E-STAR® HIPERFORM® REFRIGERATION UNIT

Model "OHSE" 3.5 and 5 HP with Electronic Valve Control

Installation and Operation Manual

Part No. 8826809

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SECTION 1.0 – INTRODUCTION

1.1 General Specifications

The Mueller® E-Star® "OHSE" HiPerForm® refrigeration unit is custom engineered to maximize the energy efficiency and cooling capacity of your milk cooling system. Custom and specialized components consist of:

1. A quiet, energy-efficient Copeland® "ZB" Scroll refrigeration compressor. This compressor is designed for commercial refrigeration service rather than air conditioning, providing improved performance over the entire milk cooling temperature range. An oil sight glass, oil fill/drain port, and screw electrical terminals are added bonuses which ensure long-term reliability and serviceability.

2. A custom electronic valve control with electric subcooling valve which controls the condenser liquid subcooling rather than evaporator superheat.

3. Accumulator heat exchanger with custom subcooling coil which maximizes refrigeration capacity while protecting the compressor from liquid refrigerant.

4. Custom tube-and-fin condenser designed for maximum condensing efficiency. Custom benefits include integral subcooling loop and tubes constructed from rifled tubing which maximizes the heat transfer to the fins.

5. Single, variable-speed, high-efficiency fan motor which provides maximum condensing efficiency over a wide range of ambient temperatures.

6. An electrical enclosure designed for safety, ease of installation, and serviceability.

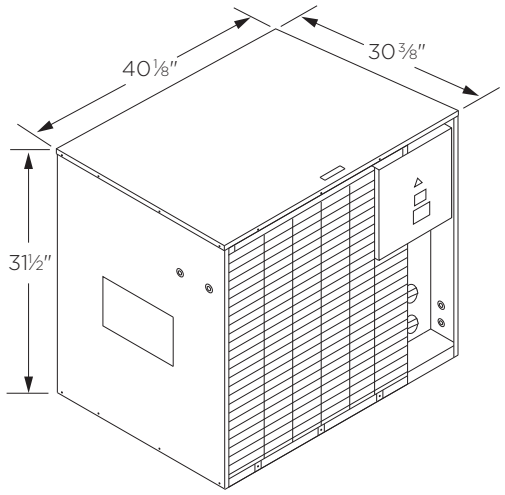
7. Three-piece galvanized steel cover with attached steel grill which provides safe operation plus easy access for service.

8. Rust-resistant brass service valves located for easy access without removing the cover.

Table 1: Dimensions and Weight

Length	101.92 cm	40⅛ in
Width	77.15 cm	30⅜ in
Height	80.00 cm	31½ in
Approx. Weight	5 hp / 176 kg	388 lb
	3.5 hp / 162 kg	358 lb

Figure 1: Dimensions and Weight



1.2 Technical Support

This manual provides the basic installation and operating information for a Mueller E-Star Model "OHSE" refrigeration unit.

Please contact your local Mueller Sales and Service Representative if you require additional technical assistance pertaining to installation or operating procedures.

Manufacturer's support is available by contacting:

Paul Mueller Company
Dairy Farm Equipment Service Department
1600 West Phelps Street • Springfield, Missouri 65802
Telephone: 1-800-756-5991 • 1-800-MUELLER (683-5537)

1.3 Installation

Electrical and refrigeration installation and service must be performed by an authorized service technician who has the proper training to install and service refrigeration and electrical equipment.

Local, state, and/or country electrical and refrigeration regulations must be followed during installation, service, and/or operation of this equipment.

United States EPA regulations require that any technician performing refrigerant installation or service on a high-pressure appliance be certified as a Type II or Universal Technician in accordance with Section 608 of the Clean Air Act. The Clean Air Act regulations may change or differ for your locality. It is the responsibility of the technician performing the refrigerant service and/or installation to abide by all regulatory requirements and procedures for their locality, state, and country.

2.0 – INSTALLATION

2.1 Inspection

Each shipment should be carefully checked for shortages or concealed damage. Any shortage or damage must be reported to the delivery carrier at the time of delivery.

Damaged material becomes the delivery carrier's responsibility and should not be returned to the manufacturer unless prior approval is obtained.

2.2 Handling

IMPORTANT: Equipment used to move or lift this equipment must be rated for the weight of the equipment. See Table 1 for equipment weight.

2.3 Location

When choosing a location for the Mueller refrigeration unit, consider these items:

- Environment: The unit must be located where it is protected from extreme environmental conditions.
- Condenser Air Flow: Ensure proper provisions for adequate air flow (6,000 CFM at 1,075 RPM) to the condenser. When installing the condenser facing a wall, the distance to the wall must be a minimum of 45.72 cm (18 in) with non-restricted air flow at the top, left, and right sides. Be especially cautious of installation methods which would allow the condenser air flow to recirculate and conditions that would allow dust or oil to enter the condenser.
- Serviceability: The "OHSE" should be located with the compressor and electrical enclosure accessible for service. Do not pipe refrigerant lines in front of the electrical enclosure.
- Efficiency: Locate the "OHSE" as close to the evaporator as possible. This will improve efficiency by reducing pressure drop in the refrigerant piping.
- Lubrication: For proper oil return, the "OHSE" should not be installed above the height of the evaporator, and the suction line returning from the evaporator should be sloped towards the refrigeration unit.

2.4 Refrigeration Piping and Evacuation

Refrigeration lines should be purged with dry nitrogen when brazing connections to prevent internal oxide formation. Proper refrigerant practices as outlined in ASHRAE 15-1994 should be followed.

The refrigerant line set must be insulated to reduce heat gain, prevent sweating and condensation, and ensure subcooled liquid refrigerant to the evaporator.

Refrigerant piping should be installed with long-radius bends or fittings.

The "OHSE" is shipped with a dry-nitrogen holding charge. The unit, refrigerant lines, and evaporator circuit will require a triple-system evacuation to 500 microns prior to refrigerant charging. The system must hold below 1,000 microns in a standing vacuum test, ensuring that it is leak free.

NOTE: Installation technicians must follow proper refrigerant practices as outlined in ASHRAE 15-1994.

2.5 Electrical Connections

Following local and NEC (National Electrical Code) regulations and procedures, connect a fused disconnect power supply of the proper voltage and phase to the "OHSE" electrical enclosure.

The control circuit is designed to be operated by a 24-VAC supply. See caution statement below.

Refer to the electrical schematics in Section 7 for connection details.

The "OHSE" is prewired for a low-voltage, 24-VAC control circuit input. Connecting high voltage control to this circuit will cause equipment failure and a possible electrical hazard.

2.6 Pump-Down Installations

An optional hard-start kit is available for single-phase models utilizing a refrigerant pump-down solenoid. Refer to Section 7.1 for details and part numbers.

An optional discharge check-valve, Part Number 8820260 for 5 hp models and Part No. 8820255 for 3.5 hp models, must be installed in the compressor's discharge line for pump-down installations.

SECTION 3.0 – REFRIGERANT CHARGING

3.1 EPA Refrigerant Regulations[1]

The "OHSE" system is designed to operate with R-507 refrigerant. R-507 is an HFC binary mixture of 50% R-125 (pentafluoroethane) and 50% R-143a (1,1,1-trifluoroethane). R-507 is specified by ASHRAE Standard 34 Safety Classification as an "A-1" refrigerant with low flame propagation and low toxicity.

EPA regulations require that any technician performing refrigerant installation or service on a high-pressure appliance be certified as a Type II or Universal Technician in accordance with Section 608 of the Clean Air Act.

IMPORTANT: The use of R-404a refrigerant is not recommended in the Mueller HiPerForm refrigeration system. The high temperature glide characteristics of R-404a can lead to fractionalization of the refrigerant, which is undesirable in a flooded evaporator system such as the Mueller HiPerForm.

[1]As adopted for the United States and Canada. These regulations may change or differ for your locality. It is the responsibility of the technician performing the refrigerant service and/or installation to abide by all regulatory requirements for the installation locality, state, and country.

3.2 Refrigerant Charge

The Mueller "OHSE" refrigeration units require the following refrigerant charge when installed with a Mueller milk cooler evaporator:

Unit Size	R-507 Refrigerant Charge
3.5 hp	6.12 kg / 13.5 lb
5.0 hp	6.80 kg / 15.0 lb

SERVICE NOTE: The refrigeration system must be triple evacuated to 500 microns prior to refrigerant charging.

3.3 Refrigerant Charging

There are several methods used to determine when a conventional system is properly charged: sight glass, compressor amperage, and refrigerant pressures, etc.

Due to the unique operating characteristics of the "OHSE" system, the most efficient and reliable method is to weigh in the refrigerant charge, ensuring that it matches the manufacturer's recommendations in Section 3.2. The following steps will outline this procedure:

3.4 Weigh-In Refrigerant Charging

Reference Figure 2, "Refrigerant Piping Schematics," which displays the access port connections described below:

1. With a clean evacuated system, connect the manifold gauges to Access Ports P2 and P6.
2. Connect the center manifold hose to a cylinder of new or reclaimed ARI 700-88 specifications refrigerant.
3. Weigh and record the gross weight of the refrigerant cylinder.
4. Purge any air from the manifold gauge hoses, as specified by EPA Section 608, de-minimus release.

3.4 Weigh-In Refrigerant Charging (Continued)

5. Break the refrigeration system's evacuation with liquid refrigerant, charging into the access port at P2, which is located before the accumulator on the suction line.

6. When the system pressure equalizes with cylinder pressure, energize the compressor.

7. Monitoring the weight of the refrigerant cylinder, weigh in the remaining refrigerant charge, in liquid state, at access port P2.

IMPORTANT: Liquid refrigerant must always be charged upstream of the accumulator heat exchanger, access ports P2 or P3, to ensure protection to the compressor against liquid refrigerant slugging.

3.5 Checking Refrigerant Charge, Weigh-Out Method

To confirm the refrigerant charge on an operating system, the charge should be weighed out. Refer to Figure 2, "Refrigerant Piping Schematics," which displays the access port connections described below.

1. Connect the manifold suction gauge to access port P2 and high-side gauge to access port P6. Connect the center hose to the liquid access port of a clean evacuated 4BA or 4BW recovery cylinder.

2. Purge any air from the manifold gauge hoses.

3. Weigh and record the gross weight of the refrigerant recovery cylinder.

4. Energize the "OHSE" compressor and open the valve on the recovery cylinder.

5. Open the high-side valve on the refrigerant manifold.

6. Completely close or front-seat the liquid service valve (P6) and then open it two turns counterclockwise.

7. Allow the system to operate until the compressor cycles off on the low-pressure switch, approximately 5 psig.

8. Completely close or front-seat the liquid service valve (P6) clockwise.

9. While monitoring the suction pressure at access port P2, manually operate the compressor by holding the contactor coil in until the suction pressure falls to 0 psig. Do not allow the system to pump into a vacuum.

10. When 0 psig is observed on the suction gauge at P2, de-energize the compressor and close the liquid valve on the recovery cylinder.

11. Allow the system to set idle for a few minutes and observe the suction pressure at P2. If it rises above 20 psig, reopen the recovery cylinder's liquid valve and repeat the procedure starting at Step 9.

12. Using an approved refrigerant recovery machine, recover the remaining refrigerant from the system until a minimum vacuum level of 0" Hg is achieved.

3.5 Checking Refrigerant Charge, Weigh-Out Method (Continued)

NOTE: Never energize the compressor while in a vacuum.

13. Weigh the gross weight of the recovery cylinder, subtracting the initial gross weight recorded in Step 3. This will be the weight of refrigerant removed from the system.

3.6 Refrigerant Testing

When removing refrigerant from a system which has had a compressor failure, the refrigerant should be tested for acid to ensure that it has not been contaminated by a burnout. If any contamination is found, recover the entire refrigerant charge, replace the filter drier, triple evacuate, and recharge with new or recycled refrigerant to meet ARI 700-88 specifications.

Safety/Alert:

Technicians should always wear side-shielded safety glasses and butyl-lined gloves when handling refrigerants.

Liquid refrigerant will cause frostbite.

If refrigerant comes in contact with an open flame or a high-heat source, dangerous gasses will form. This is characterized by a strong acidic odor. Immediately vacate the area and ventilate prior to reentry.

SECTION 4.0 – OPERATING FEATURES

4.1 Refrigerant Cycle

The Mueller "OHSE" refrigeration system utilizes an electronic valve control (EVC) and electric subcooling valve which controls the condenser liquid subcooling rather than the evaporator superheat. The EVC is preset to maintain 15°F (8.3°C) subcooled liquid refrigerant leaving the condenser coil. This effectively keeps the condenser coil drained of excess liquid, utilizing maximum coil surface for condensing purposes.

Refer to Figure 2, "Refrigeration Piping Schematic." Subcooled liquid refrigerant leaves the condenser coil and flows through the heat exchanger coil in the accumulator, providing 15–30°F (8.3–16.6°C) of additional liquid refrigerant subcooling. This heat exchange also evaporates any liquid refrigerant in the suction accumulator, protecting the compressor against liquid flood-back.

As the liquid refrigerant, now subcooled a total of 30–45°F (16.6–24.9°C), passes through the electric subcooling valve, its pressure is reduced to an evaporative pressure. Since the liquid refrigerant was extensively subcooled in the accumulator heat exchanger coil before entering the evaporator, the evaporator will be flooded during operation.

Any liquid refrigerant returned from the flooded evaporator is transformed into vapor when it contacts the warmer heat exchanger coil in the bottom of the suction accumulator. Vapor leaving the accumulator heat exchanger will be superheated 2–5°F (1.1–2.75°C) prior to entering the compressor's suction intake. This minimal superheat provides protection against liquid refrigerant entering the compressor while providing exceptional refrigerant cooling of the compressor.

