



EARTHLINKED
TECHNOLOGIES

Classic Series

SCW Geothermal Heating and Cooling System *Quick-Start Instructions*

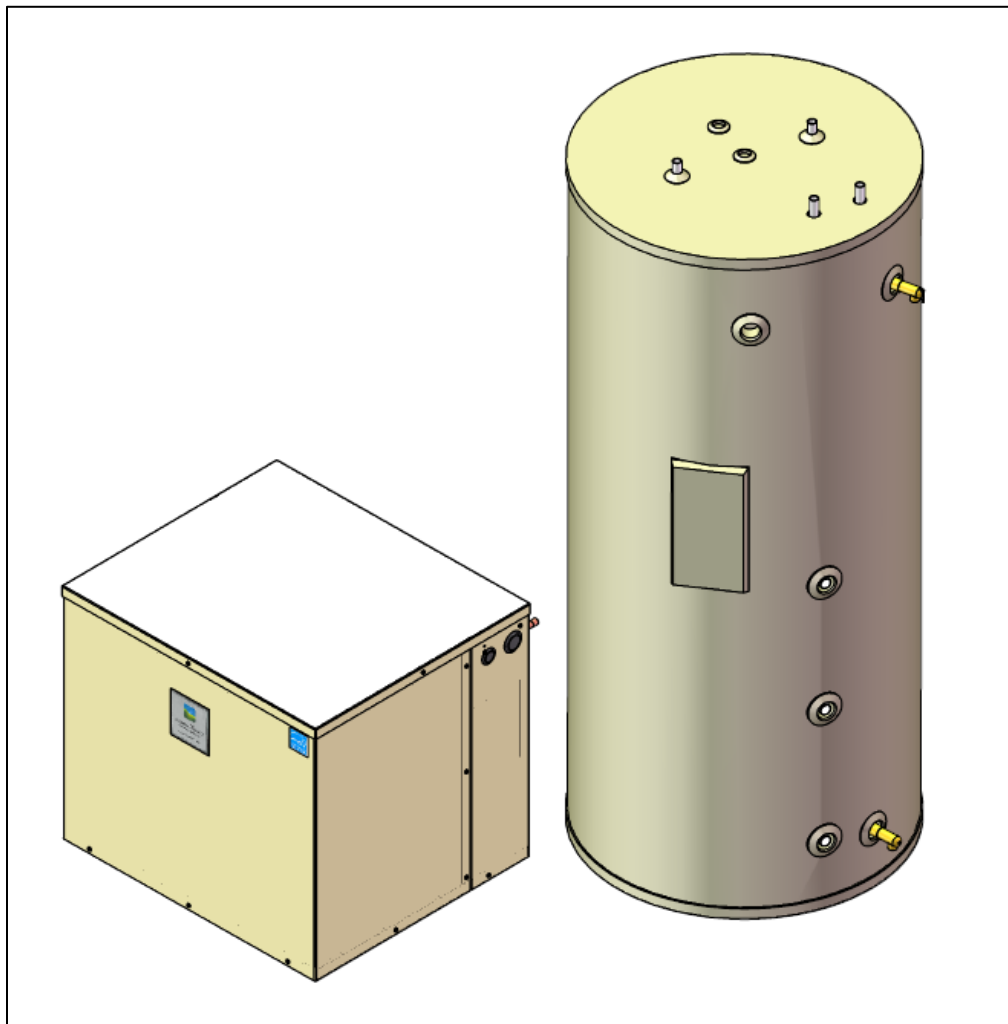


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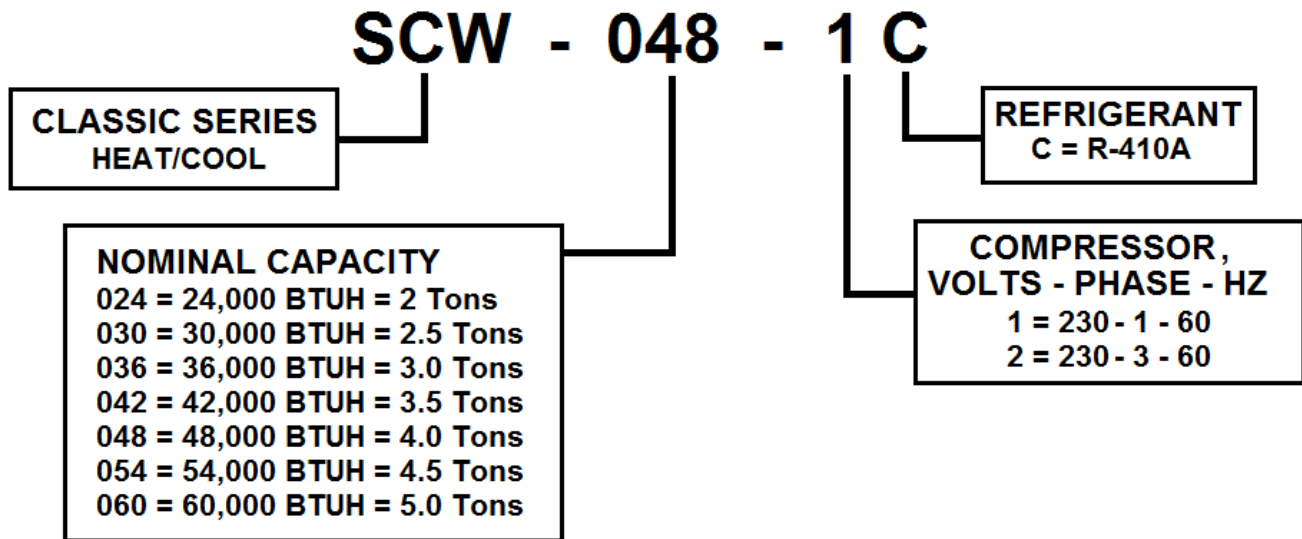
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Model Nomenclature



Disclaimer

Proper installation and servicing of the EarthLinked® Heat Pump is essential to its reliable performance. All EarthLinked® systems must be installed and serviced by a technician authorized by Earthlinked Technologies. Installation and service must be made in accordance with the instructions set forth in this manual. Failure to provide installation and service by an ETI authorized installer in a manner consistent with this manual will void and nullify the limited warranty coverage for the system. Earthlinked Technologies shall not be liable for any defect, unsatisfactory performance, damage or loss, whether direct or consequential, relative to the design, manufacture, construction, application or installation of the field specified components.



