E-Star® HiPerForm® Refrigeration Unit

Model "OHSE" 7.5 and 9 HP with Electronic Valve Control

INSTALLATION AND OPERATION MANUAL

Part No. 8828046

Effective July 12, 2017

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Section 1.0 – Introduction

1.1 GENERAL SPECIFICATIONS

Mueller® E-Star® HiPerForm® "OHSE" refrigeration units are 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 designed for commercial refrigeration service rather than air conditioning provides improved performance over the entire milk cooling temperature range. An oil sight glass, oil fill/drain port, and screw electrical terminals are added bonuses that ensure long-term reliability and serviceability.

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

3. An accumulator heat exchanger with a custom subcooling coil maximizes refrigeration capacity while protecting the compressor from liquid refrigerant.

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

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

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

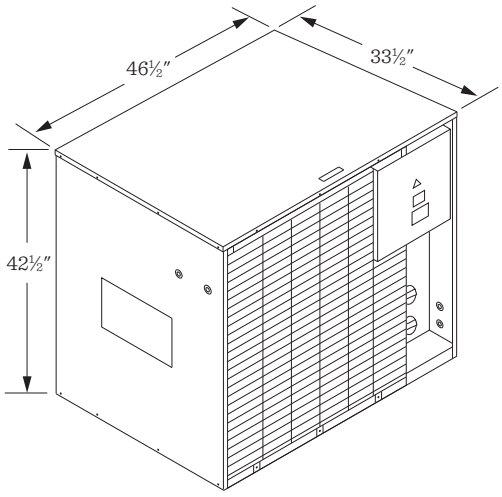
7. A three-piece galvanized steel cover with attached steel grill provides safe operation plus easy service access.

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

TABLE 1: DIMENSIONS AND WEIGHT

	7.5 and 9 HP	
Length	118.11 cm	46½ in
Width	85.09 cm	33½ in
Height	107.95 cm	42½ in
Approx. Weight	204 kg	450 lb

FIGURE 1: DIMENSIONS AND WEIGHT



1.2 TECHNICAL SUPPORT

This manual provides the basic installation and operating information for Mueller E-Star HiPerForm "OHSE" refrigeration units.

Please contact your local Paul Mueller Company 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)
Fax: 1-800-436-2466 · Email: dairyfarm@paulmueller.com

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 Environmental Protection Agency (EPA) regulations require any technician performing refrigerant installation or service on a high-pressure appliance to 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 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, there must be a minimum of 24 inches (61 cm) distance from the wall with non-restricted air flow at the top, left, and right sides. Be especially cautious of installation methods that would allow the condenser air flow to recirculate and conditions that would allow dust or oil to enter the condenser.
- **Serviceability:** The unit 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 unit 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 unit 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.

NOTE: See Tables 2–5 for connection and pipe sizes.

The Mueller E-Star HiPerForm "OHSE" refrigeration unit 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.

TABLE 2: R-507 LIQUID LINE SIZING

Compressor Horsepower	Equivalent Length of Pipe (Feet)		
	< 30′	30′ – 50′	50′ – 100′
3.5	½	½	½
5	½	½	⅝
7.5	⅝	⅝	⅝
9	⅝	⅝	⅞
10	⅝	⅝	⅞

Paul Mueller Company recommends the shortest pipe run possible.

TABLE 3: R-507 SUCTION LINE SIZING

Compressor Horsepower	Equivalent Length of Pipe (Feet)		
	< 30′	30′ – 50′	50′ – 100′
3.5	⅞	1⅛	1⅛
5	1⅛	1⅛	1⅜
7.5	1⅛	1⅜	1⅝
9	1⅜	1⅝	2⅛
10	1⅜	1⅝	2⅛

Paul Mueller Company recommends the shortest pipe run possible.

TABLE 4: R-507 DISCHARGE LINE SIZING

Compressor Horsepower	Equivalent Length of Pipe (Feet)
	0′ – 50′
3.5	⅞
5	⅞
7.5	1⅛
9	1⅛
10	1⅛

Paul Mueller Company recommends the shortest pipe run possible.

TABLE 5: CONDENSING UNIT CONNECTION SIZES

Compressor Horsepower	Liquid Line	Suction Line	Discharge Line (Fre-Heater®)
3.5	½	⅞	½
5	⅝	⅞	½
7.5	⅝	1⅝	1⅛
9	⅝	1⅝	1⅛
10	⅝	1⅝	1⅛

2.5 ELECTRICAL CONNECTIONS

Prior to installation, verify equipment is compatible with site electrical requirements (i.e., voltage, phase, hertz, etc.). Ensure that all electrical connections are secure and correspond with wiring schematics.

Following local and National Electrical Code (NEC) 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 8.0 for connection details.

CAUTION: 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 COMPRESSOR ROTOLOCK TORQUE SPECIFICATIONS

During shipment, threaded fittings under tension may stretch and relax. Copeland Corporation recommends inspecting and retorqueing the Rotolock fittings on compressors.

After installation and the compressor has been operating, the Rotolock fittings also need to be checked. This is due to changes in temperature that could also reduce the torque from original setting. Listed below are the torque specifications:

Discharge Rotolock	1¼ Nut	960–1200 inch pounds or 80–100 foot pounds
Suction Rotolock	1¾ Nut	1140–1680 inch pounds or 95–140 foot pounds

2.7 OIL SIGHT GLASS TORQUE SPECIFICATIONS

The sight glass on scroll compressor could also be susceptible to leaking due to shipment or change in temperatures during operation. However, this fitting has a thread sealer that can crack after cured if re-torque is attempted.

The sight glass should be checked for leaks, if it is not leaking do not attempt to re-torque. If the sight glass is leaking, the refrigerant must be recovered and the oil removed below the sight glass utilizing the oil fill/drain port. Remove the sight glass and clean the threads; apply Loctite anaerobic PST No. 12928/12929 Teflon sealer. Apply sealer sparingly to threads only; ***do not*** apply to end surface. Reinstall sight glass and torque to these specifications:

Oil Sight Glass Torque	380–420 inch pounds or 31–35 foot pounds

Add new refrigerant oil through fill/drain port to the same level as before sight glass removal.

Section 3.0 – Refrigerant Charging

3.1 EPA REFRIGERANT REGULATIONS[1]

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

IMPORTANT: The use of R-404a refrigerant is not recommended in the Mueller E-Star HiPerForm "OHSE" refrigeration unit. 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 "OHSE."

[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

Refer to Table 6 for the recommended refrigerant charge for Mueller E-Star HiPerForm "OHSE" refrigeration units installed with a Mueller milk cooler evaporator.

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

TABLE 6: RECOMMENDED START-UP REFRIGERANT CHARGE

Recommended Start-Up Charge (Refrigerant R-507)		
Unit Size	**Milk Cooler**	**Chiller**
7.5 HP	25 lbs / 11.3 kg	23 lbs / 10.4 kg
9 HP	25 lbs / 11.3 kg	23 lbs / 10.4 kg

3.3 REFRIGERANT CHARGING

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

Due to the unique operating characteristics of the E-Star HiPerForm "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. Section 3.4 outlines this procedure.

IMPORTANT: The compressor is equipped with Rotolock suction and discharge service valves. At no time during operation should these valves be closed. They are intended for ease of compressor charge-out only.

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 charging ports P2 (charging port located near liquid service valve) and P6.

2. Connect the center manifold hose to a cylinder of new or reclaimed ARI 700-88 specifications refrigerant.

3.4 WEIGH-IN REFRIGERANT CHARGING (CONTINUED)

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.

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 charging 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 3, "Refrigerant Piping Schematic," which displays the access-port connections described below.

1. Connect the manifold suction gauge to access port P2 (charging port located near liquid service valve) 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 10 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 5 psig, reopen the recovery cylinder's liquid valve and repeat the procedure, starting at Step 9.

3.5 CHECKING REFRIGERANT CHARGE, WEIGH-OUT METHOD (CONTINUED)

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

    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 that has had a compressor failure, the refrigerant should be tested for acid to ensure 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 may 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 "OHSE" refrigeration unit utilizes electronic valve control (EVC) with an electric valve that controls the condenser liquid subcooling rather than the evaporator superheat. The EVC is factory set 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 (8.4–16.7°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 to a temperature of 32–39°F (17.8–21.7°C), passes through the 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