4.2 Positive Oil Return

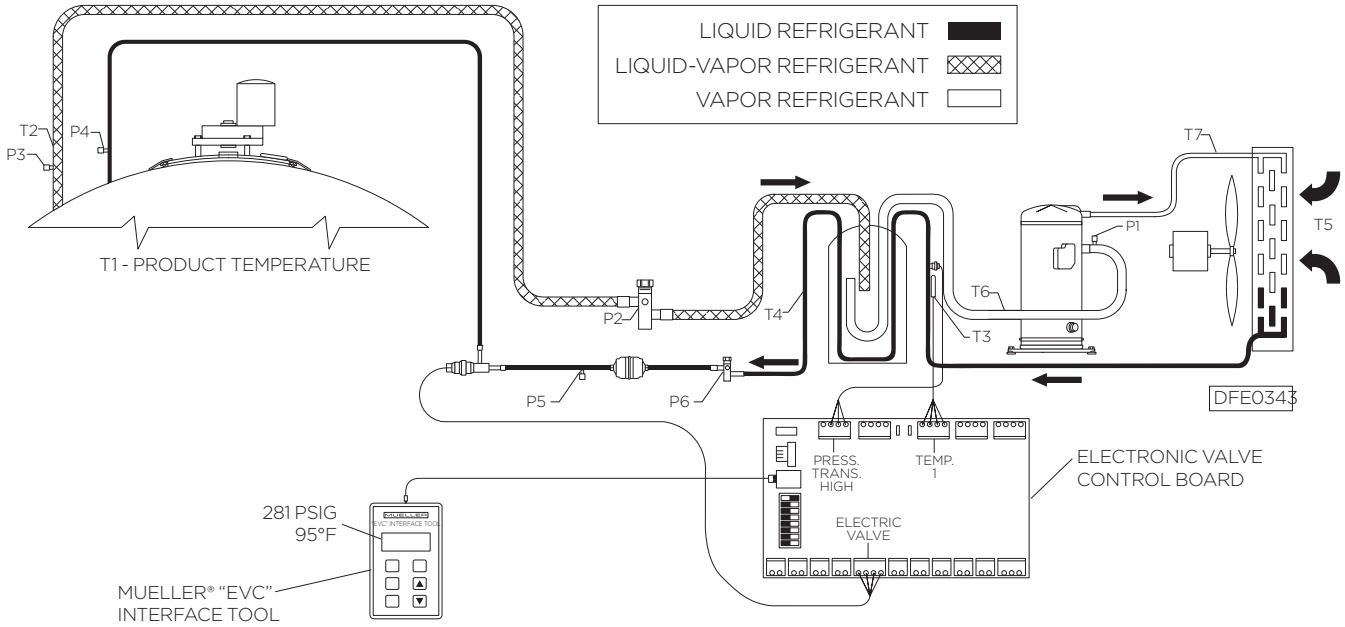
As a direct result of the flooded evaporator, the refrigerant returning from the evaporator is wet with liquid carry-over. This mixture carries oil in suspension much more readily than the dry, superheated suction refrigerant in a conventional refrigeration system. This refrigerant oil mixture drops into the accumulator where the oil separates from the refrigerant and settles to the bottom of the accumulator. This oil is metered back into the compressor through the oil pickup orifice located in the bottom of the accumulator's suction outlet "J" tube. Reference Section 6.0, "Accumulator Heat Exchanger."

4.3 Increased Operating Efficiency

The flooded evaporator utilizes the entire evaporator surface for cooling without wasting valuable surface area for super heating as in a conventional system.

The EVC and electric subcooling valve controls the quantity of liquid refrigerant in the condenser, maintaining lower head pressures while ensuring sufficient refrigerant flow to the evaporator in low-ambient temperatures. In a conventional system, the evaporator operates "starved" for refrigerant at low-ambient temperatures because the head pressure, without being raised artificially, cannot force sufficient refrigerant through the expansion valve to meet the cooling requirements.

Figure 2: Refrigerant Piping Schematic



Example (R-507):
- The EVC is sensing 281 psig through the pressure transducer.
- Convert pressure to saturation temperature, which is 110°F.
- Line temperature at T3 is 95°F.

Results:
- 110°F – 95°F = 15°F subcooling.

IMPORTANT: When charging the system with liquid refrigerant, always charge upstream of the accumulator heat exchanger, Access Ports P2 or P3, to ensure protection to the compressor against damage caused by liquid refrigerant slugging.

4.4 Measuring Subcooling

1. Operate the refrigeration system with the evaporator covered at a product temperature below 45°F (7.2°C).

2. Take an accurate high-side pressure at P5 and convert it to the refrigerant's saturation temperature with a pressure temperature chart (see Section 15).

3. Take an accurate line temperature at T3 and subtract it from the saturation temperature conversion at P5 (Step 2).

4. This provides the measurement of subcooling in the subcooling loop of the condenser controlled by the subcooling valve.

SECTION 5.0 – SUBCOOLING

5.1 Electronic Valve Control with Electric Subcooling Valve

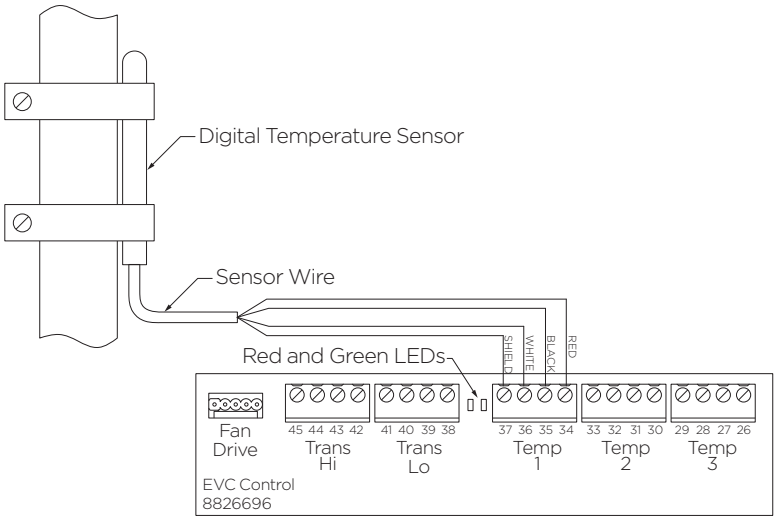
The Mueller electronic valve control (EVC) is factory set to maintain 15°F (8.3°C) of subcooling. The EVC board determines condenser subcooling using two inputs. The pressure transducer senses the liquid line pressure and the digital temperature sensor senses the liquid line temperature. This data is sent to the EVC board, which calculates a subcooling reading. The electric valve is then adjusted to maintain 15°F (8.3°C) of subcooling.

If the liquid refrigerant is subcooled more than 15°F (8.3°C), the EVC will drive the electric valve open. This reduces the amount of liquid subcooling in the bottom of the condenser. The EVC drives the electric valve open as the liquid line cools and closed as the liquid line becomes warmer. This operation is similar to that of a mechanical subcooling valve.

5.2 Digital Temperature Sensor

The digital temperature sensor, Part No. 8826856, on the EVC board is clamped to the liquid line leaving the condenser. The digital temperature sensor should be insulated using cork tape to prevent exposure to ambient temperatures.

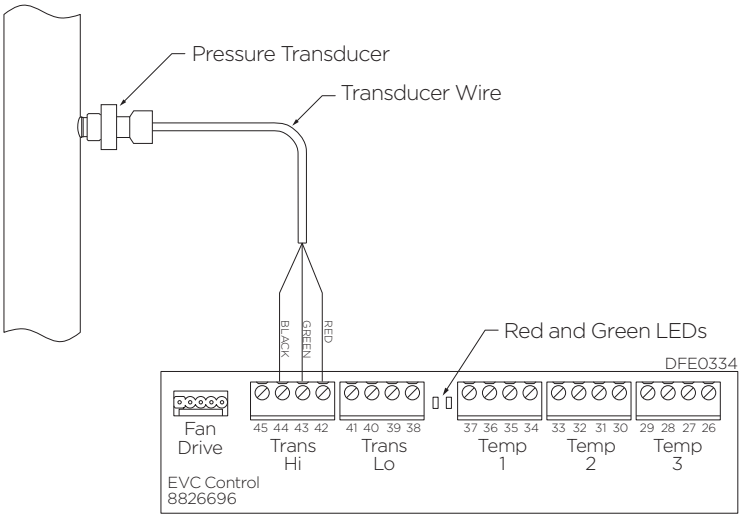
Figure 3: Digital Temperature Sensor



5.3 Pressure Transducer, 0–500 psi

The high pressure transducer, Part No. 8826758, is attached to the service port on the vertical liquid line at the inlet of the accumulator heat exchanger. The transducer senses the liquid line pressure leaving the condenser and uses a ± 5 Vdc signal to transmit that pressure reading to EVC board. The EVC board converts that pressure reading into a temperature, and then calculates subcooling. See Figure 4, "Pressure Transducer."

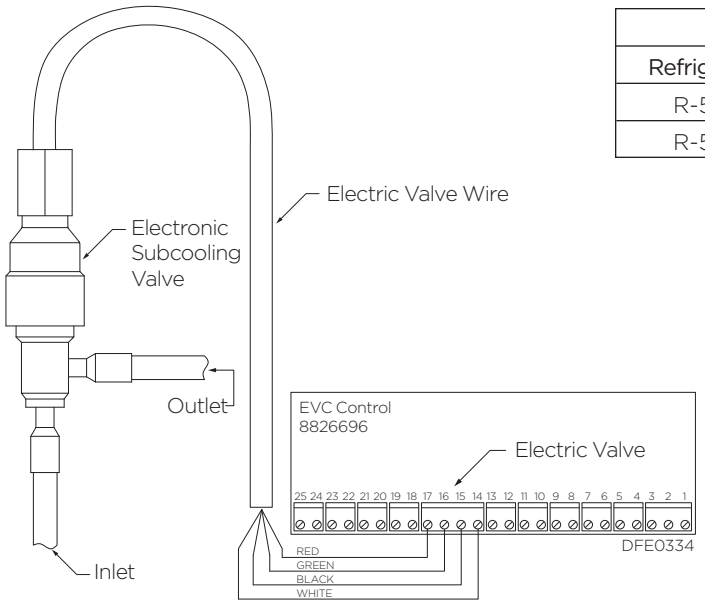
Figure 4: Pressure Transducer



5.4 Electric Subcooling Valve Operation

When a cooling signal is received, the electric valve is held open at a factory programmed start-up position for approximately 10 seconds. After this time period, the EVC will adjust the valve accordingly to maintain 15°F (8.3°C) of subcooling with R-507. Once the refrigeration system is de-energized, the valve moves to a fully closed position (homes), and then returns to the factory programmed start-up position. This setting allows for system equalization during the off cycle.

Figure 5: Electric Subcooling Valve



Electric Subcooling Valve		
Refrigerant	Application	Part No.
R-507	3.5 hp	8826763
R-507	5 hp	8826764

5.5 System Error Light Codes

The EVC board is equipped with diagnostic LEDs which will flash in the event of a system error.

Table 2: System Error Light Codes

Error Code		Possible Cause
Red LED	1 Flash	Bit-Switch Setting Error (Check Bit-Switch Configuration)
Red LED	2 Flashes	High Side Pressure Transducer (Check Transducer Connections)
Red LED	3 Flashes	Low Side Pressure Transducer (Check Bit-Switch Configuration)
Red LED	4 Flashes	Temperature Sensor Error (Check for Communication Error)
Red LED	7 Flashes	Electronic Fan Control Error (Check for Open Fuse)
Green LED	1 Flash	System Off on Anti-Cycle Timer (10 Minutes)
Green LED	Solid	Normal Operation

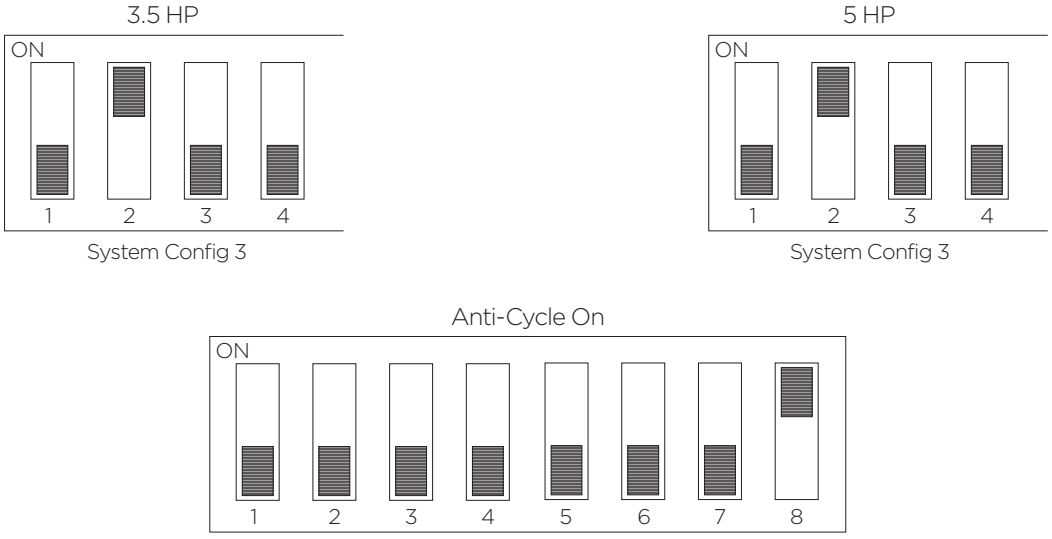
5.6 EVC Bit-Switch Configuration

The bit-switch configuration on the EVC board will determine the size of compressor used on the system to be controlled.

