controller Alarm Indications**

| <b>CODE #</b>              | <b>TITLE</b>                                      | <b>DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MODEL 69NT40-511-72</b> |                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| AL11                       | Evaporator Fan Motor 1 Safety                     | Alarm 11 is triggered by the opening of the internal protector for evaporator fan motor #1. This alarm will disable the probe check portion of defrost and the probe diagnostic logic.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| AL12                       | Evaporator Fan Motor 2 Safety                     | Alarm 12 is triggered by the opening of the internal protector for evaporator fan motor #2. This alarm will disable the probe check portion of defrost and the probe diagnostic logic.                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>ALL MODELS</b>          |                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| AL20                       | Control Circuit Fuse Open (24 vac)                | Alarm 20 is triggered by fuse (F3) opening and will cause the software shutdown of all control units. This alarm will remain active until the 15 amp fuse is replaced.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| AL21                       | Micro Circuit Fuse Open (18 vac)                  | Alarm 21 is triggered by one of the fuses (F1/F2) being opened on 18 volts AC power supply to the Controller. The suction modulation valve (SMV) will be opened and current limiting is halted. The compressor will cycle. Temperature control will be maintained by cycling the compressor.                                                                                                                                                                                                                                                                                                               |
| AL22                       | Evaporator Fan Motor Safety                       | Alarm 22 is triggered by the opening of the evaporator motor internal protector. This alarm will disable all control units until the motor protector resets. Also, refer to code Cd29.If the unit is configured for single evaporator fan operation, alarm AL22 will also activate if alarms AL11 and AL12 are active simultaneously.                                                                                                                                                                                                                                                                      |
| AL23                       | KA2-KB10 Jumper Disconnected                      | Alarm 23 is triggered by a missing jumper wire. The alarm will stay active until the jumper wire is reconnected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| AL24                       | Compressor Motor Safety                           | Alarm 24 is triggered by the opening of the compressor motor internal protector. This alarm will disable all control units except for the evaporator fans and will remain active until the motor protector resets. Also, refer to code Cd29.                                                                                                                                                                                                                                                                                                                                                               |
| AL25                       | Condenser Fan Motor Safety                        | Alarm 25 is triggered by the opening of the condenser motor internal protector and will disable all control units except for the evaporator fans. This alarm will remain active until the motor protector resets. This alarm is deactivated if the unit is operating on water cooled condensing.                                                                                                                                                                                                                                                                                                           |
| AL26                       | All Supply and Return Air Control Sensors Failure | Alarm 26 is triggered if the Controller determines that all of the control sensors are out-of-range. This can occur for box temperatures outside the range of -50°C to +70°C (-58°F to +158°F). This alarm triggers the failure action code set by Function Code Cd29.                                                                                                                                                                                                                                                                                                                                     |
| AL27                       | Probe Circuit Calibration Failure                 | The Controller has a built-in Analog to Digital (A-D) converter, used to convert analog readings (i.e. temperature sensors, current sensors, etc.) to digital readings. The Controller continuously performs calibration tests on the A-D converter. If the A-D converter fails to calibrate for 30 consecutive seconds, this alarm is activated.This alarm will be inactivated as soon as the A-D converter calibrates.                                                                                                                                                                                   |
| AL51                       | Alarm List Failure                                | During start-up diagnostics, the EEPROM is examined to determine validity of its contents. This is done by testing the set point and the alarm list. If the contents are invalid, Alarm 51 is activated.During control processing, any operation involving alarm list activity that results in an error will cause Alarm 51 to be activated.Alarm 51 is a “display only” alarm and is not written into the alarm list. Pressing the ENTER key when “CLEAR” is displayed will result in an attempt to clear the alarm list. If that action is successful (all alarms are inactive), Alarm 51 will be reset. |
| AL52                       | Alarm List Full                                   | Alarm 52 is activated whenever the alarm list is determined to be full; at start-up or after recording an alarm in the list. Alarm 52 is displayed, but is not recorded in the alarm list. This alarm can be reset by clearing the alarm list. This can be done only if all alarms written in the list are inactive.                                                                                                                                                                                                                                                                                       |

| <b>CODE #</b> | <b>TITLE</b>                              | <b>DESCRIPTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AL53          | NiCad Battery Pack Failure                | Alarm 53 is caused by the nicad battery pack being too low of a charge for battery-backed recording.<br><br><b>NOTE</b><br><br>Check for recharging or replacing battery pack.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| AL54          | Primary Supply Air Sensor Failure (STS)   | Alarm 54 is activated by an invalid primary supply sensor reading that is sensed outside the range of -50 to +70°C (-58°F to +158°F) or if the probe check logic has determined there is a fault with this sensor. If Alarm 54 is activated and the primary supply is the control sensor, the secondary supply sensor will be used for control if the unit is so equipped. If the unit does not have a secondary supply probe, and AL54 is activated, the (primary return sensor, minus 2°C) will be used for control.<br><br><b>NOTE</b><br><br>The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1).                                                              |
| AL55          | DataCORDER Failure                        | This alarm has been activated to indicate the DataCORDER has been disabled due to internal failure. To clear this alarm, simply reconfigure the unit to its OEM model number by using the multi-configuration card.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| AL56          | Primary Return Air Sensor Failure (RTS)   | Alarm 56 is activated by an invalid primary return sensor reading that is outside the range of -50 to +70°C (-58°F to +158°F). If Alarm 56 is activated and the primary return is the control sensor, the secondary return sensor will be used for control if the unit is so equipped. If the unit is not equipped with a secondary return sensor or it fails, the primary supply sensor will be used for control.<br><br><b>NOTE</b><br><br>The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1).                                                                                                                                                                  |
| AL57          | Ambient Temperature Sensor Failure (AMBS) | Alarm 57 is triggered by an ambient temperature reading outside the valid range from -50°C (-58°F) to +70°C (+158°F).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| AL58          | Compressor High Pressure Safety (HPS)     | Alarm 58 is triggered when the compressor high discharge pressure safety switch (HPS) remains open for at least one minute. This alarm will remain active until the pressure switch resets, at which time the compressor will restart.                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| AL59          | Heat Termination Thermostat (HTT) Safety  | Alarm 59 is triggered by the opening of the heat termination thermostat (HTT) and will result in the disabling of the heater. This alarm will remain active until the thermostat resets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| AL60          | Defrost Termination Sensor Failure (DTS)  | Alarm 60 is an indication of a probable failure of the defrost termination sensor (DTS). It is triggered by the opening of the heat termination thermostat (HTT) or the failure of the DTS to go above 25.6°C (78°F) within two hours of defrost initiation. After one-half hour with a frozen range set point, or one-half hour of continuous compressor run time, if the return air falls below 7°C (45°F), the Controller checks to ensure defrost termination sensor (DTS) has dropped to 10°C or below. If not, a DTS failure alarm is given and the defrost mode is operated off of return temperature sensor (RTS). The defrost mode will be terminated after one hour by the Controller. |
| AL61          | Heaters Failure                           | Alarm 61 is the heater alarm caused by detection of improper amperage resulting from heater activation (deactivation). Each phase of the power source is checked for proper amperage. This alarm is a display alarm with no resulting failure action, and will be reset by a proper amp draw of the heater.                                                                                                                                                                                                                                                                                                                                                                                      |
| AL62          | Compressor Circuit Failure                | Alarm 62 is triggered by improper current draw increase (or decrease) resulting from compressor turn on (or off). The compressor is expected to draw a minimum of 2 amps; failure to do so will activate the alarm. This is a display alarm with no associated failure action and will be reset by a proper amp draw of the compressor.                                                                                                                                                                                                                                                                                                                                                          |

| CODE #                                                                                                                                                                          | TITLE                                                                    | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| AL63                                                                                                                                                                            | Current Over Limit                                                       | Alarm 63 is triggered by the current limiting system. If the compressor is ON and current limiting procedures cannot maintain a current level below the user selected limit, the current limit alarm is activated. This alarm is a display alarm and is inactivated by power cycling the unit, changing the current limit via the code select Cd32, or if the suction modulation valve (SMV) is allowed to open to 100% and the suction solenoid valve is allowed to open. |                                                                                                  |
| AL64                                                                                                                                                                            | Discharge Temperature Over Limit (CPDT)                                  | Alarm 64 is triggered if the discharge temperature is sensed greater than 135°C (275°F) for three continuous minutes, if it exceeds 149°C (300°F), or if the sensor is out of range. This is a display alarm and has no associated failure action.                                                                                                                                                                                                                         |                                                                                                  |
| AL65                                                                                                                                                                            | Discharge Pressure Transducer Failure (DPT)                              | Alarm 65 is triggered by a compressor discharge transducer reading outside the valid range of 73.20 cm Hg (30 in Hg) to 32.34 Kg/cm <sup>2</sup> (460 psig). This is a display alarm and has no associated failure action.                                                                                                                                                                                                                                                 |                                                                                                  |
| AL66                                                                                                                                                                            | Suction Pressure Transducer Failure (SPT)                                | Alarm 66 is triggered by a suction pressure transducer reading outside the valid range of 73.20 cm Hg (30 in Hg) to 32.34 Kg/cm <sup>2</sup> (460 psig). This is a display alarm and has no associated failure action.                                                                                                                                                                                                                                                     |                                                                                                  |
| AL67                                                                                                                                                                            | Humidity Sensor Failure                                                  | Alarm 67 is triggered by a humidity sensor reading outside the valid range of 0% to 100% relative humidity. If alarm AL67 is active and the dehumidification mode was previously activated, then the dehumidification mode will be deactivated.                                                                                                                                                                                                                            |                                                                                                  |
| AL68                                                                                                                                                                            | Condenser Pressure Transducer Failure (CPT)                              | Alarm 68 is triggered by a condenser pressure transducer reading outside the valid range of 73.20 cm Hg (30 in Hg) to 32.34 Kg/cm <sup>2</sup> (460 psig). This is a display alarm and has no associated failure action.                                                                                                                                                                                                                                                   |                                                                                                  |
| AL69                                                                                                                                                                            | Suction Temperature Sensor Failure (CPSS)                                | Alarm 69 is triggered by a suction temperature sensor reading outside the valid range of -60°C (-76°F) to 150°C (302°F). This is a display alarm and has no associated failure action.                                                                                                                                                                                                                                                                                     |                                                                                                  |
| <b>NOTE</b>                                                                                                                                                                     |                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                  |
| If the Controller is configured for four probes without a DataCORDER, the DataCORDER alarms AL70 and AL71 (See Table 3-7) will be processed as Controller alarms AL70 and AL71. |                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                  |
| ERR #                                                                                                                                                                           | Internal Microprocessor Failure                                          | The Controller performs self-check routines. If an internal failure occurs, an ERR #0-5 will appear on the display. This is an indication the Controller needs to be replaced.                                                                                                                                                                                                                                                                                             |                                                                                                  |
|                                                                                                                                                                                 |                                                                          | <b>ERROR</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>DESCRIPTION</b>                                                                               |
|                                                                                                                                                                                 |                                                                          | #0 - RAM failure                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Indicates that the Controller working memory has failed.                                         |
|                                                                                                                                                                                 |                                                                          | #1 - Program Memory failure                                                                                                                                                                                                                                                                                                                                                                                                                                                | Indicates a problem with the Controller program.                                                 |
|                                                                                                                                                                                 |                                                                          | #2 - Watchdog time-out                                                                                                                                                                                                                                                                                                                                                                                                                                                     | The Controller program has entered a mode whereby the Controller program has stopped executing.  |
|                                                                                                                                                                                 |                                                                          | #3 - On board timer failure                                                                                                                                                                                                                                                                                                                                                                                                                                                | The on board timers are no longer operational. Timed items such as; defrost, etc. may not work.  |
|                                                                                                                                                                                 |                                                                          | #4 - Internal counter failure                                                                                                                                                                                                                                                                                                                                                                                                                                              | Internal multi-purpose counters have failed. These counters are used for timers and other items. |
| #5 - A-D failure                                                                                                                                                                | The Controller's Analog to Digital (A-D) converter has failed.           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                  |
| Entr StPt                                                                                                                                                                       | Enter Setpoint (Press Arrow & Enter)                                     | The Controller is prompting the operator to enter a set point.                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                  |
| LO                                                                                                                                                                              | Low Mains Voltage (Function Codes Cd27-38 disabled and NO alarm stored.) | This message will be alternately displayed with the set point whenever the mains voltage is less than 75% of its proper voltage.                                                                                                                                                                                                                                                                                                                                           |                                                                                                  |

### 3.1.6 Condenser Pressure Control (CPC)

A pressure control system has been incorporated by means of a condenser pressure transducer (CPT) and condenser pressure control (CPC) logic to maintain discharge pressures above 130 psig in low temperatures.

In order for the CPC logic to be enabled, the following conditions must be met:

- CPC configuration variable set to “In”
- CPT sensor is valid (alarm code AL68 inactive)
- AMBS sensor is valid (alarm code AL57 inactive)
- AMBS is less than or equal to 26.6°C (79.9°F)
- Voltage/Frequency ratio is less than or equal to 8.38

When condenser pressure control (CPC) is enabled (all of the above conditions are met), either pressures or timers may dictate a change of state from OFF to ON, or ON to OFF. If the condenser fan is OFF, it will be energized if saturation condensing pressure is greater than 200 psig OR if the condenser fan has been OFF for a maximum of sixty seconds depending on the ambient temperature. If the condenser fan is ON, it will de-energize only if the saturation condensing pressure is less than 130 psig and the condenser fan has been running for a minimum of thirty seconds depending on the ambient temperature. As the ambient temperature increases, the amount of time that the condenser fan is energized will correspondingly increase.

If any one of the following conditions occur the CPC logic will be disabled:

- CPT sensor is invalid (alarm code AL68 activates)
- AMBS sensor is invalid (alarm code AL57 activates)
- AMBS is greater than 29.5°C (85.1°F)
- Voltage/Frequency ratio is greater than 8.42

### 3.1.7 Controller Temperature Control

There are two control ranges, Frozen and Perishable (chill). The Frozen range is active with set points *at or below* -10°C (+14°F), or -5°C (+23°F) optionally, and the Perishable range is active at set points *above* -10°C (+14°F), or -5°C (+23°F) optionally. See Figure 3-4 and Figure 3-5.

The Controller configuration variable for “Heat Lockout” (refer to Table 3-1) can be changed for set points of either -10°C (+14°F), or -5°C (+23°F) optionally.

#### NOTES

- When upward set point changes are made at ambients below 27°C (80°F), the compressor is immediately cycled OFF. The compressor three minute time delay will be overridden, so that as soon as the control temperature is at least 0.2°C (0.4°F) above set point the compressor will turn ON.
- When the compressor starts for the first time after power is applied manually, the SMV will open to 100% and the unit will run for three minutes to boil off dissolved refrigerant from the compressor oil.

#### 3.1.7.1 Perishable (Chill) Range Above -10°C (+14°F), or -5°C (+23°F) Optionally.

For set points *above* -10°C (+14°F), or -5°C (+23°F) optionally, the Controller maintains SUPPLY air at the set temperature by the following modes of operation:

##### a. Operation in the conventional mode without dehumidification (Code 33 OFF)

1. At ambients below 27°C (80°F), the condenser fan will cycle on/off depending on condenser pressure and on/off times.

If the condenser pressure is greater than 200 psig OR the condenser fan has been OFF at least 60 seconds, the condenser fan will start.

If the condenser pressure is less than 130 psig AND the condenser fan remains ON for at least 30 seconds, the condenser fan will stop.

2. At ambients above 27°C (80°F), condenser pressure control (CPC) is disabled and the condenser fan runs continuously.

**If the unit starts when ambient is below -10°C (+14°F) and condenser pressure is below 200 psig, the condenser fan will not start until pressure reaches 200 psig.**

The supply probe is used for control and is so indicated by the “SUPPLY” LED on the display module. The Perishable temperature range demands high accuracy. The unit is capable of maintaining supply air temperature to within ±0.25°C (±0.5°F) of the set point temperature setting. In Perishable range *above* -10°C (+14°F), or -5°C (+23°F) optionally, control is maintained by controlling the positions of the suction

modulation valve (SMV) and suction solenoid valve (SSV) with the compressor energized.

When pulling down from a control temperature that is more than 5°C (9°F) above set point, both valves will be open to reduce the pulldown time unless suction solenoid override or current limiting is activated. See section 2.10 for explanation of suction solenoid override. The current limit function will restrict the valves if the current is above the selected value. When the controlling probe temperature reaches set point, the suction solenoid valve will close.

When the controlling probe temperature enters the in-range temperature tolerance as selected at function code Cd30, the in-range light will energize.

The Controller logic is designed so the suction modulation valve will begin to close as the set point is reached. The modulation valve will close to restrict refrigerant flow until the capacity of the unit and the load are balanced, unless the compressor reliability enhancement logic on the first compressor start prevents closure.

If the temperature drops below the set point, the compressor will remain running for a few minutes. This is to accommodate any initial undershoot which might occur. After this time, and at 0.2°C (0.4°F) or greater below the set point, the compressor will be turned OFF.

The heaters will be energized if the temperature drops to 0.5°C (0.9°F) below the set point. The heaters will de-energize when the temperature rises to 0.2°C (0.4°F) below the set point. The compressor will not restart until the temperature rises to 0.2°C (0.4°F) above the set point and a three minute time delay since the last compressor turn off has been satisfied.

#### **b. Operation in the dehumidification mode (Code 33 value selected) - Optional**

The dehumidification mode is activated by selecting Code 33, choosing a desired relative humidity value, and pressing the ENTER key. The control probe LED (supply 1) will flash ON and OFF every second to indicate that the dehumidification mode is active. Once the Mode is active and the following conditions are satisfied, the Controller will activate the heat relay to begin dehumidification.

1. The humidity sensor reading is above the set point and valid (AL67).
2. The pulldown mode is NOT active. (ie., The SSV valve is closed, and the control temperature is less than 5°C above set point.)

3. The control probe (i.e.; Supply 1) temperature is less than set point, plus 0.25°C.
4. Temperature control set point is greater than -10°C (+14°F), or -5°C (+23°F) optionally, in the perishable range, and the compressor is running.
5. The heater debounce timer (three minutes) has timed out.
6. Heater termination thermostat (HTT) is closed.
7. The Controlled Atmosphere (CA) option VENT or Pre-Trip mode is not initiated.
8. Humidity sensor alarm is not active (AL67).
9. High pressure switch (HPS) is not open.

If the above conditions remain true for at least one hour the evaporator fans will switch from high to low speed operation (on units so equipped). The evaporator fan speed will switch every hour thereafter as long as all conditions are met (see Bulb Mode section for different evaporator fan speed options). If any condition except for item (1.) becomes false OR if the relative humidity sensed is 2% below the dehumidification set point, the high speed evaporator fans will be energized.

The dehumidification mode applies power to the defrost and drain pan heaters. This added heat load causes the Controller to open the modulating valve to match the new total heat load while still holding the supply air temperature very close to the set point.

Opening the modulating valve reduces the temperature of the evaporator coil surface, which increases the rate at which water is condensed from the air passing through the coil. Removing water from the air reduces the relative humidity. When the relative humidity sensed is 2% below the set point (function code Cd33), the Controller de-energizes the heat relay. The Controller will continue to cycle heating to maintain relative humidity below the selected set point.

Two timers are provided in the Dehumidification mode to prevent rapid mode switching and consequent contactor wear. They are:

- Heater debounce timer (three minutes).
- Out-of-range timer (five minutes).

The heater debounce timer is activated whenever the heat contactor status is changed. The heat contactor remains energized (or de-energized) for at least three minutes even if the set point criteria are satisfied. This is to prevent rapid cycling of the heat contactor when the humidity set point is satisfied. If the mode is terminated by a condition other than the humidity sensor, e.g., an

out-of-range or compressor shutdown condition, the heat relay is de-energized immediately.

The out-of-range timer is provided to allow the heaters to remain energized during a temporary out-of-range condition. If the control probe temperature remains outside of the user selected in-range setting 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.

Cooling capacity reduction by modulation is the same as described for the conventional operating mode when any of the above first four conditions (1. thru 4.) are invalid.

With set points below  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, heating and dehumidification are locked out.

#### **c. Operation in the economy mode (Code 34 set to ON)**

The economy mode selection determines the status of the economy mode of operation. There are two values: "ON" and "OFF." A code which represents the status of this function is recorded in the DataCorder memory whenever the value is changed.

Economy mode is a user selectable mode of operation provided for power saving purposes. Economy mode could be utilized in the transportation of temperature tolerant cargo or non-respiration items which do not require high airflow for removing respiration heat.

The economy mode is activated by selecting function code Cd34 to the "ON" status. There is no active display indicator that economy mode has been activated, and a manual display of Cd34 is a way to be sure if the economy mode is or is not active.

In order to achieve economy mode perishable operation, a perishable set point must be selected PRIOR to activating economy mode. When economy mode perishable is active, the evaporator fans will be controlled as follows: At the start of each cooling or heating cycle, the high speed evaporator fans will be run for three minutes. After that initial three minutes, the evaporator fans will be switched to low speed any time the supply air temperature is within  $\pm 0.25^{\circ}\text{C}$  ( $0.45^{\circ}\text{F}$ ) of the set point and the return air temperature is less than or equal to the supply air temperature  $+ 3^{\circ}\text{C}$  ( $5.4^{\circ}\text{F}$ ). When the fans switch to low speed, they will run in low speed for one hour. At the end of the hour, the evaporator fans will switch back to high speed. The evaporator fans will again run in high speed for three

minutes and the above mentioned cycle will be repeated, just as it was from the start of the cooling or heating cycle. If the unit is not equipped with dual speed evaporator fans, then economy mode perishable will perform exactly the same as the normal control mode.

#### **d. Operation in bulb mode (Code 35 set to bulb and Code 33 selected)**

Bulb mode is an extension of the dehumidification mode. Dehumidification must be enabled by selecting a value (percentage of relative humidity) at function code Cd33 before bulb mode function code Cd35 can be initiated.

To initiate bulb mode, use the ARROW keys to scroll to function code Cd35 and change from "Nor" to "bulb." Once the bulb mode is activated, the user may then change from the normal evaporator fan operation where the fan speed alternates every hour between low or high speed operation. This is done by toggling function code Cd36 from its default of "alt" to "Lo" or "Hi" respectively. If low speed evaporator fan operation is selected, this gives the user the additional capability of selecting dehumidification set points from 60 to 95% (instead of the normal 65 to 95%).

In addition, if bulb mode is active, the user is given the option to change the defrost termination sensor (DTS) temperature, in which defrost is terminated from the normal  $25.6^{\circ}\text{C}$  ( $78^{\circ}\text{F}$ ) temperature setting to  $4^{\circ}\text{C}$  ( $39.2^{\circ}\text{F}$ ) in  $0.1^{\circ}\text{C}$  ( $0.2^{\circ}\text{F}$ ) increments. The temperature set point that the DTS temperature must go below before the defrost interval timer begins counting down also changes from  $0^{\circ}\text{C}$  to  $10^{\circ}\text{C}$  as the desired DTS termination temperature is raised.

Bulb mode is terminated when:

- Code Cd35 is set to "Nor."
- Code Cd33 for dehumidification is set to "Off."
- The user changes the set point to one that is in the frozen range.

When bulb mode is disabled by any of the above means, the evaporator fan operation for dehumidification reverts to "alt" and the DTS termination setting resets to the normal  $25.6^{\circ}\text{C}$  ( $78^{\circ}\text{F}$ ).

### 3.1.7.2 Frozen Range Below $-10^{\circ}\text{C}$ ( $+14^{\circ}\text{F}$ ), or $-5^{\circ}\text{C}$ ( $+23^{\circ}\text{F}$ ) Optionally

For set points *below*  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, the Controller maintains RETURN air at the set point temperature using the following modes of operation:

#### a. Operation in the conventional mode (Code 33 OFF)

The return air probe is used for control and is so indicated by the LED on the display board.

The Frozen temperature range is not sensitive to minor temperature changes. The method of temperature control employed in this range takes advantage of this fact to greatly improve the energy efficiency of the unit. Temperature control in the Frozen range *at or below*  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, is accomplished by cycling the compressor on and off as the load demand requires.

If the return air temperature in the container drops  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) below the set point temperature, the compressor is cycled off. When the temperature is greater than  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) above the set point and the three minute time delay has been met, the compressor will restart. The unit will always operate at full capacity, with both the suction modulation (SMV) and suction solenoid (SSV) valves fully open unless suction solenoid override or current limiting is activated. See section 2.10 for explanation of suction solenoid override.

To prevent on/off cycling of the compressor from occurring, a three minute compressor off time must be satisfied before the compressor will restart. Under a condition of rapidly changing return air temperature, the time delay may allow the return air temperature to rise slightly more than  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) above the set point temperature before the compressor can restart.

#### b. Operation in the economy mode (Code 34 OFF)

The economy mode is deactivated by setting function code Cd34 to the "OFF" status. Economy mode has no active display indicator to show that it is enabled, so a manual display of function code Cd34 must be performed to enable the user to see its current status. A second way to deactivate economy mode is to change the set point. Once economy mode is deactivated, the system will return to normal control mode operations.

In order to achieve economy mode frozen operation, a frozen set point temperature must be selected PRIOR to activating economy mode. When economy mode frozen is active, the system will perform normal frozen mode operations except that the entire refrigeration system,

excluding the Controller, will be turned off when the control temperature is less than or equal to the set point  $-2^{\circ}\text{C}$ , (i.e., the set point is set at  $-11^{\circ}\text{C}$  and the operator subtracts  $-2^{\circ}\text{C}$ , the result will equal  $-13^{\circ}\text{C}$ ). After an off-cycle period of 60 minutes, the unit will turn on high speed evaporator fans for three minutes, and then check the control temperature. If the control temperature is greater than or equal to the set point  $+0.2^{\circ}\text{C}$ ., the unit will restart the refrigeration system and continue to cool until the previously mentioned off-cycle temperature criteria are met. If the control temperature is less than the set point  $+0.2^{\circ}\text{C}$ , the unit will turn off the evaporator fans and restart another 60 minute off-cycle.

#### c. Operation in the bulb mode (Code 35 OFF)

The unit will not run in bulb mode if a frozen range set point is selected. As described in section 3.1.7.1.d., if a frozen set point is selected, dehumidification is deactivated and the temperature above which DTS must go during defrost resets to  $25.6^{\circ}\text{C}$  ( $78^{\circ}\text{F}$ ).

## 3.2 PRE-TRIP DIAGNOSTICS

### CAUTION

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

### NOTE

When Pre-Trip is initiated, dehumidification and bulb mode will be deactivated. At the completion of Pre-Trip, dehumidification and bulb mode must be turned back on again.

Pre-trip Diagnostics is an independent mode which will suspend the normal Control Mode activities when initiated by the user. With pre-trip diagnostics, either all the pre-trip tests can be executed in a defined sequence (Auto Mode), or one of the pre-trip tests can be selected to be executed (Manual Mode), based on the sequence of key selections made.

#### a. Starting and Terminating Pre-Trip

### NOTE

Prior to starting tests, verify that Controller function codes Cd04, Cd05, Cd06 and Cd07 are operational. Otherwise, tests may fail incorrectly. All alarms must be rectified and cleared.

A Pre-trip selection menu is displayed by pressing the PRE-TRIP key. This accesses a test selection menu. If no selection is made, the pre-trip menu selection process will terminate automatically. Pre-Trip will terminate if

the VENT mode is selected on the CA Controller. The user must scroll through the selection by pressing the UP ARROW or DOWN ARROW keys, then pressing the ENTER key when the selection is made. While the tests are being executed, the user can terminate the pre-trip mode by 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 machinery outputs will be de-energized and the test selection menu will be displayed.

The pre-trip diagnostics may also be initiated via communication, but when initiated will always attempt to execute the entire battery of tests (auto mode).

**b. Current Limiting During Pre-Trip**

Throughout the duration of any pre-trip mode, the Current Limit processing is active.

**c. Test Codes**

A detailed description of the pre-trip test codes is listed in Table 3-5.

**3.2.1 Pre-Trip**

In this mode, the unit will automatically test unit components using internal measurements and comparison logic, and will provide a “PASS” or “FAIL” display to indicate the results of each test.

If the user depresses the PRE-TRIP key, the unit gives access to a pre-trip selection menu. The contents of the menu are as follows:

| PRE-TRIP SELECTION MENU          |                                                   |
|----------------------------------|---------------------------------------------------|
| Auto or Auto 1                   | Auto 2 (Optional)                                 |
| P, P1, P2, P3, P4, P5, P6, rSLts | P, P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, rSLts |

If the pre-trip was last executed manually after power up, the last menu selection will appear on the left display. If pre-trip was not executed since power up, then the right display will show “Auto” or “Auto 1.” The user may scroll through the test selection menu using the arrow keys.

A given test is selected by pressing ENTER while it is displayed. The entire battery of tests may be run by pressing ENTER while “Auto 1” or “Auto 2” is displayed.

During this selection mode, failure to press either an arrow key or ENTER for five seconds will return the unit to its default display, and normal operating mode.

Any test may be interrupted by pressing the UP ARROW key. This will return the user to the test selection mode described above, and all machinery outputs will be de-energized.

While certain tests from “Auto 1” are running, “PX-X” will appear on the left display, where the X’s indicate the test number and sub-test. The right display will show a countdown time in minutes and seconds, indicating how much time there is left remaining in the test.

For “Auto 2,” the left display will show “PX-X,” while the right display will show applicable data.

**a. Manual Test Operation**

Individually selected tests, other than the LED/Display test, will perform the operations necessary to verify the operation of the component under test. 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, 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. Following any individually selected test, all outputs will be de-energized.

**b. Auto Test Operation From Keypad**

If “Auto,” “Auto 1” or “Auto 2” test is initiated, then the unit will execute a series of consecutive tests, each related to an identifiable unit component, without any need for direct user interface. These tests vary in length, depending on the component under test.

When an automatic test fails, it will be repeated once automatically. 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 to repeat the test or the UP ARROW to skip to the next test. The unit will wait indefinitely for user input. Holding the PRE-TRIP key will terminate the pre-trip mode operation.

When “Auto” or “Auto 1” is allowed to run to completion without being interrupted, the unit will exit the pre-trip mode, and return to normal control operation.

**CAUTION**

**When “Auto 2” is allowed to run to completion without being interrupted, the unit will terminate pre-trip and display “Auto 2” “end.” The unit WILL REMAIN SUSPENDED in this mode until the user depresses the ENTER key!**



### c. 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 described above except that should a test fail, the pre-trip mode will automatically terminate. When initiated via communications, a test may not be interrupted with an arrow key, but the pre-trip mode can be terminated with the PRE-TRIP key.

### d. Pre-Trip Test Results

At the end of the pre-trip test selection menu, the message “P,” “rSLts” will be displayed. Pressing the ENTER key will allow the user to see the results for all subtests (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.

### 3.2.2 Pre-Trip Mode

**Table 3-5. Pre-Trip Test Codes**

| CODE #                                                                                                                                                                                                             | TITLE                               | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NOTE</b>                                                                                                                                                                                                        |                                     |                                                                                                                                                                                                                                                                                                                                                                                   |
| “Auto” or “Auto1” menu includes the following: P, P1, P2, P3, P4, P5, P6 and rSLts. “Auto2’ (Optional) menu includes the following: P, P1, P2, P3, P4, P5, P6,P7, P8, P9, P10 and rSLts. (Refer to section 3.2.1.) |                                     |                                                                                                                                                                                                                                                                                                                                                                                   |
| P                                                                                                                                                                                                                  | Pre-Trip Initiated                  | All lights and display segments will be energized for five seconds at the start of the pre-trip. Since the unit cannot recognize lights and display failures, there are no test codes or results associated with this phase of pre-trip.                                                                                                                                          |
| P1-0                                                                                                                                                                                                               | Heaters Turned On                   | <b>Setup:</b> Heater must start in the OFF condition, and then be turned on. A current draw test is done after 15 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified.                                                                                                                                                          |
| P1-1                                                                                                                                                                                                               | Heaters Turned Off                  | <b>Setup:</b> Heater must start in the ON condition, and then be turned off. A current draw test is done after 10 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified.                                                                                                                                                          |
| P2-0                                                                                                                                                                                                               | Condenser Fan On                    | <b>Requirements:</b> Water pressure switch (WP) input must be closed.<br><b>Setup:</b> Condenser fan is turned ON, a current draw test is done after 15 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw test is within the range specified.                                                                                                               |
| P2-1                                                                                                                                                                                                               | Condenser Fan Off                   | <b>Setup:</b> Condenser fan is turned OFF, a current draw test is done after 10 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw test is within the range specified.                                                                                                                                                                                       |
| P3                                                                                                                                                                                                                 | Low Speed Evaporator Fans           | <b>Requirements:</b> The unit must be equipped with a low speed evaporator fan, as determined by the Evaporator Fan speed select configuration variable.<br><b>NOTE:</b> If the unit is configured for single evaporator fan operation, Pre-Trip tests P3-0, P3-1, P4-0 and P4-1 will fail immediately if Controller alarm codes AL11 or AL12 are active at the start of testing. |
| P3-0                                                                                                                                                                                                               | Low Speed Evaporator Fan Motors On  | <b>Setup:</b> The high speed evaporator fans will be turned on for 10 seconds, then off for two seconds, then the low speed evaporator fans are turned on. A current draw test is done after 60 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.                               |
| P3-1                                                                                                                                                                                                               | Low Speed Evaporator Fan Motors Off | <b>Setup:</b> The low speed Evaporator Fan is turned off, a current draw test is done after 10 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.                                                                                                                                |
| P4-0                                                                                                                                                                                                               | High Speed Evaporator Fan Motors On | <b>Setup:</b> The high speed Evaporator Fan is turned on, a current draw test is done after 60 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.                                                                                                                                |

| CODE # | TITLE                                                 | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                           |                           |                  |     |        |      |     |     |                               |
|--------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|------------------|-----|--------|------|-----|-----|-------------------------------|
| P4-1   | High Speed Evaporator Fan Motors Off                  | <b>Setup:</b> The high speed Evaporator Fan is turned off, a current draw test is done after 10 seconds.<br><b>Pass/Fail Criteria:</b> Passes if change in current draw is within the range specified. Fails if AL11 or AL12 activates during test.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |                           |                  |     |        |      |     |     |                               |
| P5-0   | Supply/Return Probe Test                              | <b>Setup:</b> The High Speed Evaporator Fan is turned on and run for eight minutes, with all other outputs de-energized.<br><b>Pass/Fail Criteria:</b> A temperature comparison is made between the return and supply probes.<br><b>NOTE:</b> If this test fails, "P5-0" and "FAIL" will be displayed. If both Probe tests (this test and the PRIMARY/ SECONDARY) pass, the display will read "P5" "PASS."                                                                                                                                                                                                                                                                                                            |                           |                           |                  |     |        |      |     |     |                               |
| P5-1   | Supply Probe Test                                     | <b>Requirements:</b> For units equipped with secondary supply probe only.<br><b>Pass/Fail Criteria:</b> The temperature difference between primary and secondary probe (supply) is compared.<br><br><b>NOTE</b><br><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   | Return Probe Test                                     | <b>Requirements:</b> For units equipped with secondary return probe only.<br><b>Pass/Fail Criteria:</b> The temperature difference between primary and secondary probe (return) is compared.<br><br><b>NOTES</b><br><ul style="list-style-type: none"><li>• 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."</li><li>• The results of Pre-Trip tests 5-0, 5-1 and 5-2 will be used to activate or clear control probe alarms.</li></ul>                                                                                                                                      |                           |                           |                  |     |        |      |     |     |                               |
| P6-0   | Single Speed Compressor Test (For single speed units) | <b>Setup:</b> The compressor is started. If it is the first compressor start, the compressor reliability enhancement logic (CREL) is executed, running a current draw test with the additional outputs (if installed) in the following states:                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                           |                  |     |        |      |     |     |                               |
|        |                                                       | <table border="1"> <thead> <tr> <th>Component</th> <th>Normal Logic (10 seconds)</th> <th>CREL (3 minutes)</th> </tr> </thead> <tbody> <tr> <td>SSV</td> <td>Closed</td> <td>Open</td> </tr> <tr> <td>SMV</td> <td>70%</td> <td>100% (for 3 minutes) then 70%</td> </tr> </tbody> </table>                                                                                                                                                                                                                                                                                                                                                                                                                            | Component                 | Normal Logic (10 seconds) | CREL (3 minutes) | SSV | Closed | Open | SMV | 70% | 100% (for 3 minutes) then 70% |
|        |                                                       | Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Normal Logic (10 seconds) | CREL (3 minutes)          |                  |     |        |      |     |     |                               |
|        |                                                       | SSV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Closed                    | Open                      |                  |     |        |      |     |     |                               |
| SMV    | 70%                                                   | 100% (for 3 minutes) then 70%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                           |                           |                  |     |        |      |     |     |                               |
|        |                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |                           |                  |     |        |      |     |     |                               |
|        |                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                           |                           |                  |     |        |      |     |     |                               |
| P-6    | Dual Speed Compressor Tests (For dual speed units)    | <b>Setup:</b> Prior to this testing the ambient temperature is checked. If the ambient temperature is less than 60°F, the high speed compressor test will run first. If the ambient temperature is greater than 60°F, or if the ambient temperature is invalid, the low speed compressor test will run first. Once the first compressor test has been completed, the switch over to the other compressor test will follow. Upon entry to this test section, the high speed evaporator fan should already be running, if not, it is started. After the evaporator fan has run for five seconds, the high speed condenser fan is started. After the condenser fan has run for five seconds, the compressor test is run. |                           |                           |                  |     |        |      |     |     |                               |