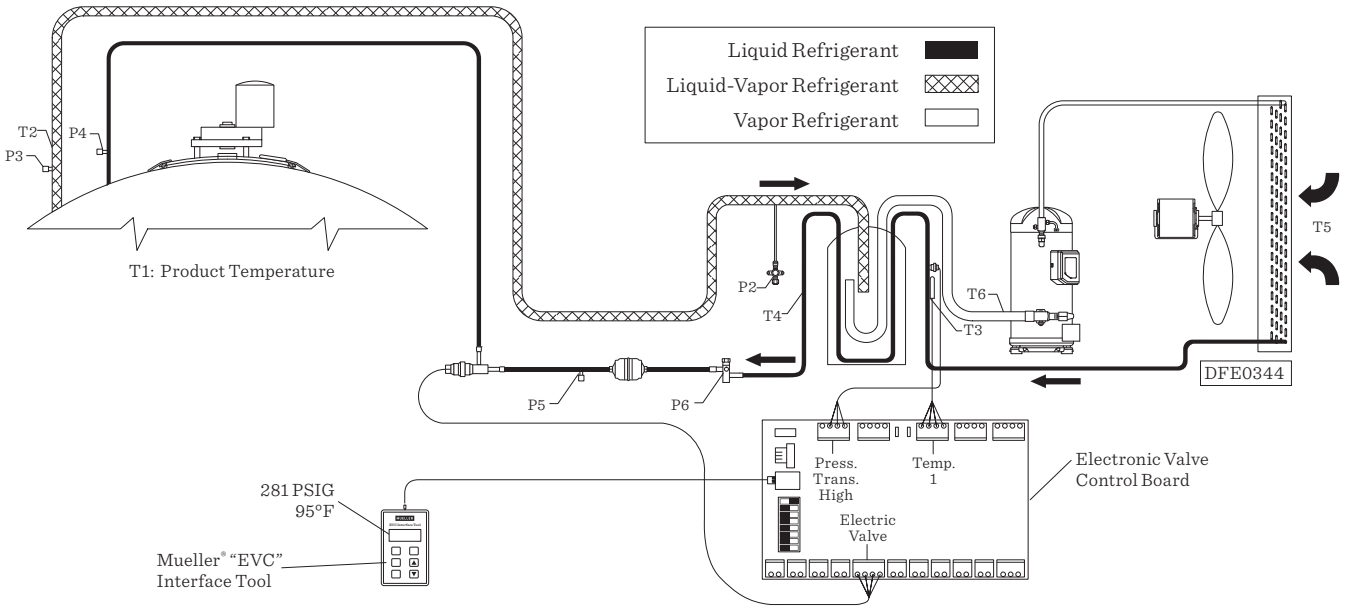
As a direct result of the flooded evaporator, the refrigerant returning from the evaporator is wet with liquid carry-over. This mixture carries oil in suspension much more readily than the dry, superheated suction refrigerant in a conventional refrigeration system. This refrigerant oil mixture drops 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 tube. Reference Section 6, "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 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):

- P5 is 281 psig.
- Convert P5 pressure to saturation temperature which is 110°F.
- Line temperature at T3 is 95°F.

Results:

- 110°F – 95°F = 15°F subcooling.
  43.3°C – 35°C = 8.3°C 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.

Section 5.0 – Subcooling

5.1 ELECTRONIC VALVE CONTROL WITH ELECTRIC SUBCOOLING VALVE

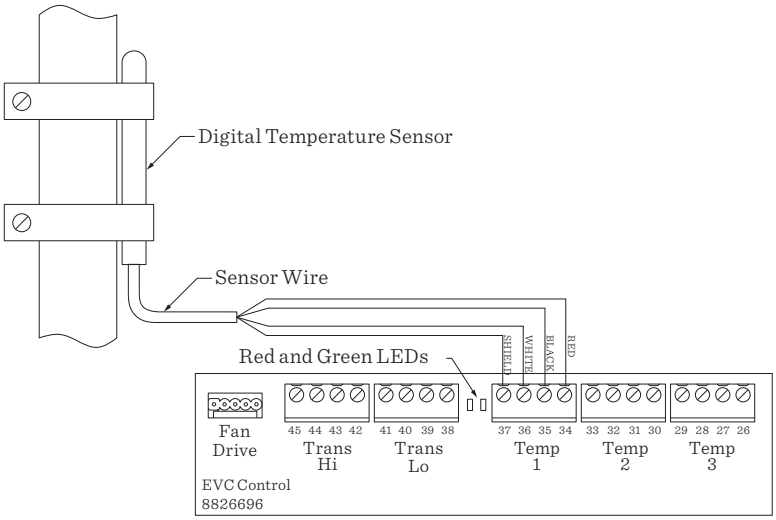
The Mueller EVC, Part No. 8826696, is factory set to maintain 15°F (8.3°C) of subcooling. The EVC board determines condenser subcooling using two inputs. The pressure transducer senses the liquid line pressure, and the digital temperature sensor senses the liquid line temperature. This data is sent to 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.

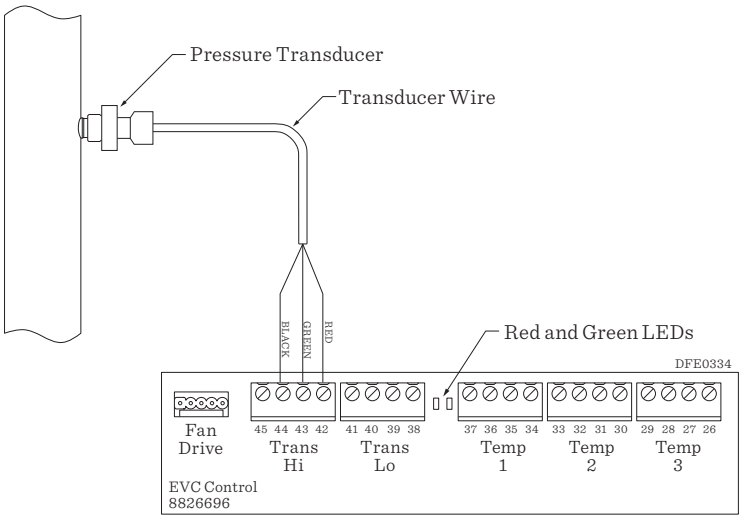
FIGURE 3: DIGITAL TEMPERATURE SENSOR



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 the EVC board. The EVC board converts that pressure reading into a temperature, and then calculates subcooling. See Figure 4, “Pressure Transducer.”

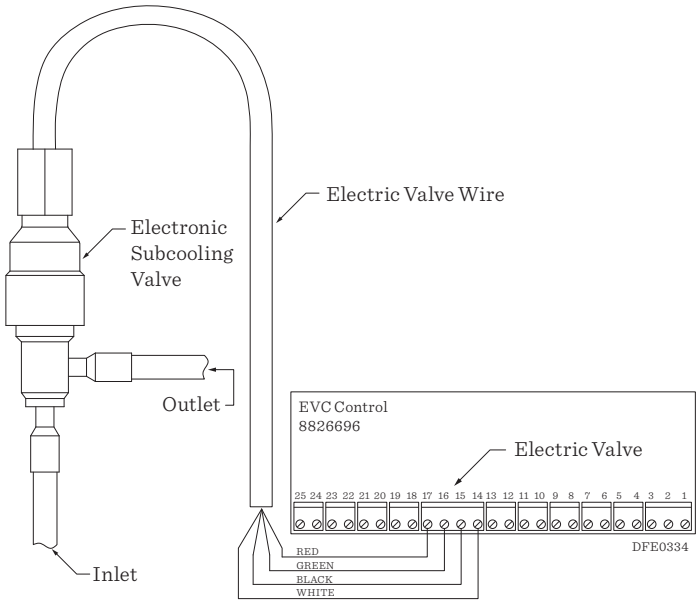
FIGURE 4: PRESSURE TRANSDUCER, 0–500 PSI



5.4 ELECTRIC 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. Once the temperature setpoint is reached, and the refrigeration system is de-energized, the valve will return to the factory programmed start-up position. This setting allows for system equalization during the off cycle.

FIGURE 5: ELECTRIC VALVE OPERATION



5.5 SYSTEM ERROR LIGHT CODES

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

TABLE 7: 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

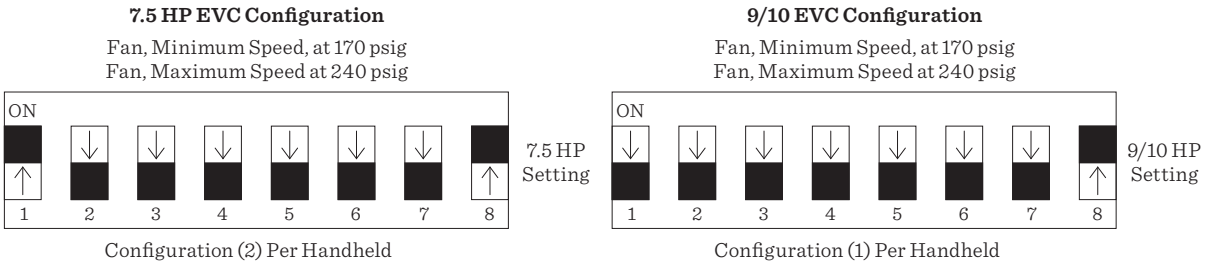
5.6 EVC BIT-SWITCH CONFIGURATION

Bit Switch 1–5: Determines the size of the compressor used on the system to be controlled, for both non-digital or digital compressors.

Bit Switch 8: Enables anti-short cycle protection. Bit switch 8 can be turned off when servicing and trouble-shooting, or if another means of cycle protection is present. The anti-short cycle control can be disabled by moving the switch toward the number 8 (downward). The anti-short cycle delay is factory set for 10 minutes.

NOTE: Always confirm that the board is properly configured for the application. All replacement boards are set for configuration 1. Power to the EVC board must be turned off when bit switch settings are changed. Once power is restored, the EVC board 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.