ETL LISTED
 CONFORMS TO
 UL STD 1995
 US CERTIFIED TO CAN/CSA
 STD C22.2 NO. 236-05



COMPLIES WITH
 IEC 60204-1
 IEC 60335-2-40
 IEC 61000-3-11

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Safety

Warning, Caution and Important notices appear throughout the manual. Read these items carefully before attempting installation, servicing or troubleshooting the equipment.



IMPORTANT!

Notification of installation, operation or maintenance information which is important, but which is not hazardous.



WARNING!

Indicates a hazardous situation, which if not avoided will result in serious injury or death, or equipment or property damage.



CAUTION!

Indicates a potentially hazardous situation or an unsafe practice, which if not avoided, may result in injury, or equipment or property damage.

Equipment Manuals

The following is a listing of the equipment installation manuals that are provided with each component specified for this EarthLinked[®] system.



IMPORTANT!

Read and follow all installation instructions in these manuals, appropriate for the EarthLinked[®] system being installed, BEFORE initiating the Start-Up procedure.

Series SV Service Valve and ADK Adapter Kit

Series HCM Hybrid Cooling Module

Series GSTE Storage Water Heater

Model HHK/CWK-1872 Temperature Control Kit

Earth Loop Specification and Installation Manual

Earth Loop Protection Kit Installation Manual

Installation

Component Matching

Upon receipt of the equipment, carefully check the component model numbers by referencing Figure 1, to ensure that all components of the system match.


HEAT/COOL Applications		
Compress. Unit ¹	Hybrid Cooling Module	Earth Loop ²
-024	HCM-1836C	-024-C
-030		-030-C
-036		-036-C
-042	HCM-4272C	-042-C
-048		-048-C
-054		-060-C
-060		-060-C

1. Contained in each compressor package:

- compressor unit
- four L-shaped hold down brackets
- service valves-liquid and vapor
- adapters for service valves and earth loop line set
- product literature

2. All series Earth Loops

Figure 1. Matching Component Model Numbers



Warning!

WEAR ADEQUATE PROTECTIVE CLOTHING AND PRACTICE ALL APPLICABLE SAFETY PRECAUTIONS WHILE INSTALLING THIS EQUIPMENT. FAILURE TO DO SO MAY RESULT IN EQUIPMENT AND/OR PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

Guidelines for the general layout of the system components are shown in Figure 2. Before placing the compressor unit (outside or indoors), review the guidelines in Figure 2.