| CODE #                                                                                     | TITLE                                              | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
|--------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------|------------------|------------------|--------|--------|--------|--------|-------------------------------|-----|-----|-------------------------------|
| P6-H                                                                                       | High Speed Compressor Tests (For dual speed units) | <b>Setup:</b> The compressor is started. If it is the first compressor start, the compressor reliability enhancement logic (CREL) is executed, running a current draw test with the additional outputs (if installed) in the following states:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    | <table border="1"> <thead> <tr> <th>Component</th> <th>Normal Logic (10 seconds)</th> <th>CREL (3 minutes)</th> </tr> </thead> <tbody> <tr> <td>SSV</td> <td>Closed</td> <td>Open</td> </tr> <tr> <td>SMV</td> <td>20%</td> <td>100% (for 3 minutes) then 20%</td> </tr> </tbody> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Component                     | Normal Logic (10 seconds) | CREL (3 minutes) | SSV              | Closed | Open   | SMV    | 20%    | 100% (for 3 minutes) then 20% |     |     |                               |
|                                                                                            |                                                    | Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Normal Logic (10 seconds)     | CREL (3 minutes)          |                  |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    | SSV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Closed                        | Open                      |                  |                  |        |        |        |        |                               |     |     |                               |
| SMV                                                                                        | 20%                                                | 100% (for 3 minutes) then 20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| <b>Pass/Fail Criteria:</b> Passes if the change in current draw is within the valid range. |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| P6-L                                                                                       | Low Speed Compressor Tests (For dual speed units)  | <b>Setup:</b> The compressor is started. When ambient temperature is greater than 60°F, a two minute CREL is executed. If the ambient temperature is less than 60°F, a three minute CREL is executed. Then a current draw test is done for 10 seconds with the additional outputs (if installed) in the following states:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    | <table border="1"> <thead> <tr> <th>Component</th> <th>Normal Logic (10 seconds)</th> <th>CREL (2 minutes)</th> <th>CREL (3 minutes)</th> </tr> </thead> <tbody> <tr> <td>SSV</td> <td>Closed</td> <td>Closed</td> <td>Closed</td> </tr> <tr> <td>SMV</td> <td>20%</td> <td>20%</td> <td>100% (for 3 minutes) then 20%</td> </tr> </tbody> </table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Component                     | Normal Logic (10 seconds) | CREL (2 minutes) | CREL (3 minutes) | SSV    | Closed | Closed | Closed | SMV                           | 20% | 20% | 100% (for 3 minutes) then 20% |
|                                                                                            |                                                    | Component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Normal Logic (10 seconds)     | CREL (2 minutes)          | CREL (3 minutes) |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    | SSV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Closed                        | Closed                    | Closed           |                  |        |        |        |        |                               |     |     |                               |
| SMV                                                                                        | 20%                                                | 20%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100% (for 3 minutes) then 20% |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| <b>Pass/Fail Criteria:</b> Passes if the change in current draw is within the valid range. |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
|                                                                                            |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| P6-2                                                                                       | Suction Modulation Valve (Open)                    | <b>Setup:</b> The suction modulation valve (SMV) is opened to 100% unless restricted by current limit function, and the unit is run for two minutes.<br><b>Pass/Fail Criteria:</b> The supply and return probe temperature reading difference is compared to a predetermined value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| P6-3                                                                                       | Quench Valve Test                                  | <b>Setup:</b> The compressor suction temperature is measured with the Quench valve closed. The Quench valve is energized and the suction temperature drop is checked.<br><b>Pass/Fail Criteria:</b> Passes if suction temperature is within the valid range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| P6-4                                                                                       | Suction Modulation Valve (Closed)                  | <b>Setup:</b> The heaters are energized. The suction modulation valve is set to 100%, and run for one minute. At the end of the one minute run, the supply temperature is subtracted from the return temperature and the result is saved (reading 1). The SMV is dropped to 60% and run for one minute. At the end of this one minute run, the supply temperature is again subtracted from the return temperature and the result is saved (reading 2).<br><b>Pass/Fail Criteria:</b> If the difference between reading 1 & 2 is within a predetermined range, the test passes. If current limiting occurs, the test passes.                                                                                                                                                                                                  |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |
| P6-5                                                                                       | Suction Solenoid Valve                             | <b>Requirements:</b> The unit must be equipped with a suction solenoid valve (SSV). Current limiting may close SSV. If this happens, the test will automatically pass.<br><b>Setup:</b> The SSV is opened, the suction modulation valve (SMV) is closed. The quench valve (if configured) will operate according to normal operating rules. If the return temperature probe is lower than -5.0°C, the test is run for two minutes, otherwise for one minute. Condenser Pressure Control (CPC) logic is used for this test if the controller is configured for it.<br><b>Pass/Fail Criteria:</b> If the SSV is closed due to current limiting, the test passes. If supply and return probes are invalid, the test fails. If the test is within a predetermined range, the test passes. The SSV is closed following this test. |                               |                           |                  |                  |        |        |        |        |                               |     |     |                               |

| CODE #                                                                                                                                        | TITLE                       | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NOTE</b>                                                                                                                                   |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Starting with test P7-0 through test P10, these tests are only included with the “Auto2” (Optional) selection menu. (Refer to section 3.2.1.) |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| P7-0                                                                                                                                          | High Pressure Switch Closed | <p><b>Setup:</b> When the unit is running, the condenser fan is de-energized, and a 15 minute timer is started. The right display shows discharge pressure if equipped with the discharge pressure transducer (DPT), or condenser pressure if equipped with a condenser pressure transducer (CPT), or discharge pressure if equipped with either a discharge pressure transducer (DPT) or a condenser pressure transducer (CPT).</p> <p><b>Pass/Fail Criteria:</b> The test fails if high pressure switch fails to open in 900 seconds.</p>                                       |
|                                                                                                                                               |                             | <p><b>Note, this test is skipped if the unit does NOT have:</b></p> <ul style="list-style-type: none"> <li>• A compressor discharge sensor (CPDS).</li> <li>• A discharge pressure transducer (DPT).</li> <li>• Condenser pressure transducer (CPT).</li> </ul>                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                               |                             | <p><b>In addition, this test is skipped if:</b></p> <ul style="list-style-type: none"> <li>• The sensed ambient temperature is less than 7°C (45°F).</li> <li>• The return air temperature is less than -17.8°C (0°F).</li> <li>• The water pressure switch (WP) is open, indicating that the unit is operating with a water-cooled condenser.</li> </ul>                                                                                                                                                                                                                         |
|                                                                                                                                               |                             | <p><b>Pass/Fail Criteria:</b> Under conditions of the above Note, the test immediately fails if the following inputs are sensed to be invalid:</p> <ul style="list-style-type: none"> <li>• Compressor discharge sensor (CPDS).</li> <li>• Discharge pressure transducer (DPT).</li> <li>• Condenser pressure transducer (CPT).</li> </ul> <p><b>OR</b> if any one of the following inputs are sensed to be invalid:</p> <ul style="list-style-type: none"> <li>• Return temperature sensor (RTS).</li> <li>• Ambient sensor (AMBS).</li> </ul>                                   |
|                                                                                                                                               |                             | <p><b>In addition, the test will fail if:</b></p> <ul style="list-style-type: none"> <li>• The high pressure switch (HPS) fails to open within 15 minutes.</li> <li>• The discharge temperature exceeds 138°C (280°F).</li> <li>• The discharge temperature is less than or equal to ambient temperature plus 5°C (9°F).</li> <li>• The condenser pressure transducer (CPT) or discharge pressure transducer (DPT) pressure exceeds 27.42 kg/cm<sub>2</sub> (390 psig).</li> </ul>                                                                                                |
| P7-1                                                                                                                                          | High Pressure Switch Open   | <p><b>Requirements:</b> Test P7-0 must pass for this test to execute. Setup: The condenser fan is started and a 60 second timer is started.</p> <p><b>Pass/Fail Criteria:</b> Passes the test if the high pressure switch (HPS) closes within the 60 second time limit, otherwise, it fails.</p>                                                                                                                                                                                                                                                                                  |
| P8-0                                                                                                                                          | Perishable Mode Heat Test   | <p><b>Setup:</b> If the container temperature is below 60°F, the set point is changed to 60°F, and a 60 minute timer is started. The left display will read “P8-0.” The control will then heat the container until 60°F is reached. If the container temperature is above 60°F at the start of the test, then the test proceeds immediately to test P8-1 and the left display will change to “P8-1.”</p> <p><b>Pass/Fail Criteria:</b> The test fails if the 180 minute timer expires before the control temperature reaches set point. The display will read “P8-0,” “FAIL.”</p> |

| CODE # | TITLE                                     | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P8-1   | Perishable Mode Pull Down Test            | <p><b>Requirements:</b> Control temperature must be at least 60°F.</p> <p><b>Setup:</b> The set point is changed to 32°F, and a 180 minute timer is started. The left display will read "P8-1," the right display will show the supply air temperature. The unit will then start to pull down the container temperature to the 32°F set point.</p> <p><b>Pass/Fail Criteria:</b> The test passes if the container temperature reaches set point before the 180 minute timer expires.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| P8-2   | Perishable Mode Maintain Temperature Test | <p><b>Requirements:</b> Test P8-1 must pass for this test to execute.</p> <p><b>Setup:</b> The left display will read "P8-2," and the right display will show the supply air temperature. A 60 minute timer is started. The unit will be required to maintain the 32°F temperature to within + or - 0.5°C (0.9°F) of set point until a DataCORDER recording is executed. The recorder supply probe temperature running total (and its associated readings counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCORDER will be an average of only this test's results. Once a recording interval is complete, the average recorder supply temperature will be recorded in the DataCORDER, as well as stored in memory for use in applying the test pass/fail criteria.</p> <p><b>Pass/Fail Criteria:</b> If the recorded temperature is within +/- 0.5°C. of set point from test start to DataCORDER recording, the test passes. If the average temperature is outside of the tolerance range at the DataCORDER recording, the test fails.</p> |
| P9-0   | Defrost Test                              | <p><b>Setup:</b> The defrost temperature sensor (DTS) temperature will be displayed on the left display. The right display will show the supply air temperature. The unit will run FULL COOL for 30 minutes maximum while the DTS sensor temperature is above 10°C. Once the DTS is below 10°C, the unit simulates defrost by running the heaters for up to two hours, or until the DTS senses the temperature above 25.6°C.</p> <p><b>Pass/Fail Criteria:</b> The test passes if DTS is sensed above 25.6°C before a two hour timer times out. The test fails if DTS does not go below 10°C after 30 minutes of full cooling, and/or the heater termination thermostat (HTT) is open when the DTS is below 10°C. The test also fails if the HTT opens anytime during the defrost cycle and/or the return air temperature exceeds 120°F anytime during the heat cycle.</p>                                                                                                                                                                                                                                                             |
| P10-0  | Frozen Mode (Setup) Test                  | <p><b>Setup:</b> After completion of the DTS test, the set point will be set to 7°C (45°F). The left display will read "P100," and if the container temperature is below 45°F, will continue this display until the container temperature is raised to set point. The left display will change to "P101" and execute the frozen pull down test when the container temperature reaches set point, or if the container temperature initially was greater than or equal to set point. The maximum time allowed in heat mode is one hour.</p> <p><b>Pass/Fail Criteria:</b> If this time limit is exceeded, the test fails. There will be no pass indication for this test. However, if the test fails the display will read "P100," "FAIL."</p>                                                                                                                                                                                                                                                                                                                                                                                           |

| CODE # | TITLE                                 | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P10-1  | Frozen Mode (Pull Down) Test          | <p><b>Setup:</b> When the container temperature is greater than or equal to the 45°F. set point which was set in the frozen mode heat test, the left display will read “P101” and the right display will show the return air temperature. The set point will then be changed to -17.7°C (0°F). The unit will then have a maximum of three hours to pull the container temperature down to the 0°F set point.</p> <p><b>Pass/Fail Criteria:</b> If this occurs within the three hour time limit, the test passes. If pulldown is not completed within the three hour time limit, the test fails.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| P10-2  | Frozen Mode Maintain Temperature Test | <p><b>Setup:</b> After the unit has successfully completed the frozen pulldown test, the left display will read “P102” and the right display will show the return air temperature. The unit will then be required to maintain the 0°F temperature within + or - 0.5°C (0.9°F) of set point until a DataCORDER recording is executed. The recorder return probe temperature running total (and its associated readings counter) will be zeroed out for the remainder of the recording period at the start of this test, so that the actual value recorded in the DataCORDER will be an average of only this test’s results. Once the recording interval is complete, the average recorder return temperature will be recorded in the DataCORDER, as well as stored in memory for use in applying the test pass/fail criteria.</p> <p><b>Pass/Fail Criteria:</b> If the recorded temperature is within +/- 0.5°C of set point from test start to DataCORDER recording, the test passes. If temperature is outside of the tolerance range at the DataCORDER recording, the test fails.</p> |

### 3.3 INTEGRATED DATACORDER (OPTIONAL)

#### 3.3.1 Brief Description

Carrier Transicold has developed a recorder, which we have termed the “DataCORDER,” and is integrated into a module with the Controller. For reader simplicity and understanding this section has been separated to explain the DataCORDER side of the module. The DataCORDER consists of:

- Microprocessor
- Program memory
- Data memory
- Internally battery backed real time clock
- Six thermistor inputs
- Two communication ports
- Power supply (optional battery pack).

This recorder eliminates the mechanical recorder and paper chart, and replaces it with a custom-designed module (see Figure 3-1) that interfaces with the Interrogator and operates in the following ways:

- a. Logs data at 15, 30, 60 or 120 minute intervals.
- b. Records and displays alarms through the digital display module. (Refer to Table 3-7.)
- c. Stores at least two years’ worth of data based on typical one hour intervals.

- d. Records DataCORDER/Network generated data and events as follows:

- Container ID Change
- S/W Upgrade
- Controller configuration change
- Alarm Activity
- Battery Low (Battery Pack)
- Data Retrieval
- Defrost Start
- Defrost End
- Dehumidification Start
- Dehumidification End
- Power Loss (w/wo battery backup)
- Power Up (w/wo battery backup)
- “Auto 1” Pre-Trip Start
- “Auto 1” Pre-Trip End
- 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 (RTC) Battery (Internal Battery) Replaced

- Real Time Clock (RTC) Modification
- Pre-Trip result & data
- Trip Start
- ISO Trip Header (Must be entered first via Interrogation program)
- Economy Mode Start
- Economy Mode End
- “Auto 2” Pre-Trip Start
- “Auto 2” Pre-Trip End
- Bulb Mode Start
- Bulb Mode changes
- Bulb Mode End
- USDA Trip Comment
- CTD Controlled Atmosphere Information
- Humidification Start
- Humidification End
- USDA Probe Calibration

### 3.3.2 DataCORDER Configuration

#### NOTE

The DataCORDER software is integrated with the Controller software.

Configuration to factory installed default configuration is achieved via a common configuration card used for controller functions, see section 3.1.2.

Changes to the factory default configuration must be made with the Interrogation device.

#### *Configuration:*

Tells the operational software what physical components are built into the container unit, how many sensors to record, what recording interval should be used, etc..

| ITEM                        | SETTING                   | FACTORY DEFAULT |
|-----------------------------|---------------------------|-----------------|
| Sensor Logging (Network)    | Average or Snapshot       | Average         |
| Sensor Logging (Thermistor) | Average, Snapshot or USDA | Average         |
| Sensor Format               | 1 or 2 byte               | 1 byte          |
| Sensor Configuration        | Refer to section 3.3.5.f. | 2 sensors       |
| Logging Interval            | 15, 30, 60 or 120 minutes | 60 minutes      |

Configuration cards are available thru CTD Replacement Components Group.

The use of a programming card in the field should only occur under unusual circumstances, such as a physical component in the container unit is changed to a different component, resulting in a new configuration for the unit.

### 3.3.3 DataCORDER Function Codes

There are 35 functions which the operator may access to examine the operating status of the unit. To access these functions, perform the following: Press the ALT. MODE & CODE SELECT keys, press an arrow key

until the left window displays the desired code number (see Table 3-6). The right window will display the value of this item for five seconds before returning to the normal display mode. If a longer time is desired, pressing the ENTER key will extend the time to 30 seconds after the last pressing of the ENTER key.

**Table 3-6. DataCORDER Function Code Assignments**

| <b>NOTE: Inapplicable Functions Display “-----”</b> |                                     |                                                                                                                                                                                                                                           |
|-----------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>To Access: Press ALT. MODE key</b>               |                                     |                                                                                                                                                                                                                                           |
| <b>CODE #</b>                                       | <b>TITLE</b>                        | <b>DESCRIPTION</b>                                                                                                                                                                                                                        |
| dC1                                                 | Recorder Supply Temperature         | Current recorder supply air temperature.                                                                                                                                                                                                  |
| dC2                                                 | Recorder Return Temperature         | Current recorder return air temperature.                                                                                                                                                                                                  |
| dC3-5                                               | USDA 1,2,3 Temperatures             | Current temperatures of the three USDA probes.                                                                                                                                                                                            |
| dC6-13                                              | Network Sensors 1-8                 | Current values of the network sensors (as configured). Network sensor 1 (Code 6) is generally the humidity sensor and its value is obtained from the Controller once every minute.                                                        |
| dC14                                                | Cargo Probe 4 Temperature           | Current temperature 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..                                                                                                                                                                       |
| 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.                            |
| 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.                                                                                                                                      |



### 3.3.4 DataCORDER Alarms

To Display Alarm Codes:

While in Set Point Selection or Default Display mode, press the ALT. MODE & ALARM LIST keys. This accesses the Alarm List Display Mode, which displays any alarms stored in the Alarm Queue. The user may scroll to the end of the alarm list by pressing the UP ARROW key after the ALARM LIST key is depressed. Depressing the DOWN ARROW key allows the user to scroll backward in the alarm list.

The left display will show “AL#” where # is the alarms number in the queue.

The right display will show:

- “AAXX,” if the alarm is active, where XX is the alarm number. See Table 3-7, DataCORDER Alarm Indications.
- “IAXX,” if the alarm is inactive

“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.

- The exception to this rule is the DataCORDER Alarm Queue Full AL91 alarm, which does not have to be inactive in order to clear the alarm list.

To Clear the Alarm List:

If no alarms are active, the Alarm Queue may be cleared.

- Press the ALT. MODE & ALARM LIST keys.
- Press the UP/DOWN ARROW key until “CLEAR” is displayed.
- Press the ENTER key. The alarm list will clear and “-----” will be displayed.
- 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.
- Upon clearing of the Alarm Queue, the Alarm light will be turned off.

**Table 3-7. DataCORDER Alarm Indications**

| <b>To Access: Press ALT. MODE key</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                          |                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>CODE #</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>TITLE</b>                             | <b>DESCRIPTION</b>                                                                                                                                                                                                                                                                       |
| AL70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Recorder Supply Temperature Out of Range | The recorder supply air temperature is sensed outside of the range of -50°C to 70°C (-58°F to +158°F) or if the probe check logic has determined there is a fault with this sensor.<br><b>NOTE</b><br>The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1). |
| AL71                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Recorder Return Temperature Out of Range | The recorder return air temperature is sensed outside of the range of -50°C to 70°C (-58°F to +158°F) or if the probe check logic has determined there is a fault with this sensor.<br><b>NOTE</b><br>The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1). |
| AL72-74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | USDA Temperatures 1, 2, 3 Out of Range   | The USDA probe temperature reading is sensed outside of range.                                                                                                                                                                                                                           |
| AL75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Cargo Probe 4 Out of Range               | The cargo probe temperature reading is sensed outside of range.                                                                                                                                                                                                                          |
| AL76, 77                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Future Expansion                         | These alarms are for future expansion, and are not in use at this time.                                                                                                                                                                                                                  |
| AL78-85                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Network Sensors 1 - 8 Out of Range       | The network sensor is outside of its specified range. See NOTE below.                                                                                                                                                                                                                    |
| <b>NOTE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                          |                                                                                                                                                                                                                                                                                          |
| <p>While the DataCORDER is normally setup to record only supply and return recorder sensors, the DataCORDER has the capability to record the data of eight additional sensors. Any sensor installed on the unit may be recorded, and are identifiable as Network Sensors AL 78 to AL85. Which alarm (AL78 to AL 85) is associated with the physical sensor, depends on how the DataCORDER was configured. To identify which sensor is at fault, the unit must be interrogated to locate the sensor being recorded. Generally, the humidity sensor is AL78, as it is the only network sensor recorded.</p> |                                          |                                                                                                                                                                                                                                                                                          |
| AL86                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RTC Battery Low                          | The Real Time Clock (RTC) backup battery is too low to adequately maintain the RTC reading.                                                                                                                                                                                              |
| AL87                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | RTC Failure                              | An invalid date or time has been detected. This situation may be corrected by changing the Real Time Clock (RTC) to a valid value using the DataView.                                                                                                                                    |
| AL88                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DataCORDER EEPROM Failure                | A write of critical DataCORDER information to the EEPROM has failed.                                                                                                                                                                                                                     |
| AL89                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Flash Memory Error                       | An error has been detected in the process of writing daily data to the non-volatile FLASH memory.                                                                                                                                                                                        |
| AL90                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Future Expansion                         | This alarm is for future expansion, and is not in use at this time.                                                                                                                                                                                                                      |
| AL91                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Alarm List Full                          | The DataCORDER alarm queue is determined to be full (eight alarms).                                                                                                                                                                                                                      |

The DataCORDER alarms for the USDA and cargo probes are configurable using the interrogation program or via a configuration card. There are four configuration variables for the DataCORDER, which are listed in Table 3-8 with their descriptions and selection values.

| Configuration Variable | Description       | Selection Values |
|------------------------|-------------------|------------------|
| dCF07                  | USDA (PR1)        | Auto,On,Off      |
| dCF08                  | USDA (PR2)        | Auto,On,Off      |
| dCF09                  | USDA (PR3)        | Auto,On,Off      |
| dCF10                  | Cargo Probe (PR4) | Auto,On,Off      |

The default configuration for the four probes is “Auto.” If the alarms are configured as “Auto,” and all the probes are missing (i.e., appear open-circuited to the DataCORDER), no alarms are activated. As soon as one of the probes is installed (plugged into the receptacle), then all of the alarms are enabled and the remaining probes that are not installed will give active alarm indications. This function is designed to assist those users who wish to keep their DataCORDER configured for USDA recording, and do not wish to install the probes for every trip.

If a probe alarm is configured to be “On,” then the associated alarm is always enabled. As long as the probe remains in-circuit (plugged in), the alarm will not be activated. Probes with this configuration have alarms that act like the alarms for the supply and return recorder sensors. It is presumed that normal operation includes the probe in question.

If a probe alarm is configured to be “Off,” then the alarm for this probe is always disabled. It is not possible to activate the respective alarm for this probe no matter what the circumstance.

### 3.3.5 Access to DataCORDER Functions

To access the DataCORDER functions codes, alarm codes, configuration and scrollback, the user must first press the ALT. MODE key, then press the applicable key for functions (CODE SELECT) or alarms (ALARM LIST).

#### a. Keypad/Display Interface

The DataCORDER uses the Controller display and keypad. The DataCORDER contains four types of display parameters. They are: functions codes, alarm codes, configuration and scrollback.

#### b. DataCORDER Power-Up

The DataCORDER may be powered up in several ways:

1. *Normal AC power:* The DataCORDER is powered up when the unit is turned on via the stop-start switch (ST).
2. *Normal DC power:* If a rechargeable battery pack is installed (fully charged), the user may plug the interrogation cable into the front interrogation receptacle and the DataCORDER will power up for communications.

On every DataCORDER wake-up, while using battery-pack power, the Controller will first perform a hardware voltage check on the battery. If the hardware check passes, the Controller will energize the appropriate circuitry and perform a software battery voltage check before DataCORDER logging. If either the hardware or software battery test fails, the real time clock (RTC) battery-backed wake-up will be disabled until the next AC power cycle. Further DataCORDER temperature logging will be prohibited until that time.

A 12 volt VCR battery pack may also be plugged into the back of the interrogation cable, which is then plugged into either interrogation port. No rechargeable battery pack is required with this method. The user may now interrogate the DataCORDER.

3. *Real Time Clock (RTC) because a logging interval has expired:* If the DataCORDER is equipped with a charged battery pack and AC power is not present, the DataCORDER will power up when the RTC indicates that a data recording should take place. When the DataCORDER is finished recording, it will power down.

#### c. DataCORDER Battery Pack Test

If the DataCORDER has the optional battery pack, then the battery voltage will be tested once every five minutes. 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 probably needs replacement.

#### d. Trip Start Processing

To initiate Trip Start:

- Press the ALT. MODE key
- Select function code dC30
- Depress the ENTER key for five seconds

Trip Start will flash for five seconds, turn solid, then the date will appear to indicate that a Trip Start is registered. Trip Start may also be initiated via communications using the interrogation program.

e. Display vs. Configuration Codes

The DataCORDER contains two types of display codes; Display and Configuration. Display codes will display parameter values, but will not let them be modified. Configuration codes can be modified via the interrogator or with the insertion of the common configuration software card.

f. Data Recording Mode

The DataCORDER recording mode is labeled as Standard. To see an example of a report using a standard configuration, see Figure 3-3.

*Generic Mode:*

The generic recording mode is used for special data recordings. The user may select up to eight different sensor readings. The sensors available for this type of recording are listed below. Changing the configuration to generic and selecting which sensors to record may be done via the Interrogation program.

Configurable Generic Recording Options:

- Control mode
- Control temperature
- Frequency
- Humidity (Standard configuration: 6 or 64)
- Phase A current
- Phase B current
- Phase C current
- Mains voltage
- Suction modulation valve (SMV) percentage
- Discrete outputs (Bit mapped - require special handling if used)
- Discrete inputs (Bit mapped - require special handling if used)
- Ambient sensor (AMBS)
- Compressor suction sensor (CPSS)
- Compressor discharge sensor (CPDS)
- Return temperature sensor (RTS)
- Supply temperature sensor (STS)
- Defrost termination sensor (DTS)
- Discharge pressure transducer (DPT)
- Suction pressure transducer (SPT)
- Condenser pressure transducer (CPT)

*Standard Mode:*

The standard recording mode allows the user to configure the DataCORDER to monitor data using one of seven standard configurations. The seven standard configuration variables, with their descriptions, are listed in Table 3-9.

The six thermistor inputs (supply, return, USDA #1, #2, #3 and cargo probe) and the humidity sensor will be DataCorder inputs. The three inputs will be read over a network from the Controlled Atmosphere module.

In addition, if NO Controller alarms are active, the most recent active DataCORDER alarm will be displayed on the Display Module alternately with set point.

| <b>Standard Configuration</b>                       | <b>Description</b>                                                                                                                                           |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 sensors<br>(dCF02 = 2)                            | 2 thermistor inputs(supply & return)                                                                                                                         |
| 5 sensors<br>(dCF02 = 5)                            | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs                                                                                             |
| 6 sensors<br>(dCF02 = 6)                            | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs<br>1 humidity input                                                                         |
| 9 sensors<br>(dCF02 = 9)                            | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs<br>* 3 Controlled Atmosphere inputs<br>1 humidity input                                     |
| 6 sensors<br>(dCF02 = 54)                           | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs<br>1 cargo probe (thermistor input)                                                         |
| 7 sensors<br>(dCF02 = 64)                           | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs<br>1 humidity input<br>1 cargo probe (thermistor input)                                     |
| 10 sensors<br>(dCF02 = 94)                          | 2 thermistor inputs(supply & return)<br>3 USDA thermistor inputs<br>* 3 Controlled Atmosphere inputs<br>1 humidity input<br>1 cargo probe (thermistor input) |
| * Not Available on models 69NT40-511 or 69NT40-521. |                                                                                                                                                              |

g. DataCORDER Alarm History List

The DataCORDER contains a buffer of up to eight alarms. The list may be displayed by pressing the ALARM LIST key. The alarm history keypad and display processing will be the same as the Controller module. The format of an alarm history display entry is as follows:

|                       |                                                              |
|-----------------------|--------------------------------------------------------------|
| <i>Left Display:</i>  | "dALnn" where nn = the alarm history entry 01-08             |
| <i>Right Display:</i> | "xA nn" where x = "I" (inactive) or "A" (active)             |
| <i>Or:</i>            | "-----" if no alarms are currently in the alarm history list |

#### h. Alarm Processing

The DataCORDER contains an eight alarm history queue which will contain the first eight alarms detected by the DataCORDER. The alarms and their corresponding alarm codes are specified in Table 3-7. The alarm queue will be located in the Battery Backed RAM (BRAM). The queue will also have a corresponding status which will indicate whether each alarm is currently active or inactive. If multiple consecutive occurrences of an alarm are generated, only the first will be stored. The queue may be cleared by using the keypad. (If more than eight alarms occur before the queue is cleared, later alarms will be ignored.) In addition, AL91 alarm code will appear if the DataCORDER queue is full.

The out of range value is as follows:

|                           |                                                  |
|---------------------------|--------------------------------------------------|
| <i>Thermistor Inputs:</i> | Low limit = -50.0 degC<br>High limit = 70.0 degC |
|---------------------------|--------------------------------------------------|

#### 3.3.6 USDA/ Message Trip Comment

A special case event is supported for allowing the user to enter comments for a (USDA or any message) trip recording. The comments will be received from the interrogator and have a maximum length of 78 characters. Only one comment will be recorded per day. In the event that multiple comments occur, then only the last is saved.

#### 3.3.7 USDA Recording

A special type of recording is provided for USDA cold treatment purposes. Cold treatment recording requires three remote temperature probes to be placed at various locations of 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 (five, on some units) receptacles are provided. Four (three-pin) receptacles are for the probes and one (five pin) receptacle is provided for the Interrogator. All receptacles are sized to accept a Deutsch HD16-5-16S size plug with a tricam coupling locking device. The DataCORDER inputs are designed to accept a two wire thermistor probe.

A label on the back panel of the unit shows which receptacle is used for each probe. The USDA #1, #2 and

#3 probes (and possibly the optional Cargo probe) are installed in their receptacles.

The DataCORDER records up to six probe temperatures (supply, return, USDA #1, #2, #3 and an optional cargo probe #4), at the logging interval.

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.

When the Relative Humidity Set Point mode is activated or de-activated (ie., Controller function code Cd33), this status is stored in the DataCORDER memory and reported at the next recording, as are like events such as economy mode and bulb mode.

#### 3.3.8 Pre-Trip Data Recording

The unit is equipped with the ability to record pass/fail information along with unit data resulting from the initiation of pre-trip (see section 3.2.2). The data is time-stamped and may be extracted via interrogation using CTD's interrogation program. See Table 3-10 for a description of the data stored in the DataCORDER for each corresponding Pre-Trip test.

#### 3.3.9 DataCORDER Communications

##### a. DataCORDER Retrieval - Interrogation

Data retrieval from the DataCORDER can be accomplished with three devices: a CTD DataReader and DataView software, a stand-alone DOS-base portable computer with appropriate cable and DataView software, or a Remote Monitoring Unit (RMU).

#### NOTE

The RMU designation is used in the industry. Be aware that CTD uses the designation CI (Communications Interface Module) on its schematics.

The optional interrogation software for a portable computer is supplied on a 3.5 and 5.25 inch floppy disk. This software allows interrogation, screen view of the data, hard copy report generation, cold treatment probe calibration, cold treatment initialization and file management.

#### NOTE

Refer to Interrogation manual 62-02575 for a more detailed explanation of the interrogation software.

A short report on that interrogation can be displayed on the computer to identify key information such as Trip

Start, Power Outages, and Temperature Out-of-Range conditions.

### 3.3.10 DataCORDER Scrollback

The DataCORDER will display probe values for the six DataCORDER probes up to 99 hours back from the current hour. The probe values may be displayed by depressing the ALT. MODE key and then depressing the UP or DOWN ARROW keys until “dCdSP” is shown in the left display window and then depressing the ENTER key. The sensor to display can then be chosen by depressing the UP or DOWN ARROW key until the desired sensor (S for supply, r for return, P1, P2, P3 and C4 for USDA and Cargo probes) is shown in the left display window and then depressing the ENTER key. A temperature value will appear in the right display window and 1 (with sensor designation) will appear in the left display window to signify the temperature displayed is the most recent reading. Each press of the DOWN ARROW key displays the temperature one hour earlier. Use the ENTER key to alternate between sensors and times/temperatures. Use the ARROW keys for scrolling. The display will return to normal if 15 seconds lapse without a key being pressed.

### 3.4 USDA COLD TREATMENT PROCEDURE

Sustained cold temperature has been employed as an effective postharvest method for the control of Mediterranean and certain other tropical fruit flies. Exposing infested fruit to temperatures of 2.2 degrees Celsius (36°F) or below for specific periods results in the mortality of the various stages of this group of notoriously injurious insects.

In response to the demand to replace fumigation with this environmentally sound process, Carrier has integrated this Cold Treatment capability into its DataCORDER. 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 (refer to section 3.3.7).

The following is a summary of the steps required to initiate a USDA Cold Treatment.

a. Pre-cool the container to the treatment temperature or below.

- b. Pre-cool to treatment temperature.
- c. Install the DataCORDER module battery pack (if not already installed).
- d. Calibrate the three USDA probes by ice bathing the probes and performing the calibration function with the hand held DataReader or a DOS-based portable computer. This calibration procedure determines the probe offsets and stores them in the Controller for use in generating the cold treatment report. Refer to the Interrogation manual 62-02575 for more details.
- e. Place the three probes required for a USDA cold treatment procedure. The probes are placed into the pulp or the fruit at the locations defined below as the product is loaded.

|          |                                                                                                                                                                                                                                               |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sensor 1 | Place in pulp of the product located next to the return air intake.                                                                                                                                                                           |
| Sensor 2 | Place in pulp of the product five feet from the end of the load for 40 foot containers, and three feet from the end of the load for 20 foot containers. This probe should be placed in a center carton at one-half the height of the load.    |
| Sensor 3 | Place in pulp of product five feet from the end of the load for 40 foot containers and three feet from the end of the load for 20 foot containers. This probe should be placed in a carton at a side wall at one-half the height of the load. |

f. To initiate USDA Recording begin the cold treatment recording, connect the Interrogator and perform the configuration as follows:

- Trip Start
- Trip Comment
- Configure for five probes
- One hour logging interval
- USDA temperature log in
- Two byte memory storage format
- Probe calibration

g. Retrieval of trip data from the DataCORDER memory can be accomplished with a DataReader and DataView software or DataView software and a DOS-based portable computer. Contact a Carrier Transicold Service Parts representative for details.