Bit-switch number 8 is the anti-cycle control; it can be disabled for servicing and troubleshooting by the service technician. This can be done by moving the switch toward the number 8. The anti-cycle delay is factory-set for 10 minutes.

NOTE: Power to the EVC board must be turned off when bit-switch settings are changed; once power is restored, the EVC will operate with the new settings.

Figure 6: EVC Bit-Switch Configuration



SECTION 6.0 – ACCUMULATOR HEAT EXCHANGER

6.1 Accumulator Heat Exchanger

The accumulator heat exchanger performs several functions on the "OHSE" system:

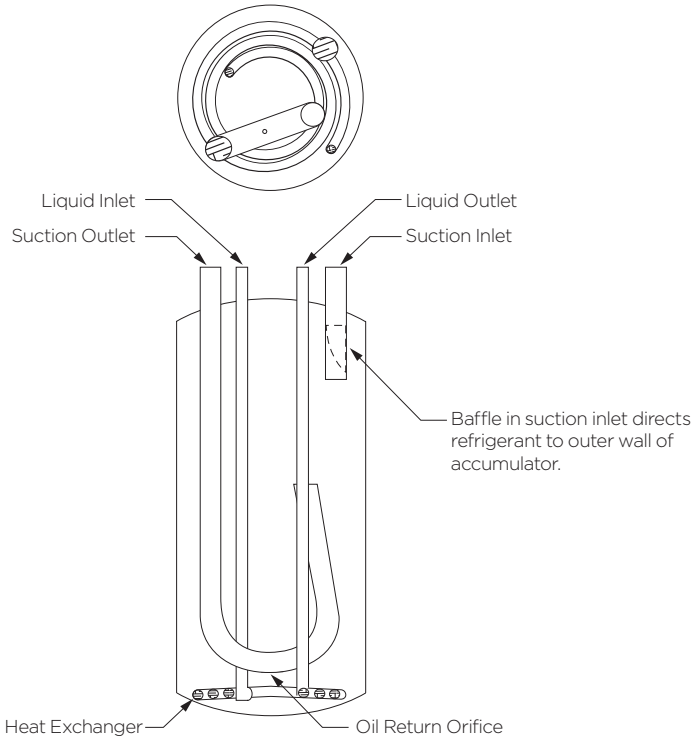
- Additional Subcooling: High-pressure liquid refrigerant from the condenser is subcooled 15–30°F (8.3-16.6°C) as it passes through the heat exchanger coil in the bottom of the accumulator which is submerged in cold liquid refrigerant that has returned from the flooded evaporator.

- Vapor Return to the Compressor: The accumulator heat exchanger evaporates accumulated liquid returning from the evaporator, providing cool vapor refrigerant to the suction inlet of the compressor.

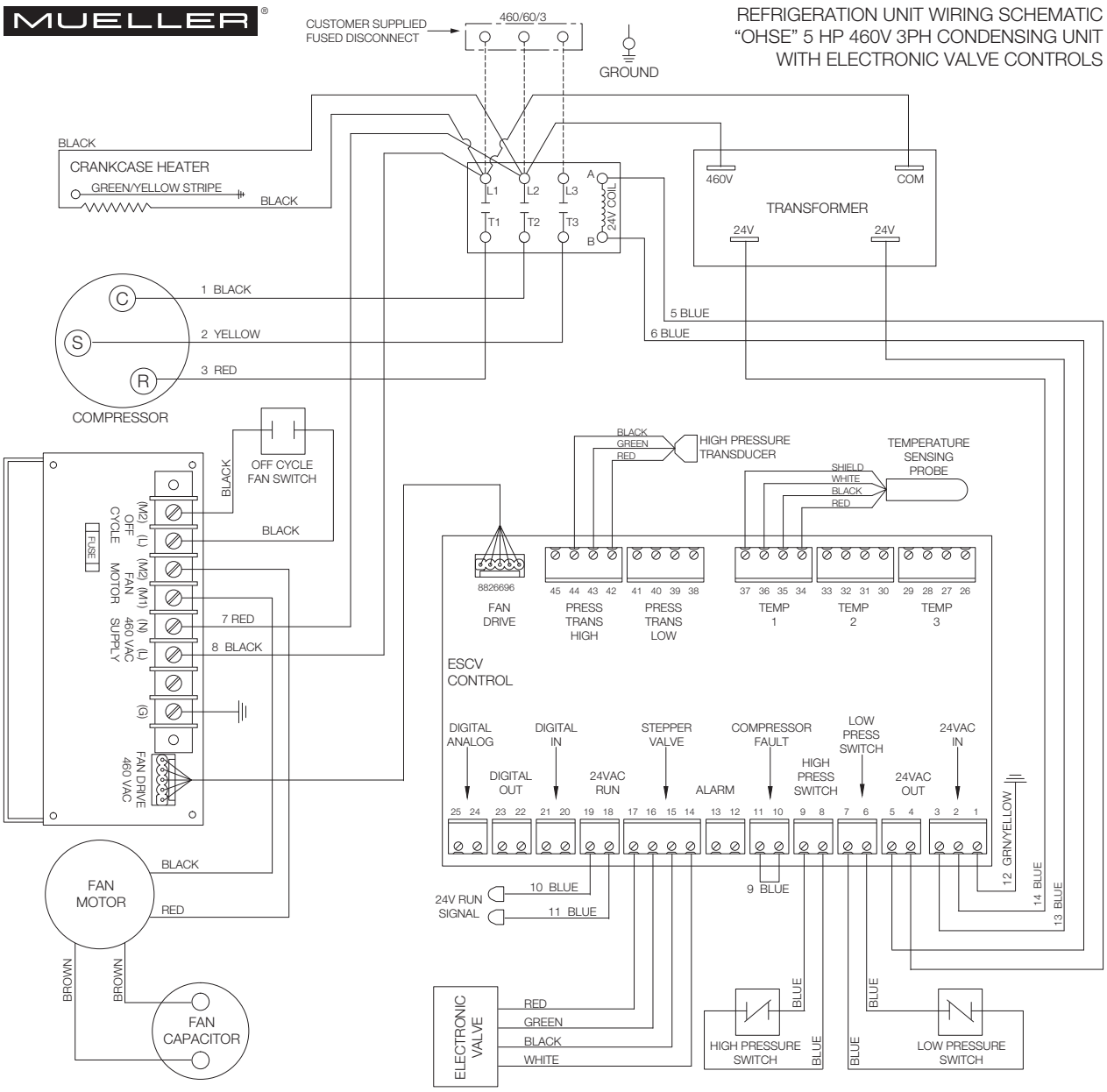
- Oil Return to the Compressor: Oil settles to the bottom of the accumulator and is returned to the compressor through an orifice in the accumulator's suction outlet.

SERVICE NOTE: The Mueller HiPerForm® accumulator heat exchanger is a custom-manufactured unit utilizing a special "pancake" heat exchange coil. The use of a generic (spiral) accumulator heat exchanger will severely reduce cooling capacity of the "OHSE" system and may cause premature compressor failure. Use genuine Mueller replacement parts only.

Figure 7: Accumulator Heat Exchanger



7.1 "OHSE" 5 hp, 460V 3-Phase Wiring Schematic



——— FACTORY INSTALLED WIRING
-------- CUSTOMER FIELD INSTALLED WIRING

CONTROL BOX NOTES:

1. INSTALL ITEM #20 ON INSIDE OF ELECTRICAL BOX COVER.
2. WIRE UNIT PER ITEM #20 WITH ITEM #19.

WIRING NOTES:

1. CAUTION: THE SIDE OF THE CONTROL CIRCUIT EMPLOYING THE SAFETY DEVICE SHALL NOT BE GROUNDED.
2. MINIMAL 20 VA TRANSFORMER REQUIRED FOR CONTROL VOLTAGE.
3. USE MINIMUM OF 75°C INSULATED COPPER WIRE ON FIELD WIRING.
4. FAN MOTOR IS INTERNALLY THERMAL PROTECTED.
5. CONNECT 24 VOLT CONTROL WIRING TO LEADS WITH SUPPLIED WIRE NUTS (ITEM #23).
6. FIELD WIRING NOT TO COME IN CONTACT WITH CONTROL BOX HEATER.
7. ALL ENFORCED ELECTRICAL CODES MUST BE FOLLOWED DURING INSTALLATION, SERVICE, AND/OR OPERATION OF THIS EQUIPMENT.
8. ALL GROUNDS TERMINATE IN THE CONTROL BOX EXCEPT THE CRANKCASE HEATER, WHICH TERMINATES NEXT TO THE COMPRESSOR ON THE BASE PLATE.

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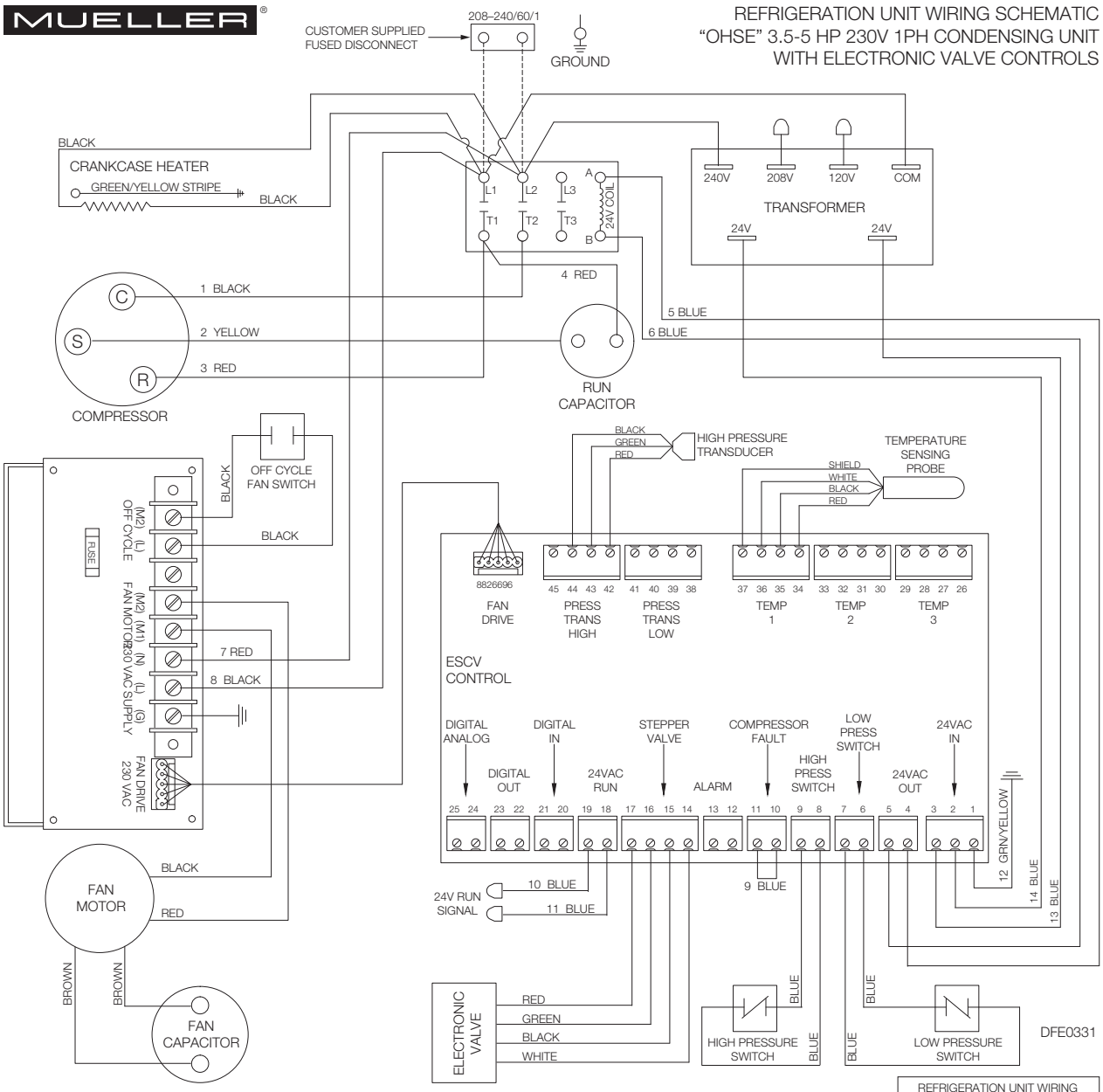
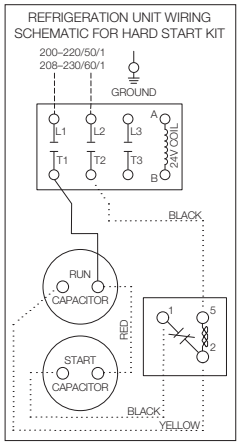
7.2 “OHSE” 3.5 and 5 hp, 230V Single-Phase Wiring Schematic



COMPRESSOR	RUN CAPACITOR	START CAPACITOR	START RELAY	(OPTIONAL) HARD START KIT
5 HP 8820736	8820595 80 MFD / 370V	8820149 270–324 MFD 330V	8820596 170–180 PUV 40–115 DOV	8822053
3.5 HP 8822549	8822021 60 MFD / 370V	8820196 88-106 MFD 330V	8820596 170–180 PUV 40–115 DOV	8822055