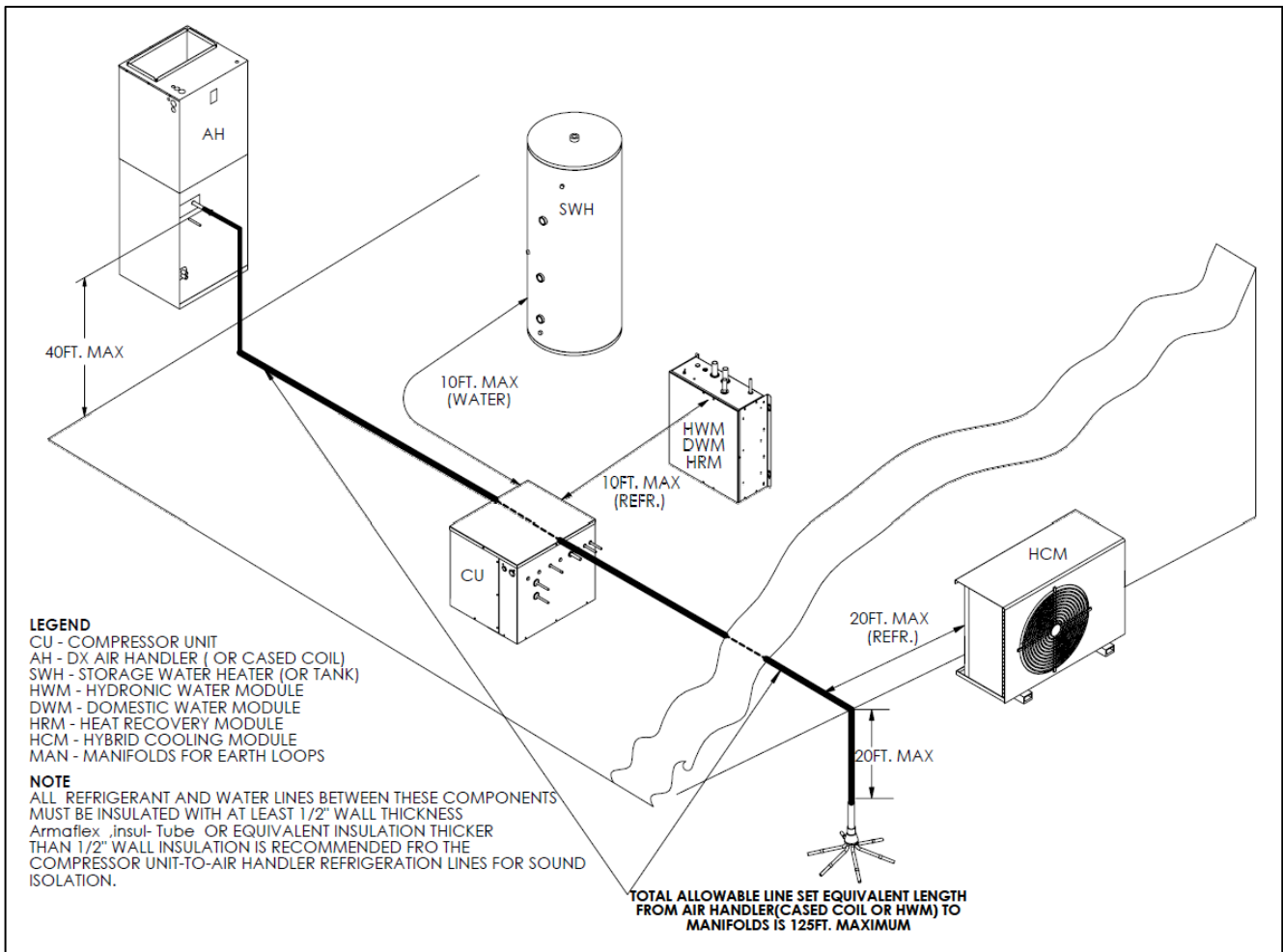


Figure 2. General Layout of System Components

Compressor Unit Placement

- EarthLinked® compressor units may be located inside or outside. If outside, place compressor unit on a standard HVAC outdoor unit pad. If inside, place it on a level, hard surface. If the compressor unit is to be fastened down, see Figure 3 for bracket installation.
- Avoid placing the compressor unit in or near the sound sensitive areas of the residence.
- Attic installations must include an auxiliary condensate pan with drain, and suspension from rafters with suspension isolators.
- Clearance around the unit for service is illustrated in Figure 4. However, local codes and applicable regulations take precedence.
- If the compressor unit is located inside, allow 40 cubic feet of unrestricted space per ton of nominal system capacity, around the compressor unit, consistent with the acceptable refrigerant concentration limit (RCL) per ASHRAE Standards 15-2010 and 34-2010.

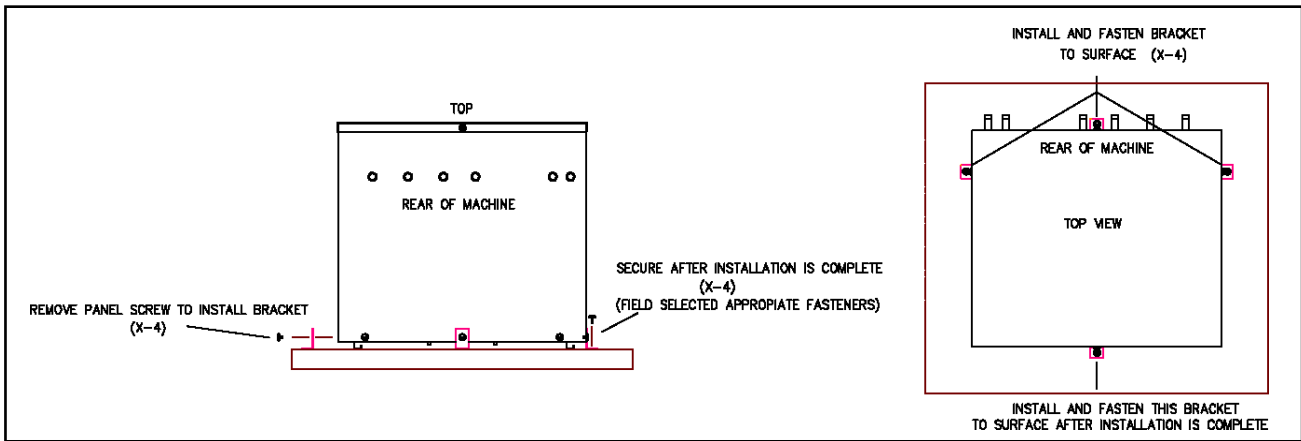


Figure 3. Compressor Unit Bracket Installation

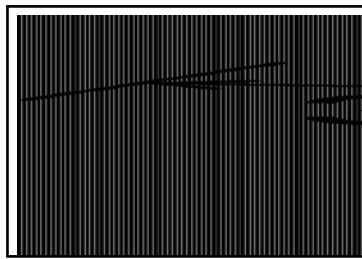


Figure 4. Compressor Unit Clearance

Placement instructions for other pieces of equipment that make up the EarthLinked® System are included with those pieces of equipment and are listed in this manual under **Equipment Manuals**.

Refrigeration

After the EarthLinked® compressor unit and other system components are placed, the refrigeration system tubing is run from the compressor unit to the other components, as appropriate. Figure 5 illustrates the refrigeration and electrical connection points for the SCW(A) compressor unit.