**Table 3-10. DataCORDER Pre-Trip Data**

| TEST #                                                                                                                                                                                                             | TITLE                           | DATA                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>NOTE</b>                                                                                                                                                                                                        |                                 |                                                                                                           |
| “Auto” or “Auto1” menu includes the following: P, P1, P2, P3, P4, P5, P6 and rSLts. “Auto2’ (Optional) menu includes the following: P, P1, P2, P3, P4, P5, P6,P7, P8, P9, P10 and rSLts. (Refer to section 3.2.1.) |                                 |                                                                                                           |
| 1-0                                                                                                                                                                                                                | Heater On                       | Pass/Fail/Skip Result, Change in current for Phase A, B and C                                             |
| 1-1                                                                                                                                                                                                                | Heater Off                      | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 2-0                                                                                                                                                                                                                | Condenser Fan On                | Pass/Fail/Skip Result, Water pressure switch (WPS) – Open/Closed, Change in currents for Phase A, B and C |
| 2-1                                                                                                                                                                                                                | Condenser Fan Off               | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 3-0                                                                                                                                                                                                                | Low Speed Evaporator Fan On     | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 3-1                                                                                                                                                                                                                | Low Speed Evaporator Fan On     | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 4-0                                                                                                                                                                                                                | High Speed Evaporator Fan On    | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 4-1                                                                                                                                                                                                                | High Speed Evaporator Fan On    | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 5-0                                                                                                                                                                                                                | Supply/Return Probe Test        | Pass/Fail/Skip Result, STS, RTS, SRS and RRS                                                              |
| 5-1                                                                                                                                                                                                                | Secondary Supply Probe Test     | Pass/Fail/Skip Result                                                                                     |
| 5-2                                                                                                                                                                                                                | Secondary Return Probe Test     | Pass/Fail/Skip Result                                                                                     |
| 6-0                                                                                                                                                                                                                | Compressor On - High Speed      | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 6-1                                                                                                                                                                                                                | Compressor On - Low Speed       | Pass/Fail/Skip Result, Change in currents for Phase A, B and C                                            |
| 6-2                                                                                                                                                                                                                | Suction Modulation Valve Open   | Pass/Fail/Skip Result, STS, RTS, Is current limit in effect? (Y,N)?                                       |
| 6-4                                                                                                                                                                                                                | Suction Modulation Valve Closed | Pass/Fail/Skip Result, STS, RTS, Delta T1, Delta T2, Is current limit in effect? (Y,N)?                   |
| 6-5                                                                                                                                                                                                                | Suction Solenoid Valve Open     | Pass/Fail/Skip Result, STS, RTS, Is current limit in effect? (Y,N)?                                       |
| 7-0                                                                                                                                                                                                                | High Pressure Switch Closed     | Pass/Fail/Skip Result, AMBS, DPT or CPT (if equipped) Input values that component opens?                  |
| 7-1                                                                                                                                                                                                                | High Pressure Switch Open       | Pass/Fail/Skip Result, STS, DPT or CPT (if equipped) Input values that component closes?                  |
| 8-0                                                                                                                                                                                                                | Perishable Heat                 | Pass/Fail/Skip Result, STS, time it takes to heat to 16°C (60°F)?                                         |
| 8-1                                                                                                                                                                                                                | Perishable Pull Down            | Pass/Fail/Skip Result, STS, time it takes to pull down to 0°C (32°F)?                                     |
| 8-2                                                                                                                                                                                                                | Perishable Maintain             | Pass/Fail/Skip Result, Averaged DataCORDER supply temperature (SRS) over last recording interval.         |
| 9-0                                                                                                                                                                                                                | Defrost Test                    | Pass/Fail/Skip Result, DTS temperature at end of test, line voltage, line frequency, time in defrost.     |
| 10-0                                                                                                                                                                                                               | Frozen Mode Set-up              | Pass/Fail/Skip Result, STS, time unit is in heat.                                                         |
| 10-1                                                                                                                                                                                                               | Frozen Mode Pull Down           | Pass/Fail/Skip Result, STS, time to pull down unit to -17.8°C (0°F).                                      |
| 10-2                                                                                                                                                                                                               | Frozen Mode Maintain            | Pass/Fail/Skip Result, Averaged DataCORDER return temperature (RRS) over last recording interval.         |

HEADER INFORMATION

DataCorder SN: XXXXXXXXX

ALARMS REPORT

ALARM NUM            FIRST ACTIVE            LAST ACTIVE

CONTROLLER ALARMS:

60                    17Apr94 03:28            17Apr94 16:13

DATAORDER ALARMS

No Alarms Reported

USDA SUMMARY

DATE: 15Apr94 23:49 Trip Start

LEGEND

|        |                   |          |                   |      |                |
|--------|-------------------|----------|-------------------|------|----------------|
| SP     | Setpoint Change   | DS       | Defrost Start     |      |                |
| PS, PE | Pretrip Start/End | DHS, DHE | Dehumid Start/End |      |                |
| NEW SN | Controller Rep.   | NEW ID   | Container ID      | DE   | Defrost End    |
| dal    | Datacorder Alm    | OFF      | Power Loss        | AL   | Alarm Activity |
| NEW SW | Software Upgrade  | COMM     | NetWork Off       | TS   | Trip Start     |
|        |                   |          |                   | BATT | Power Loss     |

----- Setp  
 - - - - - SupAir  
 - . - . - RetAir

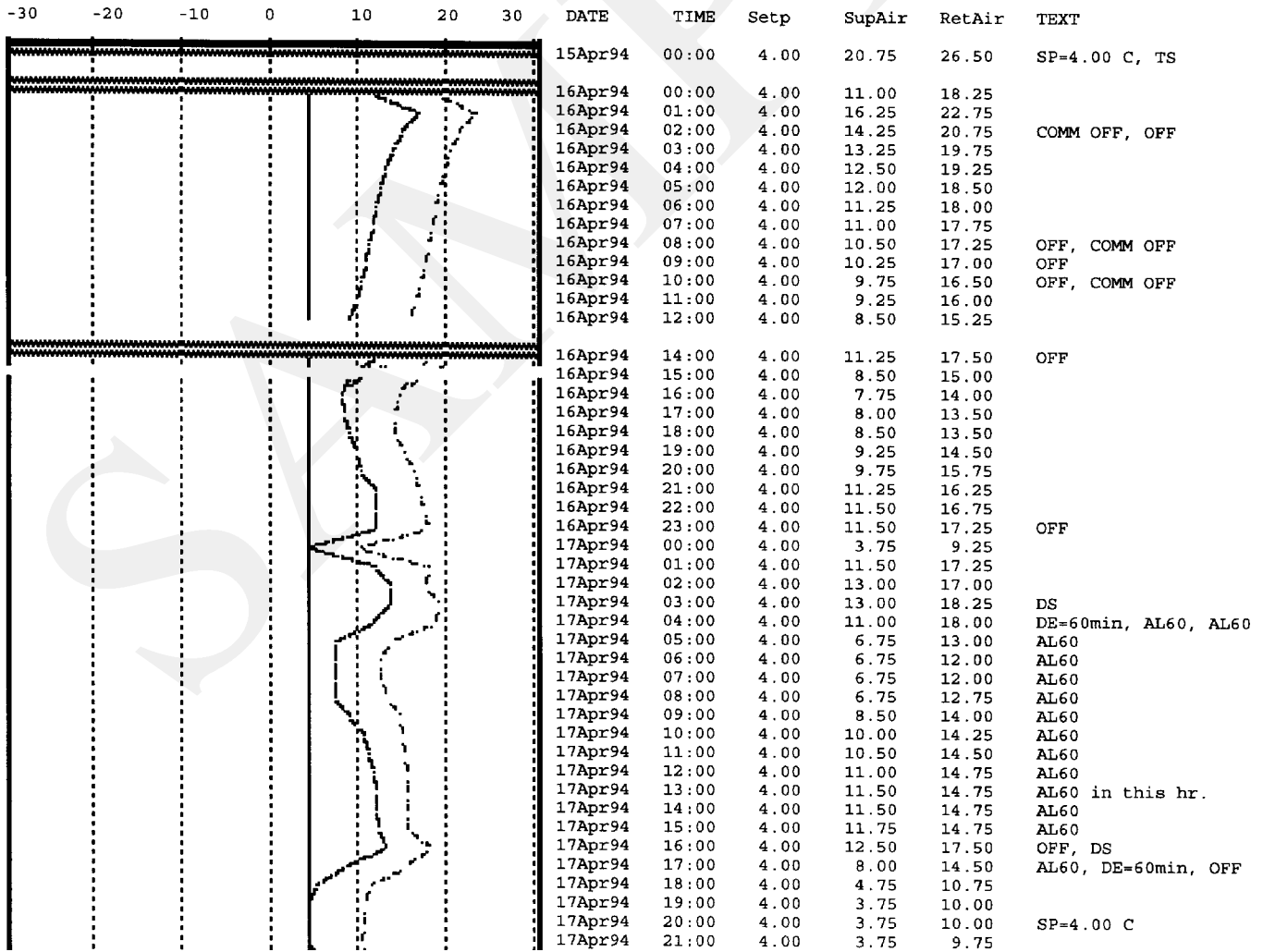
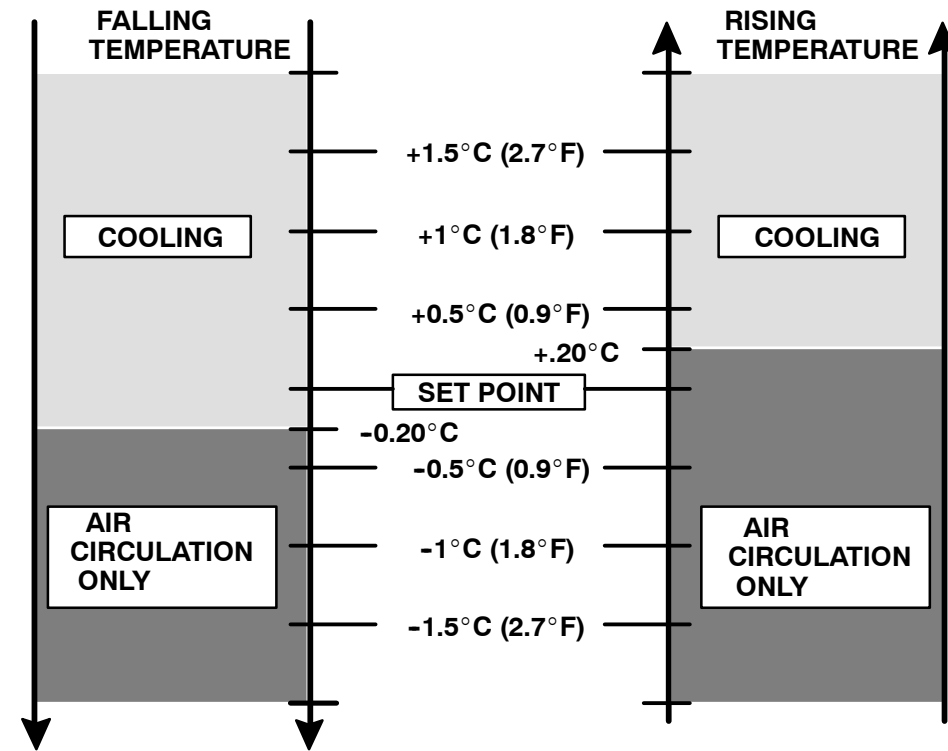


Figure 3-3. Standard Configuration Report Sample

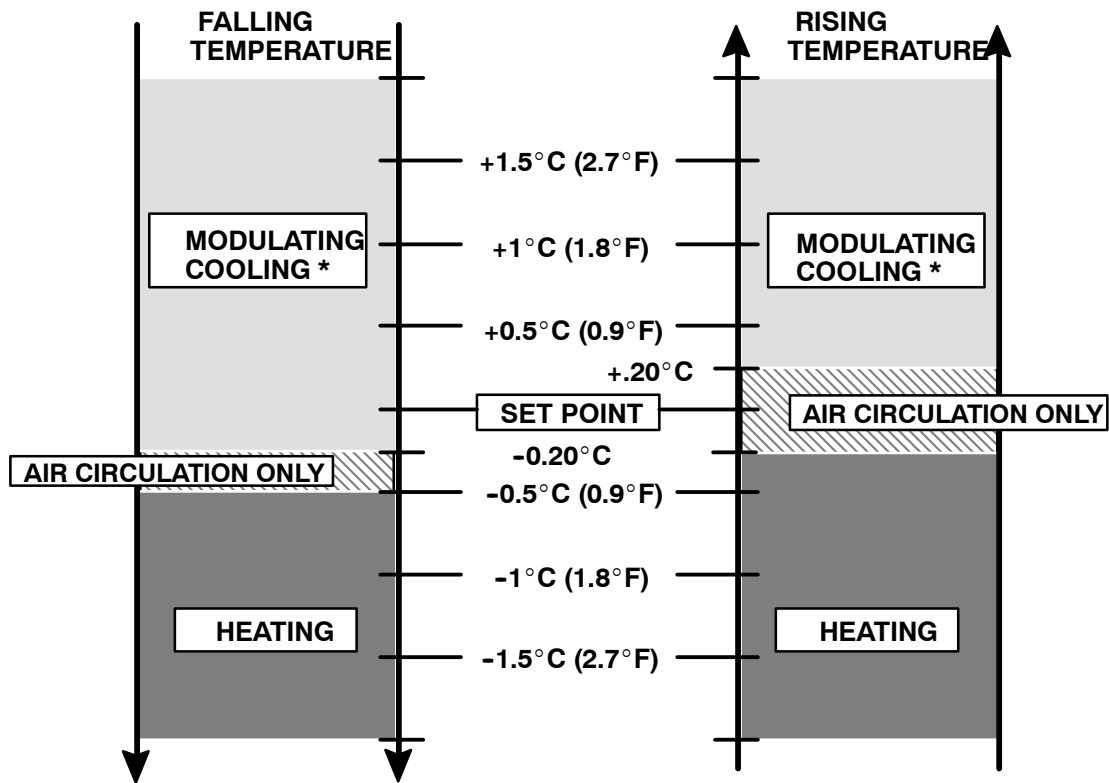




**NOTE**

For In-range Tolerance, Refer to section 3.1.4 Code 30.

**Figure 3-4. Controller Set Point BELOW  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally**



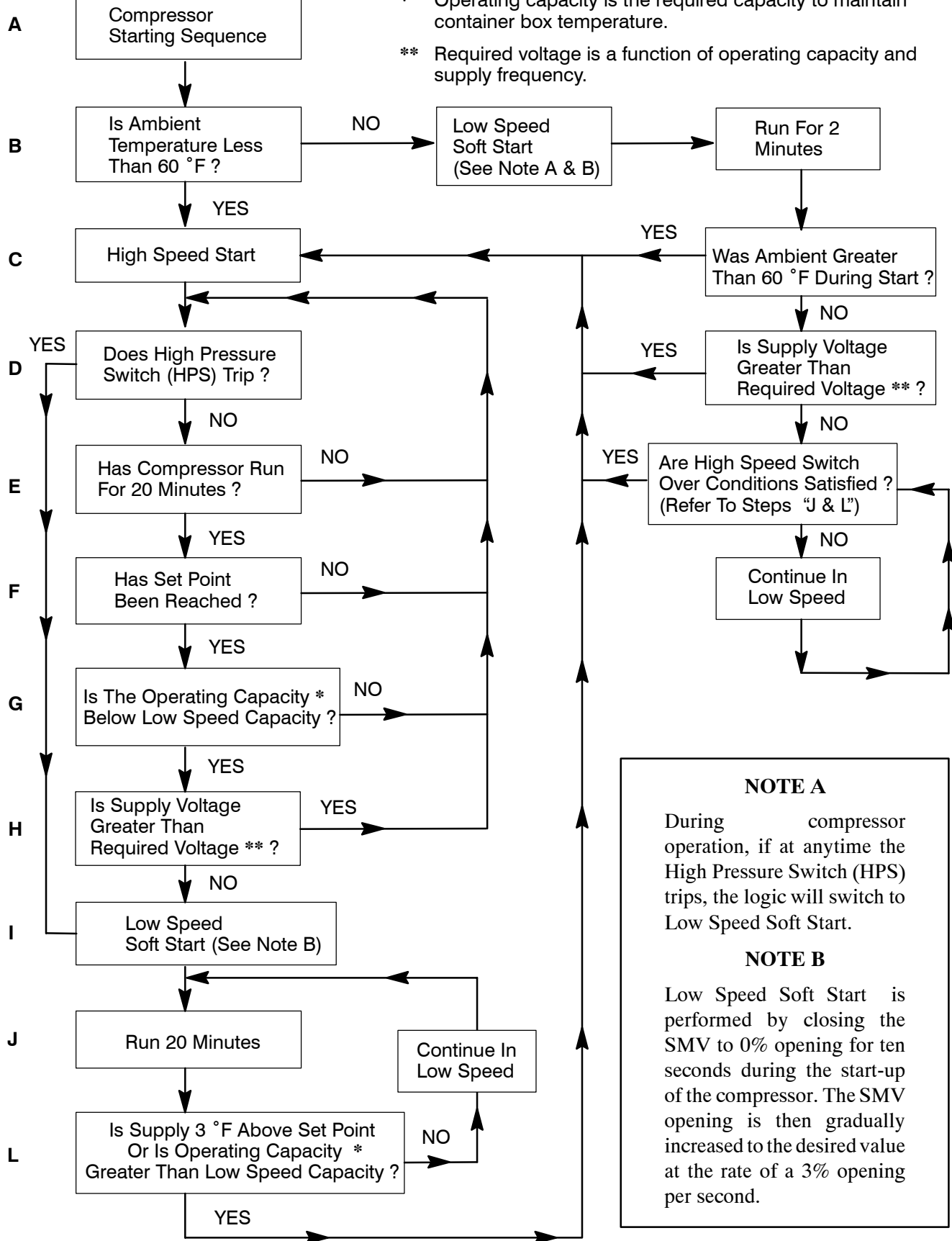
**NOTE**

For In-range Tolerance, Refer to section 3.1.4 Code 30.

\* For Two-Speed compressor operation refer to Figure 3-6.

**Figure 3-5. Controller Set Point ABOVE  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally**

**STEP**



\* Operating capacity is the required capacity to maintain container box temperature.

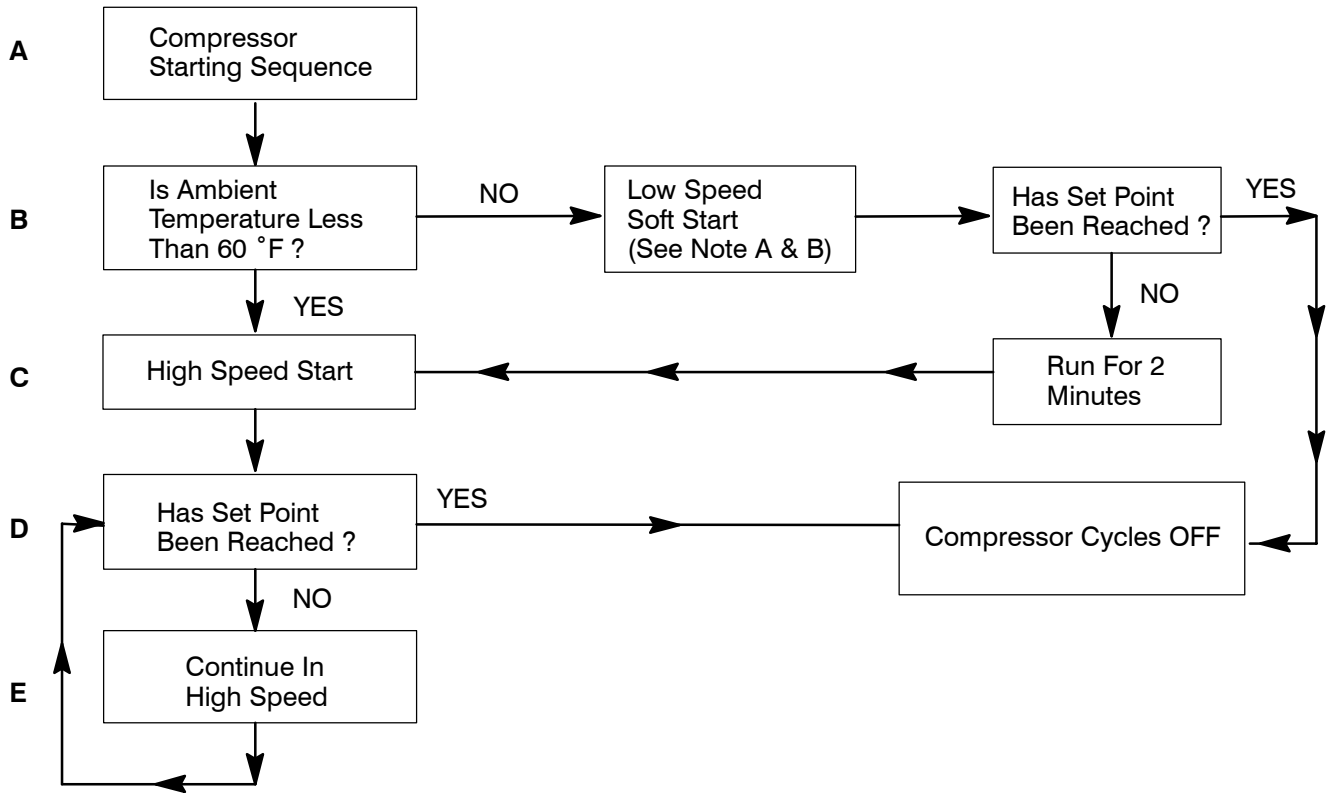
\*\* Required voltage is a function of operating capacity and supply frequency.

**NOTE A**  
 During compressor operation, if at anytime the High Pressure Switch (HPS) trips, the logic will switch to Low Speed Soft Start.

**NOTE B**  
 Low Speed Soft Start is performed by closing the SMV to 0% opening for ten seconds during the start-up of the compressor. The SMV opening is then gradually increased to the desired value at the rate of a 3% opening per second.

**Figure 3-6. Two-Speed Compressor Speed Change Logic - Perishable Range Only**

**STEP**



**NOTE A**

During compressor operation, if at anytime the High Pressure Switch (HPS) trips, the logic will switch to Low Speed Soft Start.

**NOTE B**

Low Speed Soft Start is performed by closing the SMV to 0% opening for ten seconds during the start-up of the compressor. The SMV opening is then gradually increased to the desired value at the rate of a 3% opening per second.

**SECTION 3**

**Figure 3-7. Two-Speed Compressor Speed Change Logic - Frozen Range Only**

## SECTION 4

### OPERATION

#### 4.1 PRE-TRIP INSPECTION (Before Starting)

##### WARNING

**Beware of unannounced starting of the evaporator and condenser fans.**

- a. If container is empty, check inside for the following:
  1. Check channels or “T” bars on floor for cleanliness. Channels must be free of debris for proper air circulation.
  2. Check container panels, insulation and door seals for damage. Effect permanent or temporary repairs.
  3. Visually check evaporator fan assembly clamp bolts for proper securement (refer to section 6.15).
  4. Check for dirt or grease on evaporator fan or fan deck and clean if necessary.
  5. Check evaporator coil for cleanliness or obstructions. Wash with fresh water. (Refer to section 6.13.)
  6. Check defrost drain pans and drain lines for obstructions and clear if necessary. Wash with fresh water.
  7. Check panels on refrigeration unit for loose bolts and condition of panels. Make sure T.I.R. devices are in place on access panels.
- b. Check condenser coil for cleanliness. Wash with fresh water. (Refer to section 6.17.)
- c. Check position of fresh air makeup vent cover. Operator must determine if fresh air makeup vent cover is to be opened or closed.
- d. Open Partlow recording thermometer door (if so equipped) and do the following:
  1. Manually wind clock on key wound recording thermometer (key is located in a clip.) **KEY MUST STAY WITH THE THERMOMETER.** Check battery on battery powered recording thermometer.
  2. Lift stylus (pen) by pulling the marking tip outward until the stylus arm snaps into it’s retracted position.
  3. Install new chart on recording thermometer making sure chart is under the four corner tabs. Lower the stylus until stylus has made contact with the chart. Then close and secure door.
- e. Open Saginomiya recording thermometer door (if so equipped) and do the following:
  1. Check Chart drive battery condition. (Refer to section 6.20.)
  2. Lift stylus (pen) by pushing in the stylus lifter and rotating the lifter clockwise (raising stylus at same time) until lifter locks in position.
  3. Install new chart on recording thermometer making sure chart is under the four corner tabs. Release stylus lifter by pushing down and rotating lifter counterclockwise until stylus lifter locks in position and stylus has made contact with chart. Then close door.
- f. Open control box door. Check for loose electrical connections or hardware.
- g. Check color of moisture-liquid indicator.
- h. Check oil level in compressor sight glass.
- i. Start refrigeration unit. (Refer to section 4.3.)

## 4.2 STARTING AND STOPPING INSTRUCTIONS

### CAUTION

**Make sure that the unit circuit breaker(s) (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position before connecting to any electrical power source.**

#### a. Starting the Unit

##### NOTE

The evaporator fans will always start in high speed regardless of set point and will switch to low speed after approximately 20 to 30 seconds if the set point is below  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally.

1. Refer to Pre-Trip Inspection, section 4.1.
2. Check power source for proper voltage. Connect unit power plug and turn main power ON.
3. Turn refrigeration unit circuit breaker(s), and the start-stop switch to ON (position "1").

#### 4. *Units equipped with the integrated DataCORDER:*

Trip start is initiated by depressing the ALT. MODE key and selecting Code dc30, then depressing the ENTER key for five seconds.

5. Refer to section 4.3 after unit is running.

#### b. Stopping the Unit

Turn the start-stop switch to position "0" (OFF position).

## 4.3 AFTER STARTING INSPECTION

- a. Check rotation of condenser and evaporator fans.
- b. Check compressor oil level. (Refer to section 6.10.)
- c. Run unit at least five minutes to stabilize. Start controller Pre-Trip diagnostics. (Refer to section 3.2.)

## 4.4 UNIT OPERATION

### 4.4.1 Crankcase Heater

When the crankcase heater is installed, it will be operational whenever the compressor is off and there is power to the unit. The heater is connected to a set of normally closed auxiliary contacts on the compressor contactor (CH).

### 4.4.2 Probe Check Initiation

Whenever the unit is in normal control mode, that is, not in pre-trip, defrost or shutdown modes and there are NO active probe alarms, and alarm codes AL11 and AL12 are inactive (for units so equipped), the following probe diagnostic functions are performed by the controller.

*The following is based on current ML2i operational software logic, version 5103. Older versions of software will have differences.*

#### a. Probe Diagnostic Logic

If the unit is configured for standard (Std) "Probe Check Logic," the criteria used for comparison between the primary and secondary **control** probes is:

- $1^{\circ}\text{C}$  ( $1.8^{\circ}\text{F}$ ) for **perishable** set points, above  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally.
- $2^{\circ}\text{C}$  ( $3.6^{\circ}\text{F}$ ) for **frozen** set points, below above range.
- If 25 or more of 30 readings taken within a 30 minute period are out-of-range per the above criteria, then a defrost\* is initiated and a probe check is performed.

#### b. Special

If the unit is configured for special (SPEC) "Probe Check Logic," the above criteria is identical except for the diagnostic readings which are:

- If 25 or more of 30 readings taken within a 30 minute period **OR** any 10 consecutive readings at any time are out-of-range per the above criteria, then a defrost\* is initiated and a probe check is performed.

\* The only time defrost will not be initiated is if the defrost termination sensor (DTS) is greater than  $25.56^{\circ}\text{C}$  ( $78^{\circ}\text{F}$ ).

The 30 minute timer will be reset for each of the following conditions:

- At every power up.
- At the end of every defrost.
- After every diagnostic check that does not fall outside of the limits as described under "standard or special" as outlined above.

If AL55 is active, meaning that the DataCORDER (DC) functionality is no longer active (DC configuration variable off), the Controller will act as a four probe configured system during probe checks. The only differences will be that the Controller Function Codes Cd38 and Cd39 will become enabled thus allowing access to the secondary probe readings since the DC functions, codes and alarms have become deactivated. Controller alarms AL70 and AL71 will replace DC alarms AL70 and AL71 respectively for the secondary probes.

If the unit is configured for standard (Std) "Probe Check Logic," a probe check will be run as a part of **every** normal defrost.

If the unit is configured for special (SPEC) "Probe Check Logic," a probe check will **not** be run as a part of a normal defrost, but **only** as a part of a defrost initiated due to a diagnostic reading outside of the limits as outlined above under "special."

### c. Probe Check

During a defrost cycle that includes a probe check, after the heaters turn off, the evaporator motors will be energized for an additional eight minutes after which all the primary/secondary probes will be compared to a set of predetermined limits.

*The defrost indicator will remain on throughout this period.*

Any probe(s) determined to be outside the limits will cause the appropriate alarm code(s) to be displayed to identify which probe(s) needs to be replaced.

*The limits used during a probe check are tighter than those used for the diagnostic criteria to ensure accurate detection of a faulty probe(s).*

### NOTES

- Be aware that probe check and probe diagnostics are two separate functions. The function of the diagnostic logic is to alert the microprocessor of a discrepancy with the control probe(s). The function of the probe check is to determine what probe(s) is in error.
- The P5 Pre-Trip test must be run to inactivate alarms (refer to section 3.2.1).

### 4.4.3 Cooling - Controller Set BELOW -10°C (+14°F), or -5°C (+23°F) optionally

#### NOTES

- The suction solenoid valve (SSV) will be open to increase the refrigerant flow rate and cooling capacity unless SSV override is activated.
- The suction modulation valve (SMV) is 100% open.
- The evaporator motors run in low speed.
- The compressor runs in high speed.
- Refer to Figure 3-7 for a description of the dual speed compressor change logic.

When the return air temperature decreases to 0.2°C (0.4°F) below set point, relays TD and TN de-energize. This results in de-energizing the compressor and condenser fan motor. Also, the cool light is de-energized. The evaporator fan motors continue to run to circulate air throughout the container.

When the return air temperature increases to 0.2°C (0.4°F) above set point, and providing a sufficient off-time period has elapsed, relays TD and TN energize to restart the compressor and condenser fan motor. Also at this time, the cool light is illuminated.

### 4.4.4 Controller Set ABOVE -10°C (+14°F), or -5°C (+23°F) optionally

#### NOTE

Evaporator fan motors will run in high speed. (Contactor EF energized.)

#### a. Cooling in High Speed with Two-Speed Compressor (See Figure 4-1.)

#### NOTE

A pressure control system has been incorporated by means of a condenser pressure transducer (CPT) and condenser pressure control (CPC) logic to maintain discharge pressures above 130 psig in low ambients.

The condenser fan will cycle off if the condenser pressure is below 130 psig. If the condenser pressure rises above 200 psig, the condenser fan will cycle on.

With supply air temperature decreasing, and if the supply air is above set point, the unit will be cooling with the condenser fan motor, compressor motor and evaporator fan motors energized. Also, at this time, the cool light is illuminated.

When the air temperature decreases to a predetermined tolerance above set point, relay TI energizes and the in-range light is illuminated.

(Refer to section 3.1.4, Code 30.)

If the air temperature continues to fall, modulating cooling starts at approximately 2.5°C (4.5°F) above set point. The modulating valve will have a variable current up to 1.30 amps at full modulation.

During this cooling mode, a running sum of the temperature differential (supply air temperature minus the set point) is kept. When the supply air falls below set point, the differential is negative. The longer supply air remains below set point, the greater the differential in the running sum.

When the supply air temperature decreases to 0.2°C below set point and the running sum is less than -250 degrees C-seconds, relays TN and TC de-energize

shutting off the condenser fan and compressor motors. Also, the cool light is de-energized.

The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within a tolerance of set point, and the 15 minute override is met.

If the unit is in the holding mode (neither heating nor cooling) and the supply air temperature increases to 0.2°C (0.4°F) above set point, and providing a six minute off time has elapsed, relay TC energizes to restart the compressor. Also, at this time, the condenser fan motor starts and the cool light is illuminated.

During this mode the dual speed compressor can be either running in high or low speed depending on the box load. Refer to Figure 3-6 for a description of the speed change logic.





**b. Cooling in Low Speed with Two-Speed Compressor (See Figure 4-2.)**

**NOTE**

Evaporator fan motors will run in high speed.  
(Contactor EF energized)

**NOTE**

A pressure control system has been incorporated by means of a condenser pressure transducer (CPT) and condenser pressure control (CPC) logic to maintain discharge pressures above 130 psig in low ambients.

The condenser fan will cycle off if the condenser pressure is below 130 psig. If the condenser pressure goes above 200 psig, the condenser fan will cycle on.

With supply air temperature decreasing, and if the supply air is above set point, the unit will be cooling with the condenser fan motor, compressor motor and evaporator fan motors energized. Also, at this time, the cool light is illuminated.

When the air temperature decreases to a predetermined tolerance above set point, relay TI energizes and the in-range light is illuminated.

(Refer to section 3.1.4, Code 30.)

If the air temperature continues to fall, modulating cooling starts at approximately 2.5°C (4.5°F) above set

point. The modulating valve will have a variable current up to 1.30 amps at full modulation.

During this cooling mode, a running sum of the temperature differential (supply air temperature - set point) is kept. When the supply air falls below set point, the differential is negative. The longer supply air remains below set point, the greater the negative differential in the running sum.

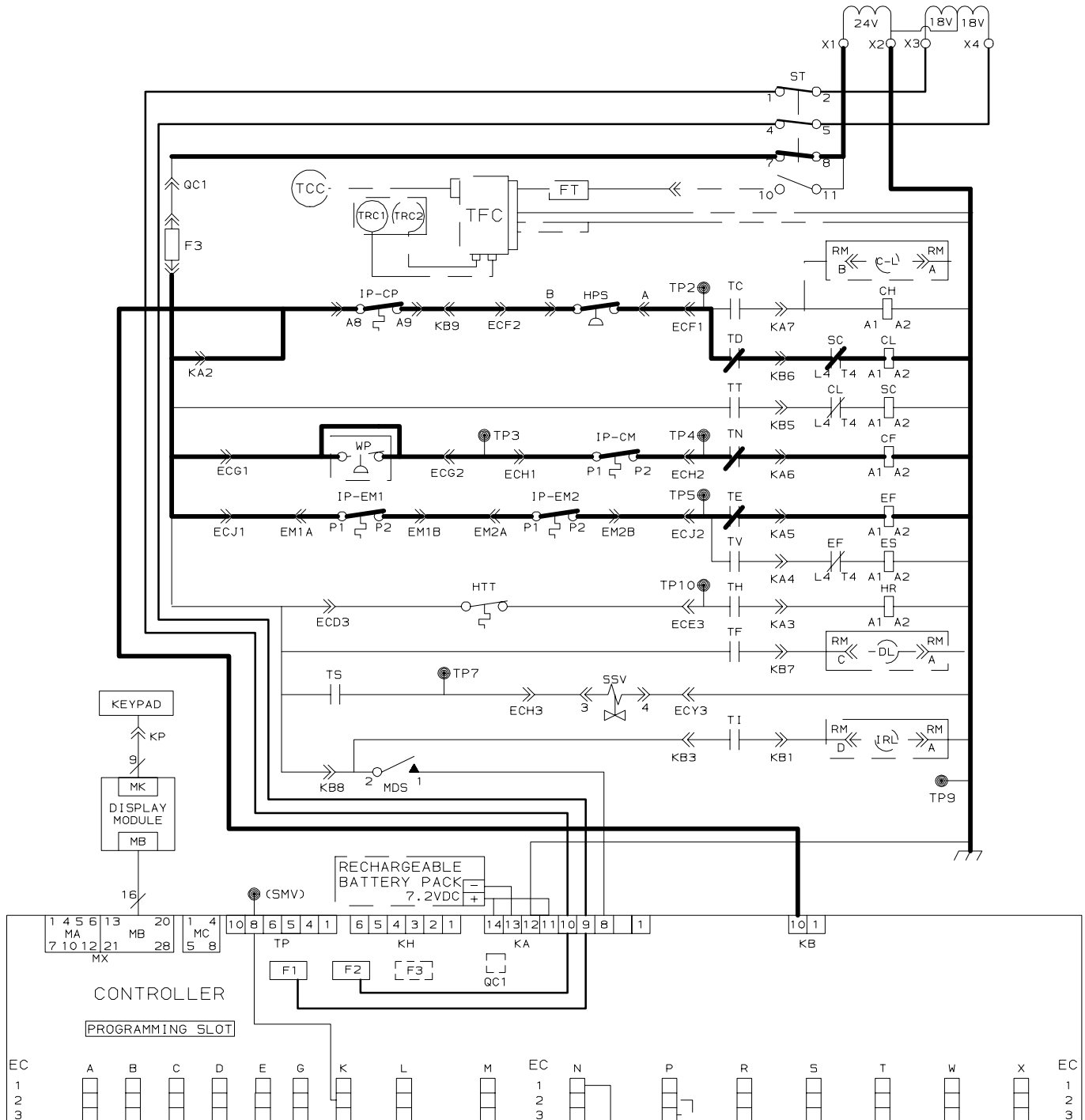
When the supply air temperature decreases to 0.2°C below set point and the running sum is less than -250 degrees C-seconds, relays TN and TC de-energize shutting off the condenser fan and compressor motors. Also, the cool light is de-energized.

The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within a tolerance of set point, and the 15 minute override is met.

If the unit is in the holding mode (neither heating nor cooling) and the supply air temperature increases to 0.2°C (0.4°F) above set point, and providing a six minute off time has elapsed, relay TC energizes to restart the compressor. Also, at this time, the condenser fan motor starts and the cool light is illuminated.