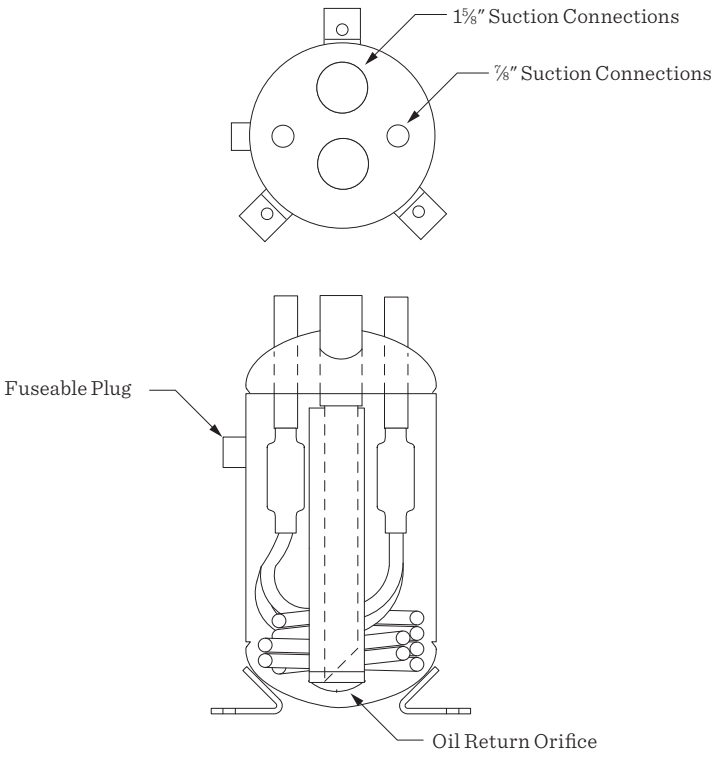
- **Additional Subcooling:** High-pressure liquid refrigerant from the condenser is subcooled to 20–25°F (6.5–19°C) as it passes through the heat exchanger coil in the bottom of the accumulator, which is submerged in cold liquid refrigerant that has returned from the flooded evaporator.

- **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 that utilizes 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 Paul Mueller Company replacement parts only.

FIGURE 7: ACCUMULATOR HEAT EXCHANGER



Section 7.0 – Electrical

7.1 "OHSE" REFRIGERATION UNIT ELECTRICAL WIRING

Authorized personnel in accordance with the National Electrical Code (NEC) and/or local and state codes must perform all wiring.

A fused disconnect must be provided of adequate size, voltage, and phase for the incoming power supply to the "OHSE" refrigeration unit.

Refer to Section 16 for refrigeration unit electrical requirements. Refer to Section 8 for wiring schematics.

7.2 CORESENSE DIAGNOSTICS™ MODULE FOR 7.5 AND 9 HP COMPRESSORS

A Copeland CoreSense module is installed in the electrical box of all 7.5 and 9 HP K5 Scroll compressors. The CoreSense module can accurately detect the cause of electrical and system related issues by monitoring and analyzing data from K5 compressors via module power, discharge line thermistor, and the current transducer (CT). A flashing LED indicator displays alert, fault, and trip conditions.

7.3 CORESENSE LED STATUS/MODULE DIAGNOSTICS

LED Color	Solid Light	Flashing Light
Green	Normal	Alerts
Yellow	Demand/No Current	Trip (Auto Reset)
Red	—	Lock Out (Manual Reset)

7.4 CORESENSE DIAGNOSTIC FAULT CODE DETAILS

The LEDs will flash a number of times consecutively, pause, and then repeat the process. To identify an alert code number, count the number of consecutive flashes. Specific alert code details are shown in Table 8 below.

TABLE 8: CORESENCE DIAGNOSTIC FAULT CODES

Fault Code	Color	Code Description	Protection Shutdown	Protection Off Time	Consecutive Detections Until Lockout
1	Red/Yellow	High Discharge Line Temperature	Yes	20 Min.	4
2	Yellow	Excessive Limit Trips	Yes	5 Min.	No Lockout
3	Green	Excessive Demand Cycling	NO	N/A	N/A
4	Red/Yellow	Locked Rotor	Yes	20 Min.	4
5	Green	Demand Present- No Current Present	No	N/A	N/A
6	Red/Yellow	Phase Loss Detected	Yes	20 Min.	10
7	Red	Reversed Phase Detected	Yes	Reset Required	1
8	Green	Welded Contactor	No[1]	—	—
9	Yellow	Low Module Voltage	Yes	5 Min.	No Lockout
10	Green	Module Communications Error	No	—	—
11	Green	Discharge Temperature Sensor Error	No	—	—
12	Green	Current Transducer Error	No	—	—

[1]Code 8 displays for 24 hours after last detection. With terminal D energized, the M1–M2 relay will open during a protection shutdown. To reset module, cycle module power.

7.5 CORESENSE PROTECTION MODULE CONNECTION WIRING

The CoreSense operates on constant power of 240 volts at terminals L1-L2. When a 120-volt run signal is applied to terminal D, and if there are no protective faults detected within the CoreSense, the M1-M2 control circuit contacts will close. The compressor will run with no external faults present. If the CoreSense detects a problem, the M1–M2 contacts will open, de-energizing the compressor.

7.6 CORESENSE PROTECTION MODULE VOLTAGE TROUBLESHOOTING

1. Verify that all wire connectors are maintaining a good mechanical connection. Replace any loose connectors.

2. Measure the voltage across L1-L2 to ensure proper supply voltage and demand voltage at terminal D are present.

3. Measure the control voltage (24 VAC) across the M1-M2 contacts:

    a. If the measured voltage is equal to the control voltage, then the M1-M2 contacts are open.

    b. If the measurement is less than one volt and the compressor is not running, then the problem is external to the motor protector module.

IMPORTANT: Do not run a Copeland Scroll compressor in a deep vacuum. Failure to heed this advice can result in arcing of the Fusite pins and permanent damage to the compressor.

IMPORTANT: Scroll compressors (as with any refrigerant compressor) should never be used to evacuate a refrigeration system.

The compressor leads must be routed through the holes in the current transducer (CT) module marked T1, T2, and T3. Only the compressor lead wires should be placed through the CT module.

Directional Dependence of Three-Phase Scroll Compressors: Scroll compressors are directionally dependent (i.e., Scroll compressors compress in one rotational direction only). The CoreSense module will provide reverse rotation protection.

7.7 CORESENSE PRODUCT SPECIFICATIONS

Operating Temperature:	–40° to 150°F (–40° to 65°C)
Storage Temperature:	–40° to 175°F (–40° to 80°C)
Power Supply Range:	85–265 VAC, 50–60 Hz
Working Amperage for CT Module:	3–200A

NOTE: The CoreSense module is not accurate below 3 amps. If the current drawn by the compressor during operation falls below 3 amps, the module may indicate a nuisance fault condition and alarm.

Maximum continuous contactor coil current is 2A with a maximum in rush current of 20A.

7.8 COPELAND SCROLL COMPRESSOR FUNCTIONAL CHECK

Copeland Scroll compressors do not have internal suction valves. It is not necessary to perform functional compressor tests to check how the compressor will pull suction pressure. This type of test may damage a Scroll compressor. The following diagnostic procedure should be used to evaluate whether a Copeland Scroll compressor is functioning properly.

1. Verify proper unit voltage.

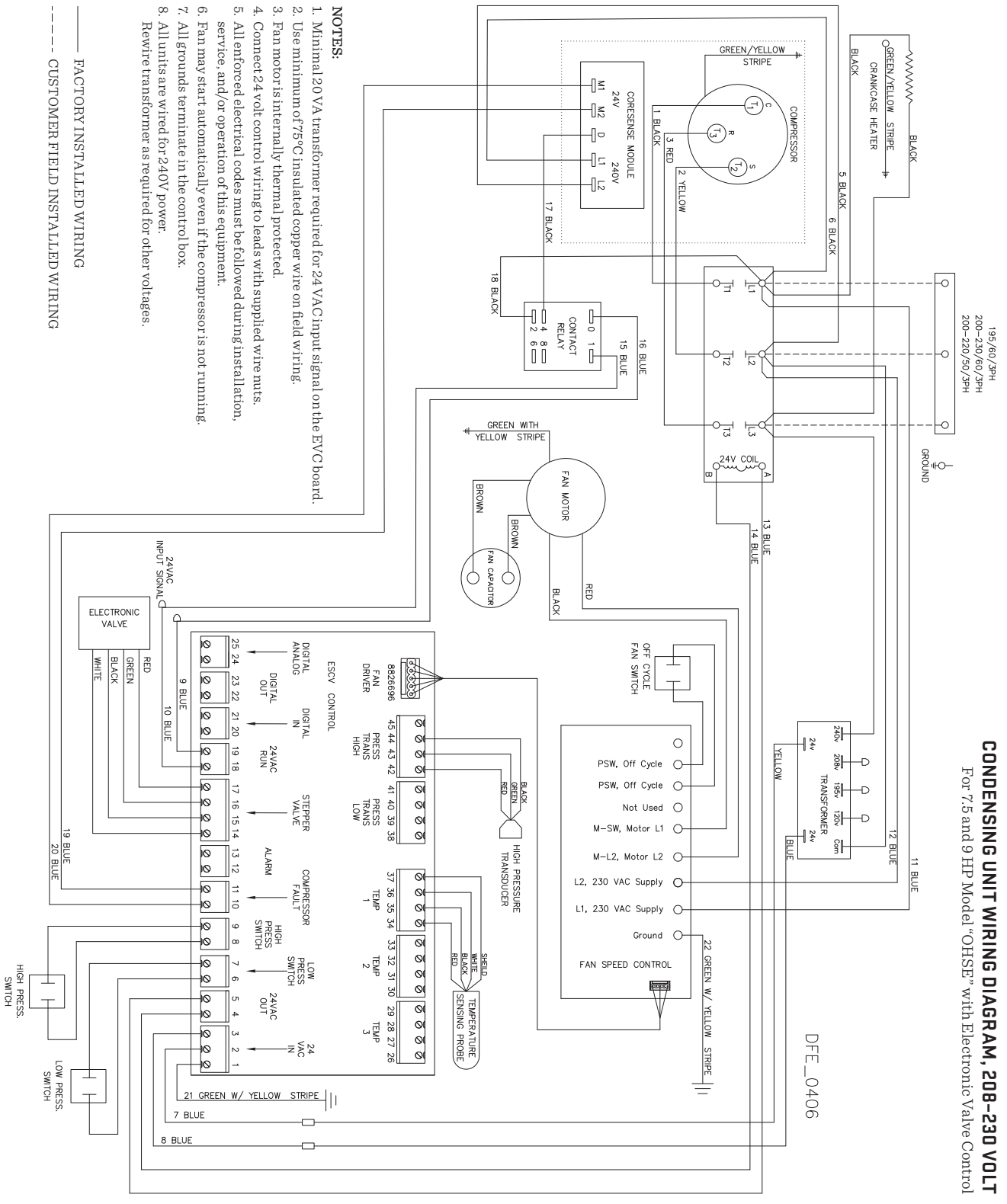
2. Normal motor winding continuity and short-to-ground checks can be used to determine proper motor resistance or if an internal short-to-ground has developed.