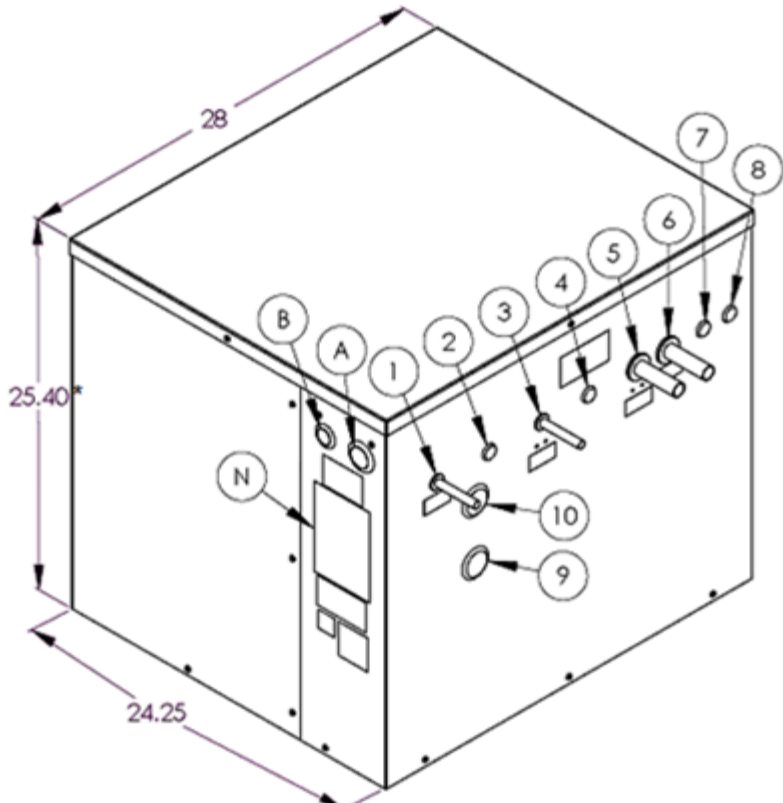
IMPORTANT!

EarthLinked® compressor units that provide space cooling shall be equipped with an EarthLinked® Hybrid Cooling Module (HCM) when:

- (1) Required by the performance tables OR where BOTH of the following circumstances occur:
- (2) Ambient outdoor temperatures have exceeded the outdoor summer design temperature conditions for a continuous system run time of at least 7 hours, coupled with the conditions described in (3).
- (3) Low thermal conductivity soils that do not effectively absorb and dissipate heat. Examples of such soils are light dry soil or dry sand, peat and organic soils dry clay soils and hardpan.

ALSO

EarthLinked® compressor units that provide space heating shall be equipped with a Heating Performance Enhancement (HPE) control when required by the performance tables.



*includes 1/2" cabinet base standoffs

PORT	FUNCTION	TYPE OF CONNECTION	COMPRESSOR UNIT MODEL CONNECTION SIZE, INCHES						
			-024	-030	-036	-042	-048	-054	-060
A ¹	Electrical, Power	1-1/4" Hole	1	1	1	1	1	1	1
B ^{1,2}	Electrical, Control	7/8" Hole	3/4	3/4	3/4	3/4	3/4	3/4	3/4
1	Plugged	---	---	---	---	---	---	---	---
2	Plugged	---	---	---	---	---	---	---	---
3	EL Liquid*	Braze	3/8	3/8	1/2	1/2	1/2	1/2	1/2
4	Anode Socket	---	---	---	---	---	---	---	---
5	EL Vapor*	Braze	5/8	3/4	3/4	3/4	7/8	7/8	7/8
6	Plugged	---	---	---	---	---	---	---	---
7	Plugged	---	---	---	---	---	---	---	---
8	Plugged	---	---	---	---	---	---	---	---
9	HWT Supply	Braze	7/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8
10	HWT Return	Braze	7/8	7/8	7/8	1-1/8	1-1/8	1-1/8	1-1/8

N = Nameplate and other information
 1: Nominal electrical connector sizes
 2: Two additional electrical control ports on opposite side, same size
 *Line set sizes with provided compressor unit adapters

- LEGEND**
 AH = Air Handler
 CC = Cased Coil
 EL = Earth Loop
 HWM = Hydronic Water Module
 DWM = Domestic Water Module
 HWT = Hydronic Water Tank
 DWT = Domestic Water Tank

Figure 5. SCW(A) Connections

Compressor units are shipped from the factory with a low pressure nitrogen holding charge. Carefully relieve the holding charge when the compressor unit is being prepared to connect refrigerant system piping.



Caution!

This compressor unit is equipped with POE lubricant. POE lubricant absorbs significant amounts of moisture from the air very rapidly. Exposure of the POE lubricant to air must be minimized. Even a few minutes of exposure to air can be harmful to the system.

After the initial nitrogen holding charge has been released from the compressor unit, it is critical that air not be allowed to enter the compressor unit during the process of preparing compressor unit refrigerant connections (tube cutting, deburring, cleaning, brazing, etc).

To ensure air does not enter the compressor unit while preparing refrigerant connections, “trickle” dry nitrogen through the compressor unit, entering at the access port nearest the Active Charge Control (ACC), to keep airborne moisture out of the compressor unit and the POE lubricant.

Complete preparing and brazing all compressor unit refrigerant connections at one setting to minimize exposure of open connections to air. Failure to implement the above precautions will result in an extended period of time to effectively evacuate the system, and may adversely affect system performance and cause system failure.



Caution!

REFRIGERANT PIPING CONNECTIONS

Refrigerant joints are to be brazed with 15% silver content brazing alloy, utilizing the NITROGEN BRAZING PROCESS.

NITROGEN BRAZING PROCESS

PURPOSE:

Utilize the NITROGEN BRAZING PROCESS on all brazed refrigerant piping connections. This process eliminates oxidation products from inside joint surfaces.

TECHNIQUE:

“Trickle” nitrogen gas at 1-2 psi pressure through the joint area being brazed, to displace the oxygen. When oxygen has been displaced, turn off the nitrogen, and relieve the pressure at the joint to atmospheric prior to brazing.

CONSEQUENCES:

Failure to displace oxygen with nitrogen at the brazed joint will result in particulate matter being released into the system. The result is discoloration of refrigerant oil, contamination of the system and possible system failure.

The compressor unit package contains a service valve kit and an adapter kit. **The two service valves are to be installed on the earth loop vapor and liquid connections of the compressor unit**, using the adapters to right-size to the proper earth loop line set.