During this mode the two-speed compressor can be either running in high or low speed depending on the box load, ambient temperature, time since power-on, AC line voltage and the position of the SSV.

# CONTROL TRANSFORMER



**SECTION 4**

= 18 Volt Energized Circuit  
  = 24 Volt Energized Circuit  
  = De-energized Circuit

**Figure 4-2. Cooling in Low Speed with Two-Speed Compressor**

**c. Cooling with Single-Speed Compressor  
(See Figure 4-3.)**

**NOTE**

Evaporator fan motors will run in high speed.  
(Contactor EF energized)

**NOTE**

A pressure control system has been incorporated by means of a condenser pressure transducer (CPT) and condenser pressure control (CPC) logic to maintain discharge pressures above 130 psig in low ambients.

The condenser fan will cycle off if the condenser pressure is below 130 psig. If the condenser pressure goes above 200 psig, the condenser fan will cycle on.

With supply air temperature decreasing, and if the supply air is above set point, the unit will be cooling with the condenser fan motor, compressor motor and evaporator fan motors energized. Also, at this time, the cool light is illuminated.

When the air temperature decreases to a predetermined tolerance above set point, relay TI energizes and the in-range light is illuminated. (Refer to section 3.1.4, Code 30.)

If the air temperature continues to fall, modulating cooling starts at approximately 2.5°C (4.5°F) above set point. The modulating valve will have a variable current up to 1.30 amps at full modulation.

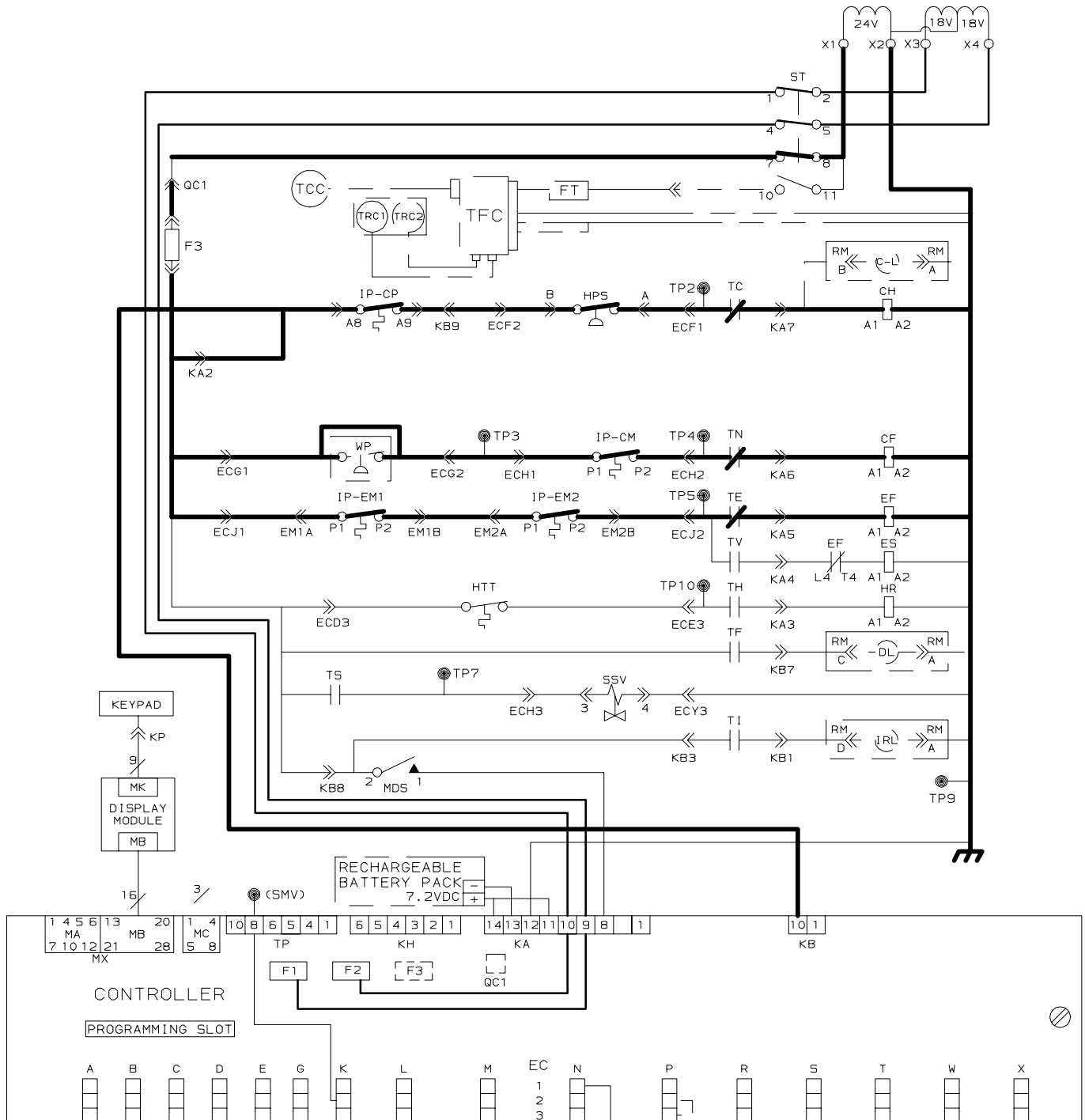
During this cooling mode, a running sum of the temperature differential (supply air temperature - set point) is kept. When the supply air falls below set point, the differential is negative. The longer supply air remains below set point, the greater the negative differential in the running sum.

When the supply air temperature decreases to 0.2°C below set point and the running sum is less than -250 degrees C-seconds, relays TN and TC de-energize shutting off the condenser fan and compressor motors. Also, the cool light is de-energized.

The evaporator fan motors continue to run to circulate air throughout the container. The in-range light remains illuminated as long as the supply air is within a tolerance of set point, and the 15 minute override is met.

If the unit is in the holding mode (neither heating nor cooling) and the supply air temperature increases to 0.2°C (0.4°F) above set point, and providing a six minute off time has elapsed, relay TC energizes to restart the compressor. Also, at this time, the condenser fan motor starts and the cool light is illuminated.

# CONTROL TRANSFORMER



**SECTION 4**

———— = 18 Volt Energized Circuit    **————** = 24 Volt Energized Circuit    - - - - - = De-energized Circuit

**Figure 4-3. Cooling with Single-Speed Compressor**

#### 4.4.5 Heating (See Figure 4-4.)

The unit *will heat only* when the controller set point is above  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, as relay TH is electronically locked out to prevent heating when the controller set point is *below*  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally.

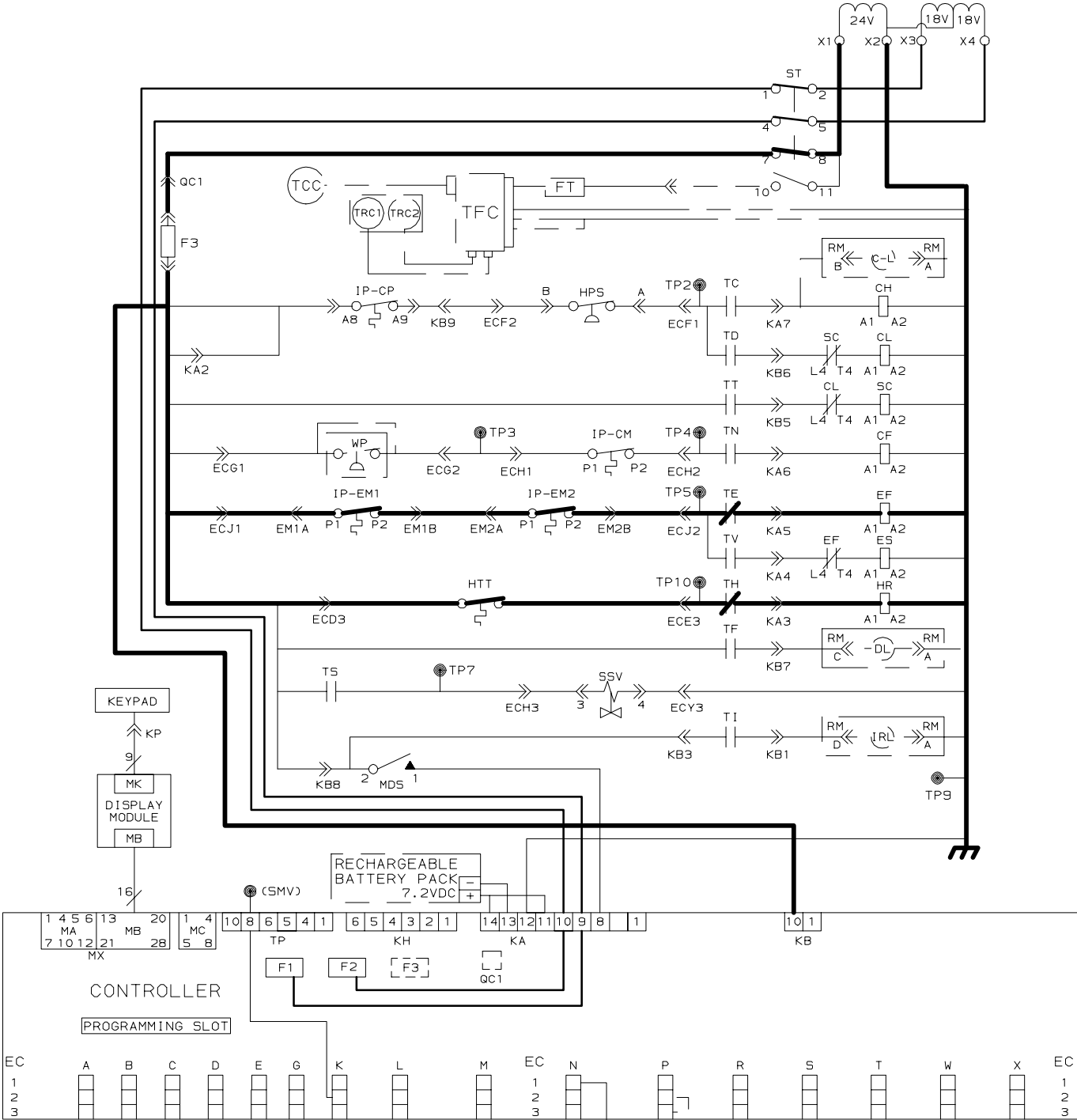
If the air temperature decreases  $0.5^{\circ}\text{C}$  ( $0.9^{\circ}\text{F}$ ) below controller set point, TH closes and the system enters the heating mode which is designed to raise the container air temperature. When TH closes, power flows through TH contacts and the heat termination thermostat to energize the heat contactor (HR). This in turn energizes the heaters and heat light. The evaporator fans continue to run to circulate air throughout the container.

As the supply air decreases to the in-range tolerance below set point, relay TI and the in-range light de-energize (after a 15 minute time delay) and will remain de-energized until the supply air increases to a tolerance below set point. (Refer to section 3.1.4, Code 30.)

When the temperature rises to  $0.2^{\circ}\text{C}$  ( $0.4^{\circ}\text{F}$ ) below set point, TH opens (heating off) and the system again enters the holding zone. The compressor and condenser fan motor are not running as contactors CH and CF remain de-energized. The evaporator fans continue to run to circulate air throughout the container.

A safety heater termination thermostat (HTT) attached to an evaporator coil support, set to open at  $54.5^{\circ}\text{C}$  ( $130^{\circ}\text{F}$ ), will open the heating circuit if overheating occurs.

**CONTROL TRANSFORMER**



**SECTION 4**

—— = 18 Volt Energized Circuit    **————** = 24 Volt Energized Circuit    - - - - = De-energized Circuit

**Figure 4-4. Heating Mode**

#### 4.4.6 Defrost

Refer to section 3.1.4 (Code 27) for description of the defrost interval selector and automatic defrost initiation.

The defrost cycle (see Figure 4-5) consists of two distinct sub-cycles. The first sub-cycle is the de-ice cycle, the second is a probe check cycle.

Defrost may take place any time the DTS allows, and no shutdown alarms are active. With these conditions satisfied, defrost is initiated when one of the following conditions becomes true:

- a. The manual defrost switch (MDS) is closed by the user. Refer to Figure 2-7 or Figure 2-8 for location. The MDS is ignored during Pre-Trip.
- b. The defrost interval timer reaches or exceeds the defrost interval selected and set by the user.
- c. During Pre-Trip (auto, not manual) defrost can occur during the advanced Pre-Trip tests P-8 and P-10. Defrost is forced during advanced Pre-Trip test P-9.
- d. When the probe diagnostic logic determines that a probe check is necessary based on the temperature values currently reported by the supply and return probes.
- e. When bulb mode is active, and the defrost termination sensor (DTS) is between 0°C and 10°C (32°F and 50°F).

When the defrost mode is initiated, the controller relay contacts (TH) close to supply power to the heat contactor (HR) and in turn, energize the defrost heaters. The defrost light is illuminated.

Relay TC and TD open to de-energize the compressor contactor and cool light. Also relay TN opens to de-energize the condenser fan contactor (CF).

Relay TE and TV open to stop the evaporator fan motors.

The in-range light remains illuminated during defrost.

When the coil tube sheet temperature reaches 25.6°C (78°F), [4°C and 25.6°C (39.2°F and 78°F) if configured for and operating in bulb mode], the defrost termination sensor (DTS) causes the controller to end the defrost cycle and the unit returns to its normal function. Under certain circumstances, defrost may also be forced to terminate through special communication commands.

Upon completion of the de-ice phase of defrost, the controller will perform a probe check cycle. The purpose of the probe check cycle is to perform a periodic check of the controller sensors to detect malfunctions or drift in the sensed temperature that is too small to be detected by the normal sensor out of range tests. The system will run for eight minutes in this condition. At the end of the eight minutes, the primary supply, primary return and DataCORDER sensor temperatures will be compared. The controller probe alarms will be set or cleared based on the conditions seen.

The 54.5°C (130°F) heat termination thermostat (HTT) will open the circuit if the defrost mode does not terminate at 25.6°C (78°F). If termination does not occur within 2.0 hours, the controller will terminate defrost. An alarm will be given of a possible DTS failure.

When the return air falls to 7°C (45°F), the controller checks to ensure the defrost termination sensor (DTS) has dropped to 10°C or below. If it has not, a DTS failure alarm is given and the defrost mode is operated by the return temperature sensor (RTS).

*Snap Freeze Option:*

#### NOTE

Controller configuration variable 33 must be set to SnAP to activate this option, refer to Table 3-1.

If the probe check portion of defrost is required (depending on the configuration of probe check), snap freeze will run after the probe check cycle. Otherwise, snap freeze will run immediately following the de-ice portion of defrost.

The snap freeze cycle consists of running the compressor without the evaporator fans running for a period of four minutes with both suction solenoid (SSV) and suction modulation (SMV) valves fully open.

If current limiting activates (see section 3.1.4, Cd32) during snap freeze, the state of the SSV and SMV valves may change. When the snap freeze cycle is completed, defrost is formally terminated.

#### 4.4.7 Arctic

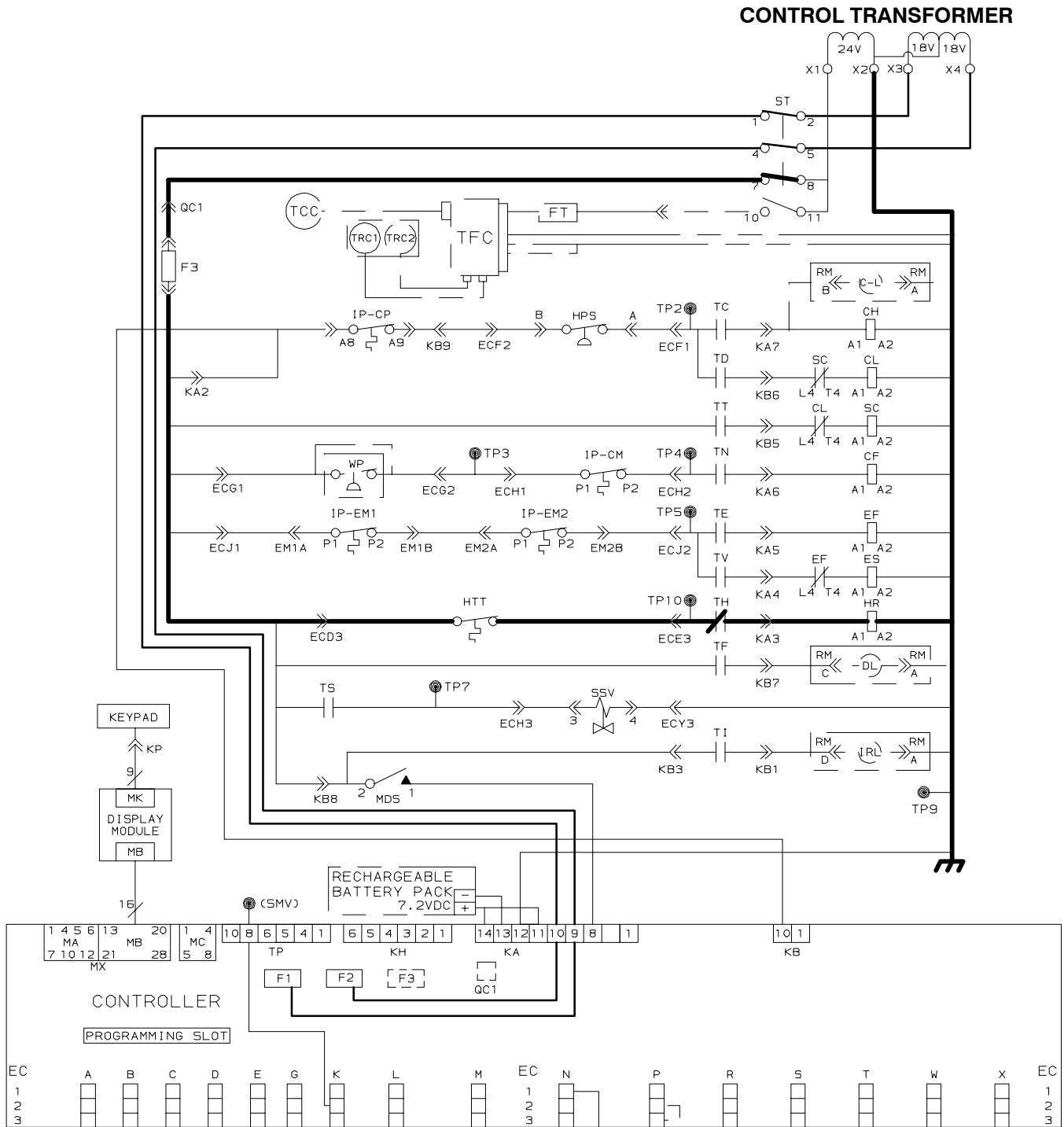
With arctic mode enabled, if the ambient is colder than -10.0°C there is a 30 minute time delay at startup for any of the components in the system, except for the controller and the compressor crankcase heater (CCH), which should be active at this point. In arctic mode, the CCH is energized for 30 minutes to warm the oil in the compressor, and boil off any liquid refrigerant that may be present in the crankcase.

If Pre-Trip is initiated during the 30 minute time period, Pre-Trip will be allowed to run normally. Once Pre-Trip is over, the controller will revert to its normal control mode logic.

If ambient is warmer than  $-10.0^{\circ}\text{C}$ , the system will run

its normal startup logic.

Arctic mode is configurable by using the configuration variable #29, refer to Table 3-1.



SECTION 4

———— = 18 Volt Energized Circuit    ————— = 24 Volt Energized Circuit    - - - - - = De-energized Circuit

Figure 4-5. Defrost



| <b>Table 4-1. Electrical Control Positions - BELOW -10°C (+14°F), or -5°C (+23°F) optionally</b> |                                                        |                     |                            |                            |                           |
|--------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|----------------------------|----------------------------|---------------------------|
| <b>CONTROL CIRCUIT</b>                                                                           | <b>COOLING</b>                                         | <b>Holding Zone</b> | <b>**Dehumidification</b>  | <b>HEATING</b>             | <b>DEFROST</b>            |
| <i>Single-Speed Compressor:</i>                                                                  |                                                        |                     |                            |                            |                           |
| Compressor Contactor (C)                                                                         | Energized                                              | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| <i>Two-Speed Compressor:</i>                                                                     |                                                        |                     |                            |                            |                           |
| Compressor Contactor (CH)                                                                        | Energized                                              | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CS)                                                                        | Energized                                              | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CL)                                                                        | De-energized                                           | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Condenser Fan Contactor (CF)                                                                     | Energized                                              | De-energized        | **                         | **                         | De-energized              |
| High Speed Evaporator Contactor (EF)                                                             | De-energized                                           | De-energized        | Refer to section 3.1.7.a.2 | Refer to section 3.1.7.a.2 | De-energized <sub>2</sub> |
| Low Speed Evaporator Contactor (ES)                                                              | Energized                                              | Energized           | Refer to section 3.1.7.a.2 | Refer to section 3.1.7.a.2 | De-energized              |
| Defrost Relay (TF)                                                                               | De-energized                                           | De-energized        | **                         | **                         | Energized                 |
| Heater Relay (HR)                                                                                | De-energized                                           | De-energized        | **                         | **                         | Energized                 |
| <b>INDICATING LIGHTS</b>                                                                         |                                                        |                     |                            |                            |                           |
| Cool                                                                                             | ON                                                     | OFF                 | **                         | **                         | OFF                       |
| Defrost                                                                                          | OFF                                                    | OFF                 | **                         | **                         | ON                        |
| In-Range                                                                                         | On - If In-Range (Refer to paragraph 3.1.4, Code 30) → |                     |                            |                            |                           |
| Heat                                                                                             | OFF                                                    | OFF                 | **                         | **                         | ON                        |
| <b>POWER CIRCUIT</b>                                                                             |                                                        |                     |                            |                            |                           |
| Compressor                                                                                       | Energized                                              | De-energized        | **                         | **                         | De-energized              |
| Condenser Fan Motor                                                                              | Energized                                              | De-energized        | **                         | **                         | De-energized              |
| Heaters                                                                                          | De-energized                                           | De-energized        | **                         | **                         | Energized                 |
| Evaporator Fan Motors                                                                            | Energized                                              | Energized           | **                         | **                         | De-energized              |

\*\* Dehumidification and heating modes do not operate at set points below -10°C (14°F), or -5°C (23°F) optionally

1 - May be energized in defrost if snap freeze portion of defrost is run.

2 - May be energized in defrost if probe check portion of defrost is run.

| <b>Table 4-2. Electrical Control Positions - ABOVE -10°C (+14°F), or -5°C (+23°F) optionally</b> |                                                                                                |                     |                            |                            |                           |
|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------|----------------------------|----------------------------|---------------------------|
| <b>CONTROL CIRCUIT</b>                                                                           | <b>COOLING</b>                                                                                 | <b>Holding Zone</b> | <b>* Dehumidification</b>  | <b>HEATING</b>             | <b>DEFROST</b>            |
| <i>Single-Speed Compressor:</i>                                                                  |                                                                                                |                     |                            |                            |                           |
| Compressor Contactor (C)                                                                         | Energized                                                                                      | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| <i>Two-Speed Compressor in high speed mode:</i>                                                  |                                                                                                |                     |                            |                            |                           |
| Compressor Contactor (CH)                                                                        | Energized                                                                                      | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CS)                                                                        | Energized                                                                                      | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CL)                                                                        | De-energized                                                                                   | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| <i>Two-Speed Compressor in low speed mode:</i>                                                   |                                                                                                |                     |                            |                            |                           |
| Compressor Contactor (CH)                                                                        | De-energized                                                                                   | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CS)                                                                        | De-energized                                                                                   | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Compressor Contactor (CL)                                                                        | Energized                                                                                      | De-energized        | **                         | **                         | De-energized <sub>1</sub> |
| Condenser Fan Contactor (CF)                                                                     | Energized                                                                                      | De-energized        | Energized                  | De-energized               | De-energized              |
| High Speed Evaporator Contactor (EF)                                                             | Energized                                                                                      | Energized           | Refer to section 3.1.7.a.2 | Refer to section 3.1.7.a.2 | De-energized <sub>2</sub> |
| Low Speed Evaporator Contactor (ES)                                                              | De-energized                                                                                   | De-energized        | Refer to section 3.1.7.a.2 | Refer to section 3.1.7.a.2 | De-energized              |
| Defrost Relay (TF)                                                                               | De-energized                                                                                   | De-energized        | De-energized               | De-energized               | Energized                 |
| Heater Relay (HR)                                                                                | De-energized                                                                                   | De-energized        | Energized                  | Energized                  | Energized                 |
| <b>INDICATING LIGHTS</b>                                                                         |                                                                                                |                     |                            |                            |                           |
| Cool                                                                                             | ON                                                                                             | OFF                 | ON                         | OFF                        | OFF                       |
| Defrost                                                                                          | OFF                                                                                            | OFF                 | OFF                        | OFF                        | ON                        |
| In-Range                                                                                         | On - If In-Range (Refer to paragraph 3.1.4, Code 30) <span style="float: right;">—————→</span> |                     |                            |                            |                           |
| Heat                                                                                             | OFF                                                                                            | OFF                 | ON                         | ON                         | ON                        |
| <b>POWER CIRCUIT</b>                                                                             |                                                                                                |                     |                            |                            |                           |
| Compressor                                                                                       | Energized                                                                                      | De-energized        | Energized                  | De-energized               | De-energized              |
| Condenser Fan Motor                                                                              | Energized                                                                                      | De-energized        | Energized                  | De-energized               | De-energized              |
| Heaters                                                                                          | De-energized                                                                                   | De-energized        | Energized                  | Energized                  | Energized                 |
| Evaporator Fan Motors                                                                            | Energized                                                                                      | Energized           | Energized                  | Energized                  | De-energized              |

\* Unit with optional Humidity sensor

\*\* Dehumidification and heating modes do not operate at set points below -10°C (14°F), or -5°C (23°F) optionally

1 - May be energized in defrost if snap freeze portion of defrost is run.

2 - May be energized in defrost if probe check portion of defrost is run.

**SECTION 4**

## SECTION 5

### TROUBLESHOOTING

| CONDITION                                                                                | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                     | REMEDY/<br>REFERENCE<br>SECTION                                                                                              |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>5.1 UNIT WILL NOT START OR STARTS THEN STOPS</b>                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |
| No power to unit                                                                         | External power source OFF<br>Start-Stop switch OFF or defective<br>Circuit breaker tripped or OFF<br>Modular transformer not connected                                                                                                                                                                                                                                                                                                                             | Turn on<br>Check<br>Check<br>6.22                                                                                            |
| Loss of control power Loss of control power in respective branch of control circuit only | Circuit breaker OFF or defective<br>Control transformer (TR) defective<br>Fuse (F3) blown<br>Start-Stop switch OFF or defective                                                                                                                                                                                                                                                                                                                                    | Check<br>Replace<br>Check<br>Check                                                                                           |
| Loss of control power in respective branch of control circuit only                       | Evaporator fan motor internal protector open<br>Condenser fan motor internal protector open<br>Compressor internal protector open<br>High pressure switch open<br>Heat termination thermostat (HTT) open                                                                                                                                                                                                                                                           | 6.15<br>6.18<br>6.7<br>5.7<br>Replace                                                                                        |
| Compressor hums, but does not start                                                      | Low line voltage<br>Single phasing<br>Shorted or grounded motor windings<br>Compressor seized<br>Contactor (SC) shorting (in high speed mode of two-speed compressor only)                                                                                                                                                                                                                                                                                         | Check<br>Check<br>6.7<br>6.7<br>Check                                                                                        |
| Compressor will occasionally de-energize for 15 seconds                                  | Compressor speed change (On units with two-speed compressor)                                                                                                                                                                                                                                                                                                                                                                                                       | Normal                                                                                                                       |
| <b>5.2 UNIT RUNS BUT HAS INSUFFICIENT COOLING</b>                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |
| Compressor                                                                               | Compressor valves defective                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6.7                                                                                                                          |
| Refrigeration System                                                                     | Abnormal pressures<br>Temperature controller malfunction<br>Evaporator fan or motor defective<br>Suction modulation valve malfunction<br>Suction solenoid valve malfunction<br>Condenser Pressure Transducer (CPT) defective<br>Shortage of refrigerant                                                                                                                                                                                                            | 5.7<br>5.9<br>6.15<br>6.25<br>2.10/6.24<br>Check<br>6.6                                                                      |
| <b>5.3 UNIT OPERATES LONG OR CONTINUOUSLY IN COOLING</b>                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |
| Container                                                                                | Hot load<br>Defective box insulation or air leak                                                                                                                                                                                                                                                                                                                                                                                                                   | Normal<br>Repair                                                                                                             |
| Refrigeration System                                                                     | Shortage of refrigerant<br>Evaporator coil covered with ice<br>Evaporator coil plugged with debris<br>Evaporator fan(s) rotating backwards<br>Defective evaporator fan motor/capacitor<br>Air bypass around evaporator coil<br>Controller set too low<br>Compressor service valves or liquid line shutoff valve partially closed<br>Dirty condenser<br>Compressor worn<br>Current limit (Code 32) set to wrong value<br>Suction modulation valve (SMV) malfunction | 6.4/6.6<br>5.6<br>6.13<br>6.15/6.16<br>6.15/6.16<br>Check<br>Reset<br>Open valves completely<br>6.17<br>6.7<br>3.1.4<br>6.25 |

| CONDITION                                                 | POSSIBLE CAUSE                                                                                                                                                                                                                                                               | REMEDY/<br>REFERENCE<br>SECTION                                             |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>5.4 UNIT WILL NOT HEAT OR HAS INSUFFICIENT HEATING</b> |                                                                                                                                                                                                                                                                              |                                                                             |
| No power to unit                                          | Start-Stop switch OFF or defective<br>Circuit breaker OFF or defective<br>External power source OFF                                                                                                                                                                          | Check<br>Check<br>Turn on                                                   |
| No control power                                          | Circuit breaker or fuse defective<br>Transformer defective (TR)<br>Evaporator fan internal motor protector open<br>Heat relay defective<br>Heater termination switch open                                                                                                    | Replace<br>Replace<br>6.15<br>Check<br>6.13                                 |
| Unit will not heat or has insufficient heat               | Heater(s) defective<br>Heater contactor or coil defective<br>Evaporator fan motor(s) defective or rotating backwards<br>Evaporator fan motor contactor defective<br>Temperature controller malfunction<br>Defective wiring<br>Loose terminal connections<br>Low line voltage | 6.14<br>Replace<br>6.15/6.16<br>Replace<br>5.9<br>Replace<br>Tighten<br>2.4 |
| <b>5.5 UNIT WILL NOT TERMINATE HEATING</b>                |                                                                                                                                                                                                                                                                              |                                                                             |
| Unit fails to stop heating                                | Temperature controller improperly set<br>Temperature controller malfunction<br>Heater termination switch remains closed along with the heat relay                                                                                                                            | Reset<br>5.9<br>6.13                                                        |
| <b>5.6 UNIT WILL NOT DEFROST PROPERLY</b>                 |                                                                                                                                                                                                                                                                              |                                                                             |
| Will not initiate defrost automatically                   | Defrost timer malfunction<br>Loose terminal connections<br>Defective wiring<br>Defrost termination sensor defective or heat termination switch open<br>Heater contactor or coil defective                                                                                    | 3.1.4<br>Tighten<br>Replace<br>Replace<br><br>Replace                       |
| Will not initiate defrost manually                        | Manual defrost switch defective<br>Defrost termination sensor open                                                                                                                                                                                                           | Replace<br>4.4.6                                                            |
| Initiates but relay (DR) drops out                        | Low line voltage                                                                                                                                                                                                                                                             | 2.4                                                                         |
| Initiates but does not defrost                            | Heater contactor or coil defective<br>Heater(s) burned out                                                                                                                                                                                                                   | Replace<br>6.14                                                             |
| Frequent defrost                                          | Wet load                                                                                                                                                                                                                                                                     | Normal                                                                      |

| CONDITION                                                               | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                               | REMEDY/<br>REFERENCE<br>SECTION                                                |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| <b>5.7 ABNORMAL PRESSURES (COOLING)</b>                                 |                                                                                                                                                                                                                                                                                                                                                              |                                                                                |
| High discharge pressure                                                 | Condenser coil dirty<br>Condenser fan rotating backwards<br>Condenser fan inoperative<br>Refrigerant overcharge or noncondensibles<br>Discharge pressure regulator valve defective<br>Discharge service valve partially closed<br>Perishable set point<br>Suction modulation valve (SMV) malfunction                                                         | 6.17<br>6.18<br>6.18<br>6.6<br>Replace<br>Open<br>Normal<br>6.25               |
| Low suction pressure                                                    | Suction service valve partially closed<br>Filter-drier partially plugged<br>Low refrigerant charge<br>Expansion valve defective<br>No evaporator air flow or restricted air flow<br>Excessive frost on evaporator coil<br>Evaporator fan(s) rotating backwards<br>Discharge pressure regulator valve defective<br>Suction modulation valve (SMV) malfunction | Open<br>6.11<br>6.4/6.6<br>6.26<br>5.10<br>5.6<br>6.14/6.16<br>Replace<br>6.25 |
| Suction and discharge pressures tend to equalize when unit is operating | Heat exchanger defective<br>Compressor valves defective<br>Compressor cycling/stopped                                                                                                                                                                                                                                                                        | Replace<br>6.8<br>Check                                                        |
| <b>5.8 ABNORMAL NOISE OR VIBRATIONS</b>                                 |                                                                                                                                                                                                                                                                                                                                                              |                                                                                |
| Compressor                                                              | Loose mounting bolts<br>Worn bearings<br>Worn or broken valves<br>Liquid slugging Insufficient oil                                                                                                                                                                                                                                                           | Tighten<br>6.7<br>6.7<br>5.11<br>6.10                                          |
| Condenser or Evaporator Fan                                             | Bent, loose or striking venturi<br>Worn motor bearings<br>Bent motor shaft                                                                                                                                                                                                                                                                                   | Check<br>6.15/6.18<br>6.15/6.18                                                |
| <b>5.9 TEMPERATURE CONTROLLER MALFUNCTION</b>                           |                                                                                                                                                                                                                                                                                                                                                              |                                                                                |
| Will not control                                                        | Defective Sensor<br>Defective wiring<br>Fuse (F1, F2) blown<br>Suction modulation valve (SMV) circuit malfunction                                                                                                                                                                                                                                            | 6.23<br>Check<br>Replace<br>6.25                                               |
| <b>5.10 NO EVAPORATOR AIR FLOW OR RESTRICTED AIR FLOW</b>               |                                                                                                                                                                                                                                                                                                                                                              |                                                                                |
| Evaporator coil blocked                                                 | Frost on coil<br>Dirty coil                                                                                                                                                                                                                                                                                                                                  | 5.6<br>6.13                                                                    |
| No or partial evaporator air flow                                       | Evaporator fan motor internal protector open<br>Evaporator fan motor(s) defective<br>Evaporator fan(s) loose or defective<br>Evaporator fan contactor defective                                                                                                                                                                                              | 6.15<br>6.15/6.16<br>6.15<br>Replace                                           |

| CONDITION                                                   | POSSIBLE CAUSE                                                                                                                                                                                                                                                         | REMEDY/<br>REFERENCE<br>SECTION                                          |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| <b>5.11 THERMOSTATIC EXPANSION VALVE MALFUNCTION</b>        |                                                                                                                                                                                                                                                                        |                                                                          |
| Low suction pressure with high superheat                    | Low refrigerant charge<br>External equalizer line plugged<br>Wax, oil or dirt plugging valve or orifice<br>Ice formation at valve seat<br>Superheat too high<br>Power assembly failure<br>Loss of element/bulb charge<br>Broken capillary<br>Foreign material in valve | 6.4/6.6<br>Open<br>6.26<br><br>6.4/6.6<br>6.26.c<br>6.26<br>6.26<br>6.26 |
| High suction pressure with low superheat                    | Superheat setting too low<br>External equalizer line plugged<br>Ice holding valve open<br>Foreign material in valve                                                                                                                                                    | 6.26.c<br>Open<br>6.4/6.5 6.26                                           |
| Liquid slugging in compressor                               | Pin and seat of expansion valve eroded or held open by foreign material                                                                                                                                                                                                | 6.26                                                                     |
| Fluctuating suction pressure                                | Improper bulb location or installation<br>Low superheat setting                                                                                                                                                                                                        | 6.26<br>6.26.c                                                           |
| <b>5.12 POWER AUTOTRANSFORMER MALFUNCTION</b>               |                                                                                                                                                                                                                                                                        |                                                                          |
| Unit will not start                                         | Circuit breaker (CB-1 or CB-2) tripped<br>Power transformer defective<br>Power source not turned ON<br>460 VAC power plug is not inserted into the receptacle                                                                                                          | Check<br>6.22<br>Check<br>2.4                                            |
| <b>5.13 WATER-COOLED CONDENSER OR WATER PRESSURE SWITCH</b> |                                                                                                                                                                                                                                                                        |                                                                          |
| High discharge pressure                                     | Dirty coil<br>Noncondensibles                                                                                                                                                                                                                                          | 6.28                                                                     |
| Condenser fan starts and stops                              | Water pressure switch malfunction<br>Water supply interruption                                                                                                                                                                                                         | Check                                                                    |

## SECTION 6

### SERVICE

#### NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA section 608.

#### 6.1 MANIFOLD GAUGE SET

The manifold gauge set can be used to determine system operating pressure, add a refrigerant charge, and to equalize or evacuate the system.