FACTORY INSTALLED WIRING

CUSTOMER FIELD INSTALLED WIRING

CUSTOMER FIELD RETROFIT INSTALLED WIRING

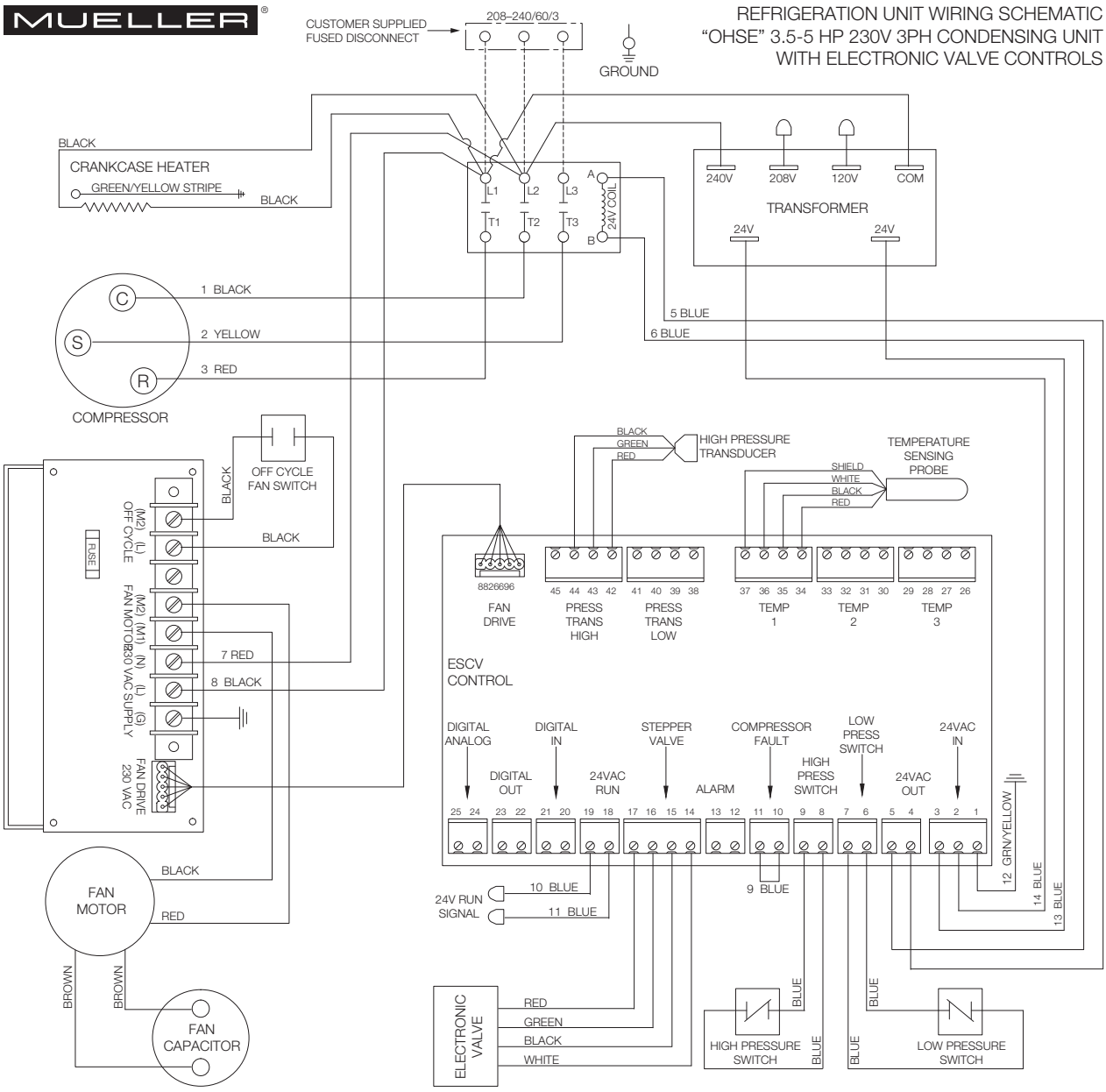
CONTROL BOX NOTES:

1. INSTALL ITEM #20 ON INSIDE OF ELECTRICAL BOX COVER.
2. WIRE UNIT PER ITEM #20 WITH ITEM #19.

WIRING NOTES:

1. CAUTION: THE SIDE OF THE CONTROL CIRCUIT EMPLOYING THE SAFETY DEVICE SHALL NOT BE GROUNDED.
2. MINIMAL 20 VA TRANSFORMER REQUIRED FOR CONTROL VOLTAGE.
3. USE MINIMUM OF 75°C INSULATED COPPER WIRE ON FIELD WIRING.
4. FAN MOTOR IS INTERNALLY THERMAL PROTECTED.
5. CONNECT 24 VOLT CONTROL WIRING TO LEADS WITH SUPPLIED WIRE NUTS (ITEM #23).
6. FIELD WIRING NOT TO COME IN CONTACT WITH CONTROL BOX HEATER.
7. ALL ENFORCED ELECTRICAL CODES MUST BE FOLLOWED DURING INSTALLATION, SERVICE, AND/OR OPERATION OF THIS EQUIPMENT.
8. ALL GROUNDS TERMINATE IN THE CONTROL BOX EXCEPT THE CRANKCASE HEATER, WHICH TERMINATES NEXT TO THE COMPRESSOR ON THE BASE PLATE.

7.3 "OHSE" 3.5 and 5 hp, 230V, 3-Phase Wiring Diagram



CONTROL BOX NOTES:

1. INSTALL ITEM #20 ON INSIDE OF ELECTRICAL BOX COVER.
2. WIRE UNIT PER ITEM #20 WITH ITEM #19.

WIRING NOTES:

1. CAUTION: THE SIDE OF THE CONTROL CIRCUIT EMPLOYING THE SAFETY DEVICE SHALL NOT BE GROUNDED.
2. MINIMAL 20 VA TRANSFORMER REQUIRED FOR CONTROL VOLTAGE.
3. USE MINIMUM OF 75°C INSULATED COPPER WIRE ON FIELD WIRING.
4. FAN MOTOR IS INTERNALLY THERMAL PROTECTED.
5. CONNECT 24 VOLT CONTROL WIRING TO LEADS WITH SUPPLIED WIRE NUTS (ITEM #23).
6. FIELD WIRING NOT TO COME IN CONTACT WITH CONTROL BOX HEATER.
7. ALL ENFORCED ELECTRICAL CODES MUST BE FOLLOWED DURING INSTALLATION, SERVICE, AND/OR OPERATION OF THIS EQUIPMENT.
8. ALL GROUNDS TERMINATE IN THE CONTROL BOX EXCEPT THE CRANKCASE HEATER, WHICH TERMINATES NEXT TO THE COMPRESSOR ON THE BASE PLATE.

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SECTION 8.0 – PRESSURE SWITCHES AND FAN CONTROL

8.1 Low-Pressure Switch with Automatic Reset

The low-pressure switch should be tested during installation to ensure proper operation. This can be accomplished by completing these steps:

1. Attach an accurate low-pressure gauge to P2, the suction service valve.

2. Slowly close P6 service valve while monitoring the suction pressure on the gauge.

3. The low-pressure switch should open and de-energize the compressor's control circuit at approximately 5 psig (± 2 psig).

4. Slowly open P6 service valve and monitor the suction pressure on the gauge.

5. The low-pressure switch should close and energize the compressor's control circuit at approximately 30 psig (± 2 psig).

6. The low-pressure switch should be replaced if it does not operate as indicated above.

8.2 High-Pressure Switch with Automatic Reset

The high-pressure switch should be tested during installation to ensure proper operation. This can be accomplished by completing these steps.

1. Attach an accurate high-pressure gauge to P6, high-side service valve.

2. Disconnect the fan motor wires from the high-voltage terminal strip and monitor the high-side pressure on the gauge.

3. The high-pressure switch should open and de-energize the compressor's control circuit at approximately 480 psig (± 10 psig) on R-507 units.

4. Reconnect the fan motor wires at the high-voltage terminal strip and monitor the high-side pressure on the gauge.

5. The high-pressure switch should close and energize the compressor's control circuit at approximately 350 psig (± 10 psig) on R-507 units..

6. The high-pressure switch should be replaced if it does not operate as indicated above.

8.3 Fan Control Drive

The "OHSE" uses an electromagnetic variable speed fan control to allow the fan motor to operate at variable speeds at different ambient temperatures. The Mueller fan control drive (FCD) must be checked for proper operation upon installation.

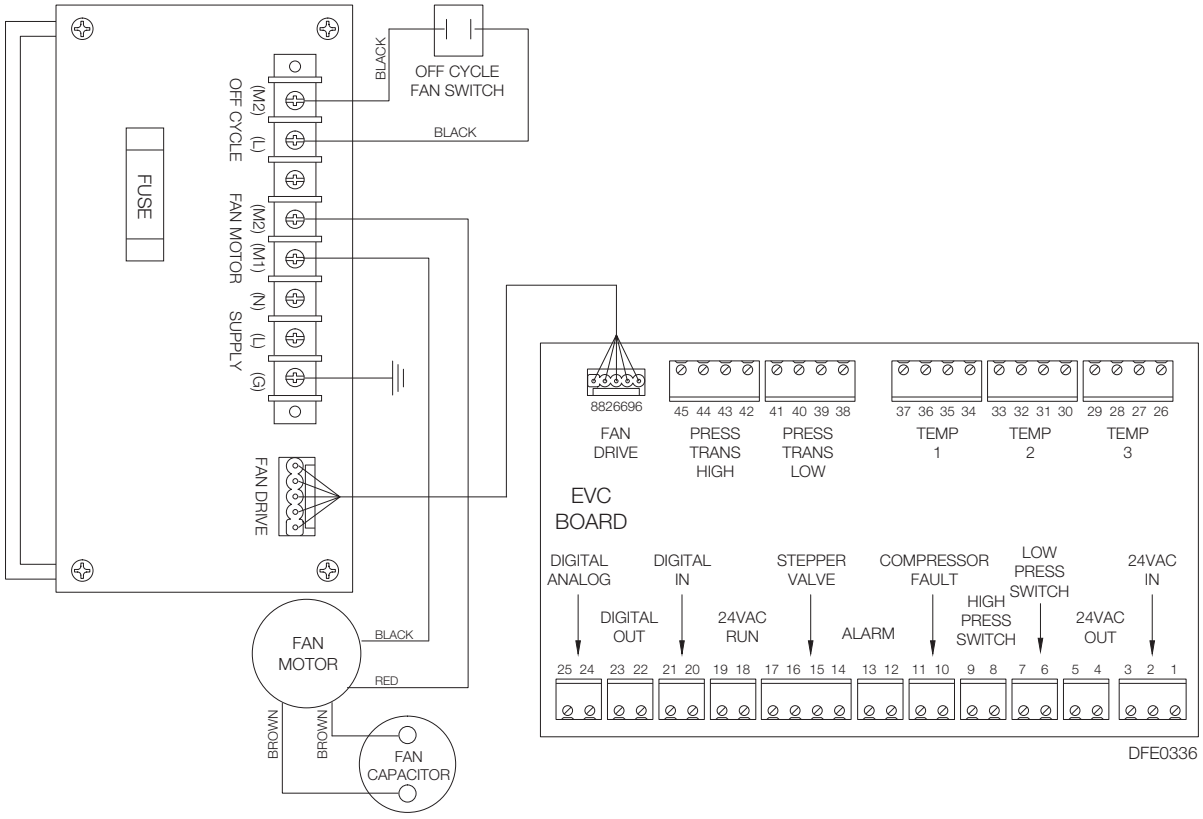
The FCD is factory set to energize the fan at minimum speed when the high side pressure rises above 170 psig. The fan motor should operate at maximum speed when the high side pressure rises above 240 psig. These settings should be verified at start up.

8.3 Fan Control Drive (Continued)

To verify FCD operation, connect the high side of a manifold gauge to the liquid line service valve (P6). Energize the condensing unit and monitor fan operation in accordance with the high side pressure. In low ambient conditions, the condenser may have to be partially blocked to increase head pressure.

When the system receives the cooling signal, the fan motor will start at maximum speed and run for approximately 8 seconds. This 8-second de-ice mode is designed to ensure that the fan motor starts in the correct clockwise rotation.

Figure 8: Fan Control Drive



8.5 Off-Cycle Fan Pressure Switch

The off-cycle fan pressure switch is designed to protect the evaporator and the condensing unit from over pressure during the wash cycle. The off-cycle switch will operate the fan at full speed if high side pressure rises above 270 psig and operate until pressure falls below 220 psig.

8.6 Schrader Core Identification

All pressure switches will be marked with a red tie band indicating a Schrader core is present. If a pressure switch connection does not have a red tie band, the refrigerant will have to be recovered before the pressure switch can be removed.

NOTE: All high-side pressure safety connections will not have a Schrader core. This is due to safety regulation on the high side of a system.