Installation of the service valves will provide isolation of the earth loop system from the compressor unit and provide easy access to the refrigerant system.

For the installation of system components requiring refrigeration connections, refer to Figure 6 for line set sizes and the appropriate installation manual(s) following Figure 6.

EARTH LOOP LINE SETS		
COMPRESSOR UNIT SIZE	LINE SET O.D., INCHES	
	LIQUID*	VAPOR*
2.0 Tons (-024)	3/8	5/8
2.5 Tons (-030)	3/8	3/4
3.0 Tons (-036)	1/2	3/4
3.5 Tons (-042)	1/2	3/4
4.0 Tons (-048)	1/2	7/8
4.5 Tons (-054)	1/2	7/8
5.0 Tons (-060)	1/2	7/8

*Liquid and Vapor lines must BOTH be insulated with Armaflex® or equivalent with at least 1/2" wall thickness for the full length of the line set.

Figure 6. Line Set Sizes

Series SV Service Valve and ADK Adapter Kit

Series HCM Hybrid Cooling Module

Earth Loop Specification and Installation Manual

After installing and nitrogen brazing the HVAC system components and compressor unit service valves, turn the Service Valves to **Full Open** and pressurize the refrigeration system to 150 psig with dry nitrogen and a trace of refrigerant. Valve off the nitrogen Tank from the HVAC system components and check joints with a sensitive Electronic Leak Detector to ensure they are sealed. Repair any leaks and re-test as appropriate.

System Applications and Electrical

The SCW(A) compressor unit electrical box major components and electric data for all compressor sizes are shown in Figure 7.

The SureStart Module is a factory installed component that (1) reduces compressor starting current and (2) reduces compressor starting torque, thus reducing stress on the compressor at start-up.

The Earth Loop Protection Control System, comprised of the EPS Power Supply, EPS Module and EPS Fuse is contained within the electric box. This system is factory wired and ready to be connected to the anode wire through an external electrical connection on the backside of the compressor cabinet. The anode wire connection is detailed in a later section of this manual.

SCW(A) Heating and Cooling System electrical and application illustrations are as follows.

Figure 8a. SCW(A) Compressor Unit Electrical Ladder Diagram, 230-1-60

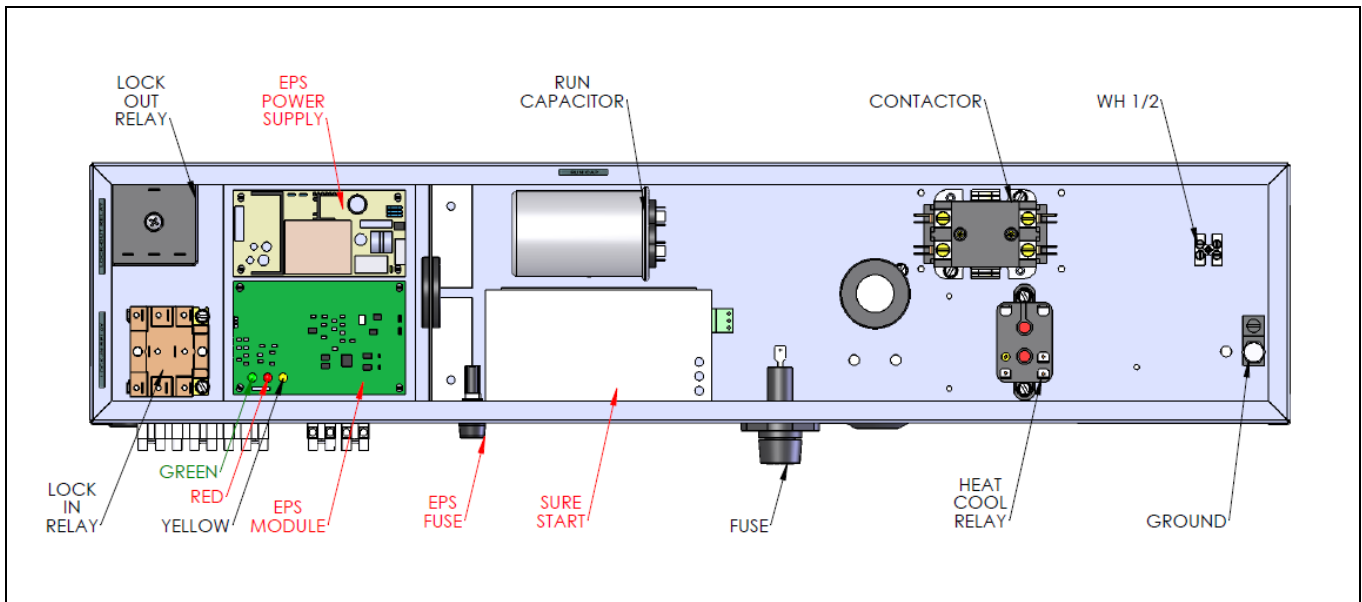
Figure 8b. SCW(A) Compressor Unit Electrical Schematic Diagram, 230-1-60