Figure 6-1 shows hand valves, gauges and refrigerant openings. When the low pressure hand valve is frontseated (turned all the way in), the low (evaporator) pressure can be checked. When the high pressure hand valve is frontseated, high (condensing) pressure can be checked. When both valves are open (turned counter-clockwise all the way out), high pressure vapor will flow into the low side. When the low pressure valve is open, the system can be charged. Oil can also be added to the system.

Only a R-134a manifold gauge set with self-sealing hoses, as shown in Figure 6-2 (CTD P/N 07-00294-00, which includes items 1 through 6) can be used when working on the models covered within this manual.

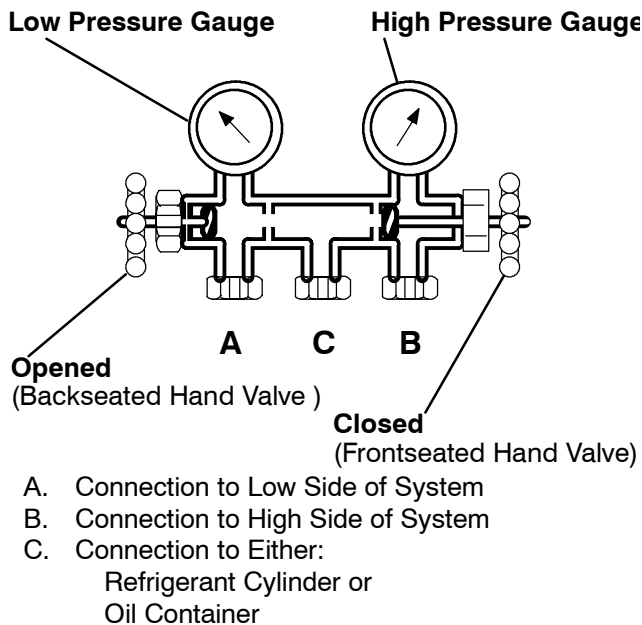


Figure 6-1. Manifold Gauge Set

#### a. Connecting the Manifold Gauge Set (See Figure 6-2)

1. Remove service valve stem caps and check both service valves to make sure they are backseated (turned counter-clockwise all the way out). Remove service port caps.
2. Connect the high side field service coupling (backseated) to the discharge service valve port (or the manual liquid line valve port, whichever is applicable).
3. Turn the high side field service coupling (red knob) clockwise, which will open the high side of the system to the gauge set.
4. Connect the low side field service coupling to the suction service valve port.
5. Turn the low side field service coupling (blue knob) clockwise, which will open the low side of the system to the gauge set.
6. To read system pressures: slightly midseat the discharge and suction service valves, and frontseat both manifold gauge set hand valves.

#### NOTE

If a manifold gauge set is new or was exposed to the atmosphere due to repair, it will need to be evacuated to remove contaminants and air as follows:

- Midseat both hand valves.
- Connect the utility hose (yellow) to a vacuum pump.
- Evacuate to 10 inches of vacuum.
- Charge with R-134a to a slightly positive pressure of 0.1 kg/cm<sup>2</sup> (1.0 psig). The gauge set is now ready for use.

## CAUTION

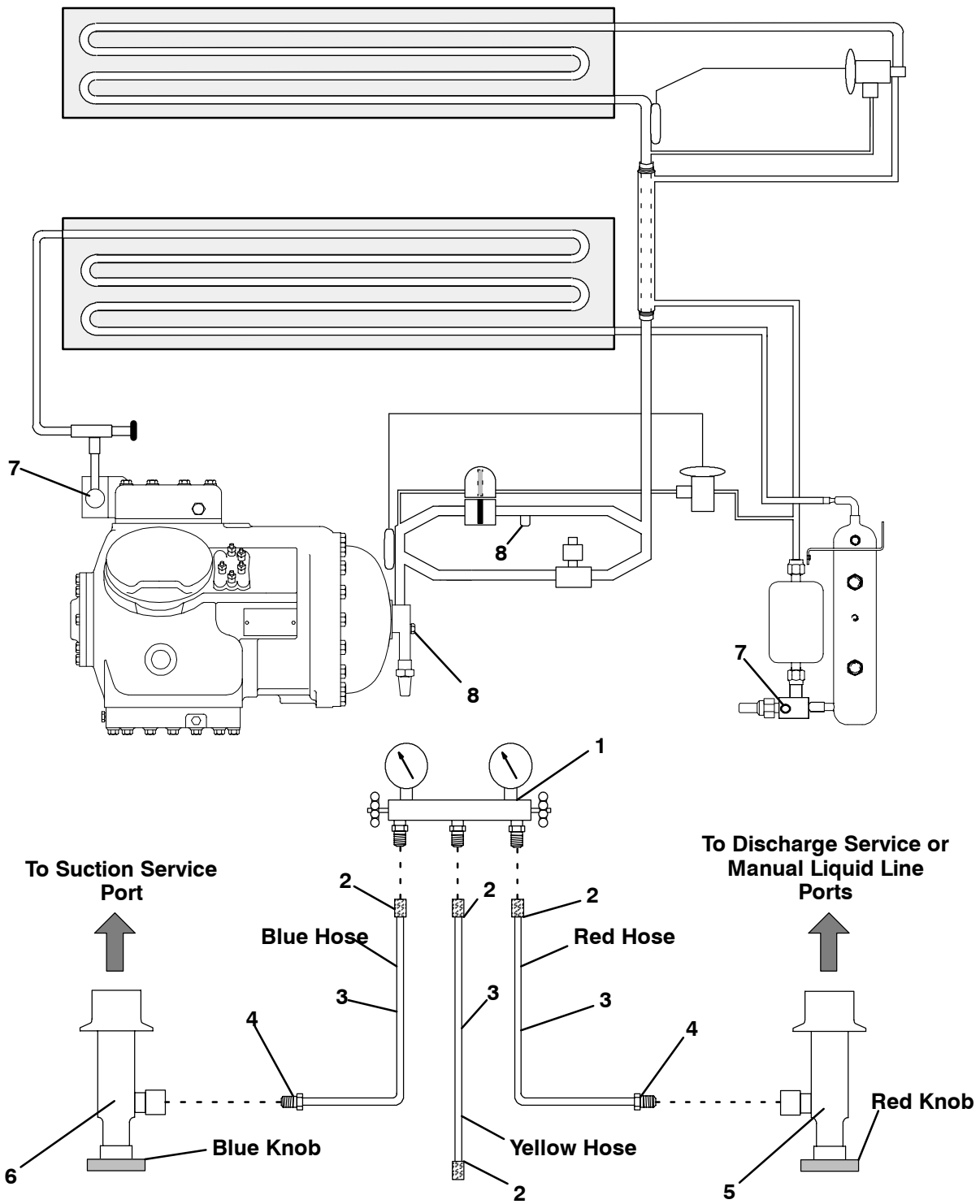
**To prevent trapping liquid refrigerant in the service valve after charging, perform the following steps while the compressor is ON and before disconnecting the manifold gauge set:**

- Backseat applicable discharge or manual liquid line valve.
- Midseat manifold gauge set hand valves.
- Allow the gauge set to pull down to suction pressure.

## b. Removing the Manifold Gauge Set

1. While the compressor is still ON, backseat the discharge service valve.
2. Midseat both hand valves on the manifold gauge set and allow the pressure in the manifold gauge set to be drawn down to suction pressure. This enables the liquid that condensed in the high side hose to be returned to the system.
3. Backseat the suction service valve. Backseat both field service couplings, and remove the couplings from the service ports.
4. Install both service valve stem caps and service port caps (finger-tight only).





- |                                                         |                                           |
|---------------------------------------------------------|-------------------------------------------|
| 1. Manifold Gauge Set                                   | Coupling                                  |
| 2. Hose Fitting (0.500-16 Acme)                         | 6. Low Side Field Service Coupling        |
| 3. Refrigeration or Evacuation Hoses (SAE J2196/R-134a) | 7. High Side Service Port (SAE J639 Male) |
| 4. Hose Fitting w/O-ring (M14 x 1.5)                    | 8. Low Side Service Port (SAE J639 Male)  |
| 5. High Side Field Service                              |                                           |

**Figure 6-2. R-134a Manifold Gauge Set Connection**

## 6.2 SUCTION AND DISCHARGE SERVICE VALVES

The suction and discharge service valves used on the compressor are equipped with mating flanges for connection to flanges on the compressor. These valves are provided with a double seat and a gauge connection which enable servicing of the compressor and refrigerant lines.

Turning the valve stem clockwise (all the way forward) will frontseat the valve to close off the suction or discharge line and open the gauge connection to the compressor. See Figure 6-3. Turning the valve stem counterclockwise (all the way out) will backseat the valve to open the suction or discharge line to the compressor and close off the gauge connection.

With the valve stem midway between frontseated and backseated positions, the suction or discharge line is open to both the compressor and the gauge connection.

For example, when connecting a manifold gauge to measure suction or discharge pressure, the valve stem is fully backseated. Then, to measure suction or discharge pressure, crack open the valves 1/4 to 1/2 turn.

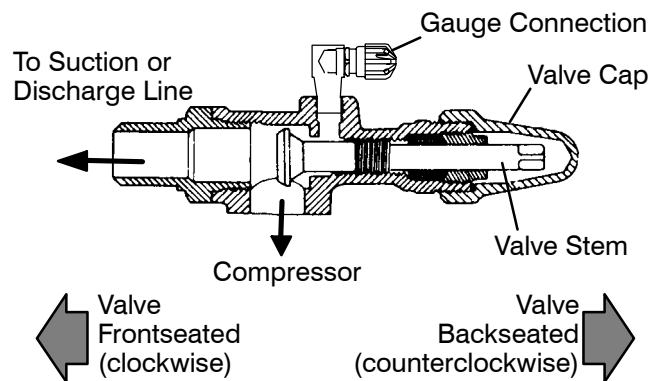


Figure 6-3. Suction or Discharge Service Valve

## 6.3 PUMPING THE UNIT DOWN

To service the filter-drier, moisture-liquid indicator, expansion valve, suction modulation valve, suction solenoid valve or evaporator coil, pump most of the refrigerant into the condenser coil and receiver as follows:

- Backseat the suction and discharge valves (turn counterclockwise) to close off gauge connections and attach manifold gauges to valves. Refer to section 6.1.a.
- Allow the compressor to run 10 to 15 minutes before frontseating the liquid line valve. Then close (front seat) the liquid line valve by turning

clockwise. Start the unit and run in a cooling mode. Place start-stop switch in the OFF position when the unit reaches a positive pressure of 0.1 kg/cm<sup>2</sup> (1.0 psig).

- Frontseat (close) the suction service valve. The refrigerant will be trapped between the compressor suction service valve and the liquid line valve.
- Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge. If a vacuum is indicated, emit refrigerant by cracking the liquid line valve momentarily to build up a slight positive pressure.
- When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.
- After repairs have been made, be sure to perform a refrigerant leak check (section 6.4), and evacuate and dehydrate the system (section 6.5).
- Check refrigerant charge (refer to section 6.6).

## 6.4 REFRIGERANT LEAK CHECKING

### WARNING

**Never mix refrigerants with air for leak testing. It has been determined that pressurized, air-rich mixtures of refrigerants and air can undergo combustion when exposed to an ignition source.**

- The recommended procedure for finding leaks in a system is with a R-134a electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.
- If the system is without refrigerant, charge the system with refrigerant to build up pressure between 2.1 to 3.5 kg/cm<sup>2</sup> (30 to 50 psig). Remove refrigerant cylinder and leak-check all connections.

### NOTE

It must be emphasized that only the correct refrigerant cylinder be connected to pressurize the system. Any other gas or vapor will contaminate the system, which will require additional purging and evacuation of the system.

- Remove refrigerant using a refrigerant recovery system and repair any leaks.

- d. Evacuate and dehydrate the unit. (Refer to section 6.5.)
- e. Charge unit per section 6.6.

## 6.5 EVACUATION AND DEHYDRATION

### 6.5.1 General

Moisture is the deadly enemy of refrigeration systems. The presence of moisture in 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.

### 6.5.2 Preparation

- a. Evacuate and dehydrate only after pressure leak test. (Refer to section 6.4.)
- b. Essential tools to properly evacuate and dehydrate any system include a vacuum pump (8 m<sup>3</sup>/hr = 5 cfm volume displacement, P/N 07-00176-01) and electronic vacuum gauge.
- c. 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.
- d. Replace the filter-drier with a section of copper tubing with the appropriate fittings. This action will help speed the evacuation procedure.

### 6.5.3 Procedure

- a. Remove all refrigerant using a refrigerant recovery system.
- b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses, as shown in Figure 6-4, to the vacuum pump and refrigeration unit. DO NOT use standard service hoses, as they are not suited for evacuation purposes. Also as shown, connect a evacuation manifold, with evacuation hoses only, to the vacuum pump, electronic vacuum gauge, and refrigerant recovery system.
- c. With the unit service valves closed (back seated) and the vacuum pump and electronic vacuum gauge valves open, start the pump and draw a deep vacuum. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks. Repair if necessary.

- d. Midseat the refrigerant system service valves.
- e. Open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate 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.
- f. Break the vacuum with clean dry refrigerant gas. Use refrigerant specified for the unit. Raise system pressure to approximately 2 psig, monitoring it with the compound gauge.
- g. Remove refrigerant using a refrigerant recovery system.
- h. Repeat steps (e) through (g) one time.
- i. Remove the copper tubing and change the filter-drier. Evacuate unit to 500 microns. 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.
- j. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. The correct amount of refrigerant may be added by observing the scales. (Refer to section 6.6)

## 6.6 REFRIGERANT CHARGE

### 6.6.1 Checking the Refrigerant Charge

#### NOTE

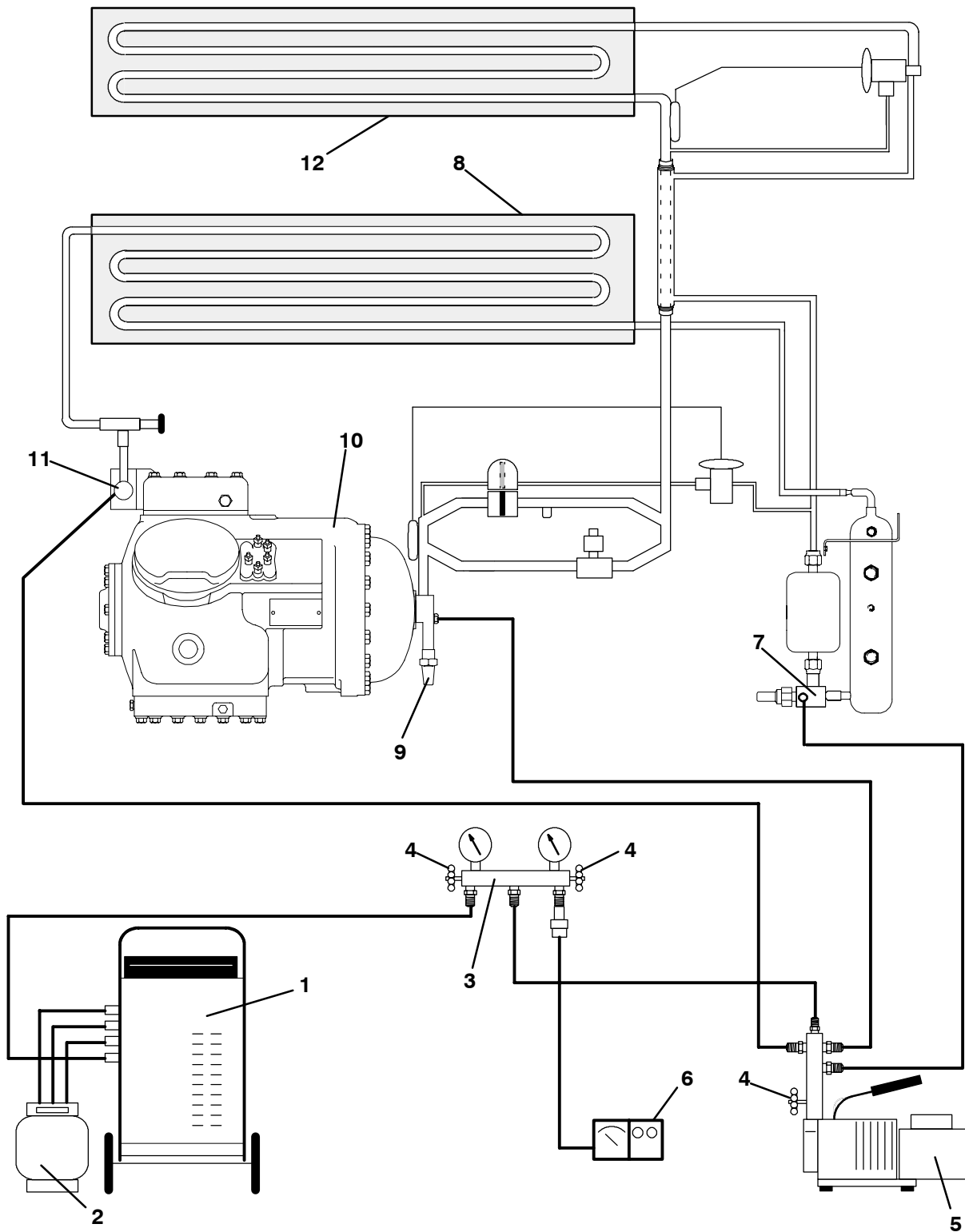
To avoid damage to the earth’s ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws. In the U.S.A., refer to EPA section 608.

#### NOTES

- Set the controller set point to -25°C (-13°F) to ensure that the suction modulation valve is fully open when checking operation of unit.
  - The refrigerant level should only be checked when the unit is running with the suction modulation valve fully open. The container temperature should be approximately 1.7°C (35°F) or -17.8°C (0°F).
- a. Connect the gauge manifold to the compressor discharge and suction service valves.

- b. *For Units equipped with receiver:* partially block the condenser coil inlet air, starting from the front of the condenser coil. Increase the area blocked until the compressor discharge pressure is raised to approximately 12 kg/cm<sup>2</sup> (175 psig). Refrigerant level on the receiver will normally be between the sight glasses. If the refrigerant level is not between these boundaries, refer to section 6.6.3.
- c. *For Units equipped with water-cooled condenser:*

check charge only on air-cooled operation. Refrigerant level in the water-cooled operation will be normally above sight glass. Partially block the condenser coil inlet air starting from the front of the condenser coil. Increase the area blocked until the compressor discharge pressure is raised to approximately 12 kg/cm<sup>2</sup> (175 psig). Refrigerant should appear at center line of sight glass on the water-cooled condenser. If the refrigerant level is not between these boundaries, refer to section 6.6.3.



- |                                 |                             |
|---------------------------------|-----------------------------|
| 1. Refrigerant Recovery Unit    | 7. Manual Liquid Line Valve |
| 2. Refrigerant Cylinder         | 8. Condenser Coil           |
| 3. Evacuation Manifold (R-134a) | 9. Suction Service Valve    |
| 4. Hand Valve                   | 10. Compressor              |
| 5. Vacuum Pump                  | 11. Discharge Service Valve |
| 6. Electronic Vacuum Gauge      | 12. Evaporator Coil         |

**Figure 6-4. Vacuum Pump Connections**

### 6.6.2 Adding Refrigerant to System (Full Charge)

- a. Evacuate unit and leave in deep vacuum. (Refer to section 6.5.)
- b. Place cylinder of R-134a on scale and connect charging line from cylinder to liquid line valve. Purge charging line at liquid line valve and then note weight of cylinder and refrigerant.
- c. Open liquid valve on cylinder. Open liquid line valve half-way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. Correct charge is noted in Table 6-6.

#### NOTE

It may be necessary to finish charging unit through suction service valve in gas form, due to pressure rise in high side of the system. (Refer to section 6.6.3)

- d. Backseat manual liquid line valve (to close off gauge port). Close liquid valve on cylinder.
- e. Start unit in cooling mode. Run approximately 10 minutes and check the refrigerant charge. (Refer to section 6.6.1.)

### 6.6.3 Adding Refrigerant to System (Partial Charge)

- a. Examine the unit refrigerant system for any evidence of leaks. Repair as necessary. (Refer to section 6.4.)
- b. Maintain the conditions outlined in section 6.6.1.
- c. Fully backseat (to close off gauge port) the suction service valve (see Figure 2-5) and remove the service port cap.
- d. Connect charging line between suction service valve port and cylinder of refrigerant R-134a. Open VAPOR valve.
- e. Partially frontseat (turn clockwise) the suction service valve and slowly add charge until the refrigerant appears at the proper level (refer to section 6.6.1).

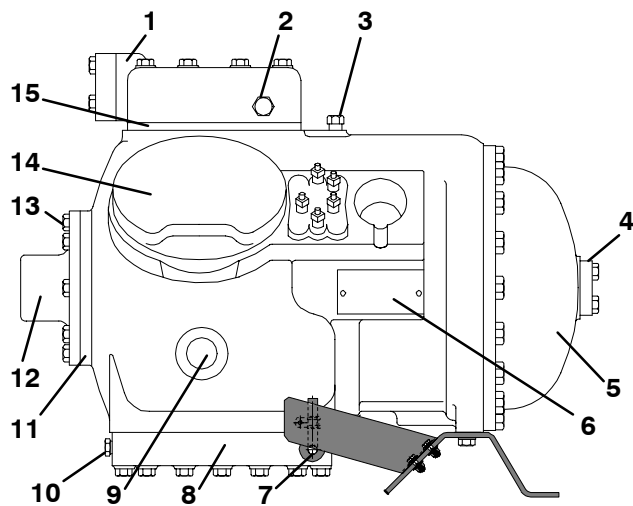
## 6.7 COMPRESSOR - MODEL 06DR

### WARNING

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

### NOTES

- The compressor should not operate in a vacuum greater than 500 mm Hg (20 inches Hg).
- The service replacement compressor is sold without shutoff valves (but with valve pads), and without terminal box and cover. Customer should retain the original terminal box, cover, and high pressure switch for use on replacement compressor.
- Check oil level in service replacement compressor. (Refer to sections 2.2 and 6.10.)
- A compressor terminal wiring kit must be ordered as a separate item when ordering replacement compressor. Appropriate installation instructions are included with kit.
- Refer to Table 6-4 and Table 6-5 for applicable compressor wear limits and torque values.
- Refer to Figure 6-34 for charts on compressor pressure-temperature and motor current curves.
- When servicing the compressor, you must first identify whether it is a single- or two-speed compressor. This can be determined by the bolt pattern of the suction service valve flange. Single-speed has a two bolt configuration and the two-speed has a four bolt configuration.



1. Discharge Valve Flange
2. High Side Pressure Connection
3. Low Side Pressure Connection
4. Suction Valve Flange (Refer to note #7)
5. Motor End Cover
6. Serial/Model No. Plate
7. Crankcase Heater (Optional)
8. Bottom Plate
9. Sight Glass
10. Oil Drain Plug
11. Bearing Head
12. Oil Pump
13. Oil Fill Plug (Refer to section 6.10)
14. Cylinder Head
15. Valve Plate

**Figure 6-5. Compressor - Model 06DR**

### 6.7.1 Removal and Replacement of Compressor

- a. Remove the protective guard from lower section of the unit.
- b. Remove all refrigerant using a refrigerant recovery system. (Refer to section 6.3)
- c. Locate the compressor junction box, see Figure 6-5. Remove wiring. Disconnect wiring from compressor terminals and remove compressor junction box.
- d. Remove bolts from service valve flanges.
- e. Remove compressor plate mounting bolts.
- f. Remove compressor and mounting plate. Refer to section 2.2 for weight of compressor.
- g. Remove high pressure switch (HPS) from compressor and check operation of switch (refer to section 6.12.2).

- h. Remove compressor mounting bolts from mounting plate and install mounting plate on replacement compressor.
- i. Install replacement compressor terminal wiring kit, following instructions included with kit.
- j. Install high pressure switch on compressor.
- k. Install compressor and mounting plate in unit.
- l. Connect junction box(es) to compressor and connect all wiring per wiring diagram. Install junction box cover(s).
- m. Install new gaskets on service valves.
- n. Install mounting bolts in service valves and torque to a value of 2.77 to 4.15 mkg (20-30 ft/lb).
- o. Install a new filter-drier. (Refer to section 6.11)
- p. Attach two hoses (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (75.9 cm Hg vacuum = 29.90 inches Hg vacuum). *Turn off valves on both hoses to pump.*
- q. Fully backseat (open) both suction and discharge service valves.
- r. Remove vacuum pump lines.
- s. Start unit and check refrigerant charge. (Refer to section 6.6.1.)
- t. Check moisture-liquid indicator for wetness. Change filter-drier if necessary. (Refer to section 6.11)
- u. Check compressor oil level per section 6.10. Add oil if necessary.

### 6.8 COMPRESSOR DISASSEMBLY

#### WARNING

**Before disassembly of the compressor make sure to relieve the internal pressure very carefully by slightly loosening the bolts on both service valve flanges/blank valve pads, then lightly tap the center of the valve flanges/pads with a lead hammer to break the seal.**

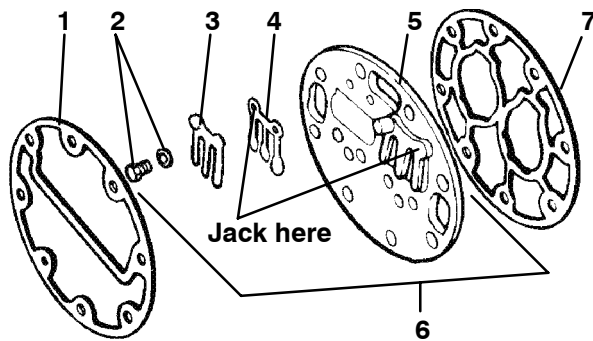
#### CAUTION

**Removing the press-fit stator in the field is not recommended. The rotor and stator are a matched pair and should not be separated.**

When disassembling compressor, matchmark parts so they may be replaced in their same relative positions. (See Figure 6-5 compressor illustration.) Refer to

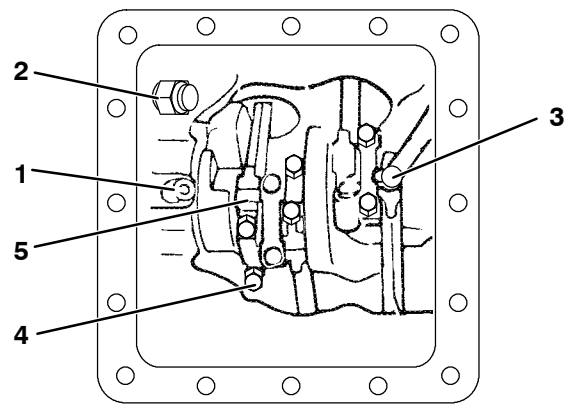
Table 6-4 and Table 6-5 for compressor wear limits and bolt torque values.

- a. Place the compressor in a position where it will be convenient to drain the oil. Remove the oil plug on the oil pump inlet passage (see Figure 6-8 for location) to vent the crankcase. Loosen the drain plug (see Figure 6-5) in bottom plate and allow the oil to drain out slowly. Remove the plug slowly to relieve any crankcase pressure. Some units have a plug in the bottom center of the crankcase which may be removed for draining the motor end more quickly.
- b. Remove cylinder head capscrews. If the cylinder head is stuck, tap the center of the cylinder head with a wooden or lead mallet. **DO NOT STRIKE THE SIDE OF THE CYLINDER HEAD!** Be careful not to drop the head or damage the gasket sealing surface. (See Figure 6-5 and Figure 6-6.) Remove cylinder head gasket.



1. Cylinder Head Gasket
2. Discharge Valve Screw and Lockwasher
3. Discharge Valve Stop
4. Discharge Valve
5. Valve Plate
6. Valve Plate Assembly
7. Valve Plate Gasket

**Figure 6-6. Exploded View of Valve Plate**



1. Oil Pressure Relief Valve
2. Oil Return Check Valve
3. Oil Suction Tube
4. Capscrew
5. Connecting Rod and Cap Assembly

**Figure 6-7. Bottom Plate Removed**

- c. Remove valve stops and valves. After they have been removed, free the valve plate from the cylinder deck by using the outside discharge valve hold-down capscrew as a jack screw through the tapped hole of the valve plate. Remove the valve plate gasket, see Figure 6-6, item 7.
- d. Turn the compressor on its side and remove the bottom plate and the oil suction screen hold down plate. Match mark each connecting rod cap and connecting rod for correct reassembly. Remove the bolts and connecting rod caps (see Figure 6-7). Push the piston rods up as far as they will go without having the piston rings extend above the cylinders.

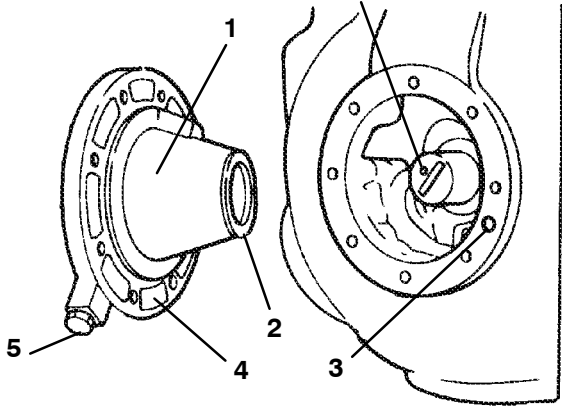
#### **CAUTION**

**The copper tube which connects to the oil suction strainer extends out the bottom with the bottom plate removed. Take precautions to avoid bending or breaking it while changing crankcase positions.**

- e. If necessary, remove the oil return check valve. Inspect it for check valve operation (flow in one direction only). Replace the assembly with a new unit if check valve operation is impaired. (See Figure 6-7.)
- f. To remove the oil pump. Remove eight capscrews, oil pump bearing head assembly, gasket and thrust washer. (See Figure 6-8.)



Set screw must be removed.

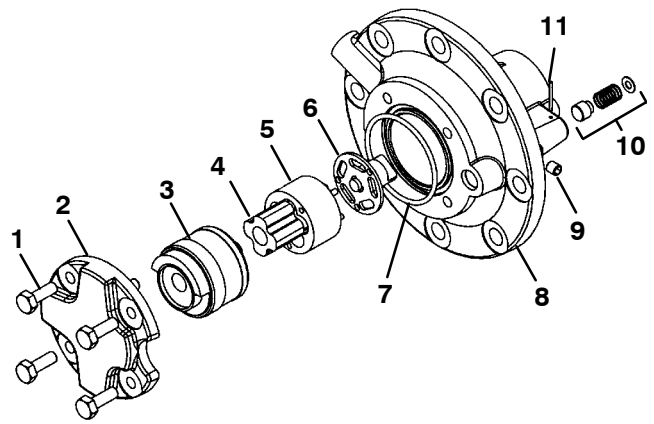


1. Oil Pump & Bearing Head
2. Thrust Washer
3. Oil Pickup Tube
4. Oil Inlet Port
5. Oil Pump Inlet

**Figure 6-8. Oil Pump and Bearing Head**

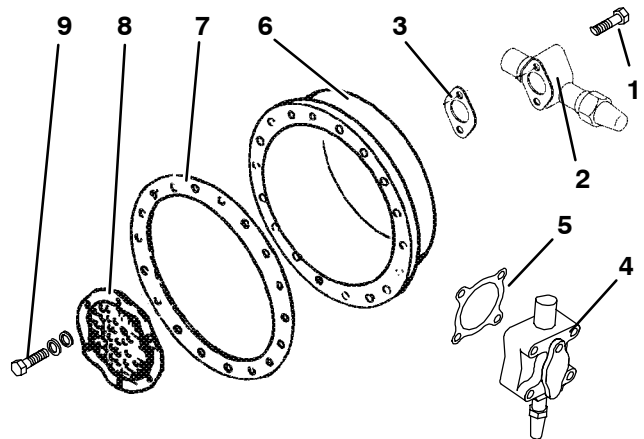
If it was determined that the oil pump is not operating properly, the entire oil pump and bearing head assembly must be replaced. Replacement parts for the pump are not available. However, in the event the pump requires inspection or cleaning, disassemble and reassemble by referring to Figure 6-9. Clean all parts and coat all moving parts with compressor oil before proceeding with reassembly.

- g. Be very careful not to damage the motor windings when removing the motor end cover, as the cover fits over the winding coils. Remove all capscrews except one in the top of the cover. Then, while holding the cover in place, remove the remaining capscrew. Do not allow the cover to drop from its own weight. To prevent striking the winding, remove the cover horizontally and in line with the motor axis.
- h. Remove the refrigerant suction strainer. If it is removed with ease it may be cleaned with solvent and replaced. (See Figure 6-10.) If the strainer is broken, corroded or clogged with dirt that is not easily removed, replace the strainer. Install new gaskets upon reassembly.
- i. Block the compressor crankshaft so that it cannot turn. Use a screwdriver to bend back the tabs on the lockwasher and remove the equalizer tube. (See Figure 6-12.) The slinger at the end of the shaft draws vapor from the crankcase. It may discharge through a tee or a single equalizer tube.



1. Capscrews
2. Cover
3. Reversing Assembly
4. Pinion
5. Gear
6. Drive
7. O-Ring
8. Oil Pump & Bearing
9. Set Screw
10. Relief Valve
11. Pin

**Figure 6-9. Low Profile Gear Oil Pump**

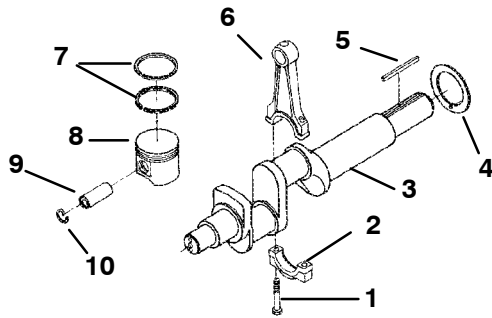


1. Valve Capscrew
2. Suction Service Valve  
(Used on single-speed compressor)
3. Valve Gasket  
(Used on single-speed compressor)
4. Suction Service Valve  
(Used on two-speed compressor)
5. Valve Gasket  
(Used on two-speed compressor)
6. Motor End Cover
7. Motor End Cover Gasket
8. Suction Strainer
9. Strainer Screws and Washers

**Figure 6-10. Motor End Cover**

- j. If the piston rings extend beyond the cylinder tops, the pistons can be pulled through the bottom plate

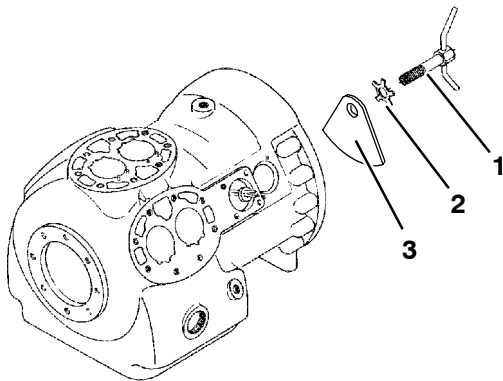
opening after the piston rings are compressed. A piston ring compressor will facilitate removal. Each piston pin is locked in place by lock rings which are snapped into grooves in the piston wall.



1. Capscrew
2. Cap
3. Crankshaft
4. Thrust Washer
5. Rotor Drive Key
6. Connecting Rod
7. Compression Ring
8. Piston
9. Pin
10. Retainer

**Figure 6-11. Crankshaft Assembly**

- k. Since the stator cannot be replaced in the field, the terminal plate assembly need not be disturbed unless a leak exists or a terminal part requires replacing.