3. With service gauges connected to the suction and discharge pressure fittings, turn on the compressor. If suction pressure falls below normal levels, the system is either low on charge or there is a flow blockage.

The operational compressor current draw should be compared to published performance curves (see Section 16, Compressor Data Charts) at the operating conditions (pressures and voltages). Significant deviation (± 15%) from published values may indicate a faulty compressor.

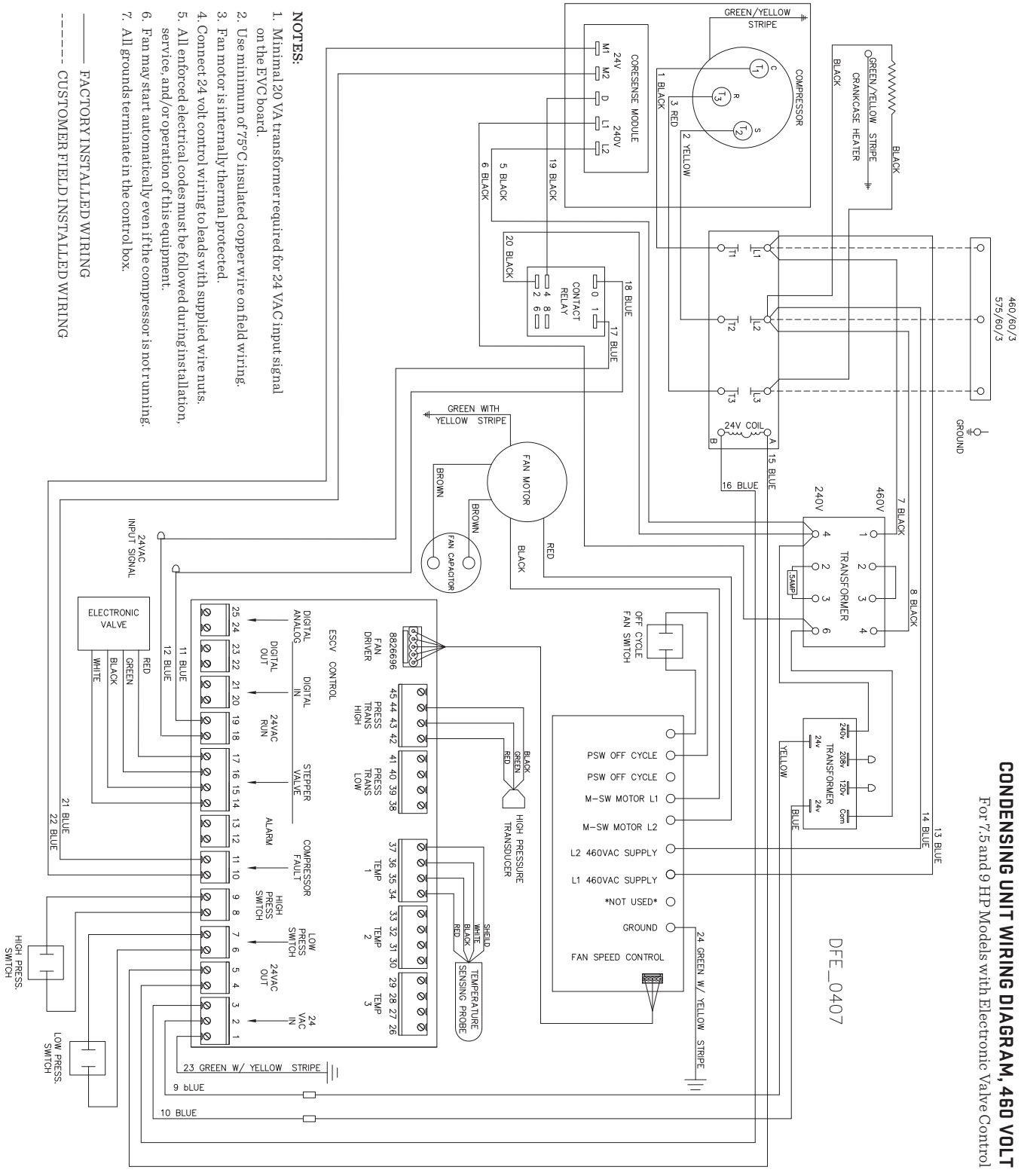
Section 8.0 – Electrical Schematics

8.1 "OHSE" 7.5 AND 9 HP, 208–230/60/3



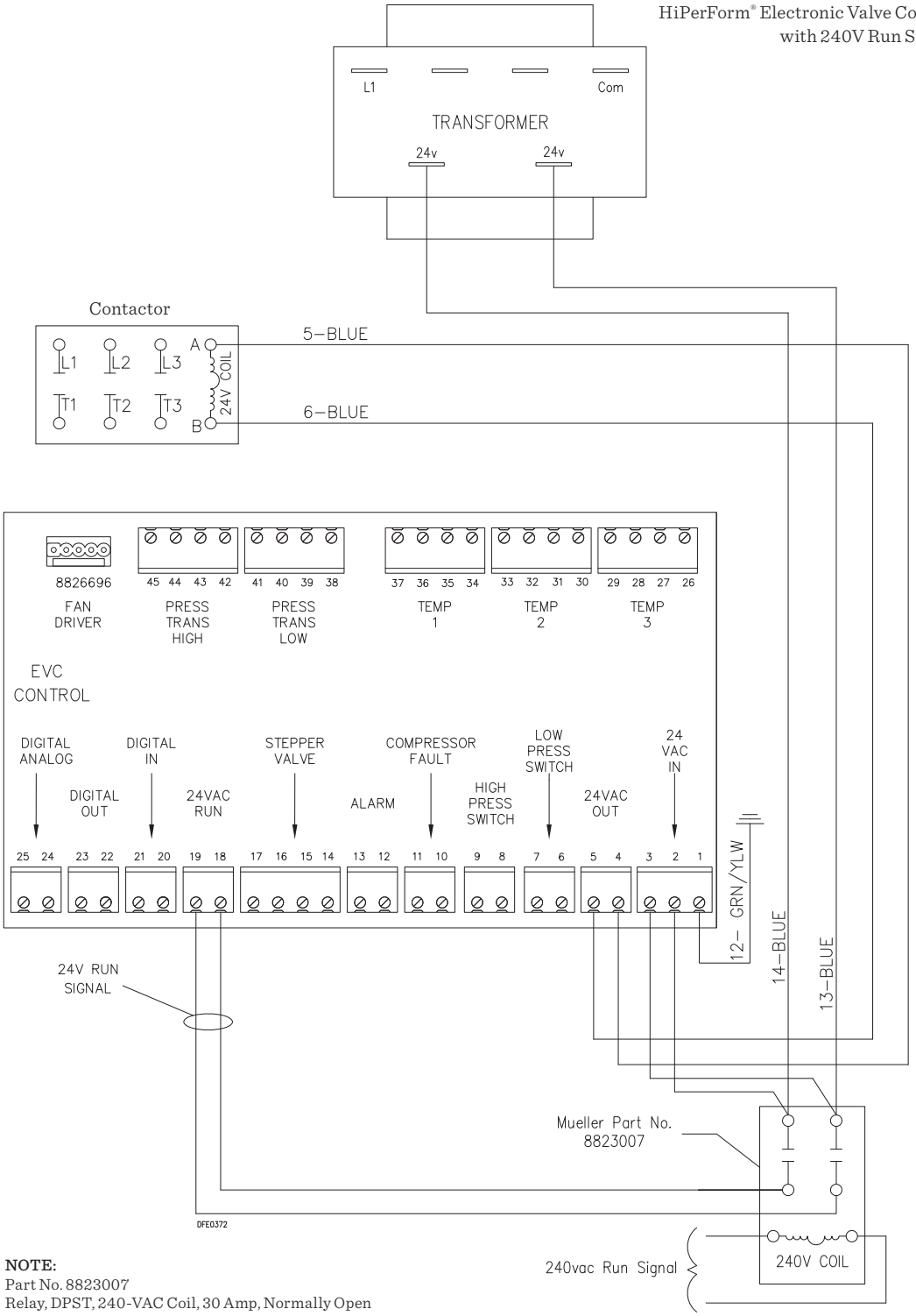
CONDENSING UNIT WIRING DIAGRAM, 208–230 VOLT
For 7.5 and 9 HP Model "OHSE" with Electronic Valve Control

8.2 "OHSE" 7.5 AND 9 HP, 460/50-60/3



CONDENSING UNIT WIRING DIAGRAM, 460 VOLT
For 7.5 and 9 HP Models with Electronic Valve Control

8.3 "OHSE" 7.5 AND 9 HP WITH 240 VOLT CONTROL



NOTE:
Part No. 8823007
Relay, DPST, 240-VAC Coil, 30 Amp, Normally Open

Section 9.0 – Pressure Switches and Fan Control

9.1 LOW-PRESSURE SWITCH WITH AUTO RESET

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

1. Attach an accurate low-pressure gauge to P2, access charging port.
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. When the suction pressure reaches approximately 30 psig, the pressure switch will reset and the compressor will energize.
6. The high/low pressure switch should be replaced if it does not operate as indicated above.