Figure 9a. SCW(A) Compressor Unit Electrical Ladder Diagram, 230-3-60

Figure 9b. SCW(A) Compressor Unit Electrical Schematic Diagram, 230-3-60

Figure 10a. SCW(A) Hydronic Heating/Cooling System Application

Figure 10b. SCW(A) Hydronic Heating/Cooling System Field Wiring Diagram

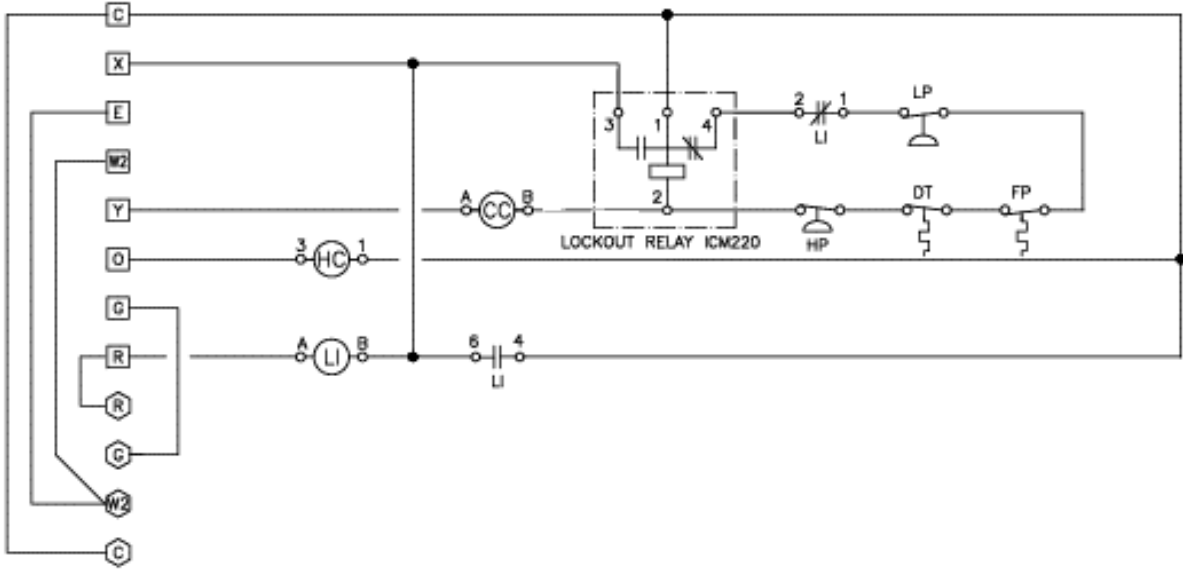
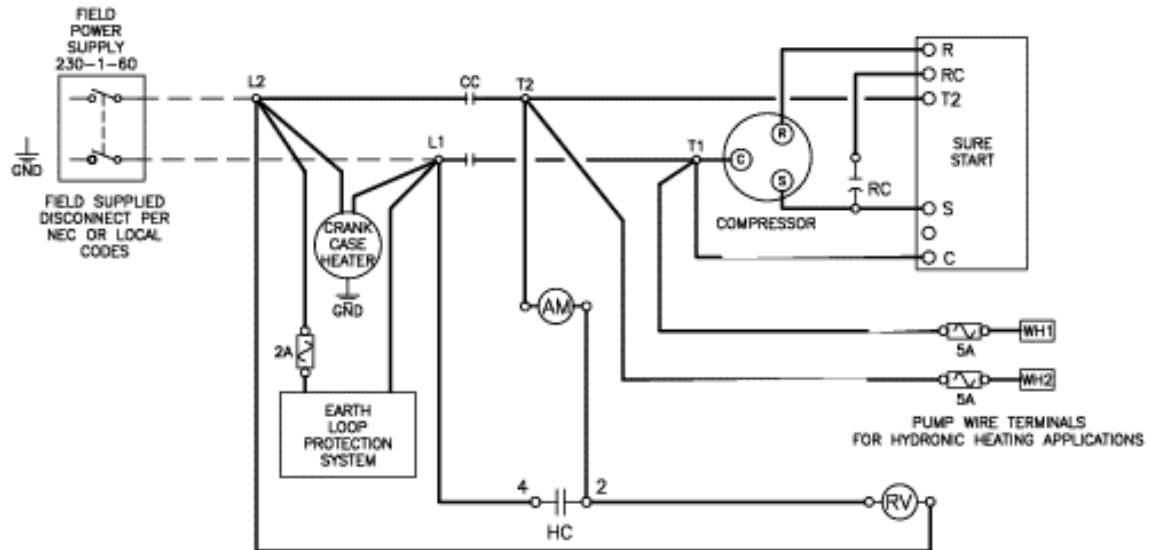


Compressor Unit Model	Compressor Model	Voltage/Phase/Hz	Voltage		LRA	RLA	MCA	MFS
			Min.	Max.				
-024-1C	ZP25K6E-PFV	230-1-60	207	253	72.5	15.0	18.0	30
-024-2C	ZP25K6E-TF5	230-3-60	207	253	61.4	9.8	12.0	20
-030-1C	ZP31K5E-PFV	230-1-60	207	253	79.0	18.6	23.0	35
-030-2C	ZP31K5E-TF5	230-3-60	207	253	73.0	11.6	14.0	20
-036-1C	ZP38K5E-PFV	230-1-60	207	253	109.0	22.1	27.0	40
-036-2C	ZP38K5E-TF5	230-3-60	207	253	83.1	15.1	19.0	30
-042-1C	ZP44K5E-PFV	230-1-60	207	253	135.0	23.9	29.0	50
-042-2C	ZP44K5E-TF5	230-3-60	207	253	98.0	16.1	20.0	30
-048-1C	ZP51K5E-PFV	230-1-60	207	253	134.0	29.4	36.0	60
-048-2C	ZP51K5E-TF5	230-3-60	207	253	110.0	17.8	22.0	35
-054-1C	ZP57K5E-PFV	230-1-60	207	253	178.0	31.6	39.0	60
-054-2C	ZP57K5E-TF5	230-3-60	207	253	136.0	21.4	26.0	40
-060-1C	ZP61K5E-PFV	230-1-60	207	253	178.0	34.3	42.0	60
-060-2C	ZP61K5E-TF5	230-3-60	207	253	136.0	21.9	27.0	40

LRA = Locked Rotor Amps
 RLA = Rated Load Amps
 MCA = Minimum Circuit Ampacity
 MFS = Maximum Fuse or HACR Circuit Breaker Size (External)
 AWS = Consult NEC and Local Codes