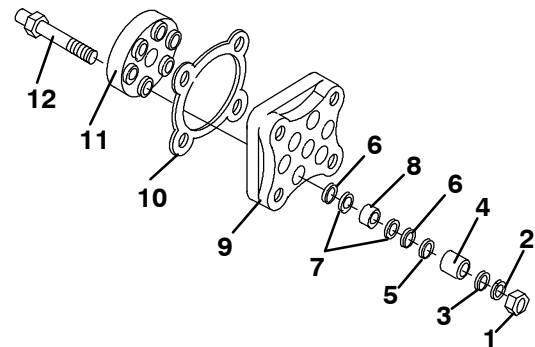


1. Equalizer Tube and Lockscrew Assembly
2. Lockwasher
3. Counterweight - Motor End

**Figure 6-12. Removing Equalizing Tube and Lock Screw Assembly**

Disassemble and assemble the terminal plate as shown in Figure 6-13.

The terminal mounting plate assembly, as originally installed, is assembled so as to leave a small space between the outer terminal bushing and the surface of the mounting plate. This is to provide further crush of the terminal bushing in case a leak should occur. To stop a leak, tighten the terminal bushing nut only enough to stop the escape of gas. Do not tighten until the terminal bushing is flush with the mounting plate. The tightening torque used at the factory is 0.21 to 0.23 mkg (18 to 20 inch pounds) maximum to prevent damage to the plastic parts.



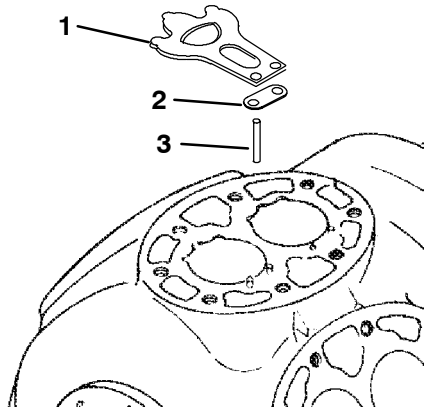
NOTE: Parts shown are for one terminal.

1. Terminal Bushing Nut
2. Lock Washer
3. Terminal Washer
4. Outer Terminal Bushing
5. O-Ring
6. Terminal Bushing Washers (Grey)
7. Terminal Bushing Washers (Red)
8. Inner Terminal Bushing
9. Terminal Mounting Plate
10. Cover Gasket
11. Inner Terminal Block
12. Terminal Screw

**Figure 6-13. Terminal Mounting Assembly**

## 6.9 COMPRESSOR REASSEMBLY

To clean compressor parts, use a suitable solvent with proper precautions. Coat all moving parts with the proper compressor oil before assembly. Refer to Table 6-5 for applicable compressor torque values.



1. Suction Valve
2. Suction Valve Positioning Spring
3. Valve Plate Dowel Pin

**Figure 6-14. Suction Valve & Positioning Springs**

### a. Suction and Discharge Valves

If the valve seats look damaged or worn, replace valve plate assembly. Always use new valves because it is difficult to reinstall used discharge valves so that they will seat as before removal. Any valve wear will cause leakage for this reason.

Suction valves are positioned by dowel pins (see Figure 6-14) and will assume their original position when reinstalled. No two valves are likely to wear in exactly the same way. Never interchange used valves.

Do not omit the suction valve positioning springs. (See Figure 6-14.) Place the springs so that the ends bear against the cylinder deck (middle bowed away from cylinder deck). Use new gaskets when reinstalling valve plates and cylinder heads.

### b. Compression Rings

The compression ring is chamfered on the inside circumference. This ring is installed with the chamfer toward the top. Stagger the ring end gaps so they are not aligned.

The gap between the ends of the piston rings can be checked with a feeler gauge by inserting the ring into the piston bore approximately one inch below the top of the bore. Square the ring in the bore by pushing it slightly with a piston. The maximum and minimum allowable ring gaps are 0.33 and 0.127 mm (0.013 and 0.005 inch) respectively.



**Figure 6-15. Piston Rings**

### c. Installing the Components

1. Push pistons from the inside of the crankcase through the cylinders, being careful not to break the rings. Place chamfered side of connecting rod against radius of crankpins. Install the crankshaft through the pump end of the compressor. Do not damage main bearings. Install matching connecting rod caps through bottom cover plate.
2. The oil screen (located in the bottom of the crankcase), is connected to the inlet of the oil pump. Whenever the compressor crankcase is opened, inspect the screen for holes or an accumulation of dirt. The screen can be cleaned with a suitable solvent.

#### CAUTION

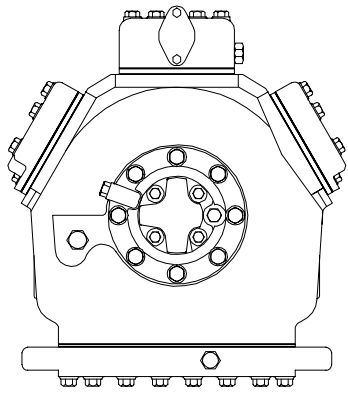
**The set screw on the crankshaft must be removed for the oil pump installation (see Figure 6-8).**

3. Install the pump end thrust washer on the two dowel pins located on the bearing head. (See Figure 6-8)

#### CAUTION

**Ensure that thrust washer does not fall off dowel pins while installing oil pump.**

4. Install the bearing head assembly with a new gasket on the compressor crankshaft. Carefully push oil pump on by hand, ensuring that the thrust washer remains on the dowel pins. The tang on the end of the drive engages the slot in the crankshaft, and the oil inlet port on the pump is aligned with the oil pickup tube in the crankcase. The pump should mount flush with the crankcase and should be oriented as shown in Figure 6-16.



**Figure 6-16. Compressor Oil Pump End View**

5. Align the gasket and install the eight capscrews in the mounting flange. Refer to Table 6-5 for applicable torque values.
6. Install rotor with key. Screw on equalizer tube and lock screw assembly with lock washer and bend over tabs of lock washer. Assemble suction strainer to motor and cover and bolt cover to crankcase. Assemble valve plates and gaskets. Assemble cylinder heads and gaskets. Turn the shaft by hand to see that it moves freely.
7. Install the oil suction screen, the oil suction screen hold down plate and the bottom plate.

### 6.10 COMPRESSOR OIL LEVEL

#### CAUTION

Use only Carrier Transicold approved Polyol Ester Oil (POE) - Castrol-Icematic SW20 compressor oil with R-134a. Buy in quantities of one quart or smaller. When using this hygroscopic oil, immediately reseal. Do not leave container of oil open or contamination will occur.

#### a. To Check the Oil Level in the Compressor:

1. Operate the unit in cooling mode for at least 20 minutes.
2. Check the front oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step 6.10.a.3.
3. Turn unit off to check the oil level. The correct oil level range should be between the bottom to one-eighth level of the sight glass. If the level is above one-eighth, oil must be removed from the

compressor. To remove oil from the compressor, follow step d in this section. If the level is below the bottom of the sight glass, add oil to the compressor following step b below.

#### b. Adding Oil with Compressor in System

In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

#### CAUTION

**Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor.**

Connect the suction connection of the gauge manifold to the compressor suction service valve port, and immerse the common connection of the gauge manifold in an open container of refrigeration oil. Crack the suction service valve and gauge valve to vent a small amount of refrigerant through the common connection and the oil to purge the lines of air. Close the gauge manifold valve.

With the unit running, frontseat the suction service valve and induce a vacuum in the compressor crankcase. SLOWLY crack the suction gauge manifold valve and oil will flow through the suction service valve into the compressor. Add oil as necessary.

Run unit for 20 minutes in cooling mode. Check oil level at the compressor sight glass.

#### c. Adding Oil to Service Replacement Compressor

#### NOTES

- The correct oil charge is 3.6 liters (7.6 U.S. pints).
- Service replacement compressors are shipped without oil.
- When first adding oil to the compressor, add only three liters (6.3 pints) to the compressor. Run the unit for 20 minutes in cooling mode. Check the oil level in the compressor sight glass. Add oil as necessary. This procedure is designed to compensate for excess oil that may have migrated with refrigerant to other parts of the system during unit operation.

*If compressor is without oil:*

If oil is present in the compressor, ensure that it is the correct oil. Add oil (sections 2.2 and 6.10) through the

suction service valve flange cavity or by removing the oil fill plug. (See Figure 6-5.) Some compressors have the oil plug located on the crankcase, at the right or left side of the oil pump.

#### d. To Remove Oil From an 06DR Compressor:

1. If the oil level recorded in step a.3 is above one-eighth level of the capacity of the sight glass, oil must be removed from the compressor.
2. Close (frontseat) suction service valve and pump unit down to 1.2 to 1.3 kg/cm<sup>2</sup> (2 to 4 psig). Frontseat discharge service valve and slowly bleed remaining refrigerant.
3. Remove the oil drain plug on the bottom plate of the compressor and drain the proper amount of oil from the compressor to obtain the correct level (maximum is one-eight level of the sight glass). Replace the plug securely back into the compressor. *DO NOT FORGET TO OPEN SUCTION AND DISCHARGE SERVICE VALVES.*
4. Repeat step (a) to ensure proper oil level.

### 6.11 FILTER-DRIER

On units equipped with a water-cooled condenser, if the sight glass appears to be flashing or bubbles are constantly moving through the sight glass when the suction modulation valve is fully open, the unit may have a low refrigerant charge or the filter-drier could be partially plugged.

#### To Check Filter-Drier:

- a. Test for a restricted or plugged filter-drier by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed.
- b. A second test for moisture in the filter-drier is that the moisture-liquid indicator shows moisture in the system.

#### To Replace Filter-Drier:

- a. Pump unit down to 0 psi and replace filter-drier. (Refer to section 6.3.)
- b. Evacuate the unit per section 6.5 and open the manual liquid line valve.
- c. After unit is in operation, inspect for moisture in system.

### 6.12 HIGH PRESSURE SWITCH

#### 6.12.1 Replacing High Pressure Switch

- a. Turn unit start-stop switch OFF. Frontseat both suction and discharge service valves to isolate compressor. Remove the refrigerant from the compressor.
- b. Disconnect wiring from defective switch. The high pressure switch is located on the center head and is removed by turning counterclockwise. (See Figure 2-1.)
- c. Install a new high pressure switch after verifying switch settings. (Refer to section 6.12.2.)
- d. Evacuate and dehydrate the compressor per section 6.5.1.

#### 6.12.2 Checking High Pressure Switch

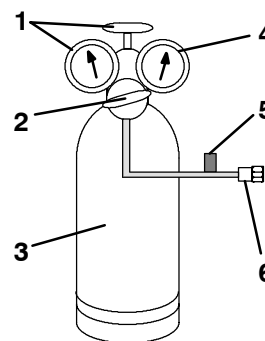
##### WARNING

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

##### NOTE

The high pressure switch (HPS) is non-adjustable.

- a. Remove switch as outlined in section 6.12.1.
- b. Connect ohmmeter or continuity light across switch terminals. Ohm meter will indicate no resistance or continuity light will be illuminated if the switch closed after relieving compressor pressure.
- c. Connect hose to a cylinder of dry nitrogen. (See Figure 6-17.)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 36 kg/cm<sup>2</sup> = 0 to 400 psig)
5. Bleed-Off Valve
6. 1/4 inch Connection

**Figure 6-17. Typical Setup for Testing High Pressure Switch**

- d. Set nitrogen pressure regulator at 26.4 kg/cm<sup>2</sup> (375 psig) with bleed-off valve closed.
- e. Close valve on cylinder and open bleed-off valve.

- f. Open cylinder valve. Slowly close bleed-off valve to increase pressure on switch. The switch should open at a static pressure up to 25 kg/cm<sup>2</sup> (350 psig). If a light is used, light will go out. If an ohmmeter is used, the meter will indicate open circuits.
- g. Slowly open bleed-off valve to decrease the pressure. The switch will close at 18 kg/cm<sup>2</sup> (250 psig).

### 6.13 EVAPORATOR COIL AND HEATER ASSEMBLY

The evaporator section, including the coil, should be cleaned regularly. The preferred cleaning fluid is fresh water or steam. Another possible cleaner is Oakite 202 or similar, following *manufacturer's instructions*.

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

*To Replace the Evaporator Coil:*

- a. Pump unit down. (See Figure 2-5, refer to section 6.3.)
- b. With power OFF and power plug removed, remove the screws securing the panel covering the evaporator section (upper panel).
- c. Disconnect the defrost heater wiring.
- d. Disconnect the sensor from the coil. The defrost termination sensor (DTS) is located on the middle coil support as shown in Figure 2-2.
- e. Remove middle coil support.
- f. Remove the mounting hardware from the coil.
- g. Unsolder the two coil connections, one at the distributor and the other at the coil header.
- h. After defective coil is removed from unit, remove defrost heaters and install on replacement coil.
- i. Install coil assembly by reversing above steps.
- j. Leak check connections per section 6.4. Evacuate the unit per section 6.5 and add refrigerant charge per section 6.6.2.

### 6.14 EVAPORATOR COIL HEATERS

#### WARNING

**Before servicing unit, make sure the unit circuit breakers (CB-1 & CB-2) and the start-stop switch (ST) are in the OFF position, and that the power plug and cable are disconnected.**

- a. Remove the lower access panel (Figure 2-1) by removing the T.I.R. locking device lockwire and mounting screws.
- b. Determine which heater(s) need replacing by checking resistance on each heater as shown in section 1.4.e.
- c. Remove hold-down clamp securing heaters to coil.
- d. Lift the "U" or "W" portion of the heater (with the opposite end down and away from coil). Move heater left (or right) enough to clear the heater end support.

### 6.15 EVAPORATOR FAN AND MOTOR ASSEMBLY

The evaporator fans circulate air throughout the container by pulling air in through 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. (Refer to section 2.3.) The fan motor bearings are factory lubricated and do not require additional grease.

*To Replace the Evaporator Fan Assembly:*

#### WARNING

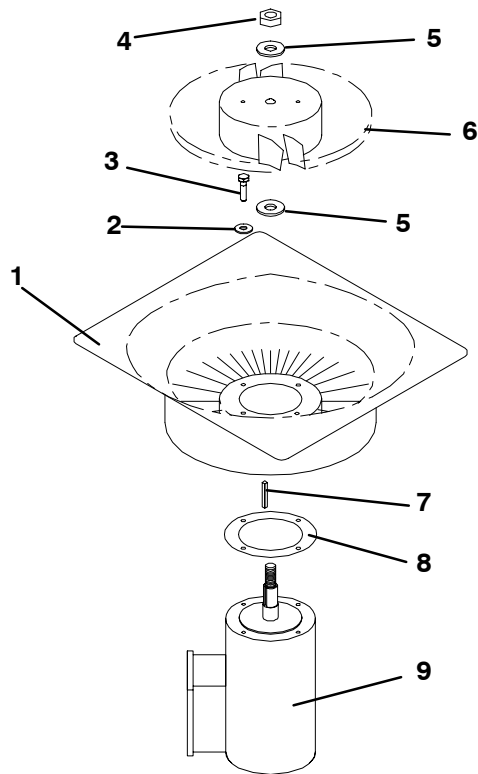
**Always turn OFF the unit circuit breakers (CB-1 & CB-2) and disconnect main power supply before working on moving parts.**

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

*To disassemble the Evaporator Fan Assembly:*

- 1. Attach a spanner wrench to the two 1/4-20 holes located in the fan hub. Loosen the 5/8-18 shaft nut

by holding the spanner wrench stationary and turning the 5/8-18 nut counter-clockwise (see Figure 6-18).



1. Stator
2. Flat washer, 1/4
3. Bolt, 1/4-20 x 3/4
4. Locknut, 5/8-18
5. Flat washer, 5/8
6. Impeller Fan
7. Key
8. Mylar Protector
9. Evaporator Motor

**Figure 6-18. Evaporator Fan Assembly**

2. Remove the spanner wrench. Use a universal wheel puller and remove the fan from the shaft. Remove the washers and key.
3. Remove the four 1/4-20 x 3/4 long bolts that are located under the fan that support the motor and stator housing. Remove the motor and plastic spacer.

*To assemble the Evaporator Fan Assembly:*

1. Assemble the motor and plastic spacer onto the stator.
2. Apply loctite to the 1/4-20 x 3/4 long bolts and torque to 0.81 mkg (70 inch-pounds).
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.
- d. Install the evaporator fan assembly in reverse order of removal. Torque the four 1/4-20 clamp bolts to 0.81 mkg (70 inch-pounds) Apply power momentarily to check for proper fan rotation (refer to section 2.3). If fan spins backward, then motor wiring or motor is defective.
- e. Replace access panel making sure that panel does not leak. Make sure that the T.I.R. locking device is lockwired.

### 6.16 EVAPORATOR FAN MOTOR CAPACITORS

The evaporator fan motors are of the permanent-split capacitor type. The motor is equipped with one capacitor (used in the high speed circuit) and another capacitor used for the low speed circuit.

#### a. When to check for a defective capacitor

1. Fan motor will not change speed. For example: controller settings above  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, should cause the motor to run in high speed.

#### NOTE

The evaporator fan motors will always start in high speed.

Controller settings below  $-10^{\circ}\text{C}$  ( $+14^{\circ}\text{F}$ ), or  $-5^{\circ}\text{C}$  ( $+23^{\circ}\text{F}$ ) optionally, should cause the motor to run in low speed.

2. Motor running in wrong direction (after checking for correct wiring application).

#### b. Removing the capacitor

#### WARNING

**Make sure power to the unit is OFF and power plug disconnected before removing capacitor(s).**

1. The capacitor located on the motor and above the evaporator fan deck may be removed by two methods:
  - (a) *If container is empty*, open upper rear panel of the unit. The capacitor may be serviced after disconnecting power plug.
  - (b) *If container is full*, turn the unit power OFF and disconnect power plug. Remove the evaporator fan motor access panel. (See Figure 2-1). For removal of the evaporator fan assembly, refer to section 6.15.

## WARNING

**With power OFF discharge the capacitor and disconnect the circuit wiring.**

### c. Checking the capacitor

If the capacitor is suspected of malfunction, you may choose to simply replace it. Direct replacement requires a capacitor of the same value. Two methods for checking capacitor function are:

1. *Volt-ohmmeter set on RX 10,000 ohms.* Connect ohmmeter leads across the capacitor terminals and observe the meter needle. If the capacitor is good, the needle will make a rapid swing toward zero resistance and then gradually swing back toward a very high resistance reading.

If the capacitor has failed open, the ohmmeter needle will not move when the meter probes touch the terminals. If the capacitor is shorted, the needle will swing to zero resistance position and stay there.

### 2. Capacitor analyzer

The function of the analyzer is to read the microfarad value of a capacitor and to detect insulation breakdown under load conditions. The important advantages of a analyzer are its ability to locate capacitors that have failed to hold their microfarad ratings, or those that are breaking down internally during operation. It is also useful in identifying capacitors when their microfarad rating marks have become unreadable.

## 6.17 CONDENSER COIL

The condenser consists of a series of parallel copper tubes expanded into copper fins. The condenser coil must be cleaned with fresh water or steam so the air flow is not restricted. Fan rotation is counterclockwise when viewed from shaft end of motor.

## WARNING

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

*To Replace Condenser Coil:*

- Remove the refrigerant charge per section 6.3.
- Remove the condenser coil guard.
- Unsolder discharge line and remove the line to the receiver or water-cooled condenser (if so equipped).
- Remove coil mounting hardware and remove the coil.

- Install replacement coil and solder connections.
- Leak-check the coil per section 6.4. Evacuate the unit per section 6.5, then charge the unit with refrigerant per section 6.6.1.

## 6.18 CONDENSER FAN AND MOTOR ASSEMBLY

## WARNING

**Do not open condenser fan grille before turning power OFF and disconnecting power plug.**

The condenser fan rotates counter-clockwise (viewed from front of unit), pulls air through the the condenser coil, and discharges horizontally through the front of the unit. To replace motor assembly:

- Open condenser fan screen guard.
- Loosen two square head set screws on fan. (Thread sealer has been applied to set screws at installation.) Disconnect wiring from motor junction box.

## CAUTION

**Take necessary steps (place plywood over coil or use sling on motor) to prevent motor from falling into condenser coil.**

- Remove motor mounting hardware and replace the motor. It is recommended that new locknuts be used when replacing motor. Connect wiring per wiring diagram.
- Install fan loosely on motor shaft (hub side in). DO NOT USE FORCE. If necessary, tap the hub only, not the hub nuts or bolts. Install venturi. Apply "Loctite H" to fan set screws. Adjust fan within venturi so that the outer edge of the fan projects 3.2 to 6.4 mm (3/16"  $\pm$  1/16") back from edge of the venturi. Spin fan by hand to check clearance.
- Close and secure condenser fan screen guard.
- Apply power to unit and check fan rotation. If fan motor rotates backward, reverse wire numbers 5 and 8.

## 6.19 PARTLOW RECORDING THERMOMETER

## NOTE

The Controller/DataCORDER return air probe is located adjacent to the Partlow bulb, and can be used to calibrate the chart recorder.

### a. Instruments for Checking Bulb Temperature

The recording thermometer may be optionally equipped with one or two Simpson accessories (#344 units), each consisting of a thermistor probe and receptacle



(mounted to instrument case). A single probe is attached to the element (bulb) capillary which senses the container return air temperature. If using two probes, one probe will be attached to the supply air temperature sensor.

In the event of a failure with the #344 test lead, other instruments for checking bulb temperatures are:

*Simpson Meter, CTC P/N 07-00013 or Robinair Thermistor Temperature Tester, Model 12860:*

A resistance thermometer with RCA lead and a phono-plug at each end may be used to compare the bulb temperature and the stylus indicated temperature on the chart by inserting one end of the lead into the receptacle provided on the controller and the other end in the meter. Always check resistance thermometer before using. (Refer to 6.19.b.)

*Ohmmeter:*

1. Place one probe of ohmmeter in the middle of the receptacle provided on the chart platen (Figure 6-19). Ground other probe to unit.
2. Note reading of meter and using Table 6-2, convert resistance to temperature.

### CAUTION

**The inside mechanism of the control, particularly the inside of the element housing should never be oiled, however, control mechanisms should be sprayed periodically (every 60 days) with corrosion inhibiting CRC 3-36a or 6-66 or LPS no. 2.**

#### b. Checking Resistance Thermometer (Optional)

Calibrate the resistance thermometer by completely filling a thermos container full of ice cubes or chips and filling the voids between the ice with plain water. Stir the solution until the mixture registers 0 to 0.3°C (32 to 32.5°F), as indicated by a laboratory thermometer. Immerse the resistance thermometer in the 0°C (32°F) solution to check its accuracy at this temperature. It is important that the recommended length of the check probe is immersed so that it will accurately reflect temperature. This measurement checks the test probe at 0°C (32°F) only. It is possible for the resistance thermometer to be inaccurate at other temperatures. Rezero check thermometer if necessary following manufacturer's instructions.

#### c. Checking the Recording Thermometer Bulb Temperature

Checking temperature is accomplished by comparing the instrument's indicated temperature (stylus) with the known temperature existing at the element sensing bulb. To properly check the temperature of the recorder, the element sensing bulb should be stabilized at a temperature of 0°C (32°F). This is accomplished by using one of the two following methods, whichever is more convenient.

*Unit Running:*

Place set point at 0°C (32°F). After unit has pulled down to this temperature, allow the compressor to cycle ON-OFF three to five times to be certain temperature has stabilized at 0°C (32°F) as verified by the resistance thermometer. If the temperature indicated by the thermometer differs from 0°C (32°F) by more than 0.6°C (1°F) when compressor cycles off, rezeroing must be performed.

*Unit Off:*

Place the recording thermometer element (sensing bulb) in 0°C (32°F) ice-water bath. Ice-water bath is prepared by filling an insulated container (of sufficient size to completely immerse bulb) with ice cubes or chipped ice, filling voids between ice with water, and agitating until mixture reaches 0°C (32°F) as shown by a laboratory thermometer.

When the temperature at the element sensing bulb has stabilized at 0°C (32°F), as shown by stable stylus indication, compare the temperature indicated by stylus with temperature shown by a laboratory thermometer. If the two readings do not agree, the recording thermometer should be rezeroed. (Refer to paragraph d.)

#### d. Rezeroing the Recording Thermometer

1. Be certain that the element bulb temperature has stabilized at 0°C (32°F). Note the amount of temperature difference between the test meter or thermometer reading and the stylus indicated temperature.

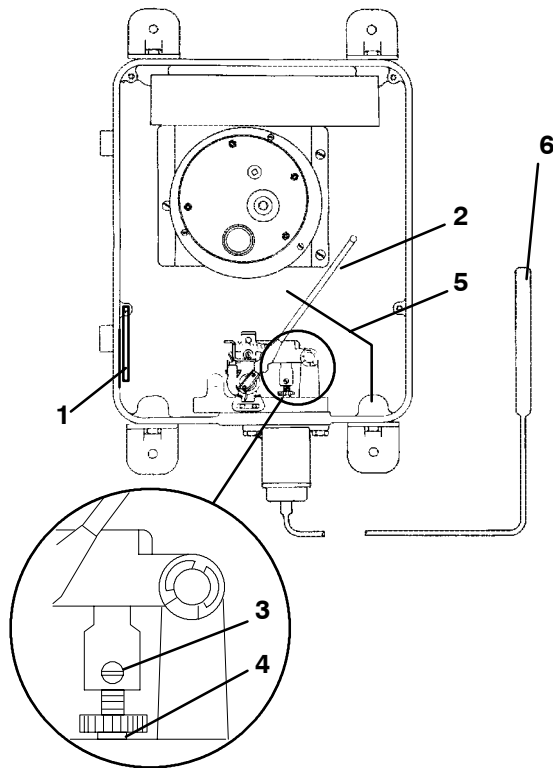
If the difference noted between the known element temperature and indicated temperature is within acceptable limits (0.3 of 0°C = 1/2° of 32°F), do not attempt to rezero. If more than 0.3°C (1/2°F) in variation, carefully note the number of degrees.

2. If recording thermometer is found to require rezeroing:

- (a) Loosen set screw (item 3, Figure 6-19) and zero thermometer by turning pinion shaft (item 4). Lengthening pinion shaft (counterclockwise)

raises stylus indicated temperature reading; shortening shaft (clockwise) lowers stylus reading. Then retighten set screw.

- (b) Reset control at 0°C (32°F), start the refrigeration unit and repeat accuracy check. After temperature stabilization, recording thermometer should be within 0.3°C (1/2°F) limits.



1. Wind-up Key
2. Stylus
3. Set Screw
4. Pinion Shaft
5. Stylus Lifter
6. Bulb

**Figure 6-19. Partlow Recording Thermometer**

**e. Replacing Recording Thermometer Element (Bulb and Capillary)**

The element is mercury-filled and the temperature-pressure of the element controls the stylus, which moves across the chart in response to temperature changes as sensed by the bulb located in the evaporator supply air.

The element flange contains three O-rings. Care should be taken to install the new element flange without damaging the O-rings. It is possible for a mercury leak to develop at the flange if O-ring damage occurs.

The stylus will continue to fall (container temperature will actually be higher) if a leak develops in the flange, capillary or bulb.

*To replace the recording thermometer element:*

1. Turn unit OFF and disconnect power source.
2. Remove upper back panel. Remove bulb clamps securing bulb to unit.
3. Remove two flange screws from recording thermometer and feed capillary and element through the unit.
4. Push replacement bulb end and capillary through the unit.
5. Fill slots with silastic (RTV432, Dow Corning).
6. Attach bulb clamps tightly to bulb.
7. Connect element flange to recorder making sure hub of flange faces out to fit into the hole in instrument case (recording thermometer).
8. Rezero the recorder. (Refer to sections 6.19.a. through 6.19.d.)
9. Install inlet air grille and upper panel. Start unit and check recorder calibration.

**CAUTION**

**Capillary tubing may be bent, but never sharper than 1/2" radius; extra care should be taken when bending adjacent to welds. The sensing bulb should never be bent, as this will affect calibration.**

**6.20 SAGINOMIYA RECORDING THERMOMETER**

**NOTE**

Do not overtighten chart nut after replacing chart.

**a. Battery**

1. Open door and remove chart nut and platen.
2. Push voltage indicator test switch (item 2, Figure 6-20). Replace battery if voltage indicator points to the red or white zone.

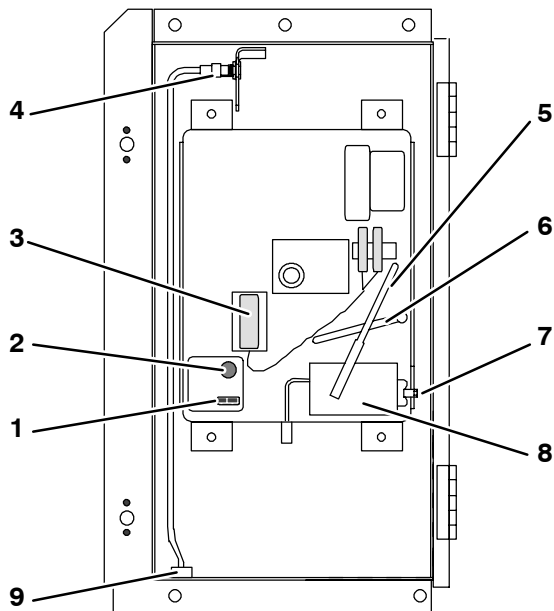
**b. Calibration**

1. Install new chart on platen.
2. Place recorder bulb in ice bath ( $0 \pm 0.2^\circ\text{C} = 32 \pm 0.35^\circ\text{F}$ ). (Remove rear upper panel to remove bulb.) Leave bulb immersed in ice bath for **10 minutes**.
3. After 10 minutes, rotate the chart by hand and check the stylus indicated temperature. Do not touch stylus during the checkout procedure.

4. If adjustment is required, loosen setscrew (cross-recessed head). Using a 7 mm wrench, rotate the adjustment screw clockwise to set the stylus 1 to 2°C (1.8 to 3.6°F) higher than desired temperature.
5. Rotate the adjustment screw counterclockwise to set the stylus about 0.5°C (0.9°F) higher than set temperature. Rotate the chart by hand. The indicated temperature should be 0°C (32°F).

### c. Replacing Sensor Probe

1. Remove box from unit.
2. Remove nut and bushing (item 9, Figure 6-20).



1. Voltage Indicator
2. Indicator Test Switch
3. Battery ("C" size, Alkaline)
4. Sensor Assembly
5. Stylus
6. Stylus Lifter
7. Setscrew (Adjustment)
8. Bulb and Mechanism
9. Bushing and Nut

**Figure 6-20. Saginomiya Recording Thermometer**

3. Install replacement probe and bushing. Seal with silicone before securing to case.
4. Install box into unit.

### NOTES

- One full turn with the adjustment screw changes the indicated temperature by approximately 5°C (9°F).
- Overtightening of setscrew may change set temperature.

- Calibration should only be done when bulb temperature is decreasing.
- DO NOT move stylus by hand.

### 6.21 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, spray or brush on zinc-rich primer. After the primer has dried, spray or brush on finish coat of paint to match original unit color.

### 6.22 POWER AUTOTRANSFORMER (OPTIONAL)

If the unit does not start, check the following:

- a. Make sure the 460 vac (yellow) power cable is plugged into the receptacle (item 3, Figure 2-9) and locked in place.
- b. Make sure that circuit breakers CB-1 and CB-2 are in the "ON" position. If the circuit breakers do not hold in, check voltage supply.
- c. There is no internal protector for this particular transformer design, therefore, no checking of the internal protector is required.
- d. Using a voltmeter, and with the primary supply circuit ON, check the primary (input) voltage (460 vac). Next, check the secondary (output) voltage (230 vac). The transformer is defective if voltage is not available.

### 6.23 SENSOR CHECKOUT PROCEDURE (AMBS, DTS, RRS, RTS, SRS & STS)

An accurate ohmmeter must be used to check the resistance values shown in Table 6-1.

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 in Table 6-1.

#### 6.23.1 Checking Sensor (RRS, RTS, SRS or STS)

- a. Place the sensor (sensing bulb) in a 0°C (32°F) ice-water bath. The ice-water bath is prepared by filling an insulated container (of sufficient size to

completely immerse bulb) with ice cubes or chipped ice, then filling voids between ice with water and agitating until mixture reaches 0°C (32°F) measured on a laboratory thermometer.

- b. Start unit and check air temperature/data readout on the control panel. The reading should be 0°C (32°F); if it is not, continue on to the following step.
- c. Turn unit OFF and disconnect power supply.
- d. Refer to section 6.27 for removal of the Controller module.

*RTS or STS:*

Using the plug connector marked “EC” that is connected to the Controller module. Locate the wires marked RTS or STS, depending on which sensor needs to be replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 6-1.

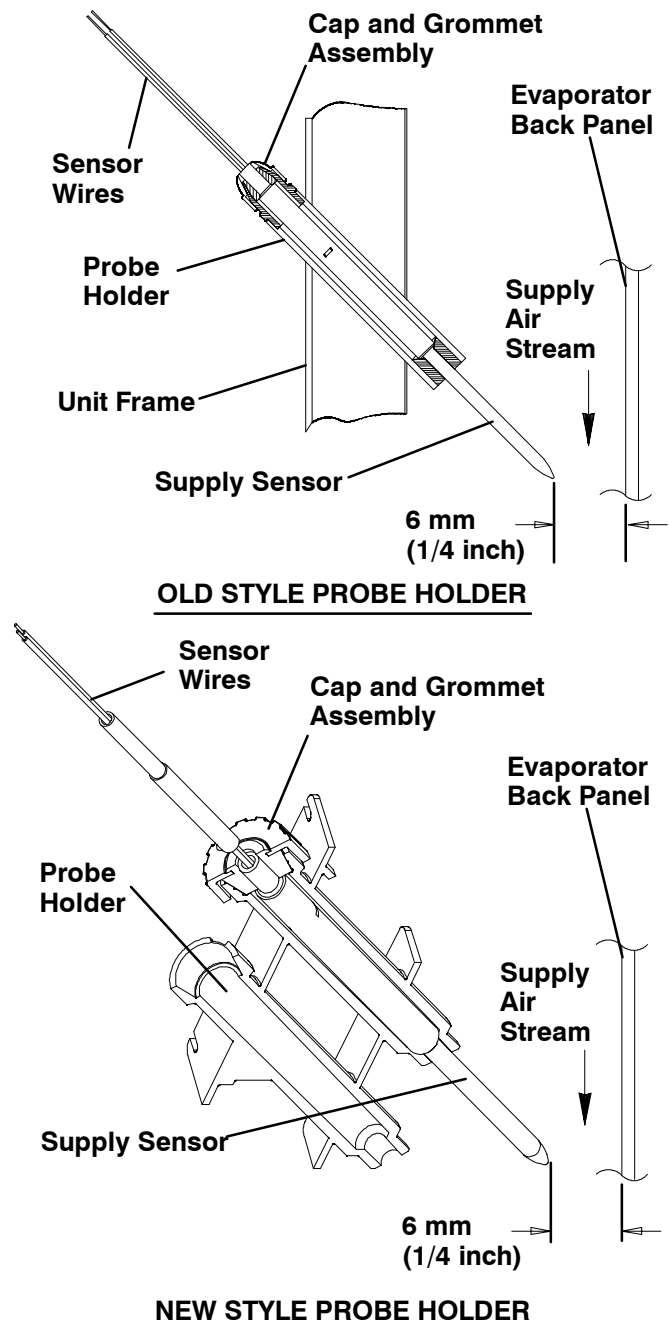
*RRS or SRS:*

Using the plug connector marked “EC” that is connected to the Controller module. Locate the wires marked RRS or SRS, depending on which sensor needs to be replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 6-1.

**6.23.2 Replacing Sensor (STS and SRS)**

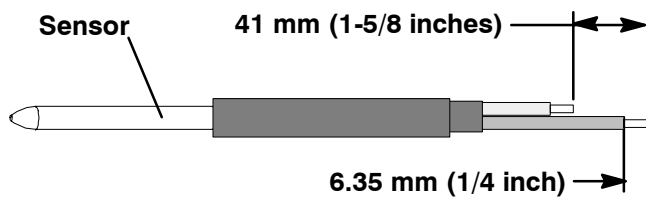
To properly position a unit supply sensor, the sensor must be fully inserted into the probe holder. This positioning will give the sensor the optimum amount of exposure to the supply air stream, and will allow the Controller to operate correctly. Insufficient probe insertion into the probe holder will result in poor temperature control due to the lack of air flow over the sensor.

It is also necessary to ensure that the probe tip does not contact the evaporator back panel. The design minimum clearance of 6 mm (1/4 inch) should be maintained (see Figure 6-21).