9.2 HIGH-PRESSURE SWITCH WITH AUTO RESET

The high-pressure switch should be tested during installation to ensure proper operation by completing these steps:

1. Attach an accurate high-pressure gauge to P6, the high-side service valve.
2. Disconnect the fan motor wires from the 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 (± 5 psig) on R-507 units.
4. Reconnect the fan motor wires and monitor the high-side pressure on the gauge.
5. The pressure switch will reset and the compressor will energize when the high-side pressure reaches approximately 350 psig on R-507 units.
6. The high/low pressure switch should be replaced if it does not operate as indicated above.

9.3 FAN CONTROL DRIVE

The Mueller "OHSE" refrigeration unit 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.

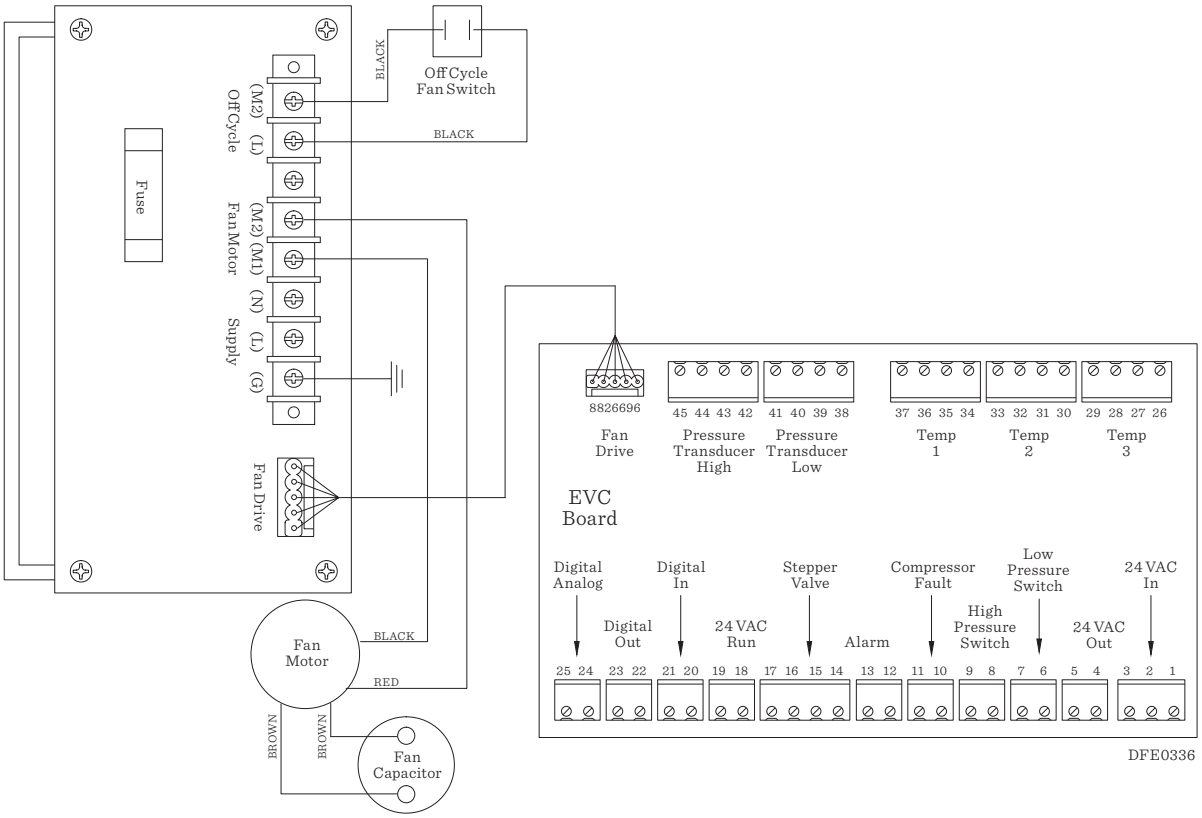
The FCD is factory set to energize the fan at minimum speed when the high side pressure rises above 170 psig. The fan motor should operate at maximum speed when the high side pressure rises above 240 psig. These settings should be verified at start up.

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.

9.3 FAN CONTROL DRIVE (CONTINUED)

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

FIGURE 8: FAN CONTROL DRIVE



9.5 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 the high side pressure rises above 270 psig until pressure falls below 220 psig.

9.6 SCHRADER CORE IDENTIFICATION

All pressure switches will be marked with a red tie band indicated a Schrader core is present. If a pressure switch connection does not have a red tie band, the refrigerant will require recovery 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 10.0 – Equipment Sound Level

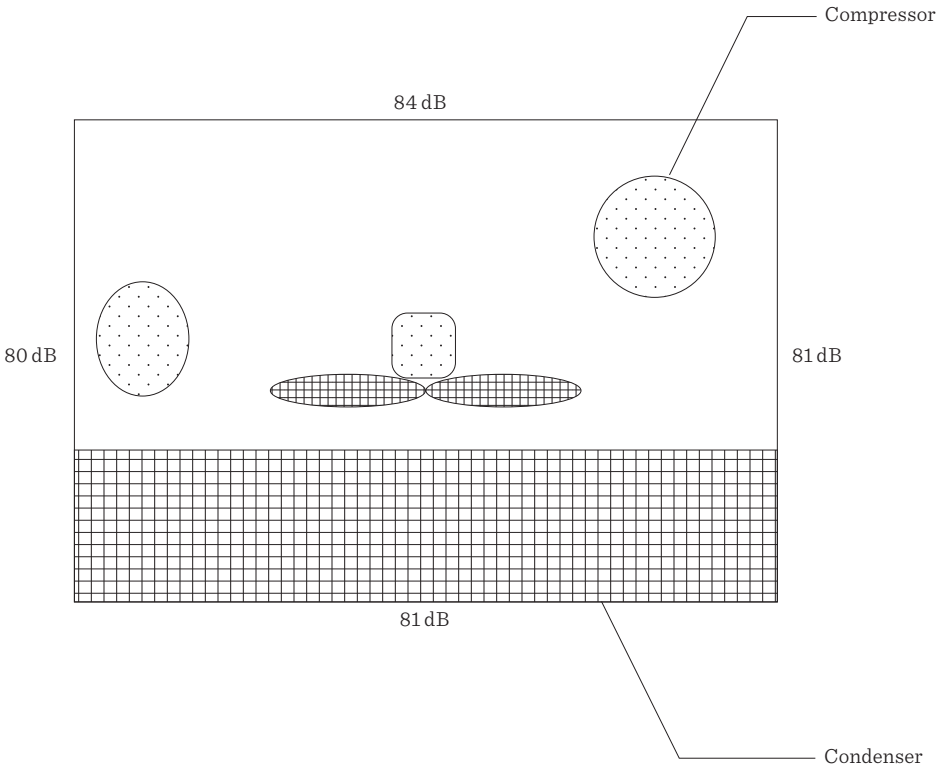
10.1 SOUND TESTING EQUIPMENT

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.

10.2 SOUND MEASUREMENT

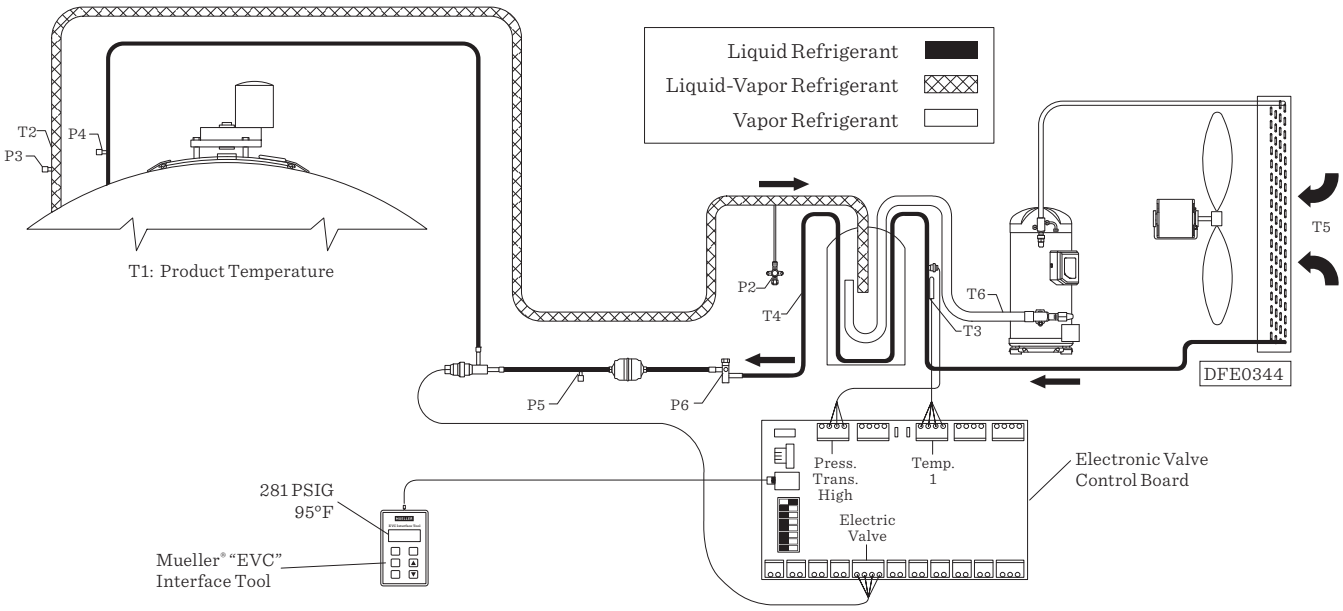
All sound measurements were recorded at a distance of 1 meter (3.28 feet) from the operating equipment. The highest recorded measurement was 84 dB.