SECTION 9.0 – EQUIPMENT SOUND LEVEL

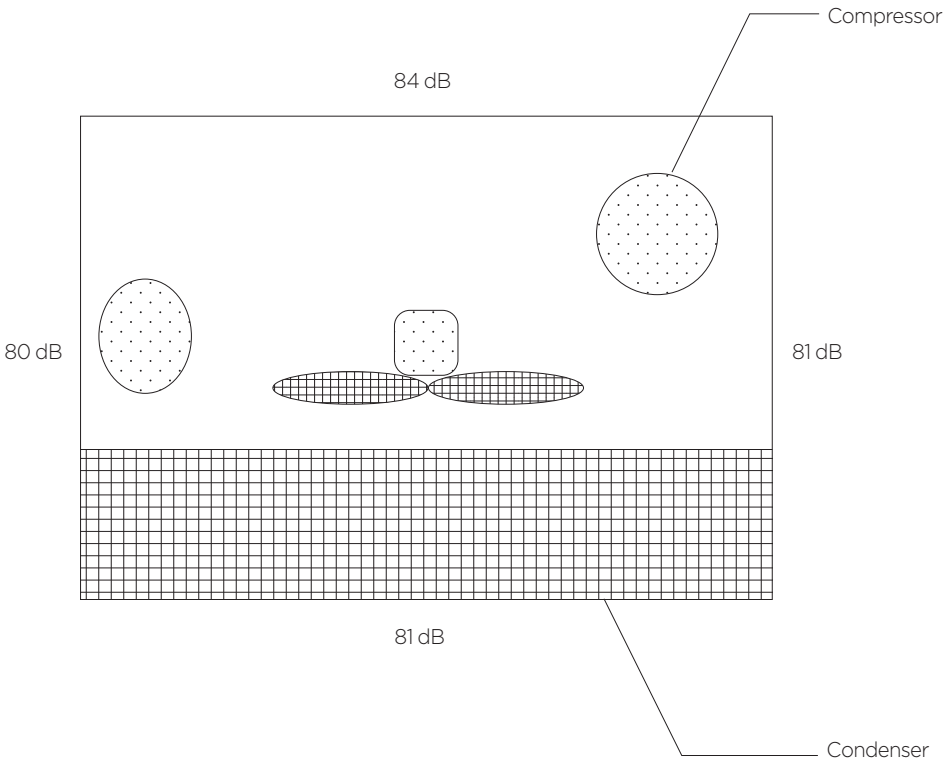
9.1 Sound Testing Equipment

The manufacturer tested sound levels of the "OHSE" system under normal operating conditions with the compressor and condenser fan motor operating. Measurements were taken with a sound meter, Model 33-2055, on the "A-Weighted" scale.

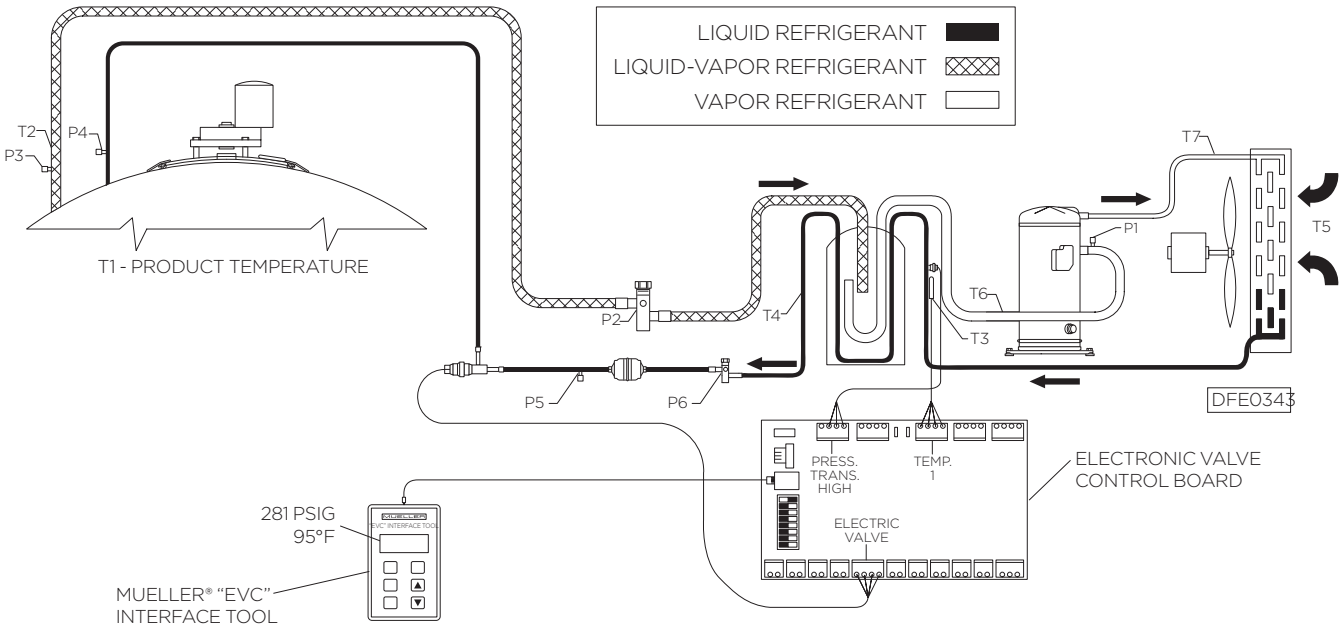
9.2 Sound Measurement

All sound measurements were recorded at a distance of 1 meter (3.28 feet) from the operating equipment. The highest recorded measurement was 84 dB.

Figure 9: Sound Measurement



10.1 "OHSE" Refrigeration Survey



Pressure Readings
P1 - Suction Pressure at Compressor Inlet
P2 - Suction Pressure at Accumulator Inlet
P3 - Suction Pressure at Evaporator Outlet
P4 - Pressure at Evaporator Inlet
P5 - Pressure at Subcooling Valve Inlet
P6 - Pressure at Liquid-Line Service Valve

Temperature Readings
T1 - Milk Temperature
T2 - Suction Line Temperature at Evaporator Outlet
T3 - Line Temperature at Subcooling Valve Bulb
T4 - Line Temperature at Accumulator Outlet
T5 - Ambient Temperature Entering Condenser
T6 - Suction Line Temperature Entering Compressor
T7 - Compressor Discharge Temperature

Survey Data to be Supplied by Technician
Provide the actual time below. Readings should be taken at 5-minute intervals.

														Compressor Amperage		
Time*	P1	P2	P3	P4	P5	P6	T1	T2	T3	T4	T5	T6	T7	L1	L2	L3

Measured Supply Voltage:	"OHSE" Model and Part No.:	Serial No.:

10.2 General

The "OHSE" unit requires minimal maintenance. The following scheduled maintenance procedures are recommended to be performed by a knowledgeable service technician on an annual basis:

1. Clean the condenser tubes and fins from accumulated dust or other foreign matter to ensure proper air flow.

2. Check the refrigerant charge by the weigh-out method described in Section 3.5. If the charge is low, perform a leak test on the complete system and repair.

3. Check for proper subcooling as described in Section 5.

4. Check for proper incoming supply voltage.

5. Measure the amperage draw of the compressor and verify that it is within 10% of the compressor's technical data chart.

6. Check all electrical connections, ensuring that they are clean and tight.

7. Check the compressor's wrap-around crankcase heater for proper operation.

8. Check for proper operation of the low-, high-, and fan pressure switches as described in Section 8.

9. Complete a performance survey for each refrigeration unit verifying proper cooling capacity. Refer to Section 10.1.

Safety/Alert:

All maintenance and service must be performed by trained and knowledgeable service technicians.

Individuals who are not trained and certified in proper refrigeration and electrical procedures should not attempt servicing this equipment.

This equipment starts automatically!

All guards and covers must be in place during operation to prevent mechanical and electrical hazards!

SECTION 11.0 – DISPOSAL

11.1 General

If the "OHSE" refrigeration unit is removed for resale or disposal, ensure the materials, refrigerant, and oils are handled and/or disposed of according to applicable codes and regulations.

11.2 Compressor Refrigerant Oil

R-507: The compressor contains a lubricant consisting of POE (polyolester). Dispose of in accordance with local regulations.

11.3 Metal Components

The refrigeration unit's basic structure consists of steel, tin, aluminum, plastic, and copper, all of which may be separated and recycled.

SECTION 12.0 – EQUIPMENT MARKINGS

12.1 Label No. 8820454, Dry Nitrogen Holding Charge

IMPORTANT

THIS EQUIPMENT CONTAINS A HOLDING CHARGE OF DRY NITROGEN GAS. SLOWLY RELEASE PRESSURE THROUGH SERVICE PORTS OR SCHRADER VALVES BEFORE REMOVING FITTINGS.

EVACUATE THE SYSTEM TO 500 MICRONS BEFORE CHARGING WITH REFRIGERANT. DISCARD THIS TAG UPON CHARGING SYSTEM WITH REFRIGERANT AND APPLY A SYSTEM REFRIGERANT SPECIFICATION DECAL.

NOTE: IT IS THE TECHNICIAN'S RESPONSIBILITY TO COMPLY WITH ALL CURRENT REFRIGERANT USAGE REGULATIONS.

(11/94) 8820454

12.2 Label No. 8824716, Warning: HFC Refrigerant

REFRIGERANT R-507
POE OIL

0305 8824716

12.3 Label No. 8824497, Data Tag

MUELLER®

Model Number
Part Number
Serial Number
Electrical
Compressor (RLA/LRA)
Fan (HP/FLA)
Minimum Circuit Ampacity
Maximum Fuse Size
No. of Wires

Design Pressure - High Side 475 psig and Low Side 200 psig
Outdoor Use *For Use With R-507*

0204 8824497

12.4 Label No. 8822574, Inspection Card

MUELLER®

Condensing Unit Inspection Card

Unit Part No.: Unit Serial No.:
Comp. Part No.: Comp. Serial No.:

Initial	Condensing Unit Inspection
	Add proper amount of oil (3.5 and 5 hp models only)
	Leak test and evacuate
	Run test unit
	Dry nitrogen holding charge psi
	Manual Part No.:

Final Inspection: Date:

9908 8822574

12.5 Label No. 8820155, Wiring Connections for 3-Phase Scrolls

IMPORTANT!

MUELLER®

WIRING CONNECTIONS FOR THREE-PHASE SCROLLS

Scroll compressors will only compress gas in the clockwise direction when viewed from the top. Since single-phase motors will start and run in only one direction, reverse rotation is not a major consideration. Three-phase motors will start and run in either direction depending on the phase angles of the supplied power. This requires care during installation to ensure the compressor is operating in the proper direction. Verification of proper rotation is done by observing suction and discharge pressures when the compressor is energized. Reverse rotation is indicated by a decrease in discharge pressure and an increase in suction pressure. Reverse rotation has no negative impact on the scroll compressors. However, after several minutes of operation the compressor-line break will de-energize the compressor. In order to correct this, disconnect power and switch any two power leads at the unit contactor. Never switch leads directly at the compressor.

6902 8820155

12.6 Label No. 8820156, Brief Power Interruptions on Scroll Single-Phase Compressors

NOTE!

MUELLER®

BRIEF POWER INTERRUPTIONS ON SCROLL SINGLE-PHASE COMPRESSORS

Brief power interruptions (less than one-half second) may result in powered reverse rotation of single-phase scroll compressors. This occurs as a result of the high-pressure discharge gas expanding backwards through the scroll at power interruption, causing the scroll to orbit in the reverse direction. When power is reapplied while reverse rotation is occurring, the compressor may continue to run noisily in the reverse direction for several minutes until the compressor's internal protector trips. This has no effect on durability. When the protector resets, the compressor will start and run normally.

6902 8820156

12.7 Label No. 8822225, CE Data Tag (UK Models Only)

Year of Construction Année de fabrication Año de fabricación	CE
Model Number Numéro de modèle Número de modelo	
Serial Number Numéro de série Número de serie	
Noise Level Niveau de bruit Nivel de ruido	
Weight Poids Peso	

0408 8822225

12.8 Label No. 31193, Screen, Identifies Suction Line Screen Location

SCREEN INSIDE • SCREEN INSIDE • SCREEN INSIDE • SCREEN INSIDE

12.9 Label No. 8822232, Warning Symbol: Hot

12.10 Label No. 8820623, Warning Symbol: Electrical

12.11 Label No. 8822226, Warning: Screen Guard Removal (UK Models Only)

12.12 Label No. 8822141, Warning: Risk of Electric Shock

12.13 Label No. 8820764, Warning: Risk of Electric Shock

12.14 Label No. 8820768, Warning: Screen Guard

12.15 Label No. 8820769, Warning: Fan Will Start Automatically

12.16 Label No. 8824383, Mueller Logo

12.17 Label No. 8802896, CSA LR67608

SECTION 13.0 – SAFETY

NOTE: See all Safety, Warning, and/or Caution Labels displayed in Section 12.0.

13.1 General

Improper handling or service of equipment containing refrigerant and/or powered by electricity can create a health hazard. All installation, service, and/or maintenance must be performed by service technicians who are trained and knowledgeable in proper refrigeration and electrical procedures.

This equipment can start automatically. Use extreme caution when servicing.

All guards and covers must be in place during operation to prevent mechanical and electrical hazards.

13.2 Refrigerant Health Hazards

Although the toxicity and flammability of HCFC and HFC refrigerants is low, the possibility of injury or death exists in unusual situations or if they are deliberately misused. These refrigerant vapors are several times heavier than air. Good ventilation must be provided in areas where high concentration of refrigerant vapors might accumulate and exclude oxygen.

Most halogenated compounds will decompose at high temperatures such as those associated with gas flames or electric heaters. The chemicals that result under these circumstances always include hydrofluoric acid.

These dangerous vapors have a sharp, stinging effect on the nose and can be detected by odor at concentrations below their toxic level. These odors serve as a warning that decomposition has occurred. If detected, evacuate the area until ventilation has cleared the area of the decomposed vapors.

Skin or eye contact can result in irritation and frostbite.

13.3 First Aid

If refrigerant vapors are inhaled, remove victim to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Avoid stimulants. Do not give adrenaline (epinephrine), as this can complicate possible effects on the heart. Call a physician.

In case of eye contact, flush eyes promptly with cool water for at least 15 minutes. Call a physician. Flush exposed skin with cool water. Call a physician.

13.4 Safety Equipment

Technicians handling refrigerants should wear side-shielded safety glasses, impervious (preferably butyl-lined) gloves, and other protective equipment or clothing as required by the situation.