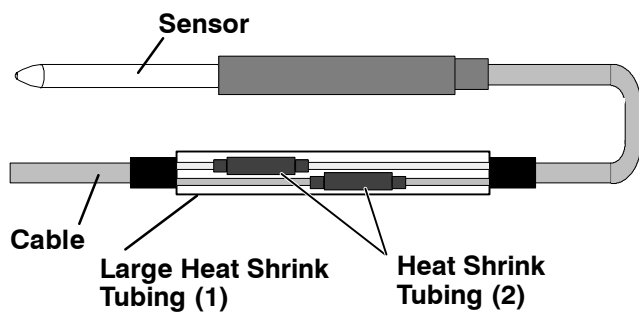
**Figure 6-21. Supply Sensor Positioning**

- a. Turn unit power OFF and disconnect power supply.
- b. Remove and save any cover (if present) over wiring and probe holder.
- c. Cut cable 5 cm (2 inches) from shoulder of defective sensor and discard the defective probe only. Save cap and grommet assembly for reuse on the replacement probe. **Do not cut the grommet.**
- d. Cut one wire of existing cable 41 mm (1-5/8 inches) shorter than the other wire.
- e. Cut one replacement sensor wire (opposite color) back 41 mm (1-5/8 inches). (See Figure 6-22.)



**Figure 6-22. Sensor (RRS, RTS, SRS or STS)**

- f. Strip back insulation on all wiring 6.35 mm (1/4 inch).
- g. 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 6-23.
- h. Slide the cap and grommet assembly, which was saved in step (c.), onto the replacement sensor.
- i. 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.
- j. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
- k. Slide heat shrink tubing over splice so that both ends of tubing cover both ends of crimp as shown in Figure 6-23.



**Figure 6-23. Sensor and Cable Assembly (RRS, RTS, SRS or STS)**

- l. Heat tubing, preferably with a flameless heat gun. If not available, a propane torch will work (*caution should be taken not to burn the heat shrink tubing or wire insulation*). Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.
- m. Slide large heat shrink tubing over both splices and shrink tubing and heat as in step (l.).

**CAUTION**

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

- n. Position sensor in unit per Figure 6-21 and check sensor resistance as detailed in section 6.23.1.
- o. Reinstall the cover (if present) that was removed in step (b.) over wiring and probe holder.

**NOTE**

The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1).

**6.23.3 Replacing Sensor (RRS and RTS)**

- a. Turn unit power OFF and disconnect power supply.
- b. Cut cable 5 cm (6 inches) from shoulder of defective sensor and discard the defective probe only.
- c. Cut one wire of existing cable 41 mm (1-5/8 inches) shorter than the other wire.
- d. Cut one replacement sensor wire (opposite color) back 41 mm (1-5/8 inches). (See Figure 6-22.)
- e. Strip back insulation on all wires 6.35 mm (1/4 inch).
- f. Slide a large piece of heat shrink tubing over the unit cable, and place the two small pieces of heat shrink tubing, one over each wire, before adding crimp fittings as shown in Figure 6-23.
- g. 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.
- h. Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
- i. Slide heat shrink tubing over splice so that both ends of tubing cover both ends of crimp as shown in Figure 6-23.
- j. Heat tubing, preferably with a flameless heat gun. If not available, a propane torch will work (*caution should be taken not to burn the heat shrink tubing or wire insulation*). Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.
- k. Slide large heat shrink tubing over both splices and shrink tubing and heat as in step (j).

**CAUTION**

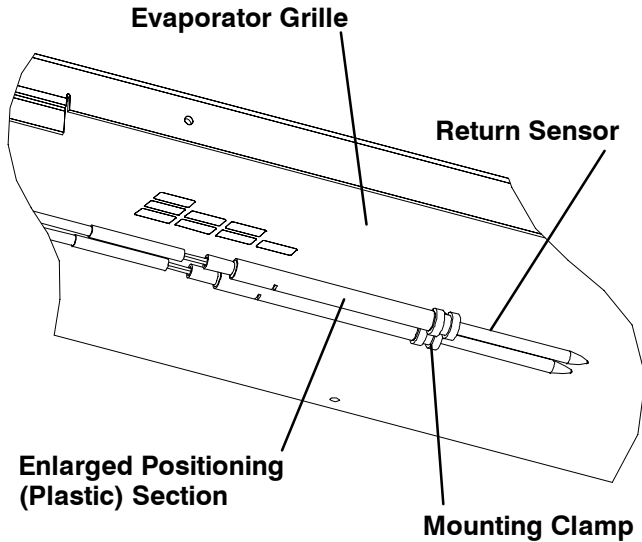
**Do not allow moisture to enter wire splice area as this may affect the sensor resistance.**

- l. Check sensor resistance as detailed in section 6.23.1.
- m. Reinstall the return sensor as shown in Figure 6-24. For proper placement of the return sensor, be sure to

position the enlarged positioning section of the sensor against the the side of the mounting clamp.

**NOTE**

The P5 Pre-Trip test must be run to inactivate the alarm (refer to section 3.2.1).



**Figure 6-24. Return Sensor Positioning**

**6.23.4 Checking Sensor (AMBS or DTS)**

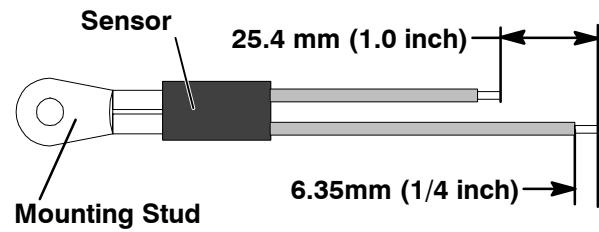
- Turn unit OFF and disconnect power supply.
- Refer to section 6.27 for removal of the Controller module.

*AMBS or DTS:*

Using the plug connector marked “EC” that is connected to the Controller module. Locate the wires marked AMBS or DTS, depending on which sensor needs to be replaced. Follow that wire to the connector and using the pins of the plug, measure the ohms resistance. Readings are shown in Table 6-1.

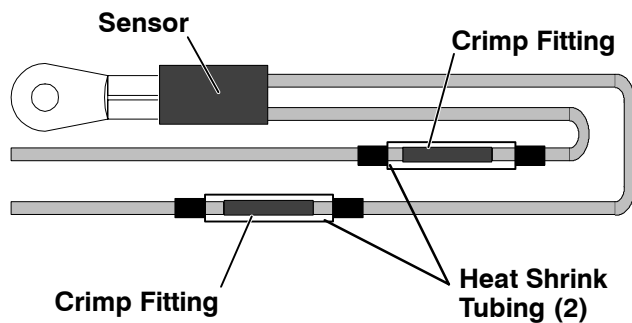
**6.23.5 Replacing Sensor (AMBS or DTS)**

- Turn unit power OFF and disconnect power supply.
- Cut wires to 25.4 cm (10 inches) from the back of the mounting stud of the defective sensor and discard.
- Cut one of the two wires from step b 25.4 mm (1.0 inch) shorter than the other wire.
- Cut one replacement sensor wire back 25.4 mm (1.0 inch). (See Figure 6-25.)
- Strip back insulation on all wiring 6.35mm (1/4 inch).



**Figure 6-25. Sensor (AMBS or DTS)**

- Slide two small pieces of heat shrink tubing over each wire before adding crimp fittings as shown in Figure 6-26.
- Slip crimp fittings over dressed wires. Make sure wires are pushed into crimp fittings as far as possible and crimp with crimping tool.
- Solder spliced wires with a 60% tin and 40% lead Rosincore solder.
- Slide heat shrink tubing over splice so that both ends of tubing cover both ends of crimp as shown in Figure 6-26.



**Figure 6-26. Sensor and Wire Assembly (AMBS or DTS)**

- Heat tubing, preferably with a flameless heat gun. If not available, a propane torch will work (*caution should be taken not to burn the heat shrink tubing or wire insulation*). Make sure all seams are sealed tightly against the wiring to prevent moisture seepage.

**CAUTION**

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

- Secure sensor to unit and check sensor resistance as detailed in section 6.23.4.

**NOTE**

The DTS sensor must have “Presstite” insulating material placed completely over the sensor to insure proper function of the sensor.

## 6.24 SUCTION SOLENOID VALVE (SSV)

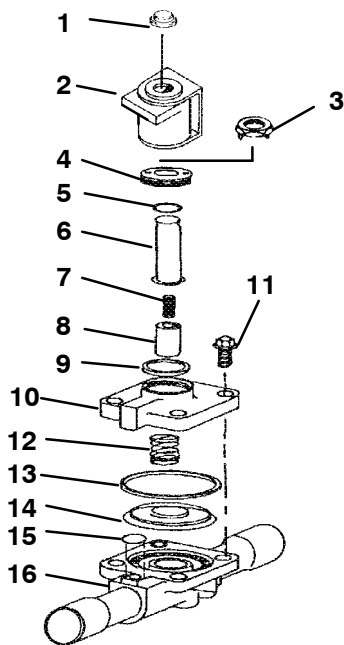
### a. Replacing the Coil

#### NOTE

The coil may be replaced without removing the refrigerant.

1. Disconnect leads by unplugging the connector. Remove snap cap or locknut. Lift off coil. (See Figure 6-27)
2. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.

### b. Replacing Valve Internal Parts - Alco (See Figure 6-27)



1. Snap Cap
2. Coil
3. Installation/Removal Tool
4. Enclosing Tube Collar
5. O-Ring
6. Enclosing Tube
7. Spring
8. Plunger
9. Gasket
10. Top Plate
11. Capscrews
12. Spring
13. Gasket
14. Diaphragm
15. O-Ring
16. Body

Figure 6-27. Suction Solenoid Valve (SSV) - Alco

1. Pump down the unit. (Refer to section 6.3.)

2. Remove snap cap and coil.
3. Remove enclosing tube collar (item 4, Figure 6-27) using installation/removal tool supplied with repair kit (item 3).
4. Check plunger for restriction due to: (a) corroded or worn parts; (b) foreign material lodged in valve; (c) bent or dented enclosing tube.
5. Remove top plate, diaphragm spring, diaphragm and body gaskets.
6. Install new parts, assemble in reverse order of disassembly.
7. Torque the four capscrews to 40 inch-pounds.
8. Do not overtighten enclosing tube assembly. Torque to a value of 1.15 mkg (100 inch pounds).
9. Remove supplied installation/removal tool. Install coil, and snap cap.
10. Dehydrate and evacuate the system. (Refer to section 6.5) Charge unit with refrigerant per section 6.6.1.
11. Plug in the connector. Start unit and check operation.

## 6.25 SUCTION MODULATION VALVE (SMV)

#### NOTE

When repairing suction modulation valve with the enclosing tube kit (CTD P/N 14-50021-01) be sure not to remove items 7, 8 & 10. (See Figure 6-28) Proper alignment of these items is achieved only at the factory.

### a. Coil Checkout Procedure

#### WARNING

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

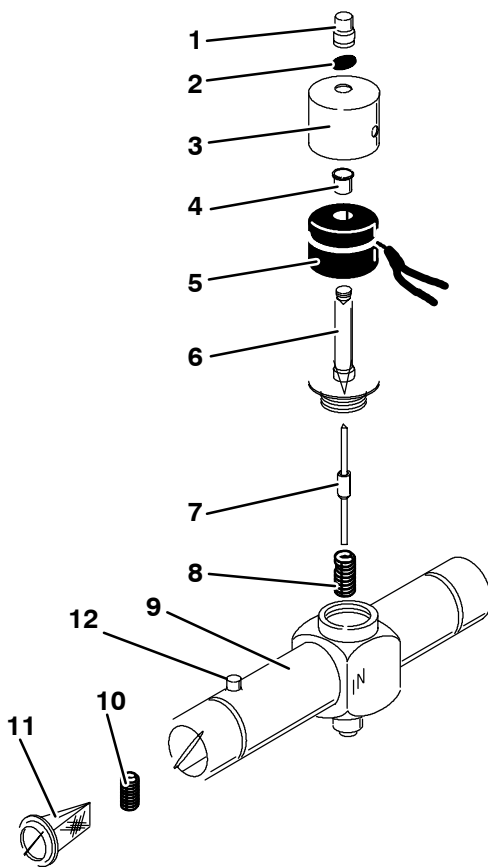
1. Disconnect the suction modulation valve coil wires by unplugging the connector (Refer to section 5).
2. Using a reliable digital ohmmeter, test each lead's resistance to ground. If the resistance indicates a ground short is present, inspect the length of wiring for damaged or exposed wires. Replace where necessary.
3. Setting the digital ohmmeter for low range, check coil's resistance. If coil's resistance is below five ohms, replacement is recommended. New coils have an approximate resistance of 7.6 ohms at 25° C (77° F). The chart below gives the resistance of a new coil at various ambient temperatures.

| Ambient Temperature | Cold Coil |
|---------------------|-----------|
| 10° F               | 6.45 ohms |
| 40° F               | 6.90 ohms |
| 70° F               | 7.40 ohms |
| 100° F              | 7.90 ohms |

- Plug in the connector for the modulation valve.

**NOTE**

A cold coil is a coil which has not been operating and is assumed to be at ambient temperature. Hot coils, taken after the unit has been operating in deep modulation for a long period of time, may give higher resistance readings.



- Coil Nut
- Coil Nut O-ring
- Coil Housing
- Solenoid Coil Sleeve
- Solenoid Coil
- Enclosing Tube Assy.
- Piston
- Top Return Spring
- Valve Body
- Bottom Return Spring
- Filter
- Schrader Valve

**Figure 6-28. Suction Modulation Valve (SMV)**

**b. Replacing the Coil**

Remove locking nut and remove coil after disconnecting wiring. When replacing nut, torque to a value of 0.41 mkg (3 ft-lb).

**c. To Replace Valve**

- Pump down the unit per section 6.3.
- Remove two bolts from suction service valve.
- Melt solder at modulating valve connection and rotate valve and tubing enough to clear compressor. Remove valve and tubing. Replace defective suction modulation valve, being careful to wrap body of replacement valve with a wet cloth while brazing (inert gas brazing procedures MUST be used only). The coil need not be removed.
- Install new suction service valve gasket and install bolts in suction service valve. Torque to a value of 2.77 to 4.15 mkg (20 to 30 ft/lb).
- Solder all connections and leak check same.
- Dehydrate and evacuate the unit per section 6.5. Add refrigerant charge per section 6.6.

**6.26 THERMOSTATIC EXPANSION VALVE**

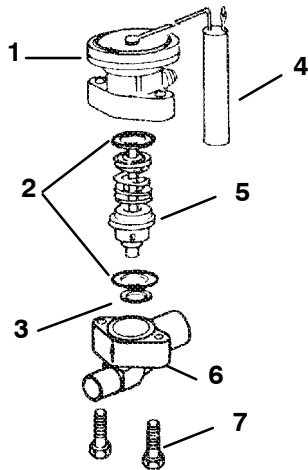
The thermal expansion valve is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator, regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance other than minor periodic maintenance as follows:

- Make sure that the excess capillary tube is secured to the power head assembly and wrapped with "Presstite."
- Make sure that the thermal bulb is tightly secured to the suction line and wrapped with "Presstite."

**a. Removing Expansion Valve (See Figure 6-29)**

- Pump down the unit per section 6.3.
- Remove insulation (Presstite) from expansion valve bulb and power assembly and then remove thermal bulb from the suction line.
- Loosen flare nut and disconnect equalizing line from expansion valve.
- Remove capscrews and lift off power assembly and remove cage assembly. Check for foreign material in valve body.





1. Power Assembly
2. Body Flange Gaskets
3. Seat Gasket
4. Bulb
5. Cage Assembly
6. Body Flange
7. Body Flange Screws

**Figure 6-29. Thermostatic Expansion Valve - Alco**

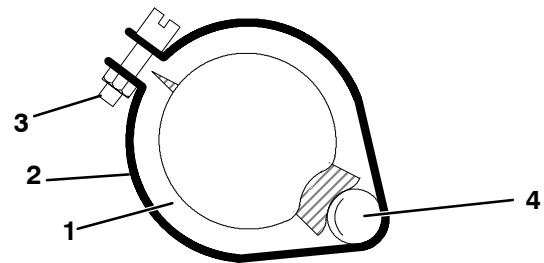
5. The thermal bulb is located below the center of the suction line (4 o'clock position). This area must be clean to ensure positive bulb contact.

#### b. Installing Expansion Valve

##### CAUTION

**If the thermostatic expansion valve is found to be in need of replacement, then the power head and cage assembly are to be replaced as a pair. They are a matched pair and replacing one without the other will affect the superheat setting.**

1. Replace all gaskets, making sure to lightly coat with oil. Insert cage and power assembly and bolts. Tighten bolts equally. Fasten equalizer flare nut to expansion valve.
2. Leak check the unit per section 6.4. Evacuate and dehydrate unit per section 6.5. Add refrigerant charge per section 6.6.2.
3. Clean suction line with sandpaper before installing bulb to ensure proper heat transfer. Strap thermal bulb to suction line, making sure bulb is placed firmly into the indentation of the suction line. See Figure 6-30 for bulb placement.
4. Check superheat. (Refer to section 2.2 and Table 6-6.) Container box temperature should be at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ).



1. Suction Line
2. TXV Bulb Clamp
3. Nut and Bolt
4. TXV Bulb

**Figure 6-30. Thermostatic Expansion Valve Bulb**

#### c. Checking Superheat

##### NOTE

Adjusting internal adjustable valves is not recommended. This valve has been factory adjusted and set with "Loctite" that is applied to the internal adjusting nut.

Due to the time involved in adjusting the superheat, replace the valve (power head & cage assembly) rather than adjusting it. Refer to section 6.26.b.

*To Measure Superheat:*

##### NOTE

Proper superheat measurement should be completed at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) container box temperature where possible.

1. Open access panel to expose the expansion valve (see Figure 2-1).
2. Attach a temperature tester sensor near the expansion valve bulb and insulate. Make sure the suction line is clean and that firm contact is made with the sensor.
3. Connect an accurate gauge to the service port directly upstream of the suction modulation valve.
4. Run unit until unit has stabilized. Set controller  $5.5^{\circ}\text{C}$  ( $10^{\circ}\text{F}$ ) below container temperature.
5. From the temperature/pressure chart (Table 6-6), determine the saturation temperature corresponding to the evaporator outlet pressure at the suction modulation valve.
6. Note the temperature of the suction gas at the expansion valve bulb.
7. Subtract the saturation temperature determined in step (5.) from the average temperature measured in step (6.). The difference is the superheat of the suction gas.

## NOTE

Suction pressure must be 0.5 kg/cm<sup>2</sup> (6 psig) below valve maximum operating pressure (M.O.P.). Example: if valve rated at 55 MOP, suction pressure must be below this MOP. Recommended pressure is below 3.44 kg/cm<sup>2</sup> (49 psig).

### 6.27 CONTROLLER/DATACORDER

#### a. Handling of Controller/DataCORDER

These guidelines should be followed when handling the Controller/DataCORDER module. These steps should be implemented when replacing the module, when doing *any* arc welding on the unit, or *when service to the refrigeration unit requires handling and removal of the Controller*.

## CAUTION

**Remove Controller/DataCORDER module and unplug all connectors before performing any arc welding on any part of the container.**

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

1. Obtain a grounding wrist strap and a static dissipation mat. 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 Controller/DataCORDER module.

## NOTE

Use a dissipation mat, order CTD P/N 07-00277-00.

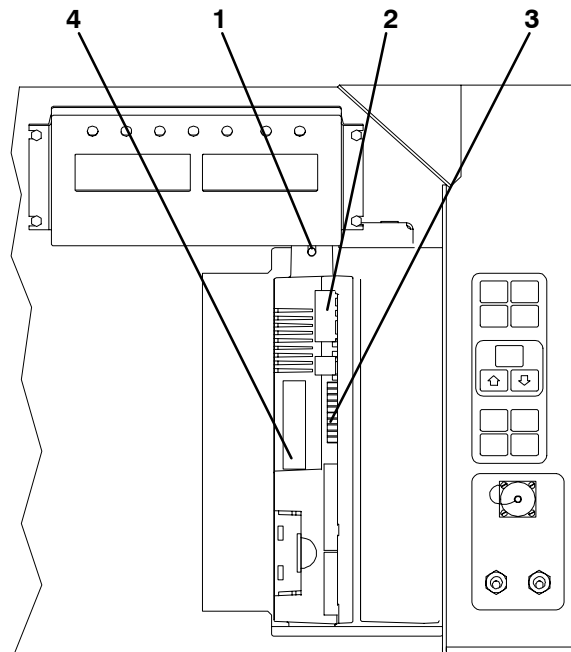
2. Disconnect and secure power to the unit.
3. Place strap on wrist and attach the ground or clip end of the wrist strap to any exposed unpainted metal area on the refrigeration unit frame (bolts, screws, etc.).
4. Carefully remove the Controller/DataCORDER. Do not touch any of the electrical components if possible. Place the module on the static mat.
5. If you are servicing the refrigeration unit, you are free to remove the ground strap from your wrist and complete your work.

6. Upon completion of your service work, put the wrist strap back on, and re-install the module into the refrigeration unit.

#### b. Removing and Installing the Controller/DataCORDER Module

##### Removal:

1. Disconnect all front wire harness connectors (MA, MB, MC, KA & KB) and move wiring out of way.
2. Loosen one mounting screw (see Figure 6-31, item 1) and pull out the top of the module (item 2). Lift up and out.
3. Turning the module around will give access to the two back connectors (EC) which can be disconnected. Remove module.
4. Remove the new Controller/DataCORDER module from its packaging and install it in the refrigeration unit. Place the old module into the same packaging that accompanied the new module. *Make sure that you package it in the exact manner that you received it.*



1. Mounting Screw
2. Controller/DataCORDER Module
3. Test Points
4. Controller/DataCORDER Software Programming Port

**Figure 6-31. Controller side of the Control Box**

## NOTE

This packaging has been designed to protect the Controller/DataCORDER module from both physical and electrostatic discharge damage during storage and transit.

### *Installation:*

Install the module by reversing the steps in section 6.27.b.

Torque values for mounting screws (item 1, Figure 6-31) are 0.23 mkg (20 inch-pounds), and 0.12 mkg (10 inch-pounds) for all connectors (MA, MB, MC, KA & KB).

### **6.27.1 Controller/DataCORDER Programming Procedure**

To load new software into the module, the programming card is inserted into the programming/software port.

#### **WARNING**

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

**The metal door on the programming card must be facing to the left when inserting.**

### *Procedure for loading Operational Software:*

- a. Turn unit OFF, via start-stop switch (ST).
- b. Insert the programming card for Operational Software into the programming/software port. (See Figure 6-31)
- c. Turn unit ON, via start-stop switch (ST).
- d. The Display module will read:
  - (1.) If the correct card is being used the digital display will alternate back and forth between the messages “rEV XXXX” and “Press EntR.”
  - (2.) If a defective card is being used: the Display will blink the message “bAd CArD.” (Turn start-stop switch OFF and remove the card.)
- e. Press the ENTER key on the keypad.
- f. The Display will show the message “Pro SoFt.” This message will last for up to one minute.
- g. The Display module will read:
  - (1.) When the software loading has successfully completed: the Display will show the message “Pro donE.”

- (2.) If a problem occurs while loading the software: the Display will blink the message “Pro FAIL” or “bad 12V.” (Turn start-stop switch OFF and remove the card.)

- h. Turn unit OFF, via start-stop switch (ST).
- i. Remove the programming card from the programming/software port.
- j. Turn unit ON, via start-stop switch (ST).

### *Procedure for loading Configuration Software:*

- a. Turn unit OFF using start-stop switch (ST).
- b. Insert the programming card, for Configuration Software, into the programming/software port. (See Figure 6-31.)
- c. Turn unit ON using start-stop switch (ST).
- d. The Display module will read:

- (1.) If the correct card is being used, the digital display will show “nt40” on the left LCD display and “511XXX” on the right LCD display. “XXX” will indicate the dash number for a given unit model number, use the UP or DOWN ARROW key to scroll through the list to obtain the proper model dash number (i.e., For the unit 69NT40-511-105, the left display will show “nt40,” press the UP or DOWN ARROW key until the right display shows “511105.”)

- (2.) If a defective card is being used, the Display will blink the message “bAd CArD.” (Turn start-stop switch OFF and remove the card.)

- e. Press the ENTER key on the keypad.
- f. The Display module will read:
  - (1.) When the software loading has successfully completed, the Display will show the message “EEPrM donE.”
  - (2.) If a problem occurs while loading the software, the Display will blink the message “Pro FAIL” or “bad 12V.” Turn start-stop switch OFF and remove the card.
- g. Turn unit OFF using start-stop switch (ST).
- h. Remove the programming card from the programming/software port.
- i. Turn unit ON using start-stop switch (ST).

### **6.27.2 Controller Trouble-Shooting**

A group of test points (tp) are provided on the Controller (see Figure 6-31, item 3) for trouble-shooting electrical

circuits (refer to section 5). A description of the test points follows:

#### NOTE

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

#### TP2

This test point enables the user to check if the internal protector for the compressor motor (IP-CP) is open or closed (and the Auto Transformer-IP if so equipped).

#### TP3

This test point enables the user to check if the optional water pressure switch (WP) contact is open or closed.

#### TP7

This test point enables the user to check if the Controller relay (TS) contact is open or closed.

#### TP8

This test point enables the user to check the suction modulation valve (SMV) current (amps), it is represented by twice the dc volts between TP8 and TP9.

#### TP9

This test point is the chassis (unit frame) ground connection.

### 6.28 WATER-COOLED CONDENSER

The water-cooled condenser is of the shell and coil type with water circulating through the cupro-nickel coil. The refrigerant vapor is admitted to the shell side and is condensed on the outer surface of the coil.

Rust, scale and slime on the water-cooling surfaces inside of the coil interfere with the transfer of heat, reduce system capacity, cause higher head pressures and increase the load on the system.

By checking the leaving water temperature and the actual condensing temperature, it can be determined if the condenser coil is becoming dirty. A larger than normal difference between leaving condensing water temperature and actual condensing temperature, coupled with a small difference in temperature of entering and leaving condensing water, is an indication of a dirty condensing coil.

To find the approximate condensing temperature, with the unit running in the cooling mode, install a gauge 0 to 36.2 kg/cm<sup>2</sup> (0 to 500 psig) on the compressor discharge service valve.

**Example:** Discharge pressure is 10.3 kg/cm<sup>2</sup> (146.4 psig). Referring to Table 6-6 (R-134a pressure-temperature chart), the 10.3 kg/cm<sup>2</sup> (146.4 psig) value converts to 43°C (110°F).

If the water-cooled condenser is dirty, it may be cleaned and de-scaled by the following procedure:

- a. Turn unit off and disconnect main power.
- b. Disconnect water pressure switch tubing by loosening the two flare nuts. Install one-quarter inch flare cap on water-cooled condenser inlet tube (replaces tubing flare nut). De-scale tubing if necessary.

*What You Will Need:*

1. Oakite composition No. 22, available as a powder in 68 kg (150 lb) and 136 kg (300 lb).
2. Oakite composition No. 32, available as a liquid in cases, each containing 3.785 liters (4 U.S. gallon) bottles and also in carboys of 52.6 kg (116 lbs) net.
3. Fresh clean water.
4. Acid proof pump and containers or bottles with rubber hose.

#### NOTE

When Oakite compound No. 32 is being used for the first time, the local Oakite Technical Service representative should be called in for their suggestions in planning the procedure. They will show you how to do the work with a minimum dismantling of equipment: how to estimate the time and amount of compound required; how to prepare the solution; how to control and conclude the de-scaling operation by rinsing and neutralizing equipment before putting it back into service. Their knowledge of metals, types of scale, water conditions and de-scaling techniques will be highly useful to you.

*Summary of Procedure:*

1. Drain water from condenser tubing circuit. Clean water tubes with Oakite No. 22 to remove mud and slime.
2. Flush.
3. De-scale water tubes with Oakite No. 32 to remove scale.
4. Flush.
5. Neutralize.
6. Flush.

- Put unit back in service under normal load and check head (discharge) pressure.

*Detailed Procedure:*

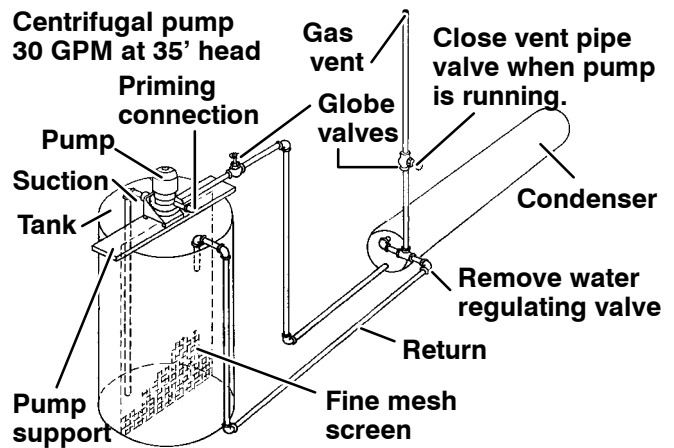
- Drain and flush the water circuit of the condenser coil. If scale on the tube inner surfaces is accompanied by slime, a thorough cleaning is necessary before de-scaling process can be accomplished.
- To remove slime or mud, use Oakite composition No. 22. Mixed 170 grams (6 ounces) per 3.785 liters (1 U.S. gallon) of water. Warm this solution and circulate through the tubes until all slime and mud has been removed.
- After cleaning, flush tubes thoroughly with fresh clean water.
- Prepare a 15% by volume solution for de-scaling, by diluting Oakite compound No. 32 with water. This is accomplished by slowly adding 0.47 liter (1 U.S. pint) of the acid (Oakite No. 32) to 2.8 liters (3 U.S. quarts) of water.

**WARNING**

**Oakite No. 32 is an acid -be sure that the acid is slowly added to the water. DO NOT PUT WATER INTO THE ACID! - this will cause spattering and excessive heat.**

**Wear rubber gloves and wash the solution from the skin immediately if accidental contact occurs. Do not allow the solution to splash onto concrete.**

- Fill the tubes with this solution by filling from the bottom. See Figure 6-32. Important: be sure to provide a vent at the top for escaping gas.



**Figure 6-32. Water-Cooled Condenser Cleaning - Forced Circulation**

- Allow the Oakite No. 32 solution to soak in the tube coils for several hours, periodically pump-circulating it with an acid-proof pump.

An alternate method may be used whereby a bottle (see Figure 6-33) filled with the solution and attached to the coils by a hose can serve the same purpose by raising and lowering of the bottle. The solution must contact the scale at every point for thorough de-scaling. Air pockets in the solution should be avoided by regularly opening the vent to release gas. *Keep flames away from the vent gases.*

- The time required for de-scaling will vary, depending upon the extent of the deposits. One way to determine when de-scaling has been completed is to titrate the solution periodically, using titrating equipment provided free by the Oakite Technical Service representative. As scale is being dissolved, titrate readings will indicate that the Oakite No. 32 solution is losing strength. When the reading remains constant for a reasonable time, this is an indication that scale has been dissolved.
- When de-scaling is complete, drain the solution and flush thoroughly with water.
- Following the water flush, circulate a 56.7 gram (2 ounce) per 3.785 liter (1 U.S. gallon) solution of Oakite No. 22 thru the tubes to neutralize. Drain this solution.
- Flush the tubes thoroughly with fresh water.

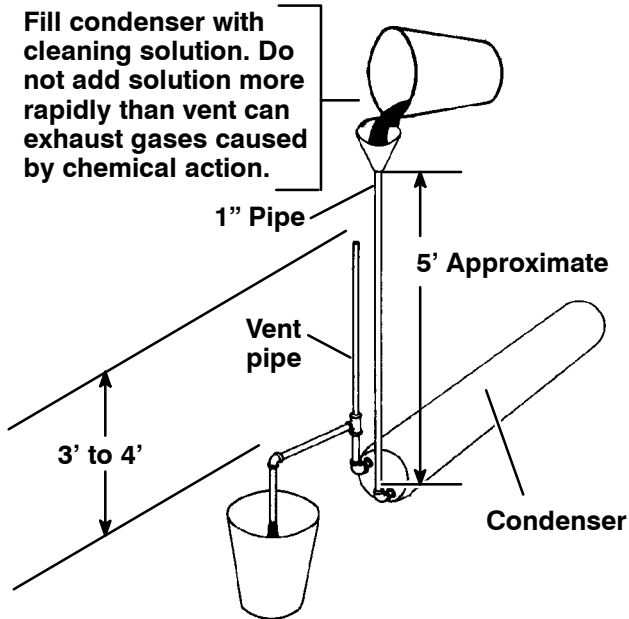
**NOTE**

If the condenser cooling water is not being used as drinking water or is not re-circulated in a closed or tower system, neutralizing is not necessary.

- Put the unit back in service and operate under normal load. Check the head pressure. If normal, a thorough de-scaling has been achieved.

*What You Can Do For Further Help:*

Contact the Engineering and Service Department of the OAKITE PRODUCTS CO., 19 Rector Street, New York, NY 10006 U.S.A. for the name and address of the service representative in your area.