FIGURE 9: SOUND MEASUREMENT



Section 11.0 – Maintenance

11.1 "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 five-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.:**

11.2 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 of 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 9.
9. Complete a performance survey for each refrigeration unit verifying proper cooling capacity. Refer to Section 11.1.

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 12.0 – Disposal

12.1 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.

12.2 COMPRESSOR REFRIGERANT OIL

The compressor contains a lubricant consisting of white mineral oil. Dispose of in accordance with local regulations.

12.4 METAL COMPONENTS

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

Section 13.0 – Equipment Markings

13.1 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

13.2 LABEL NO. 8824716, REFRIGERANT

REFRIGERANT R-507
POE OIL

0305 8824716

13.3 LABEL NO. 8824388, 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 450 psig and Low Side 150 psig
Outdoor Use *For Use With R-22*

0109 8824388

13.4 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

13.5 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

13.6 LABEL NO. 8822225, CE DATA TAG (International 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

13.7 LABEL NO. 8822232, WARNING SYMBOL: HOT

6911 8822232

13.8 LABEL NO. 8820623, WARNING SYMBOL: ELECTRICAL

13.9 LABEL NO. 8822226, WARNING: SCREEN GUARD REMOVAL (International Models Only)

⚠ WARNING

Authorized Personnel Only To Remove Screen Guard

6911 8822226

13.10 LABEL NO. 8822141, WARNING: RISK OF ELECTRIC SHOCK

⚠ WARNING

**RISK OF ELECTRIC SHOCK.
CAN CAUSE INJURY OR DEATH.
DISCONNECT ALL REMOTE ELECTRIC
POWER SUPPLIES BEFORE SERVICING.**

⚠ ADVERTISSEMENT

**RISQUE DE DÉCHARGE ÉLECTRIQUE.
PEUT CAUSER DES BLESSURES OU
PROVOQUER LA MORT. DÉBRANCHER
TOUTES LES SOURCES D'ALIMENTATION
À DISTANCE AVANT L'ENTRETIEN.**

⚠ PELIGRO

**RIESGO DE CHOQUE ELÉCTRICO.
PUEDE CAUSAR HERIDA O MUERTE.
DESCONECTAR TODOS LOS
SUMINISTROS DE REMOTO ELÉCTRICO
DE PODER ANTES DE SERVICIO.**

0001 8822141

13.11 LABEL NO. 8820764, WARNING: RISK OF ELECTRIC SHOCK

13.12 LABEL NO. 8820768, WARNING: SCREEN GUARD

13.13 LABEL NO. 8820769, WARNING: FAN WILL START AUTOMATICALLY

13.14 LABEL NO. 8824383, MUELLER LOGO

Section 14.0 – Safety

NOTE: See all Safety, Warning, and/or Caution Labels displayed in Section 13.

14.1 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.

14.2 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.

14.3 FIRST AID

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

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.

14.4 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 15.0 – Technical Data

15.1 "OHSE" ELECTRICAL DATA

Model	Part No.	Description	Voltage	HZ	PH	Full Load Amps	Locked Rotor Amps	Rated Load Amps	Min. Circuit Ampacity	Max. Fuse Size
OHSE-753E	8827007	7.5 HP, 3 Phase Unit, R-507	200–230	50/60	3	–	–	–	48	60
	8827021	Compressor, Scroll, ZB58K5E-TFC	200–230	50/60	3	–	203	35.4	–	–
	8824390	Fan Motor, ½ HP	200–208–230	50/60	1	2.5	–	–	–	–
OHSE-754E	8827008	7.5 HP, 3 Phase Unit, R-507	380–460	50/60	3	–	–	–	25	30
	8827022	Compressor, Scroll, ZB58K5E-TFD	380–460	50/60	3	–	95	15.4	–	–
	8824825	Fan Motor, ½ HP	380–460	50/60	1	1.4	–	–	–	–
OHSE-93E	8827010	9 HP, 3 Phase Unit, R-507	200–240	50/60	3	–	–	–	55	90
	8827023	Compressor, Scroll, ZB66K5E-TFC	200–240	50/60	3	–	231	40.3	–	–
	8824390	Fan Motor, ½ HP	200–208–230	50/60	1	2.5	–	–	–	–
OHSE-94E	8827011	9 HP, 3 Phase Unit, R-507	380–460	50/60	3	–	–	–	23	40
	8827024	Compressor, Scroll, ZB66K5E-TFD	380–460	50/60	3		114	17.5	–	–
	8824825	Fan Motor, ½ HP	380–460	50/60	1	1.4	–	–	–	–

15.2 "OHSE" REFRIGERANT DATA

Model	Part No.	Description	Refrigerant	Refrigerant Charge	
				Milk Tank	Chiller
OHSE-753E	8827007	7.5 HP, 3 Phase Unit, R-507	R-507	25 lbs / 11.3 kg	23 lbs / 10.4 kg
OHSE-754E	8827008	7.5 HP, 3 Phase Unit, R-507	R-507	25 lbs / 11.3 kg	23 lbs / 10.4 kg
OHSE-93E	8827010	9 HP, 3 Phase Unit, R-507	R-507	25 lbs / 11.3 kg	23 lbs / 10.4 kg
OHSE-94E	8827011	9 HP, 3 Phase Unit, R-507	R-507	25 lbs / 11.3 kg	23 lbs / 10.4 kg

15.3 "OHSE" COMPRESSOR OIL CHARGE

Model	Part No.	Description	Oil Charge	Oil Type
OHSE-753E	8827007	7.5 HP, 3 Phase Unit, ZB58K5E, R-507	114 oz.	Copeland Ultra 32-3MAF
OHSE-753E	8827008	7.5 HP, 3 Phase Unit, ZB58K5E, R-507	114 oz.	Copeland Ultra 32-3MAF
OHSE-93E	8827010	9 HP, 3 Phase Unit, ZB66K5E,R-507	114 oz.	Copeland Ultra 32-3MAF
OHSE-94E	8827011	9 HP, 3 Phase Unit, ZB66K5E,R-507	114 oz.	Copeland Ultra 32-3MAF

Section 16.0 – Data Charts

16.1 ZB58K5E 3-PHASE, 7.5 HP COMPRESSOR DATA CHART

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

MEDIUM TEMPERATURE

Bold Area Restrictions: 20°F Max Superheat

ZB58K5E-TFC
HFC-507
COPELAND SCROLL®
TFC 208/230-3-60

60 Hz Operation

Evaporating Temperature °F (Sat Dew Pt Pressure, psig)

Condensing Temperature °F (Sat Dew Pt Pressure, psig)

		-10(26)	0(35)	10(46)	15(52)	20(59)	25(66)	30(73)	35(81)	45(99)
140 (413)	C					**44700**	**50200**	**55900**	62000	75500
	P					**10750**	**10800**	**10800**	10800	10850
	A					**31.55**	**31.6**	**31.7**	31.75	31.75
	M					**1225**	**1390**	**1565**	1755	2190
	E					**4.2**	**4.7**	**5.2**	5.8	7
	%					**56.5**	**59.6**	**62.4**	64.7	68.4
130 (364)	C			**41500**	**46800**	**52400**	58300	64600	71300	86200
	P			**9530**	**9550**	**9580**	9610	9640	9660	9690
	A			**28.55**	**28.65**	**28.75**	28.85	28.9	29	29
	M			**981**	**1120**	**1265**	1420	1590	1775	2200
	E			**4.3**	**4.9**	**5.5**	6	6.7	7.3	8.9
	%			**54.8**	**58.2**	**61.1**	63.6	65.8	67.6	70.2
120 (320)	C		**37000**	**47800**	53400	59400	65700	72500	79900	96400
	P		**8410**	**8460**	8500	8540	8580	8620	8640	8650
	A		**25.95**	**26.1**	26.2	26.35	26.45	26.55	26.6	26.6
	M		**781**	**1020**	1150	1290	1440	1610	1790	2210
	E		**4.4**	**5.7**	6.3	7	7.7	8.4	9.3	11.2
	%		**53**	**59.9**	62.5	64.7	66.5	68.1	69.3	70.9
110 (279)	C	**31700**	**42200**	53300	59300	65700	72600	80000	87900	106000
	P	**7380**	**7440**	7530	7590	7640	7680	7710	7730	7720
	A	**23.8**	**23.85**	24.05	24.15	24.25	24.4	24.5	24.55	24.55
	M	**611**	**819**	1045	1170	1305	1455	1620	1800	2220
	E	**4.3**	**5.7**	7.1	7.8	8.6	9.4	10.3	11.3	13.8
	%	**50.5**	**58.6**	63.8	65.7	67.2	68.4	69.4	70	70.5
100 (243)	C	**36100**	46700	58300	64700	71500	78900	86900	95600	115500
	P	**6500**	6610	6730	6790	6840	6880	6910	6920	6870
	A	**22**	22.1	22.3	22.4	22.55	22.65	22.75	22.8	22.8
	M	**647**	844	1060	1185	1315	1465	1625	1805	2220
	E	**5.5**	7	8.7	9.6	10.4	11.4	12.6	13.8	16.8
	%	**56.6**	62.8	66.4	67.6	68.4	69	69.3	69.4	68.7
80 (180)	C	42900	54100	66900	74200	82100	90700	100000	110500	134000
	P	5110	5270	5410	5470	5500	5520	5510	5480	5320
	A	19.25	19.4	19.6	19.75	19.85	19.95	20.05	20.1	20
	M	681	863	1075	1195	1325	1475	1640	1820	2250
	E	8.4	10.3	12.3	13.6	14.9	16.4	18.1	20.1	25.2
	%	64.1	66.7	67.3	67.1	66.7	66	65	63.7	59.6
70 (154)	C	45700	57300	70900	78600	87100	96400	106500	117500	
	P	4560	4730	4860	4900	4920	4920	4880	4820	
	A	18.25	18.4	18.6	18.75	18.85	18.95	19	19	
	M	684	864	1075	1195	1330	1480	1650	1840	
	E	10	12.1	14.6	16.1	17.7	19.6	21.8	24.4	
	%	65.2	66.3	65.5	64.7	63.6	62.1	60.3	58	
50 (109)	C	50600	63200	78600	87500					
	P	3660	3800	3870	3870					
	A	16.8	16.95	17.15	17.2					
	M	674	861	1085	1210					
	E	13.8	16.6	20.3	22.6					
	%	62.3	60.8	57.3	54.9					