SECTION 14.0 – TECHNICAL DATA

14.1 "OHSE" Electrical Data

Model	Part No.	Description	Voltage	Hz	Ph	FLA	LRA	Min. Circuit Ampacity	Max. Fuse Size
OHSE-A351E-HFC	8826791	3.5 hp, single-phase unit, R-507	208–230	50/60	1	–	–	31.4	50
	8825340	Compressor, scroll, ZB26KCE-PFV	200–220/208–230	50/60	1	23.6	127	–	–
	8823340	Fan motor, ⅓ hp	200–220/208–230	50/60	1	1.9	–	–	–
OHSE-A353E-HFC	8826792	3.5 hp, single-phase unit, R-507	208–230	50/60	3	–	–	18.4	30
	8825341	Compressor, scroll, ZB26KCE-TF5	200–220/208–230	50/60	3	13.2	88	–	–
	8823340	Fan motor, ⅓ hp	200–220/208–230	50/60	1	1.9	–	–	–
OHSE-A51E-HFC	8826793	5 hp, single-phase unit, R-507	200–240	50/60	1	–	–	40.8	70
	8825337	Compressor, scroll, ZB38KCE-PFV	200–220/208–230	50/60	1	31.1	175	–	–
	8823340	Fan motor, ⅓ hp	200–220/208–230	50/60	1	1.9	–	–	–
OHSE-A53E-HFC	8826794	5 hp, single-phase unit, R-507	200–240	50/60	3	–	–	30	50
	8825338	Compressor, scroll, ZB38KCE-TF5	200–220/208–230	50/60	3	22.1	115	–	–
	8823340	Fan motor, ⅓ hp	200–220/208–230	50/60	1	1.9	–	–	–
OHSE-A534E-HFC	8826795	5 hp, 3-phase unit, R-507	380–420/460	50/60	3	–	–	13.2	20
	8825336	Compressor, scroll, ZB38KCE-TFD	380–420/460	50/60	3	9.6	63	–	–
	8825021	Fan motor, ⅓ hp	380–420/460	50/60	1	1.2	–	–	–

14.2 "OHSE" Refrigerant Data

Model	Part No.	Description	Refrigerant Charge	Electronic Subcooling Valve Part No.	Accumulator Heat Exchanger Part No.	Drier Part No.
OHSE-A351E-HFC	8826791	3.5 hp, single-phase unit	13.5 lbs (R-507)	8826763	8800051	8825333
OHSE-A353E-HFC	8826792	3.5 hp, 3-phase unit	13.5 lbs (R-507)	8826763	8800051	8825333
OHSE-A51E-HFC	8826793	5 hp, single-phase unit	15 lbs (R-507)	8826764	8800051	8826825
OHSE-A53E-HFC	8826794	5 hp, 3-phase unit	15 lbs (R-507)	8826764	8800051	8826825
OHSE-A534E-HFC	8826795	5 hp, 3-phase unit	15 lbs (R-507)	8826764	8800051	8826825

14.3 "OHSE" Compressor Oil Charge (R-507 Applications)

Model	Part No.	Description	Oil Charge	Oil Type
OHSE-A351E-HFC	8826791	3.5 hp, single-phase unit (ZB26KCE)	42 oz.	Copeland Ultra 22cc (or) Mobil EAL Arctic 22CC
OHSE-A353E-HFC	8826792	3.5 hp, 3-phase unit (ZB26KCE)	42 oz.	Copeland Ultra 22cc (or) Mobil EAL Arctic 22CC
OHSE-A51E-HFC	8826793	5 hp, single-phase unit (ZB38KCE)	64 oz.	Copeland Ultra 22cc (or) Mobil EAL Arctic 22CC
OHSE-A53E-HFC	8826794	5 hp, 3-phase unit (ZB38KCE)	64 oz.	Copeland Ultra 22cc (or) Mobil EAL Arctic 22CC
OHSE-A534E-HFC	8826795	5 hp, 3-phase unit (ZB38KCE)	64 oz.	Copeland Ultra 22cc (or) Mobil EAL Arctic 22CC

15.1 ZB26KCE 1-Phase Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB26KCE-PFV
HFC-507
COPELAND SCROLL™
PFV 208/230-1-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10 (26)	0 (35)	10 (46)	20 (59)	30 (73)	40 (90)	45 (99)					
(413)	C			16600	20600	25200	30600	33600					
	P			5150	5150	5150	5150	5150					
	A			22.5	22.6	22.6	22.5	22.5					
	M			452	570	715	890	990					
	E			3.2	4	4.9	6	6.6					
	%			49.8	55	59.7	63.6	65.1					
130	C		15400	19200	23700	29000	35000	38400					
(364)	P		4560	4570	4570	4570	4560	4550					
	A		20.3	20.3	20.4	20.4	20.3	20.3					
	M		362	459	575	720	890	985					
	E		3.4	4.2	5.2	6.3	7.7	8.4					
	%		48.3	53.6	58.4	62.6	65.9	67					
120	C	13800	17500	21800	26800	32600	39200	42900					
(320)	P	4010	4030	4040	4050	4050	4030	4020					
	A	18.3	18.4	18.5	18.5	18.5	18.5	18.4					
	M	290	371	467	585	725	895	990					
	E	3.4	4.3	5.4	6.6	8	9.7	10.7					
	%	47	52.5	57.5	61.8	65.3	67.7	68.3					
110	C	15400	19400	24100	29600	36000	43300	47400					
(279)	P	3540	3550	3570	3580	3580	3570	3550					
	A	16.7	16.8	16.8	16.9	16.9	16.8	16.8					
	M	299	379	476	590	730	900	995					
	E	4.4	5.5	6.8	8.3	10.1	12.2	13.3					
	%	51.5	56.8	61.3	65	67.6	68.8	68.7					
100	C	16900	21300	26400	32400	39300	47300	51500					
(243)	P	3120	3140	3150	3160	3160	3150	3140					
	A	15.3	15.4	15.4	15.5	15.5	15.5	15.4					
	M	305	387	484	600	740	905	1000					
	E	5.4	6.8	8.4	10.3	12.4	15	16.5					
	%	55.6	60.7	64.7	67.5	69	68.7	67.7					
90	C	18300	23000	28600	35100	42600	51000	56000					
(210)	P	2750	2770	2780	2790	2790	2780	2770					
	A	14.1	14.2	14.3	14.3	14.3	14.3	14.3					
	M	310	393	491	610	745	915	1010					
	E	6.7	8.3	10.3	12.6	15.3	18.4	20.2					
	%	59.3	64	67.3	69	69	66.8	64.7					
80	C	19600	24700	30700	37700	45800	55000	60000					
(180)	P	2420	2440	2460	2470	2470	2450	2440					
	A	13.1	13.2	13.3	13.3	13.4	13.3	13.3					
	M	311	397	496	615	755	920	1020					
	E	8.1	10.1	12.5	15.3	18.6	22.5	24.7					
	%	61.9	66.2	68.6	68.9	67	62.3	58.7					
70	C	20900	26300	32800	40200	48900							
(154)	P	2130	2160	2170	2180	2180							
	A	12.3	12.4	12.5	12.6	12.6							
	M	309	398	499	620	760							
	E	9.8	12.2	15.1	18.5	22.5							
	%	63.1	67	68.2	66.8	62.5							

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON. Climate Technologies

Copeland®

1.4dMT60-05-184-PFV
Printed 04/24/2006 05-184

15.2 ZB26KCE 3-Phase, 230V Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB26KCE-TF5
HFC-507
COPELAND SCROLL™
TF5 200/230-3-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10	(26)	0	(35)	10	(46)	20	(59)	30	(73)	40	(90)	45	(99)
(413)	C					16500		20500		25100		30400		33400	
	P					4960		4960		4960		4950		4930	
	A					14.1		14.1		14.1		14.1		14.1	
	M					449		570		710		885		985	
	E					3.3		4.1		5.1		6.2		6.8	
	%					51.4		56.8		61.7		65.8		67.4	
130	C			15300		19100		23600		28800		34800		38100	
(364)	P			4380		4390		4400		4400		4380		4370	
	A			12.7		12.8		12.8		12.8		12.8		12.7	
	M			360		456		575		715		885		985	
	E			3.5		4.4		5.4		6.6		7.9		8.7	
	%			49.9		55.4		60.4		64.8		68.2		69.4	
120	C	13700		17400		21600		26600		32400		39000		42700	
(320)	P	3860		3870		3880		3890		3890		3880		3870	
	A	11.5		11.5		11.6		11.6		11.6		11.6		11.5	
	M	289		368		464		580		720		890		985	
	E	3.6		4.5		5.6		6.8		8.3		10.1		11	
	%	48.6		54.3		59.4		63.9		67.6		70		70.6	
110	C	15300		19300		24000		29500		35800		43100		47100	
(279)	P	3400		3420		3430		3440		3440		3430		3420	
	A	10.5		10.5		10.5		10.6		10.6		10.6		10.5	
	M	297		377		473		590		730		895		990	
	E	4.5		5.6		7		8.6		10.4		12.6		13.8	
	%	53.2		58.7		63.3		67.2		69.9		71.1		71.1	
100	C	16800		21100		26300		32200		39100		47000		51500	
(243)	P	3000		3020		3030		3040		3040		3030		3020	
	A	9.6		9.6		9.7		9.7		9.7		9.7		9.7	
	M	303		384		481		595		735		900		995	
	E	5.6		7		8.7		10.6		12.9		15.5		17	
	%	57.5		62.7		66.8		69.8		71.3		71		70	
90	C	18200		22900		28400		34900		42300		51000		55500	
(210)	P	2640		2660		2680		2690		2690		2670		2660	
	A	8.8		8.9		8.9		9		9		9		9	
	M	308		390		488		605		745		910		1000	
	E	6.9		8.6		10.6		13		15.8		19		20.9	
	%	61.2		66.1		69.5		71.3		71.2		68.9		66.7	
80	C	19500		24600		30500		37500		45500		54500		60000	
(180)	P	2330		2350		2360		2370		2370		2360		2340	
	A	8.2		8.3		8.3		8.4		8.4		8.4		8.4	
	M	309		394		493		610		750		915		1010	
	E	8.4		10.5		12.9		15.8		19.2		23.2		25.5	
	%	63.9		68.4		70.8		71.2		69.2		64.3		60.6	
70	C	20800		26200		32600		40000		48600					
(154)	P	2050		2070		2090		2100		2090					
	A	7.7		7.8		7.8		7.9		7.9					
	M	308		395		496		615		755					
	E	10.1		12.6		15.6		19.1		23.2					
	%	65.2		69.1		70.4		69		64.5					

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON Climate Technologies

Copeland®

1.4dMT60-04-1338-TF5
Printed 04/24/2006 04-1338

15.3 ZB26KCE 3-Phase, 460V Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB26KCE-TFD
HFC-507
COPELAND SCROLL™
TFD 460-3-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10 (26)	0 (35)	10 (46)	20 (59)	30 (73)	40 (90)	45 (99)
(413)	C			16500	20500	25100	30400	33400
	P			4960	4960	4960	4950	4930
	A			7.1	7.1	7.1	7.1	7
	M			449	570	710	885	985
	E			3.3	4.1	5.1	6.2	6.8
	%			51.4	56.8	61.7	65.8	67.4
130	C		15300	19100	23600	28800	34800	38100
(364)	P		4380	4390	4400	4400	4380	4370
	A		6.4	6.4	6.4	6.4	6.4	6.4
	M		360	456	575	715	885	985
	E		3.5	4.4	5.4	6.6	7.9	8.7
	%		49.9	55.4	60.4	64.8	68.2	69.4
120	C	13700	17400	21600	26600	32400	39000	42700
(320)	P	3860	3870	3880	3890	3890	3880	3870
	A	5.7	5.8	5.8	5.8	5.8	5.8	5.8
	M	289	368	464	580	720	890	985
	E	3.6	4.5	5.6	6.8	8.3	10.1	11
	%	48.6	54.3	59.4	63.9	67.6	70	70.6
110	C	15300	19300	24000	29500	35800	43100	47100
(279)	P	3400	3420	3430	3440	3440	3430	3420
	A	5.2	5.3	5.3	5.3	5.3	5.3	5.3
	M	297	377	473	590	730	895	990
	E	4.5	5.6	7	8.6	10.4	12.6	13.8
	%	53.2	58.7	63.3	67.2	69.9	71.1	71.1
100	C	16800	21100	26300	32200	39100	47000	51500
(243)	P	3000	3020	3030	3040	3040	3030	3020
	A	4.8	4.8	4.8	4.9	4.9	4.8	4.8
	M	303	384	481	595	735	900	995
	E	5.6	7	8.7	10.6	12.9	15.5	17
	%	57.5	62.7	66.8	69.8	71.3	71	70
90	C	18200	22900	28400	34900	42300	51000	55500
(210)	P	2640	2660	2680	2690	2690	2670	2660
	A	4.4	4.4	4.5	4.5	4.5	4.5	4.5
	M	308	390	488	605	745	910	1000
	E	6.9	8.6	10.6	13	15.8	19	20.9
	%	61.2	66.1	69.5	71.3	71.2	68.9	66.7
80	C	19500	24600	30500	37500	45500	54500	60000
(180)	P	2330	2350	2360	2370	2370	2360	2340
	A	4.1	4.1	4.2	4.2	4.2	4.2	4.2
	M	309	394	493	610	750	915	1010
	E	8.4	10.5	12.9	15.8	19.2	23.2	25.5
	%	63.9	68.4	70.8	71.2	69.2	64.3	60.6
70	C	20800	26200	32600	40000	48600		
(154)	P	2050	2070	2090	2100	2090		
	A	3.9	3.9	3.9	3.9	3.9		
	M	308	395	496	615	755		
	E	10.1	12.6	15.6	19.1	23.2		
	%	65.2	69.1	70.4	69	64.5		