Figure 7. SCW(A) Electric Box Components & Electrical Data

ELECTRICAL LADDER DIAGRAM
SCW(A) UNIT
 230 VAC, SINGLE PHASE, 60 Hz
 [07-28-15]



- | | | | |
|--|--|---|---|
| <p>3W - 3 WAY VALVE SOLENOID
 CC - COMPRESSOR CONTACTOR
 CR - CONTACTOR RELAY
 CT - CLOCK TIMER
 DA - DIRECT AXES LOGIC
 HC - HEAT/COOL RELAY
 HP - HIGH PRESSURE LIMIT SWITCH
 HX - HEAT EXCHANGER
 LI - LOCK-IN FOR LOCK-OUT RELAY
 LP - LOW PRESSURE SWITCH
 LR - LOCK-OUT RELAY
 RC - RUN CAPACITOR
 RV - REVERSING VALVE SOLENOID</p> | <p>SC - START CAPACITOR
 SV1 - SOLENOID VALVE #1
 SV2 - SOLENOID VALVE #2
 TR - TIME RELAY (DPDT)
 WH - WATER HEATER RELAY (DPDT)
 WH1 - HWHX LINE TERMINAL 1
 WH2 - HWHX LINE TERMINAL 2
 WH3 - HWHX LINE TERMINAL 1
 WH4 - HWHX LINE TERMINAL 2
 DT - DISCHARGE THERMOSTAT
 OR - OIL RELAY
 AM - ANTI MIGRATION SOLENOID
 FP - FREEZE PROTECTION</p> | <p>NOTE: SEE APPLICATION MANUAL FOR APPROPRIATE WIRE SIZES.
 --- UTILITY FEED
 ——— LINE CIRCUIT
 - - - CONTROL VOLTAGE
 - - - - FIELD INSTALLED</p> | <p>ALL WIRING AND FIELD CONNECTIONS PER NEC OR LOCAL CODES</p> <p>⊗ AIR HANDLER UNIT TERMINAL
 □ THERMOSTAT TERMINAL UNLESS NOTED OTHERWISE</p> |
|--|--|---|---|