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice. Current @ 230 V

C: Capacity (Btu/hr), P: Power (Watts), A: Current (Amps), M: Mass Flow (lbs/hr), E: EER (Btu/Watt-hr), %: Isentropic Efficiency (1%)

Copeland brand products — EMERSON Climate Technologies

1.4dMT60-11-88-TFC
Printed 08/11/2014
11-88

16.2 ZB58K5E 3-PHASE, 7.5 HP, 460V COMPRESSOR DATA CHART

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

MEDIUM TEMPERATURE

Bold Area Restrictions: 20°F Max Superheat

ZB58K5E-TFD
HFC-507
COPELAND SCROLL®
TFD 460-3-60

60 Hz Operation

Evaporating Temperature °F (Sat Dew Pt Pressure, psig)

Condensing Temperature °F (Sat Dew Pt Pressure, psig)		-10(26)	0(35)	10(46)	15(52)	20(59)	25(66)	30(73)	35(81)	45(99)
140 (413)	C					**44700**	**50200**	**55900**	62000	75500
	P					**10750**	**10800**	**10800**	10800	10850
	A					**15.75**	**15.8**	**15.85**	15.85	15.85
	M					**1225**	**1390**	**1565**	1755	2190
	E					**4.2**	**4.7**	**5.2**	5.8	7
	%					**56.5**	**59.6**	**62.4**	64.7	68.4
130 (364)	C			**41500**	**46800**	**52400**	58300	64600	71300	86200
	P			**9530**	**9550**	**9580**	9610	9640	9660	9690
	A			**14.3**	**14.3**	**14.35**	14.4	14.45	14.5	14.5
	M			**981**	**1120**	**1265**	1420	1590	1775	2200
	E			**4.3**	**4.9**	**5.5**	6	6.7	7.3	8.9
	%			**54.8**	**58.2**	**61.1**	63.6	65.8	67.6	70.2
120 (320)	C		**37000**	**47800**	53400	59400	65700	72500	79900	96400
	P		**8410**	**8460**	8500	8540	8580	8620	8640	8650
	A		**13**	**13.05**	13.1	13.15	13.2	13.25	13.3	13.3
	M		**781**	**1020**	1150	1290	1440	1610	1790	2210
	E		**4.4**	**5.7**	6.3	7	7.7	8.4	9.3	11.2
	%		**53**	**59.9**	62.5	64.7	66.5	68.1	69.3	70.9
110 (279)	C	**31700**	**42200**	53300	59300	65700	72600	80000	87900	106000
	P	**7380**	**7440**	7530	7590	7640	7680	7710	7730	7720
	A	**11.9**	**11.95**	12	12.1	12.15	12.2	12.25	12.3	12.3
	M	**611**	**819**	1045	1170	1305	1455	1620	1800	2220
	E	**4.3**	**5.7**	7.1	7.8	8.6	9.4	10.3	11.3	13.8
	%	**50.5**	**58.6**	63.8	65.7	67.2	68.4	69.4	70	70.5
100 (243)	C	**36100**	46700	58300	64700	71500	78900	86900	95600	115500
	P	**6500**	6610	6730	6790	6840	6880	6910	6920	6870
	A	**11**	11.05	11.15	11.2	11.25	11.35	11.35	11.4	11.4
	M	**647**	844	1060	1185	1315	1465	1625	1805	2220
	E	**5.5**	7	8.7	9.6	10.4	11.4	12.6	13.8	16.8
	%	**56.6**	62.8	66.4	67.6	68.4	69	69.3	69.4	68.7
80 (180)	C	42900	54100	66900	74200	82100	90700	100000	110500	134000
	P	5110	5270	5410	5470	5500	5520	5510	5480	5320
	A	9.65	9.7	9.8	9.85	9.95	10	10	10.05	10
	M	681	863	1075	1195	1325	1475	1640	1820	2250
	E	8.4	10.3	12.3	13.6	14.9	16.4	18.1	20.1	25.2
	%	64.1	66.7	67.3	67.1	66.7	66	65	63.7	59.6
70 (154)	C	45700	57300	70900	78600	87100	96400	106500	117500	
	P	4560	4730	4860	4900	4920	4920	4880	4820	
	A	9.15	9.2	9.3	9.35	9.45	9.45	9.5	9.5	
	M	684	864	1075	1195	1330	1480	1650	1840	
	E	10	12.1	14.6	16.1	17.7	19.6	21.8	24.4	
	%	65.2	66.3	65.5	64.7	63.6	62.1	60.3	58	
50 (109)	C	50600	63200	78600	87500					
	P	3660	3800	3870	3870					
	A	8.4	8.45	8.55	8.6					
	M	674	861	1085	1210					
	E	13.8	16.6	20.3	22.6					
	%	62.3	60.8	57.3	54.9					

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice. Current @ 460 V

C: Capacity (Btu/hr), P: Power (Watts), A: Current (Amps), M: Mass Flow (lbs/hr), E: EER (Btu/Watt-hr), %: Isentropic Efficiency (1%)

Copeland brand products — EMERSON Climate Technologies

1.4dMT60-11-88-TFD
Printed 08/11/2014
11-88

16.3 ZB66K5E 3-PHASE, 9 HP COMPRESSOR DATA CHART

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

MEDIUM TEMPERATURE

Bold Area Restrictions: 20°F Max Superheat

ZB66K5E-TFC
HFC-507
COPELAND SCROLL®
TFC 208/230-3-60

60 Hz Operation

Evaporating Temperature °F (Sat Dew Pt Pressure, psig)

Condensing Temperature °F (Sat Dew Pt Pressure, psig)

		-10(26)	0(35)	10(46)	15(52)	20(59)	25(66)	30(73)	35(81)	45(99)
140 (413)	C					**52000**	**57300**	**63000**	69100	82900
	P					**11850**	**11900**	**11900**	11950	12000
	A					**34.7**	**34.8**	**34.9**	34.95	35
	M					**1440**	**1605**	**1785**	1985	2440
	E					**4.4**	**4.8**	**5.3**	5.8	6.9
	%					**60.4**	**62.5**	**64.5**	66.2	68.6
130 (364)	C			**48600**	**53900**	**59600**	65700	72200	79300	95100
	P			**10500**	**10550**	**10600**	10650	10700	10750	10850
	A			**31.45**	**31.55**	**31.7**	31.85	31.95	32.05	32.2
	M			**1160**	**1300**	**1450**	1615	1795	1995	2450
	E			**4.6**	**5.1**	**5.6**	6.2	6.8	7.4	8.8
	%			**58.9**	**61.2**	**63.3**	65.2	66.8	68.2	69.8
120 (320)	C		**43900**	**54700**	60600	67000	73800	81200	89200	107000
	P		**9250**	**9400**	9470	9530	9580	9630	9680	9770
	A		**28.45**	**28.75**	28.95	29.1	29.25	29.4	29.55	29.75
	M		**933**	**1175**	1315	1465	1630	1810	2010	2470
	E		**4.8**	**5.8**	6.4	7	7.7	8.4	9.2	10.9
	%		**57.5**	**62.1**	64.1	65.8	67.3	68.5	69.4	70.1
110 (279)	C	**38200**	**48600**	60400	67000	74100	81700	89900	98800	118500
	P	**8020**	**8240**	8430	8500	8570	8630	8680	8730	8810
	A	**25.9**	**26.15**	26.45	26.65	26.85	27.05	27.2	27.35	27.6
	M	**739**	**948**	1190	1330	1480	1645	1825	2030	2490
	E	**4.8**	**5.9**	7.2	7.9	8.7	9.4	10.3	11.3	13.4
	%	**56.2**	**61.2**	65	66.5	67.8	68.8	69.6	69.9	69.4
100 (243)	C	**42000**	53100	66000	73200	80900	89300	98400	108000	130000
	P	**7120**	7370	7570	7650	7720	7780	7830	7870	7930
	A	**23.85**	24.15	24.5	24.7	24.9	25.1	25.3	25.45	25.7
	M	**755**	962	1205	1345	1495	1660	1845	2050	2520
	E	**5.9**	7.2	8.7	9.6	10.5	11.5	12.6	13.8	16.4
	%	**60.2**	64.2	67.1	68.1	68.9	69.4	69.6	69.3	67.3
80 (180)	C	48800	61400	76300	84800	94000	104000	114500	126500	152500
	P	5660	5930	6130	6210	6260	6300	6330	6350	6340
	A	20.75	21	21.4	21.6	21.8	22.05	22.2	22.4	22.65
	M	776	985	1230	1370	1530	1700	1890	2100	2580
	E	8.6	10.3	12.4	13.7	15	16.5	18.1	19.9	24
	%	65.9	67.6	68.2	68	67.5	66.7	65.3	63.4	57.3
70 (154)	C	51900	65300	81300	90300	100000	111000	122500	135000	
	P	5060	5330	5510	5570	5620	5640	5650	5640	
	A	19.55	19.8	20.2	20.4	20.6	20.8	20.95	21.15	
	M	780	991	1240	1385	1545	1720	1910	2120	
	E	10.3	12.3	14.8	16.2	17.9	19.6	21.7	23.9	
	%	67	67.5	66.7	65.9	64.6	62.8	60.4	57.3	
50 (109)	C	57600	72500	90700	101000					
	P	4030	4250	4360	4380					
	A	17.75	17.95	18.2	18.4					
	M	772	990	1250	1400					
	E	14.3	17.1	20.8	23.1					
	%	64.7	62.6	58.7	55.9					