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON. Climate Technologies

Copeland®

1.4dMT60-04-1338-TFD
Printed 04/24/2006 04-1338

15.4 ZB38KCE 1-Phase Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB38KCE-PFV
HFC-507
COPELAND SCROLL™
PFV 208/230-1-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10 (26)		0 (35)		10 (46)		20 (59)		30 (73)		40 (90)	45 (99)
(413)	C					22900		28600		35500		43400	47800
	P					6850		6900		7000		7050	7100
	A					32		32.4		32.7		33	33.2
	M					620		795		1010		1260	1410
	E					3.3		4.1		5.1		6.2	6.7
	%					51.5		57.1		62.1		65.8	67
130	C			20900		26600		33300		41100		50000	55000
(364)	P			6100		6150		6200		6250		6350	6400
	A			28.7		29.1		29.3		29.6		29.9	30.2
	M			491		635		810		1020		1270	1410
	E			3.4		4.3		5.4		6.5		7.9	8.6
	%			49.2		54.9		60.3		64.8		67.6	68.2
120	C	18400		23800		30200		37800		46500		56500	61500
(320)	P	5400		5450		5500		5550		5650		5700	5800
	A	25.8		26.1		26.4		26.6		26.9		27.3	27.5
	M	388		505		650		825		1030		1280	1420
	E	3.4		4.4		5.5		6.8		8.2		9.8	10.7
	%	46.8		52.7		58.4		63.4		66.9		68.5	68.2
110	C	20700		26700		33900		42200		51500		62000	68000
(279)	P	4840		4900		4950		5000		5050		5150	5250
	A	23.6		23.8		24.1		24.3		24.6		25	25.3
	M	401		520		665		840		1050		1290	1430
	E	4.3		5.5		6.8		8.4		10.2		12	13
	%	50.5		56.5		61.9		66.1		68.4		68.2	67
100	C	22900		29600		37400		46400		56500		68000	74000
(243)	P	4340		4390		4440		4490		4570		4690	4770
	A	21.6		21.8		22		22.2		22.5		23	23.4
	M	414		535		685		855		1060		1300	1430
	E	5.3		6.7		8.4		10.3		12.4		14.4	15.5
	%	54.2		60.1		64.9		67.8		68.4		66	63.6
90	C	25200		32400		40800		50500		61000		73000	79000
(210)	P	3890		3940		3980		4050		4150		4300	4390
	A	19.9		20		20.2		20.4		20.8		21.5	21.9
	M	426		550		700		870		1070		1300	1430
	E	6.5		8.2		10.2		12.4		14.7		17	18
	%	57.5		63.1		66.8		68.1		66.4		61.4	57.7
80	C	27500		35100		43900		54000		65000		77500	84000
(180)	P	3490		3530		3590		3670		3790		3970	4090
	A	18.4		18.5		18.7		19		19.5		20.2	20.7
	M	435		560		705		875		1070		1300	1420
	E	7.9		9.9		12.2		14.7		17.2		19.5	20.5
	%	60		64.8		67		66.1		61.9		54.1	48.9
70	C	29600		37600		46700		57000		68500			
(154)	P	3130		3180		3250		3350		3510			
	A	17.1		17.2		17.4		17.8		18.4			
	M	440		565		710		875		1070			
	E	9.5		11.8		14.4		17		19.6			
	%	61		64.6		64.9		61.5		54.3			

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON. Climate Technologies

Copeland®

1.4dMT60-04-1308-PFV
Printed 04/24/2006 04-1308

15.5 ZB38KCE 3-Phase, 230V Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB38KCE-TF5
HFC-507
COPELAND SCROLL™
TF5 200/230-3-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10 (26)	0 (35)	10 (46)	20 (59)	30 (73)	40 (90)	45 (99)					
(413)	C			23600	29300	35900	43600	47900					
	P			7000	7000	7000	6950	6950					
	A			20.6	20.6	20.6	20.6	20.5					
	M			645	815	1020	1270	1410					
	E			3.4	4.2	5.1	6.3	6.9					
	%			52.4	57.8	62.8	67	68.7					
130	C		21900	27400	33800	41200	49800	54500					
(364)	P		6150	6200	6200	6200	6150	6150					
	A		18.5	18.6	18.6	18.6	18.6	18.5					
	M		515	655	820	1020	1270	1410					
	E		3.5	4.4	5.5	6.7	8.1	8.9					
	%		50.8	56.4	61.4	65.9	69.4	70.7					
120	C	19600	24800	31000	38100	46300	56000	61000					
(320)	P	5450	5450	5450	5450	5450	5450	5450					
	A	16.7	16.8	16.8	16.9	16.9	16.9	16.8					
	M	412	530	665	830	1030	1270	1410					
	E	3.6	4.6	5.7	7	8.5	10.2	11.2					
	%	49.3	55.3	60.4	64.9	68.6	71.2	72					
110	C	21900	27600	34300	42200	51000	61500	67500					
(279)	P	4780	4810	4830	4840	4840	4820	4810					
	A	15.2	15.3	15.4	15.4	15.4	15.4	15.3					
	M	425	540	675	840	1040	1280	1420					
	E	4.6	5.7	7.1	8.7	10.6	12.8	14					
	%	54.1	59.8	64.4	68.2	71	72.4	72.4					
100	C	24000	30300	37600	46100	56000	67500	73500					
(243)	P	4220	4240	4260	4280	4280	4260	4250					
	A	14	14	14.1	14.1	14.1	14.1	14.1					
	M	434	550	690	850	1050	1290	1430					
	E	5.7	7.1	8.8	10.8	13.1	15.8	17.3					
	%	58.5	63.9	68	70.8	72.4	72.2	71.3					
90	C	26100	32800	40700	49900	60500	73000	79500					
(210)	P	3710	3740	3770	3780	3780	3760	3740					
	A	12.9	13	13	13.1	13.1	13.1	13					
	M	441	560	700	865	1060	1300	1440					
	E	7	8.8	10.8	13.2	16	19.4	21.3					
	%	62.4	67.4	70.7	72.4	72.4	70.2	68.1					
80	C	28000	35200	43700	53500	65000	78500	85500					
(180)	P	3270	3300	3330	3340	3340	3320	3300					
	A	12	12.1	12.1	12.2	12.2	12.2	12.2					
	M	443	565	705	870	1070	1310	1450					
	E	8.5	10.6	13.1	16.1	19.5	23.6	25.9					
	%	65.1	69.7	72.1	72.3	70.3	65.5	61.8					
70	C	29800	37500	46600	57000	69500							
(154)	P	2890	2920	2940	2950	2940							
	A	11.3	11.3	11.4	11.5	11.5							
	M	440	565	710	880	1080							
	E	10.3	12.9	15.9	19.4	23.6							
	%	66.3	70.4	71.6	70.1	65.5							

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON Climate Technologies

Copeland®

1.4dMT60-04-1317-TF5
Printed 04/24/2006 04-1317

15.6 ZB38KCE 3-Phase, 460V Compressor Data Chart

RATING CONDITIONS
65 °F Return Gas
0 °F Subcooling
95 °F Ambient Air Over

60 Hz Operation

MEDIUM TEMPERATURE

HFCs Require Use of Polyol Ester Lubricant Approved by Copeland Corp. Bulletin AE-1248

ZB38KCE-TFD
HFC-507
COPELAND SCROLL™
TFD 460-3-60

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		Evaporating Temperature °F (Sat Dew Pt Pressure, psig)											
140		-10	(26)	0	(35)	10	(46)	20	(59)	30	(73)	40	(90)	45	(99)
(413)	C						23600		29300		35900		43600		47900
	P						7000		7000		7000		6950		6950
	A						10.3		10.3		10.3		10.3		10.3
	M						645		815		1020		1270		1410
	E						3.4		4.2		5.1		6.3		6.9
	%						52.4		57.8		62.8		67		68.7
130	C				21900		27400		33800		41200		49800		54500
(364)	P				6150		6200		6200		6200		6150		6150
	A				9.3		9.3		9.3		9.3		9.3		9.3
	M				515		655		820		1020		1270		1410
	E				3.5		4.4		5.5		6.7		8.1		8.9
	%				50.8		56.4		61.4		65.9		69.4		70.7
120	C		19600		24800		31000		38100		46300		56000		61000
(320)	P		5450		5450		5450		5450		5450		5450		5450
	A		8.4		8.4		8.4		8.4		8.4		8.4		8.4
	M		412		530		665		830		1030		1270		1410
	E		3.6		4.6		5.7		7		8.5		10.2		11.2
	%		49.3		55.3		60.4		64.9		68.6		71.2		72
110	C		21900		27600		34300		42200		51000		61500		67500
(279)	P		4780		4810		4830		4840		4840		4820		4810
	A		7.6		7.6		7.7		7.7		7.7		7.7		7.7
	M		425		540		675		840		1040		1280		1420
	E		4.6		5.7		7.1		8.7		10.6		12.8		14
	%		54.1		59.8		64.4		68.2		71		72.4		72.4
100	C		24000		30300		37600		46100		56000		67500		73500
(243)	P		4220		4240		4260		4280		4280		4260		4250
	A		7		7		7		7.1		7.1		7.1		7
	M		434		550		690		850		1050		1290		1430
	E		5.7		7.1		8.8		10.8		13.1		15.8		17.3
	%		58.5		63.9		68		70.8		72.4		72.2		71.3
90	C		26100		32800		40700		49900		60500		73000		79500
(210)	P		3710		3740		3770		3780		3780		3760		3740
	A		6.4		6.5		6.5		6.5		6.5		6.5		6.5
	M		441		560		700		865		1060		1300		1440
	E		7		8.8		10.8		13.2		16		19.4		21.3
	%		62.4		67.4		70.7		72.4		72.4		70.2		68.1
80	C		28000		35200		43700		53500		65000		78500		85500
(180)	P		3270		3300		3330		3340		3340		3320		3300
	A		6		6		6.1		6.1		6.1		6.1		6.1
	M		443		565		705		870		1070		1310		1450
	E		8.5		10.6		13.1		16.1		19.5		23.6		25.9
	%		65.1		69.7		72.1		72.3		70.3		65.5		61.8
70	C		29800		37500		46600		57000		69500				
(154)	P		2890		2920		2940		2950		2940				
	A		5.6		5.7		5.7		5.7		5.7				
	M		440		565		710		880		1080				
	E		10.3		12.9		15.9		19.4		23.6				
	%		66.3		70.4		71.6		70.1		65.5				

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice.
C:Capacity(Btu/hr), P:Power(Watts), A:Current(Amps), M:Mass Flow(lbs/hr), E:EER(Btu/Watt-hr), %:Isentropic Efficiency(%)