**Figure 6-33. Water-Cooled Condenser Cleaning - Gravity Circulation**

| <b>Table 6-2. Partlow Bulb Temperature-Resistance Chart</b> |           |                   |
|-------------------------------------------------------------|-----------|-------------------|
| <b>TEMPERATURE</b>                                          |           | <b>RESISTANCE</b> |
| <b>°F</b>                                                   | <b>°C</b> | <b>(OHMS)</b>     |
| -10                                                         | -23.3     | 12561.00          |
| -5                                                          | -20.6     | 10579.70          |
| 0                                                           | -17.8     | 8944.17           |
| 5                                                           | -15.0     | 7588.89           |
| 15                                                          | -9.4      | 5520.32           |
| 20                                                          | -6.7      | 4731.71           |
| 25                                                          | -3.9      | 4068.68           |
| 30                                                          | -1.1      | 3509.36           |
| 32                                                          | 0         | 3310.57           |
| 35                                                          | 1.7       | 3035.99           |
| 40                                                          | 4.4       | 2634.10           |
| 45                                                          | 7.2       | 2291.85           |
| 50                                                          | 10.0      | 1999.52           |
| 55                                                          | 12.8      | 1749.11           |
| 60                                                          | 15.6      | 1534.00           |
| 65                                                          | 18.3      | 1348.72           |
| 75                                                          | 23.9      | 1050.14           |
| 80                                                          | 26.7      | 929.87            |
| 85                                                          | 29.4      | 825.21            |
| 90                                                          | 32.2      | 733.93            |
| 95                                                          | 35.0      | 654.12            |
| 100                                                         | 37.8      | 584.19            |
| 105                                                         | 40.6      | 522.79            |

| <b>Table 6-1. AMBS, DTS, RRS, RTS, SRS and STS Temperature-Resistance Chart</b> |                               |                          |
|---------------------------------------------------------------------------------|-------------------------------|--------------------------|
| <b>Temperature Centigrade</b>                                                   | <b>Temperature Fahrenheit</b> | <b>Resistance (Ohms)</b> |
| <b>RRS, RTS, SRS and STS:</b>                                                   |                               |                          |
| 0                                                                               | 32                            | 32,650 ± 91              |
| 25                                                                              | 77                            | 10,000 ± 50              |
| <b>AMBS and DTS</b>                                                             |                               |                          |
| 0                                                                               | 32                            | 32,650 +1720<br>- 1620   |
| 25                                                                              | 77                            | 10,000 + 450<br>- 430    |

| <b>Table 6-3. Recommended Bolt Torque Values</b> |                |               |            |
|--------------------------------------------------|----------------|---------------|------------|
| <b>BOLT DIA.</b>                                 | <b>THREADS</b> | <b>TORQUE</b> | <b>MKG</b> |
| <b>FREE SPINNING</b>                             |                |               |            |
| #4                                               | 40             | 5.2 in-lbs    | 0.05       |
| #6                                               | 32             | 9.6 in-lbs    | 0.11       |
| #8                                               | 32             | 20 in-lbs     | 0.23       |
| #10                                              | 24             | 23 in-lbs     | 0.26       |
| 1/4                                              | 20             | 75 in-lbs     | 0.86       |
| 5/16                                             | 18             | 11 ft-lbs     | 1.52       |
| 3/8                                              | 16             | 20 ft-lbs     | 2.76       |
| 7/16                                             | 14             | 31 ft-lbs     | 4.28       |
| 1/2                                              | 13             | 43 ft-lbs     | 5.94       |
| 9/16                                             | 12             | 57 ft-lbs     | 7.88       |
| 5/8                                              | 11             | 92 ft-lbs     | 12.72      |
| 3/4                                              | 10             | 124 ft-lbs    | 17.14      |
| <b>NONFREE SPINNING (LOCKNUTS ETC.)</b>          |                |               |            |
| 1/4                                              | 20             | 82.5 in-lbs   | 0.95       |
| 5/16                                             | 18             | 145.2 in-lbs  | 1.67       |
| 3/8                                              | 16             | 22.0 ft-lbs   | 3.04       |
| 7/16                                             | 14             | 34.1 ft-lbs   | 4.71       |
| 1/2                                              | 13             | 47.3 ft-lbs   | 6.54       |
| 9/16                                             | 12             | 62.7 ft-lbs   | 8.67       |
| 5/8                                              | 11             | 101.2 ft-lbs  | 13.99      |
| 3/4                                              | 10             | 136.4 ft-lbs  | 18.86      |

| <b>Table 6-4. Wear Limits For Compressors</b> |                        |           |                        |           |                                   |           |
|-----------------------------------------------|------------------------|-----------|------------------------|-----------|-----------------------------------|-----------|
| <b>PART NAME</b>                              | <b>FACTORY MAXIMUM</b> |           | <b>FACTORY MINIMUM</b> |           | <b>MAXIMUM WEAR BEFORE REPAIR</b> |           |
|                                               | <b>INCHES</b>          | <b>MM</b> | <b>INCHES</b>          | <b>MM</b> | <b>INCHES</b>                     | <b>MM</b> |
| <b>MAIN BEARING</b>                           |                        |           |                        |           |                                   |           |
| Main Bearing Diameter                         | 1.6268                 | 41.3207   |                        |           | .0020                             | 0.0508    |
| Main Bearing Journal Diameter                 |                        |           | 1.6233                 | 41.2318   | .0020                             | 0.0508    |
| <b>PUMP END</b>                               |                        |           |                        |           |                                   |           |
| Main Bearing Diameter                         | 1.3760                 | 34.9504   |                        |           | .0020                             | 0.0508    |
| Main Bearing Journal Diameter                 |                        |           | 1.3735                 | 34.8869   | .0020                             | 0.0508    |
| <b>CONNECTING ROD</b>                         | 1.3768                 | 34.9707   |                        |           | .0020                             | 0.0508    |
| Piston Pin Bearing                            |                        |           | 0.6878                 | 17.4701   | .0010                             | 0.0254    |
| <b>CRANKPIN DIAMETER</b>                      |                        |           | 1.3735                 | 34.8869   | .0025                             | 0.0635    |
| Throw                                         | 1.072                  | 27.2288   | 1.070                  | 27.1780   |                                   |           |
| THRUST WASHER (Thickness)                     | 0.154                  | 3.9116    | 0.1520                 | 03.8608   | .0250                             | 0.6350    |
| <b>CYLINDERS</b>                              |                        |           |                        |           |                                   |           |
| Bore                                          | 2.0010                 | 50.8254   |                        |           | .0020                             | 0.0508    |
| Piston (Diameter)                             |                        |           | 1.9860                 | 50.4444   | .0020                             | 0.0508    |
| Piston Pin (Diameter)                         |                        |           | 0.6873                 | 17.4574   | .0010                             | 0.0254    |
| Piston Ring Gap                               | 0.013                  | 00.3302   | 0.0050                 | 00.1270   | .0250                             | 0.6350    |
| Piston Ring Side Clearance                    | 0.002                  | 00.0508   | 0.0010                 | 00.0254   | .0020                             | 0.0508    |

**Table 6-5. Compressor Torque Values**

| SIZE<br>DIAMETER<br>(INCHES) | THREADS<br>PER INCH | TORQUE RANGE |              | USAGE                                    |
|------------------------------|---------------------|--------------|--------------|------------------------------------------|
|                              |                     | FT-LB        | MKG          |                                          |
| 1/16                         | 27 (pipe)           | 8 - 12       | 1.11 - 1.66  | Pipe Plug - Crankshaft                   |
| 1/8                          | 20 (pipe)           | 6 - 10       | 0.83 - 1.38  | Oil Return Check Valve - Crankcase       |
| 1/4                          | 20 (pipe)           | 20 - 25      | 2.77 - 3.46  | Pipe Plug - Gauge Connection             |
| 1/4                          | 20                  | 10 - 12      | 1.38 - 1.66  | Connecting Rod Capscrew                  |
| 1/4                          | 28                  | 12 - 15      | 1.66 - 2.07  | Baffle Plate - Crankcase                 |
|                              |                     | 12 - 16      | 1.66 - 2.21  | Side Shield                              |
|                              |                     | 6 - 10       | 0.83 - 1.38  | Oil Pump Drive Segment                   |
|                              |                     | 12 - 16      | 1.66 - 2.21  | Unloader Valve                           |
| 5/16                         | 18                  | 16 - 20      | 2.21 - 2.77  | Cover Plate - Plate End                  |
|                              |                     |              |              | Bearing Head                             |
|                              |                     |              |              | Terminal Block Cap Screws                |
|                              |                     | 20 - 30      | 2.77 - 4.15  | Suction Valve                            |
|                              |                     |              |              | Discharge Valve                          |
| 3/8                          | 16                  | 40 - 50      | 5.53 - 6.92  | Pump End Bearing Head                    |
|                              |                     |              |              | Bottom Plate - Crankcase Compressor Foot |
|                              |                     |              |              | Cylinder Head                            |
| 7/16                         | 14                  | 55 - 60      | 7.61 - 8.30  | Motor End Cover - Crankcase              |
| 5/8                          | 11                  | 25 - 30      | 3.46 - 4.15  | Crankshaft                               |
| 5/8                          | 18                  | 60 - 75      | 8.30 - 10.37 | Oil Bypass Plug - Crankcase              |
| #10                          | 32                  | 4 - 6        | 0.55 - 0.83  | Oil Pump Drive Segment                   |
| 1-1/2                        | 18 NEF              | 35 - 45      | 4.84 - 6.22  | Oil Level Sight Glass                    |
| NEF - National Extra Fine    |                     |              |              |                                          |



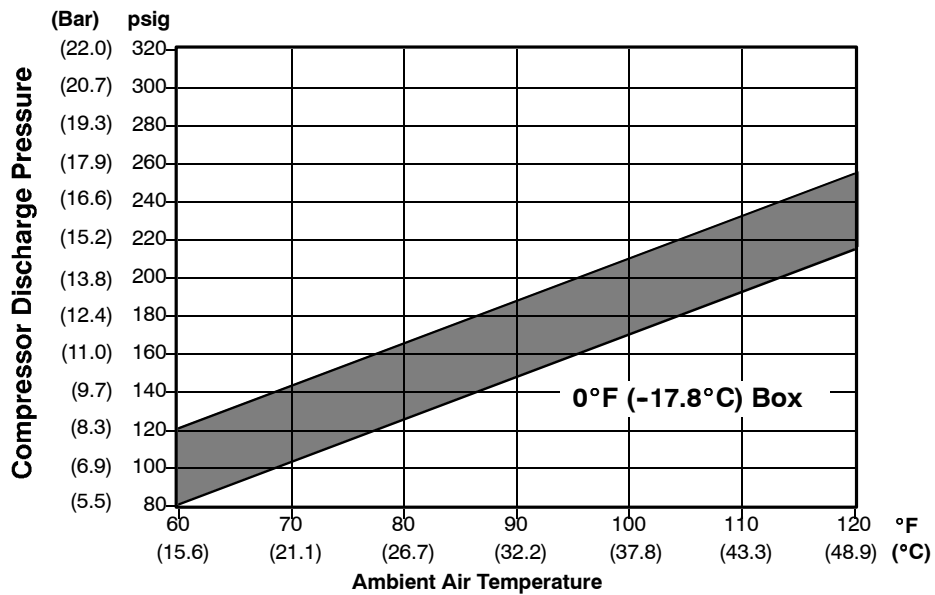
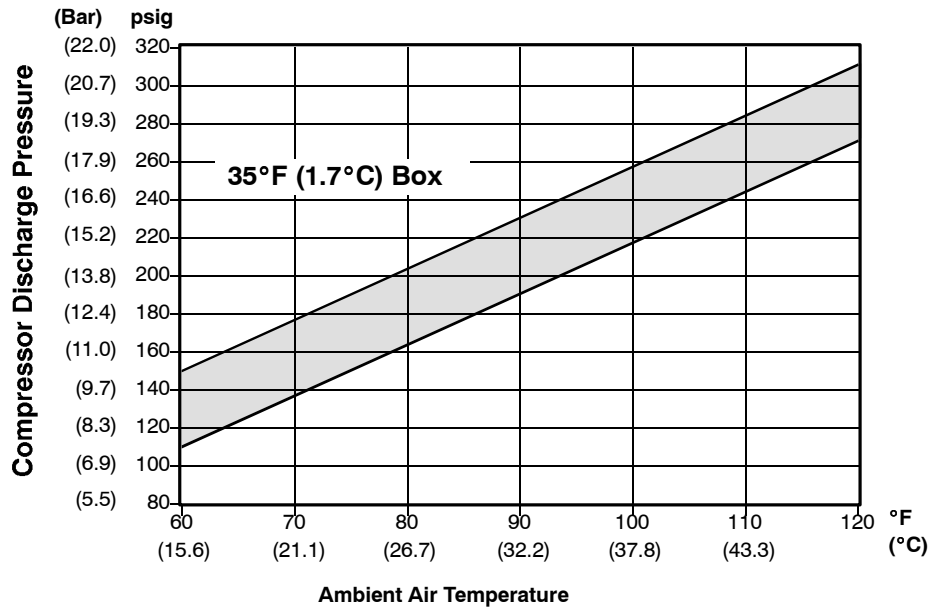
**Table 6-6. Temperature-Pressure Chart - R-134a**

**BOLD FIGURES = Inches Mercury Vacuum (cm Hg VAC)**

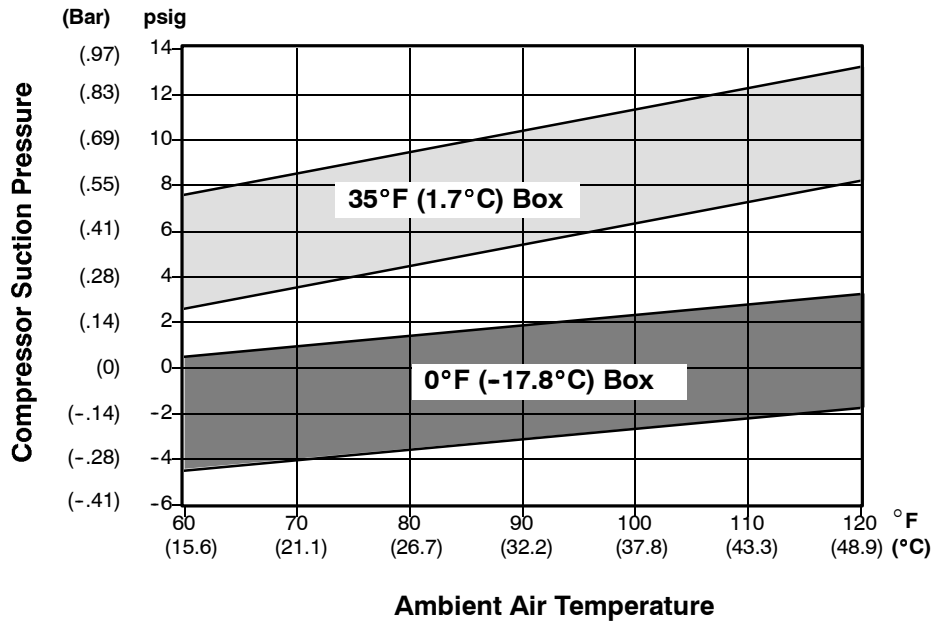
LIGHT FIGURES = psig (kg/cm<sup>2</sup>)

| TEMPERATURE |     | PRESSURE    |                    |             | TEMPERATURE |    | PRESSURE |                    |       |
|-------------|-----|-------------|--------------------|-------------|-------------|----|----------|--------------------|-------|
| °F          | °C  | Psig        | Kg/cm <sup>2</sup> | Bar         | °F          | °C | Psig     | Kg/cm <sup>2</sup> | Bar   |
| -40         | -40 | <b>14.6</b> | <b>37.08</b>       | <b>-.49</b> | 30          | -1 | 26.1     | 1.84               | 1.80  |
| -35         | -37 | <b>12.3</b> | <b>31.25</b>       | <b>-.42</b> | 32          | 0  | 27.8     | 1.95               | 1.92  |
| -30         | -34 | <b>9.7</b>  | <b>24.64</b>       | <b>-.33</b> | 34          | 1  | 29.6     | 2.08               | 2.04  |
| -25         | -32 | <b>6.7</b>  | <b>17.00</b>       | <b>-.23</b> | 36          | 2  | 31.3     | 2.20               | 2.16  |
| -20         | -29 | <b>3.5</b>  | <b>8.89</b>        | <b>-.12</b> | 38          | 3  | 33.2     | 2.33               | 2.29  |
| -18         | -28 | <b>2.1</b>  | <b>5.33</b>        | <b>-.07</b> | 40          | 4  | 35.1     | 2.47               | 2.42  |
| -16         | -27 | <b>0.6</b>  | <b>1.52</b>        | <b>-.02</b> | 45          | 7  | 40.1     | 2.82               | 2.76  |
| -14         | -26 | 0.4         | .03                | .03         | 50          | 10 | 45.5     | 3.30               | 3.14  |
| -12         | -24 | 1.2         | .08                | .08         | 55          | 13 | 51.2     | 3.60               | 3.53  |
| -10         | -23 | 2.0         | .14                | .14         | 60          | 16 | 57.4     | 4.04               | 3.96  |
| -8          | -22 | 2.9         | .20                | .20         | 65          | 18 | 64.1     | 4.51               | 4.42  |
| -6          | -21 | 3.7         | .26                | .26         | 70          | 21 | 71.1     | 5.00               | 4.90  |
| -4          | -20 | 4.6         | .32                | .32         | 75          | 24 | 78.7     | 5.53               | 5.43  |
| -2          | -19 | 5.6         | .39                | .39         | 80          | 27 | 86.7     | 6.10               | 5.98  |
| -0          | -18 | 6.5         | .46                | .45         | 85          | 29 | 95.3     | 6.70               | 6.57  |
| 2           | -17 | 7.6         | .53                | .52         | 90          | 32 | 104.3    | 7.33               | 7.19  |
| 4           | -16 | 8.6         | .60                | .59         | 95          | 35 | 114.0    | 8.01               | 7.86  |
| 6           | -14 | 9.7         | .68                | .67         | 100         | 38 | 124.2    | 8.73               | 8.56  |
| 8           | -13 | 10.8        | .76                | .74         | 105         | 41 | 135.0    | 9.49               | 9.31  |
| 10          | -12 | 12.0        | .84                | .83         | 110         | 43 | 146.4    | 10.29              | 10.09 |
| 12          | -11 | 13.2        | .93                | .91         | 115         | 46 | 158.4    | 11.14              | 10.92 |
| 14          | -10 | 14.5        | 1.02               | 1.00        | 120         | 49 | 171.2    | 12.04              | 11.80 |
| 16          | -9  | 15.8        | 1.11               | 1.09        | 125         | 52 | 184.6    | 12.98              | 12.73 |
| 18          | -8  | 17.1        | 1.20               | 1.18        | 130         | 54 | 198.7    | 13.97              | 13.70 |
| 20          | -7  | 18.5        | 1.30               | 1.28        | 135         | 57 | 213.6    | 15.02              | 14.73 |
| 22          | -6  | 19.9        | 1.40               | 1.37        | 140         | 60 | 229.2    | 16.11              | 15.80 |
| 24          | -4  | 21.4        | 1.50               | 1.48        | 145         | 63 | 245.6    | 17.27              | 16.93 |
| 26          | -3  | 22.9        | 1.61               | 1.58        | 150         | 66 | 262.9    | 18.48              | 18.13 |
| 28          | -2  | 24.5        | 1.72               | 1.69        | 155         | 68 | 281.1    | 19.76              | 19.37 |

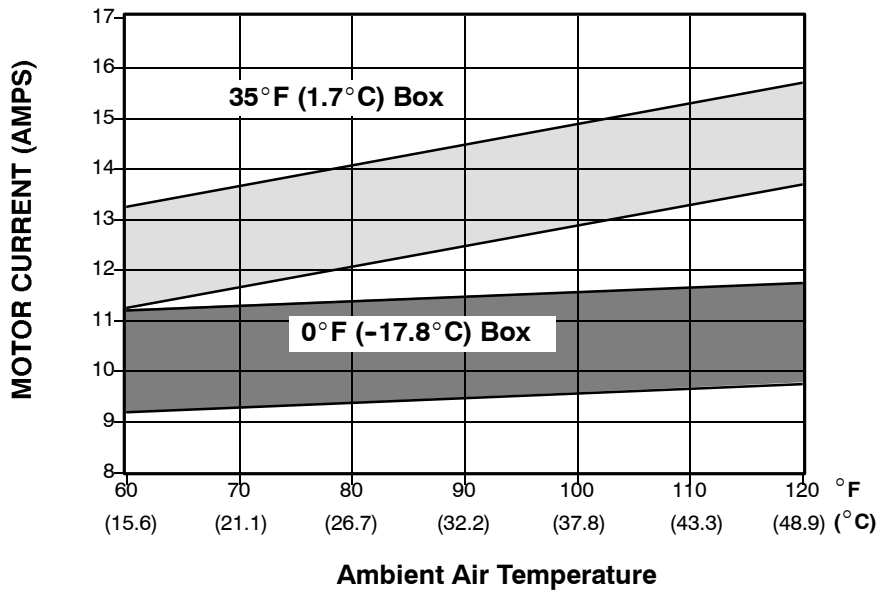
**Note:** Curves to be used as troubleshooting guide only for model series 69NT40-511 with fresh air makeup vent closed, unit powered on 460 VAC/60hz and SMV 100% open.



Compressor Discharge Pressure Versus Ambient Air Temperature at Stable Box Temperature



Compressor Suction Pressure Versus Ambient Air Temperature at Stable Box Temperature



Compressor-Motor Current Versus Ambient Air Temperature At Stable Box Temperature

Figure 6-34. R-134a Compressor Pressure and Motor Current Curves Versus Ambient Temperature

## SECTION 7

### ELECTRICAL WIRING SCHEMATIC AND DIAGRAMS

#### 7.1 INTRODUCTION

PLEASE REFER TO FILE  
T-268 DIAGRAMS  
FOR SCHEMATICS AND DIAGRAMS

# INDEX

## A

- Access Panel, 2-1
- Air Makeup Vent
  - Lower Fresh, 2-13
  - Upper Fresh, 2-13
- Air-Cooled Condenser, 2-15, 2-17
- Alarms
  - Controller, 3-11
  - DataCORDER, 3-28
  - DataCORDER Configurations, 3-29
- Ambient Sensor, 2-6, 2-7
- Arctic, 4-12

## B

- Battery Pack, Controller/DataCORDER, 2-8, 2-9, 3-1
- Bulb
  - Expansion Valve, 2-14, 2-15, 2-16, 2-17, 5-4, 6-27
  - Mechanical Recording Thermometer, 2-3, 6-18
  - Mode, 3-9, 3-16, 3-17, 3-25, 4-12
  - Partlow, 6-18, 6-20
  - Saginomiya, 6-20, 6-21
  - Sensor, 6-22
  - Temperature-Resistance Chart, Partlow, 6-32

## C

- Cargo Probe Receptacle, 2-3
- Chart
  - Model, 1-2
  - Partlow Bulb, 6-32
  - R-134a Temperature-Pressure, 6-35
  - Sensor, 6-32
- Circuit
  - Refrigeration with Receiver, 2-15
  - Refrigeration with Water-Cooled Condenser, 2-17
- Circuit Breaker, 2-8, 2-9, 2-11, 2-12, 2-19, 5-1, 5-2, 5-4
- Codes
  - Controller Alarm, 3-11
  - Controller Function, 3-6
  - DataCORDER Alarm, 3-28
  - DataCORDER Function, 3-26
  - Pre-Trip, 3-19

- Compressor
  - Disassembly, 6-9
  - Full Load Amps, 2-11
  - Oil Level, 6-14
  - Reassembly, 6-13
  - Removal/Replacement, 6-9
  - Specifications, 2-10
- Compressor Contactor, 2-8, 2-9, 4-2, 4-10, 4-14, 4-15
- Compressor Contactor Shorting, 2-9, 4-14, 4-15, 5-1
- Compressor Crankcase Heater, 2-4, 2-11, 4-2, 6-9
- Compressor Motor, 2-4
- Condenser
  - Air-Cooled, 2-15, 2-17
  - Coil, 5-3, 6-18
  - Fan and Motor Assembly, 5-3, 6-18
  - Specifications, 2-11
  - Water-Cooled, 2-17
- Condenser Fan Contactor, 2-8, 2-9, 4-10, 4-12, 4-14, 4-15
- Condenser Fan Motor, 2-5
- Condenser Fan Relay, 4-3, 4-4, 4-6, 4-8, 4-12
- Condenser Fan Switch, 2-8, 2-16
- Condenser Pressure Control, 2-14, 3-3, 3-7, 3-14, 4-3, 4-6, 4-8
- Condenser Pressure Transducer, 2-6, 2-7, 2-10, 2-14, 2-15, 2-17, 3-14, 3-30, 4-3, 4-6, 4-8, 5-1
- Connector, Interrogator, 2-8
- Contactors
  - Compressor, 2-8, 2-9, 4-2, 4-10, 4-14, 4-15
  - Compressor Shorting, 2-9, 4-14, 4-15, 5-1
  - Condenser Fan, 2-8, 2-9, 4-10, 4-12, 4-14, 4-15
  - Evaporator Fan, 2-8, 2-9, 4-3, 4-6, 4-8, 4-14, 4-15, 5-2, 5-3
  - Heat, 2-8, 2-9, 3-15, 4-10, 4-12, 5-2
- Control Circuit Power Connection, 3-1
- Control Transformer, 2-8, 2-9
- Controller
  - Alarms, 3-10
  - Configuration Variables, 3-3
  - Display Module, 2-8, 2-9, 3-5
  - Function Codes, 3-6
  - Installing, 6-28
  - Key Pad, 3-4
  - Module, 3-1
  - Programming Cards, 3-2
  - Programming Procedure, 6-29
  - Removing, 6-28
  - Serial Number, 3-26
  - Temperature Control, 3-14
  - Test Points, 6-28, 6-29
  - Trouble-Shooting, 6-29
- Controller/DataCORDER Battery Pack, 2-8, 2-9, 3-1
- Controller/DataCORDER Module, 2-8

# INDEX

Cooling Relay, 4-4, 4-6, 4-8, 4-12

Current Sensor Module, 2-8, 2-9

## D

### Data

Electrical, 2-11

Refrigeration System, 2-10

### DataCORDER, 3-24

Access to Functions, 3-29

Alarms, 3-27

Communications, 3-31

Configuration, 3-25

Function Codes, 3-26

Pre-Trip Data Recording, 3-31

Scrollbar, 3-32

Serial Number, 3-26

USDA Cold Treatment, 3-32

USDA Recording, 3-31

USDA/Message, 3-31

### Defrost, 4-12

Defrost Relay, 4-14, 4-15, 5-2

Defrost Termination Sensor, 2-3, 3-7, 3-16, 3-23, 5-2  
Alarm, 3-12

Dehydration, 6-5

Disc, Rupture, 2-7, 2-17

Discharge Pressure Regulator Valve, 2-6, 2-7, 2-15,  
2-17

Discharge Pressure Transducer, 2-4

Discharge Service Valve, 2-4, 2-15, 2-17

Display Module, 2-8, 2-9, 3-5

Drain Pan Heaters, 2-3, 2-11  
Specifications, 2-11

## E

Economy Mode, 3-16, 3-17

Electrical Data, 2-11

Electrical Schematic, 7-1

Electro-Coated Modular Receiver, 2-6, 2-15

Emergency Bypass Switch, 2-8, 3-1

Emergency Defrost Fuse, 2-8

Emergency Defrost Switch, 2-8

Evacuation, 6-5

### Evaporator, 2-15, 2-17

Coil, 5-1, 5-3, 6-16

Contactors, Fan, 2-8, 2-9, 4-3, 4-6, 4-8, 4-14, 4-15,  
5-2, 5-3

Fan and Motor Assembly, 5-3, 6-16

Fan Motor Capacitors, 6-17

Heaters, 6-16

Evaporator Coil, 2-3

Evaporator Coil Heater, Specifications, 2-11

Evaporator Coil Heaters, 2-3

Evaporator Fan Contactor, 2-8, 2-9, 4-3, 4-6, 4-8,  
4-14, 4-15, 5-2, 5-3

Evaporator Fan Motor, 2-1, 2-3  
Specifications, 2-11

Exchanger, Heat, 2-3, 2-15, 2-17

Expansion Valve, 2-10, 5-3, 5-4, 6-26

## F

Filter-Drier, 2-7, 2-15, 2-17, 5-3, 6-15

Fork Lift Pockets, 2-1

Fuse, Emergency Defrost, 2-8

Fuses, 2-11, 2-19, 3-1, 5-1, 5-2, 5-3  
Specifications, 2-11

Fusible Plug, 2-6, 2-10, 2-14, 2-15, 2-19

## G

### Gauge

High Pressure, 6-1

Low Pressure, 6-1

Manifold, 6-1

Manifold Connections, 6-3

Gauges, Suction/Discharge Pressure, 2-4

Glass, Sight, 2-6, 2-17

# INDEX

## H

- Heat Contactor, 2-8, 2-9, 3-15, 4-10, 4-12, 5-2
- Heat Exchanger, 2-3, 2-15, 2-17, 5-3
- Heat Relay, 3-15, 4-10, 4-12, 4-14, 4-15, 5-2
- Heater, 2-1
  - Alarm, 3-12
  - Compressor Crankcase, 2-4, 2-11, 6-9
  - Configuration Variable, 3-3
  - Drain Pan, 2-11
  - Evaporator Coil, 2-11, 6-16
- Heater Termination Thermostat, 2-3, 2-10, 3-23, 4-10, 4-12, 5-1, 5-2
  - Alarm, 3-12
- Heaters, Evaporator Coil, 2-3
- Heating, 4-10
- High Pressure Switch, 2-6, 2-10, 2-19, 3-12, 3-22, 5-1, 6-15
- High Speed Evaporator Fans Relay, 4-12
- Hour Meter, 2-8
- Humidity Sensor, 2-3, 3-7, 3-9, 3-13, 3-15
  - Specifications, 2-12

## I

- Indicator
  - Moisture-Liquid, 2-7, 2-17
  - Sight Glass/Moisture, 2-6
- Inrange Relay, 4-4, 4-6, 4-8, 4-10
- Internal Protector
  - Compressor Motor, 2-19, 5-1, 6-30
  - Condenser Fan Motor, 2-19, 5-1
  - Evaporator Fan Motor, 2-19, 5-1, 5-2, 5-3
  - Power Autotransformer, 6-21
- Interrogator Connector, 2-1, 2-8
- Interrogator Receptacle, 2-3

## K

- Key Pad, 3-4

## L

- Low Speed Compressor Relay, 4-3, 4-12
- Low Speed Evaporator Fans Relay, 4-12
- Lower Fresh Air Makeup Vent, 2-13

## M

- Manual Defrost Switch, 2-8
- Manual Liquid Line Valve, 2-6, 2-7, 2-15, 2-17
- Manual Start, 4-2
- Manual Stop, 4-2
- Mechanical Recording Thermometer Bulb, 2-3
- Meter, Hour, 2-8
- Micro-link 2i, 3-1, 6-28
- Models, 1-2
- Modes of Operation
  - Arctic, 4-12
  - Cooling, 4-3
  - Defrost, 4-12
  - Frozen Range, 3-17
  - Heating, 4-10
  - Perishable Range, 3-14
- Moisture Indicator, Sight Glass/, 2-6, 2-10, 2-15
- Moisture-Liquid Indicator, 2-7, 2-17
- Motor
  - Compressor, 2-4
  - Condenser Fan, 2-5
  - Evaporator Fan, 2-1, 2-3

## O

- Override, Suction Solenoid, 2-18

# INDEX

## P

- Pad, Key, 2-8
- Parts Identification Number (PID), 1-1, 1-2, 2-1
- PID, (Parts Identification Number), 1-1, 1-2, 2-1
- Plug, Fusible, 2-6, 2-15
- Port
  - Software Programming, 3-1, 6-28
  - Supply Air Thermometer, 2-6, 2-7
- Power Autotransformer, 2-4, 2-12, 5-1, 5-4, 6-21
- Pre-Trip
  - Auto Test, 3-18
  - Current Limiting, 3-17
  - Inspection, 4-1
  - Manual Test, 3-18
  - Selection Menu, 3-18
  - Starting, 3-17
  - Test Codes, 3-19
- Probe Check Initiation, 4-2
- Probe Holder, Supply, 6-22
- Pump
  - Down, 6-4
  - Oil, 6-11, 6-14
  - Vacuum, 6-5
  - Vacuum Connections, 6-7

## Q

- Quench Expansion Valve, 2-6, 2-7, 2-15, 2-17, 3-6, 3-21

## R

- Receiver, Electro-Coated Modular, 2-6, 2-15
- Receptacle
  - Cargo Probe, 2-3
  - Interrogator, 2-3
  - Remote Monitoring, 2-8, 2-9
  - USDA Probe, 2-3
- Recording Thermometer
  - Bulb, 2-3
  - Partlow, 2-1, 4-1, 6-18
  - Saginomiya, 2-1, 4-1, 6-20
- Refrigerant
  - Charge, 2-10, 5-4
  - Full Charge, 6-8
  - Leak Checking, 6-4
  - Partial Charge, 6-8
- Refrigeration
  - Charge, 2-10
  - Checking Charge, 6-5
  - Dehydration, 6-5
  - Evacuation, 6-5
  - Full Charge, 6-8
  - Leak Checking, 6-4
  - Partial Charge, 6-8
  - System Data, 2-10
- Refrigeration Circuit
  - Receiver, 2-14
  - Water-Cooled Condenser, 2-16
- Relay
  - Condenser Fan, 4-3, 4-4, 4-6, 4-8, 4-12
  - Cooling, 4-4, 4-6, 4-8, 4-12
  - Defrost, 4-14, 4-15, 5-2
  - Heat, 3-15, 4-10, 4-12, 4-14, 4-15, 5-2
  - High Speed Evaporator Fans, 4-12
  - Inrange, 4-4, 4-6, 4-8, 4-10
  - Low Speed Compressor, 4-3, 4-12
  - Low Speed Evaporator Fans, 4-12
  - Suction Solenoid Valve, 2-18, 6-30
- Remote Monitoring, 2-18
- Remote Monitoring Receptacle, 2-8, 2-9
- Return Recorder Sensor, 2-3
- Return Temperature Sensor, 2-3
- Rupture Disc, 2-7, 2-10, 2-17, 2-19



# INDEX

## S

Safety and Protective Devices, 2-19

Safety Summary  
  General, Safety-1  
  Warning and Cautions, Safety-2

Sample, Standard Configuration Report, 3-34

Schematic, Electrical Wiring and Diagrams, 7-1

Schrader Valve, 2-6, 2-7

Sensor  
  Ambient, 2-6, 2-7, 3-6, 3-12, 3-14, 3-30, 6-24  
  Bulb, 6-22  
  Chart, 6-32  
  Checking, 6-21, 6-24  
  Current, 2-8, 2-9  
  Defrost Termination, 2-3, 3-7, 3-9, 3-12, 3-16, 3-23, 5-2, 6-16, 6-24  
  Defrost termination, 4-12  
  Discharge Temperature, 3-13, 3-22  
  Humidity, 2-3, 2-12, 3-7, 3-9, 3-13, 3-15  
  Network, 3-26, 3-28  
  Positioning  
    Return, 6-24  
    Supply, 6-22  
  Replacing, 6-24  
    Return, 6-23  
    Supply, 6-22  
  Return Recorder, 2-3, 6-22  
  Return Temperature, 2-3, 2-18, 3-11, 3-12, 3-26, 3-30, 4-12, 6-22  
  Suction Temperature, 3-13  
  Supply Recorder, 2-6, 2-7, 6-22  
  Supply Temperature, 2-6, 2-7, 3-11, 3-12, 3-26, 3-30, 6-22  
  Thermister (CPDS), 2-6  
  Thermister (CPSS), 2-6  
  USDA Cold Treatment, 3-32

Serial Number  
  Controller, 3-26  
  DataCORDER, 3-26  
  Unit, 2-1

Sight Glass, 2-6, 2-17

Sight Glass/Moisture Indicator, 2-6, 2-10, 2-15

Sightglass, 2-15

Snap Freeze, 4-12

Software Programming Port, 3-1, 6-28

Start-Stop Switch, 2-8

Starting Instructions, 4-2

Stopping Instructions, 4-2

Suction Modulation Valve, 2-6, 2-7, 2-15, 2-17, 3-6, 3-14, 3-17, 3-21

Suction Pressure Transducer, 2-4

Suction Service Valve, 2-4, 2-15, 2-17

Suction Solenoid Override, 2-18

Suction Solenoid Valve, 2-6, 2-7, 2-15, 2-17, 3-6, 3-15, 3-17, 3-21

Suction Solenoid Valve Relay, 2-18, 6-30

Suction/Discharge Pressure Gauges, 2-4

Supply Air Thermometer Port, 2-6, 2-7

Supply Recorder Sensor, 2-6, 2-7

Supply Temperature Sensor, 2-6, 2-7

Switch  
  Condenser Fan, 2-8, 2-16  
  Emergency Bypass, 2-8, 3-1  
  Emergency Defrost, 2-8  
  High Pressure, 2-6, 2-10, 2-19, 3-12, 3-22, 5-1, 6-15  
  Manual Defrost, 2-8, 2-9, 5-2  
  Start-Stop, 2-8, 2-9, 4-2, 5-1, 5-2  
  Water Pressure, 2-7, 2-10, 2-16, 5-4

## T

Test Points, Controller, 3-1, 6-28, 6-29

Thermister Sensor (CPDS), 2-6

Thermister Sensor (CPSS), 2-6

Thermostat, Heater Termination, 2-3, 2-10, 3-23, 4-10, 4-12, 5-1, 5-2  
  Alarm, 3-12

Thermostatic Expansion Valve, 2-3, 2-15, 2-17

Thermostatic Expansion Valve Bulb, 2-15, 2-17

Transducer  
  Condenser Pressure, 2-6, 2-7, 2-10, 2-14, 2-15, 2-17, 3-13, 3-14, 3-30, 4-3, 4-6, 4-8, 5-1  
  Discharge Pressure, 2-4, 3-7, 3-13, 3-22, 3-30  
  Suction Pressure, 2-4, 3-6, 3-13, 3-30

Transformer, 5-1, 5-2  
  Control, 2-8, 2-9  
  Power, Auto, 5-1, 5-4  
  Power Auto, 2-4, 2-12

Troubleshooting, 5-1

# INDEX

## U

Unit, Remote Monitoring, 2-8  
Unit Operation, 4-2  
Unit Serial Number, 2-1  
Upper Fresh Air Makeup Vent, 2-13  
USDA, 2-3, 3-31, 3-32  
USDA Probe Receptacle, 2-3

## V

Vacuum Pump, 6-5, 6-7  
Connections, 6-7  
Valve  
Bulb, Expansion, 2-14, 2-16, 5-4, 6-27  
Discharge Pressure Regulator, 2-6, 2-7, 2-15, 2-17,  
5-3  
Discharge Service, 2-4, 2-15, 2-17  
Expansion, 2-3, 2-10, 2-15, 2-17, 5-3, 5-4, 6-26  
Manual Liquid Line, 2-6, 2-7, 2-15, 2-17  
Quench Expansion, 2-6, 2-7, 2-15, 2-17, 3-6, 3-21  
Schrader, 2-6, 2-7  
Suction and Discharge, 5-3, 6-4  
Suction Modulation, 2-6, 2-7, 2-15, 2-17, 3-6, 3-14,  
3-17, 3-21, 4-3, 4-6, 4-8, 4-12, 5-1, 6-25  
Suction Service, 2-4, 2-15, 2-17  
Suction Solenoid, 2-6, 2-7, 2-15, 2-17, 2-18, 3-6,  
3-15, 3-17, 3-21, 4-3, 4-12, 5-1, 6-25

## W

Water Pressure Switch, 2-7, 2-10, 2-16  
Water-Cooled Condenser, 2-16, 2-17, 5-4, 6-30  
Wiring Diagram, 7-1

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