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice. Current @ 230 V
C: Capacity (Btu/hr), P: Power (Watts), A: Current (Amps), M: Mass Flow (lbs/hr), E: EER (Btu/Watt-hr), %: Isentropic Efficiency (1%)

Copeland brand products
EMERSON Climate Technologies

1.4dMT60-11-90-TFC
Printed 08/11/2014
11-90

16.4 ZB66K5E 3-PHASE, 9 HP, 460V COMPRESSOR DATA CHART

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

MEDIUM TEMPERATURE

Bold Area Restrictions: 20°F Max Superheat

ZB66K5E-TFD
HFC-507
COPELAND SCROLL®
TFD 460-3-60

60 Hz Operation

Evaporating Temperature °F (Sat Dew Pt Pressure, psig)

Condensing Temperature °F (Sat Dew Pt Pressure, psig)

		-10(26)	0(35)	10(46)	15(52)	20(59)	25(66)	30(73)	35(81)	45(99)
140 (413)	C					**52000**	**57300**	**63000**	69100	82900
	P					**11850**	**11900**	**11900**	11950	12000
	A					**17.35**	**17.4**	**17.45**	17.5	17.5
	M					**1440**	**1605**	**1785**	1985	2440
	E					**4.4**	**4.8**	**5.3**	5.8	6.9
	%					**60.4**	**62.5**	**64.5**	66.2	68.6
130 (364)	C			**48600**	**53900**	**59600**	65700	72200	79300	95100
	P			**10500**	**10550**	**10600**	10650	10700	10750	10850
	A			**15.7**	**15.8**	**15.85**	15.9	16	16.05	16.1
	M			**1160**	**1300**	**1450**	1615	1795	1995	2450
	E			**4.6**	**5.1**	**5.6**	6.2	6.8	7.4	8.8
	%			**58.9**	**61.2**	**63.3**	65.2	66.8	68.2	69.8
120 (320)	C		**43900**	**54700**	60600	67000	73800	81200	89200	107000
	P		**9250**	**9400**	9470	9530	9580	9630	9680	9770
	A		**14.25**	**14.4**	14.45	14.55	14.65	14.7	14.75	14.85
	M		**933**	**1175**	1315	1465	1630	1810	2010	2470
	E		**4.8**	**5.8**	6.4	7	7.7	8.4	9.2	10.9
	%		**57.5**	**62.1**	64.1	65.8	67.3	68.5	69.4	70.1
110 (279)	C	**38200**	**48600**	60400	67000	74100	81700	89900	98800	118500
	P	**8020**	**8240**	8430	8500	8570	8630	8680	8730	8810
	A	**12.95**	**13.05**	13.25	13.35	13.4	13.5	13.6	13.7	13.8
	M	**739**	**948**	1190	1330	1480	1645	1825	2030	2490
	E	**4.8**	**5.9**	7.2	7.9	8.7	9.4	10.3	11.3	13.4
	%	**56.2**	**61.2**	65	66.5	67.8	68.8	69.6	69.9	69.4
100 (243)	C	**42000**	53100	66000	73200	80900	89300	98400	108000	130000
	P	**7120**	7370	7570	7650	7720	7780	7830	7870	7930
	A	**11.95**	12.05	12.25	12.35	12.45	12.55	12.65	12.75	12.85
	M	**755**	962	1205	1345	1495	1660	1845	2050	2520
	E	**5.9**	7.2	8.7	9.6	10.5	11.5	12.6	13.8	16.4
	%	**60.2**	64.2	67.1	68.1	68.9	69.4	69.6	69.3	67.3
80 (180)	C	48800	61400	76300	84800	94000	104000	114500	126500	152500
	P	5660	5930	6130	6210	6260	6300	6330	6350	6340
	A	10.35	10.5	10.7	10.8	10.9	11	11.1	11.2	11.3
	M	776	985	1230	1370	1530	1700	1890	2100	2580
	E	8.6	10.3	12.4	13.7	15	16.5	18.1	19.9	24
	%	65.9	67.6	68.2	68	67.5	66.7	65.3	63.4	57.3
70 (154)	C	51900	65300	81300	90300	100000	111000	122500	135000	
	P	5060	5330	5510	5570	5620	5640	5650	5640	
	A	9.8	9.9	10.1	10.2	10.3	10.4	10.5	10.55	
	M	780	991	1240	1385	1545	1720	1910	2120	
	E	10.3	12.3	14.8	16.2	17.9	19.6	21.7	23.9	
	%	67	67.5	66.7	65.9	64.6	62.8	60.4	57.3	
50 (109)	C	57600	72500	90700	101000					
	P	4030	4250	4360	4380					
	A	8.85	8.95	9.1	9.2					
	M	772	990	1250	1400					
	E	14.3	17.1	20.8	23.1					
	%	64.7	62.6	58.7	55.9					

Nominal Performance Values (±5%) based on 72 hours run-in. Subject to change without notice. Current @ 460 V

C: Capacity (Btu/hr), P: Power (Watts), A: Current (Amps), M: Mass Flow (lbs/hr), E: EER (Btu/Watt-hr), %: Isentropic Efficiency (1%)

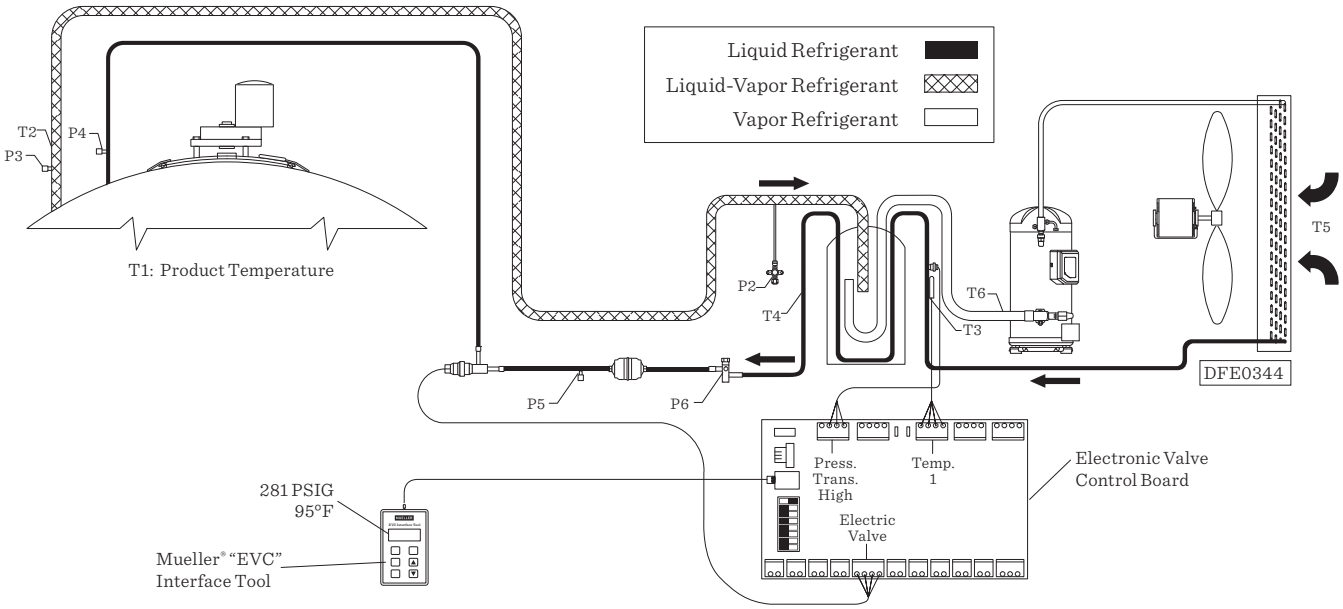
Copeland brand products — EMERSON Climate Technologies

1.4dMT60-11-90-TFD
Printed 08/11/2014
11-90

16.5 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" 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 five-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.:**

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