EMERSON. Climate Technologies

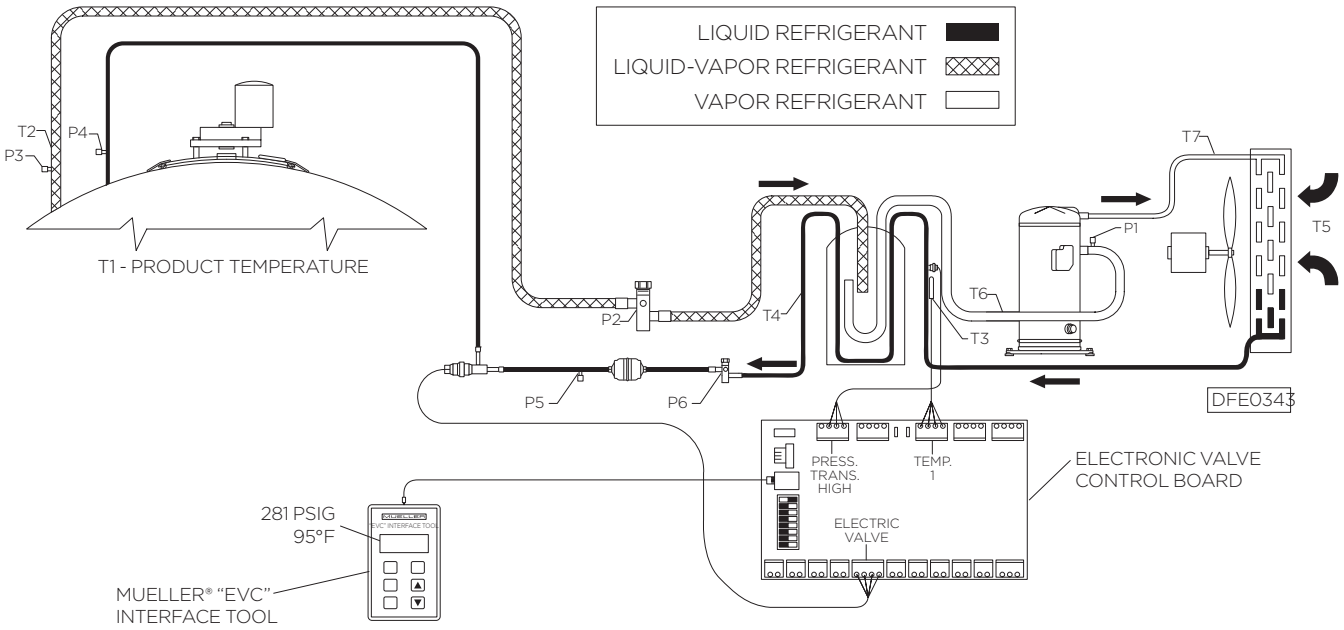
Copeland®

1.4dMT60-04-1317-TFD
Printed 04/24/2006 **04-1317**

15.7 R-507 Pressure/Temperature Chart

psig	°C	°F	psig	°C	°F	psig	°C	°F	psig	°C	°F	psig	°C	°F	psig	°C	°F	psig	°C	°F
0	-46.73	-52.11	71	-1.93	28.52	142	18.50	65.29	213	32.72	90.89	284	43.84	110.90	355	52.95	127.30	426	60.73	141.30
1	-45.37	-49.66	72	-1.57	29.17	143	18.72	65.70	214	32.89	91.20	285	43.95	111.10	356	53.06	127.50	427	60.84	141.50
2	-44.08	-47.34	73	-1.21	29.82	144	18.96	66.12	215	33.06	91.51	286	44.11	111.40	357	53.17	127.70	428	60.95	141.70
3	-42.85	-45.12	74	-0.85	30.47	145	19.18	66.53	216	33.24	91.82	287	44.23	111.60	358	53.28	127.90	429	61.06	141.90
4	-41.67	-43.00	75	-0.49	31.11	146	19.41	66.94	217	33.41	92.13	288	44.39	111.90	359	53.45	128.20	430	61.17	142.10
5	-40.54	-40.96	76	-0.14	31.74	147	19.64	67.35	218	33.58	92.44	289	44.50	112.10	360	53.56	128.40	431	61.28	142.30
6	-39.45	-39.00	77	0.21	32.37	148	19.87	67.76	219	33.75	92.75	290	44.67	112.40	361	53.67	128.60	432	61.34	142.40
7	-38.40	-37.11	78	0.55	32.99	149	20.10	68.17	220	33.92	93.06	291	44.78	112.60	362	53.78	128.80	433	61.45	142.60
8	-37.39	-35.29	79	0.89	33.61	150	20.32	68.57	221	34.09	93.36	292	44.95	112.90	363	53.89	129.00	434	61.56	142.80
9	-36.41	-33.53	80	1.23	34.22	151	20.54	68.97	222	34.26	93.67	293	45.06	113.10	364	54.00	129.20	435	61.67	143.00
10	-35.46	-31.82	81	1.57	34.83	152	20.76	69.37	223	34.43	93.97	294	45.23	113.40	365	54.12	129.40	436	61.78	143.20
11	-34.54	-30.17	82	1.91	35.44	153	20.99	69.77	224	34.60	94.28	295	45.34	113.60	366	54.23	129.60	437	61.84	143.30
12	-33.65	-28.56	83	2.24	36.04	154	21.21	70.17	225	34.77	94.58	296	45.45	113.80	367	54.34	129.80	438	61.95	143.50
13	-32.78	-27.00	84	2.57	36.63	155	21.42	70.56	226	34.94	94.88	297	45.61	114.10	368	54.45	130.00	439	62.06	143.70
14	-31.94	-25.48	85	2.90	37.22	156	21.64	70.95	227	35.10	95.18	298	45.73	114.30	369	54.56	130.20	440	62.17	143.90
15	-31.11	-24.00	86	3.23	37.81	157	21.86	71.34	228	35.27	95.48	299	45.89	114.60	370	54.73	130.50	441	62.28	144.10
16	-30.31	-22.56	87	3.55	38.39	158	22.07	71.73	229	35.44	95.78	300	46.00	114.80	371	54.84	130.70	442	62.34	144.20
17	-29.53	-21.15	88	3.87	38.97	159	22.29	72.12	230	35.60	96.07	301	46.17	115.10	372	54.95	130.90	443	62.45	144.40
18	-28.77	-19.78	89	4.19	39.54	160	22.51	72.51	231	35.76	96.37	302	46.28	115.30	373	55.06	131.10	444	62.56	144.60
19	-28.02	-18.44	90	4.51	40.11	161	22.72	72.89	232	35.93	96.67	303	46.39	115.50	374	55.17	131.30	445	62.67	144.80
20	-27.30	-17.13	91	4.82	40.67	162	22.93	73.27	233	36.09	96.96	304	46.56	115.80	375	55.28	131.50	446	62.78	145.00
21	-26.58	-15.84	92	5.13	41.24	163	23.15	73.66	234	36.25	97.25	305	46.67	116.00	376	55.39	131.70	447	62.84	145.10
22	-25.89	-14.59	93	5.44	41.79	164	23.35	74.03	235	36.42	97.55	306	46.84	116.30	377	55.50	131.90	448	62.95	145.30
23	-25.20	-13.36	94	5.75	42.35	165	23.56	74.41	236	36.58	97.84	307	46.95	116.50	378	55.62	132.10	449	63.06	145.50
24	-24.53	-12.15	95	6.06	42.90	166	23.77	74.79	237	36.74	98.13	308	47.06	116.70	379	55.73	132.30	450	63.17	145.70
25	-23.87	-10.97	96	6.36	43.44	167	23.98	75.16	238	36.90	98.42	309	47.23	117.00	380	55.84	132.50	451	63.23	145.80
26	-23.22	-9.80	97	6.66	43.98	168	24.19	75.54	239	37.06	98.71	310	47.34	117.20	381	55.95	132.70	452	63.34	146.00
27	-22.59	-8.66	98	6.96	44.52	169	24.40	75.91	240	37.22	98.99	311	47.50	117.50	382	56.06	132.90	453	63.45	146.20
28	-21.97	-7.55	99	7.26	45.06	170	24.60	76.28	241	37.38	99.28	312	47.61	117.70	383	56.17	133.10	454	63.56	146.40
29	-21.36	-6.45	100	7.55	45.59	171	24.81	76.65	242	37.54	99.57	313	47.73	117.90	384	56.28	133.30	455	63.62	146.50
30	-20.76	-5.37	101	7.85	46.12	172	25.01	77.01	243	37.70	99.85	314	47.89	118.20	385	56.39	133.50	456	63.73	146.70
31	-20.17	-4.30	102	8.13	46.64	173	25.21	77.38	244	37.84	100.10	315	48.00	118.40	386	56.50	133.70	457	63.84	146.90
32	-19.59	-3.26	103	8.42	47.16	174	25.41	77.74	245	38.00	100.40	316	48.11	118.60	387	56.62	133.90	458	63.95	147.10
33	-19.02	-2.23	104	8.71	47.68	175	25.61	78.10	246	38.17	100.70	317	48.28	118.90	388	56.73	134.10	459	64.01	147.20
34	-18.45	-1.21	105	9.00	48.19	176	25.81	78.46	247	38.34	101.00	318	48.39	119.10	389	56.84	134.30	460	64.12	147.40
35	-17.90	-0.22	106	9.28	48.70	177	26.01	78.82	248	38.50	101.30	319	48.50	119.30	390	56.95	134.50	461	64.23	147.60
36	-17.35	0.77	107	9.56	49.21	178	26.21	79.18	249	38.61	101.50	320	48.67	119.60	391	57.06	134.70	462	64.28	147.70
37	-16.81	1.74	108	9.85	49.72	179	26.41	79.54	250	38.78	101.80	321	48.78	119.80	392	57.17	134.90	463	64.39	147.90
38	-16.28	2.69	109	10.12	50.22	180	26.61	79.89	251	38.95	102.10	322	48.89	120.00	393	57.28	135.10	464	64.51	148.10
39	-15.76	3.63	110	10.40	50.72	181	26.81	80.25	252	39.11	102.40	323	49.00	120.20	394	57.39	135.30	465	64.62	148.30
40	-15.25	4.56	111	10.67	51.21	182	27.00	80.60	253	39.28	102.70	324	49.17	120.50	395	57.50	135.50	466	64.67	148.40
41	-14.74	5.47	112	10.95	51.71	183	27.20	80.95	254	39.39	102.90	325	49.28	120.70	396	57.62	135.70	467	64.78	148.60
42	-14.23	6.38	113	11.22	52.20	184	27.39	81.30	255	39.56	103.20	326	49.39	120.90	397	57.73	135.90	468	64.89	148.80
43	-13.74	7.27	114	11.49	52.68	185	27.59	81.65	256	39.73	103.50	327	49.56	121.20	398	57.84	136.10	469	64.95	148.90
44	-13.25	8.15	115	11.76	53.17	186	27.77	81.99	257	39.89	103.80	328	49.67	121.40	399	57.89	136.20	470	65.06	149.10
45	-12.77	9.02	116	12.03	53.65	187	27.97	82.34	258	40.00	104.00	329	49.78	121.60	400	58.00	136.40	471	65.17	149.30
46	-12.30	9.87	117	12.30	54.13	188	28.16	82.68	259	40.17	104.30	330	49.89	121.80	401	58.12	136.60	472	65.23	149.40
47	-11.82	10.72	118	12.56	54.60	189	28.35	83.03	260	40.34	104.60	331	50.06	122.10	402	58.23	136.80	473	65.34	149.60
48	-11.36	11.56	119	12.82	55.08	190	28.54	83.37	261	40.45	104.80	332	50.17	122.30	403	58.34	137.00	474	65.45	149.80
49	-10.90	12.38	120	13.08	55.55	191	28.73	83.71	262	40.61	105.10	333	50.28	122.50	404	58.45	137.20	475	65.56	150.00
50	-10.45	13.20	121	13.34	56.01	192	28.92	84.05	263	40.78	105.40	334	50.39	122.70	405	58.56	137.40	476	65.62	150.10
51	-10.00	14.01	122	13.60	56.48	193	29.10	84.38	264	40.89	105.60	335	50.56	123.00	406	58.67	137.60	477	65.73	150.30
52	-9.55	14.81	123	13.86	56.94	194	29.29	84.72	265	41.06	105.90	336	50.67	123.20	407	58.78	137.80	478	65.84	150.50
53	-9.11	15.60	124	14.11	57.40	195	29.48	85.06	266	41.23	106.20	337	50.78	123.40	408	58.89	138.00	479	65.89	150.60
54	-8.68	16.38	125	14.37	57.86	196	29.66	85.39	267	41.34	106.40	338	50.89	123.60	409	59.00	138.20	480	66.01	150.80
55	-8.25	17.15	126	14.62	58.32	197	29.85	85.72	268	41.50	106.70	339	51.00	123.80	410	59.12	138.40	481	66.12	151.00
56	-7.82	17.92	127	14.87	58.77	198	30.03	86.05	269	41.67	107.00	340	51.17	124.10	411	59.17	138.50	482	66.17	151.10
57	-7.41	18.67	128	15.12	59.22	199	30.21	86.38	270	41.78	107.20	341	51.28	124.30	412	59.28	138.70	483	66.28	151.30
58	-6.99	19.42	129	15.37	59.67	200	30.40	86.71	271	41.95	107.50	342	51.39	124.50	413	59.39	138.90	484	66.39	151.50
59	-6.58	20.16	130	15.62	60.11	201	30.58	87.04	272	42.11	107.80	343	51.50	124.70	414	59.50	139.10	485	66.45	151.60
60	-6.17	20.90	131	15.87	60.56	202	30.76	87.37	273	42.23	108.00	344	51.62	124.90	415	59.62	139.30	486	66.56	151.80
61	-5.77	21.62	132	16.11	61.00	203	30.94	87.69	274	42.39	108.30	345	51.78	125.20	416	59.73	139.50	487	66.67	152.00
62	-5.37	22.34	133	16.36	61.44	204	31.12	88.02	275	42.50	108.50	346	51.89	125.40	417	59.84	139.70	488	66.73	152.10
63	-4.97	23.05	134	16.60	61.87	205	31.30	88.34	276	42.67	108.80	347	52.00	125.60	418	59.95	139.90	489	66.84	152.30
64	-4.58	23.76	135	16.84	62.31	206	31.48	88.66	277	42.84	109.10	348	52.12	125.80	419	60.00	140.00	490	66.89	152.40
65	-4.19	24.46	136	17.08	62.74	207	31.66	88.99	278	42.95	109.30	349	52.23	126.00	420	60.12	140.20	491	67.01	152.60
66	-3.81	25.15	137	17.32	63.17	208	31.84	89.31	279	43.11	109.60	350	52.34	126.20	421	60.23	140.40	492	67.12	152.80
67	-3.43	25.83	138	17.56	63.60	209	32.01	89.62	280	43.23	109.80	351	52.50	126.50	422	60.34	140.60	493	67.17	152.90
68	-3.05	26.51	139	17.79	64.02	210	32.19	89.94	281	43.39	110.10	352	52.62	126.70	423	60.45	140.80	494	67.28	153.10
69	-2.67	27.19	140	18.02	64.44	211	32.37	90.26	282	43.50	110.30	353	52.73	126.90	424	60.56	141.00	495	67.39	153.30
70	-2.31	27.85	141	18.26	64.87	212	32.54	90.57	283	43.67	110.60	354	52.84	127.10	425	60.67	141.20	496	67.45	153.40

"OHSE" INSTALLATION SURVEY



Pressure Readings
P1 - Suction Pressure at Compressor Inlet
P2 - Suction Pressure at Accumulator Inlet
P3 - Suction Pressure at Evaporator Outlet
P4 - Pressure at Evaporator Inlet
P5 - Pressure at Subcooling Valve Inlet
P6 - Pressure at Liquid-Line Service Valve

Temperature Readings
T1 - Milk Temperature
T2 - Suction Line Temperature at Evaporator Outlet
T3 - Line Temperature at Subcooling Valve Bulb
T4 - Line Temperature at Accumulator Outlet
T5 - Ambient Temperature Entering Condenser
T6 - Suction Line Temperature Entering Compressor
T7 - Compressor Discharge Temperature

Survey Data to be Supplied by Technician
Provide the actual time below. Readings should be taken at 5-minute intervals.

														Compressor Amperage		
Time*	P1	P2	P3	P4	P5	P6	T1	T2	T3	T4	T5	T6	T7	L1	L2	L3
Measured Supply Voltage:					"OHSE" Model and Part No.:						Serial No.:					