Figure 8a. SCW(A) Compressor Unit Ladder Diagram, 230-1-60

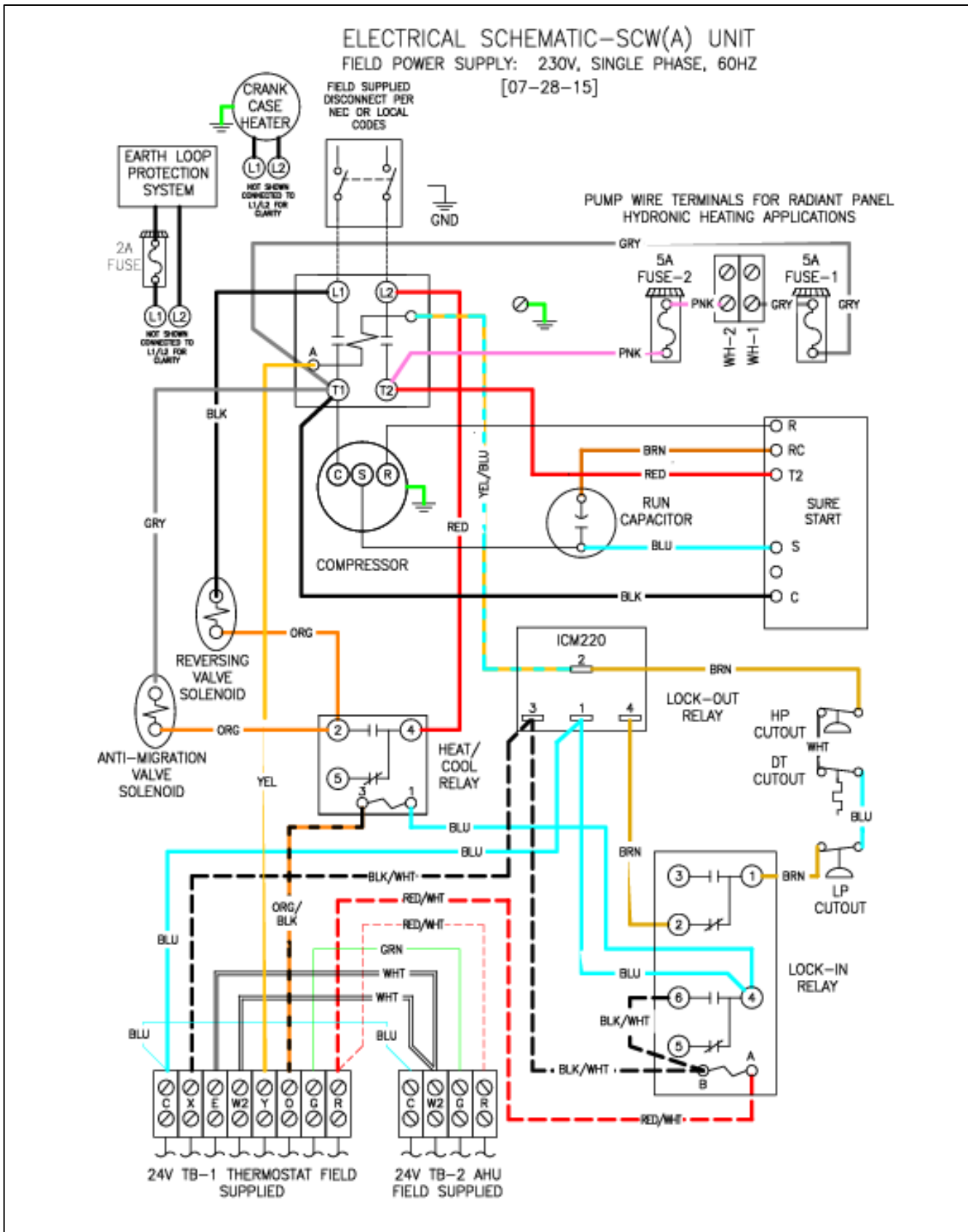
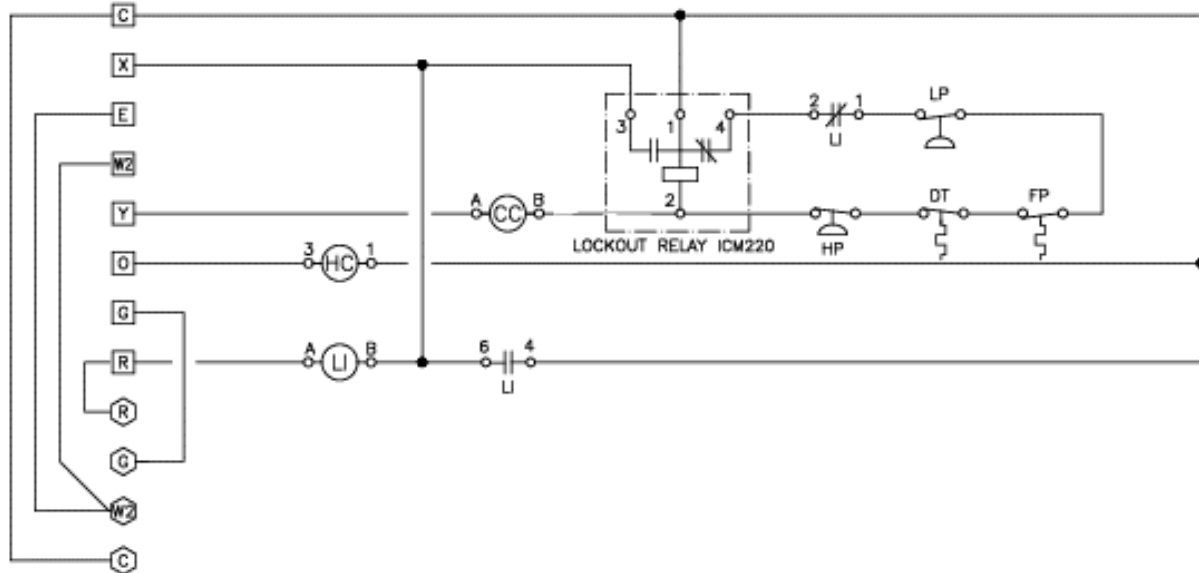
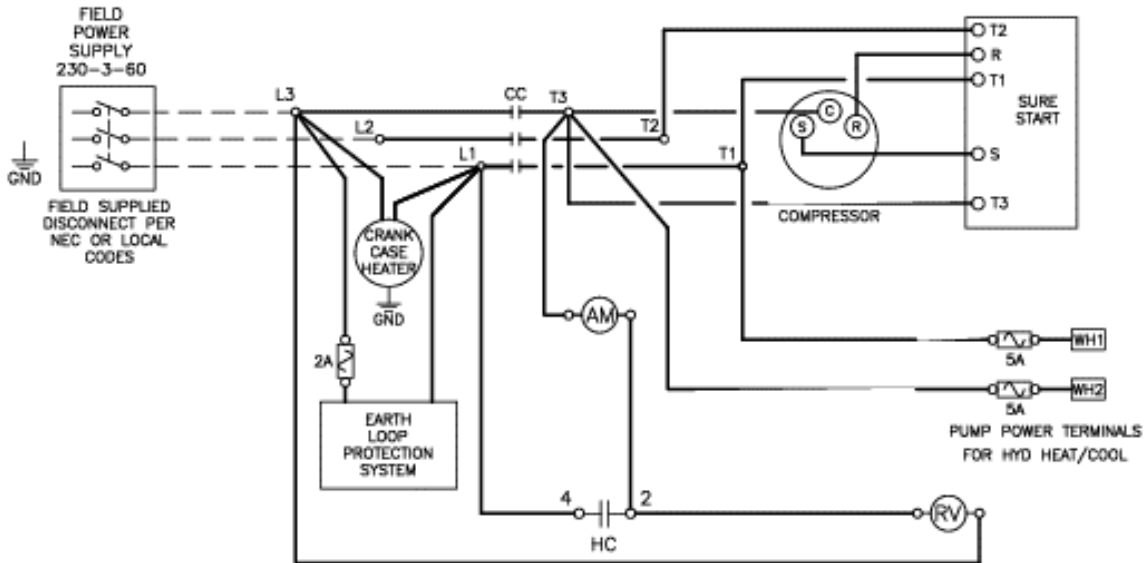


Figure 8b. SCW(A) Compressor Unit Electrical Schematic Diagram, 230-1-60

ELECTRICAL LADDER DIAGRAM
SCW(A) UNIT
 230 VAC, THREE PHASE, 60 Hz
 [07-28-15]



- JW - 3 WAY VALVE SOLENOID
- CC - COMPRESSOR CONTACTOR
- CR - CONTACTOR RELAY
- CT - CLOCK TIMER
- DA - DIRECT AXES LOGIC
- HC - HEAT/COOL RELAY
- HP - HIGH PRESSURE LIMIT SWITCH
- HX - HEAT EXCHANGER
- LI - LOCK-IN FOR LOCK-OUT RELAY
- LP - LOW PRESSURE SWITCH
- LR - LOCK-OUT RELAY
- RC - RUN CAPACITOR
- RV - REVERSING VALVE SOLENOID

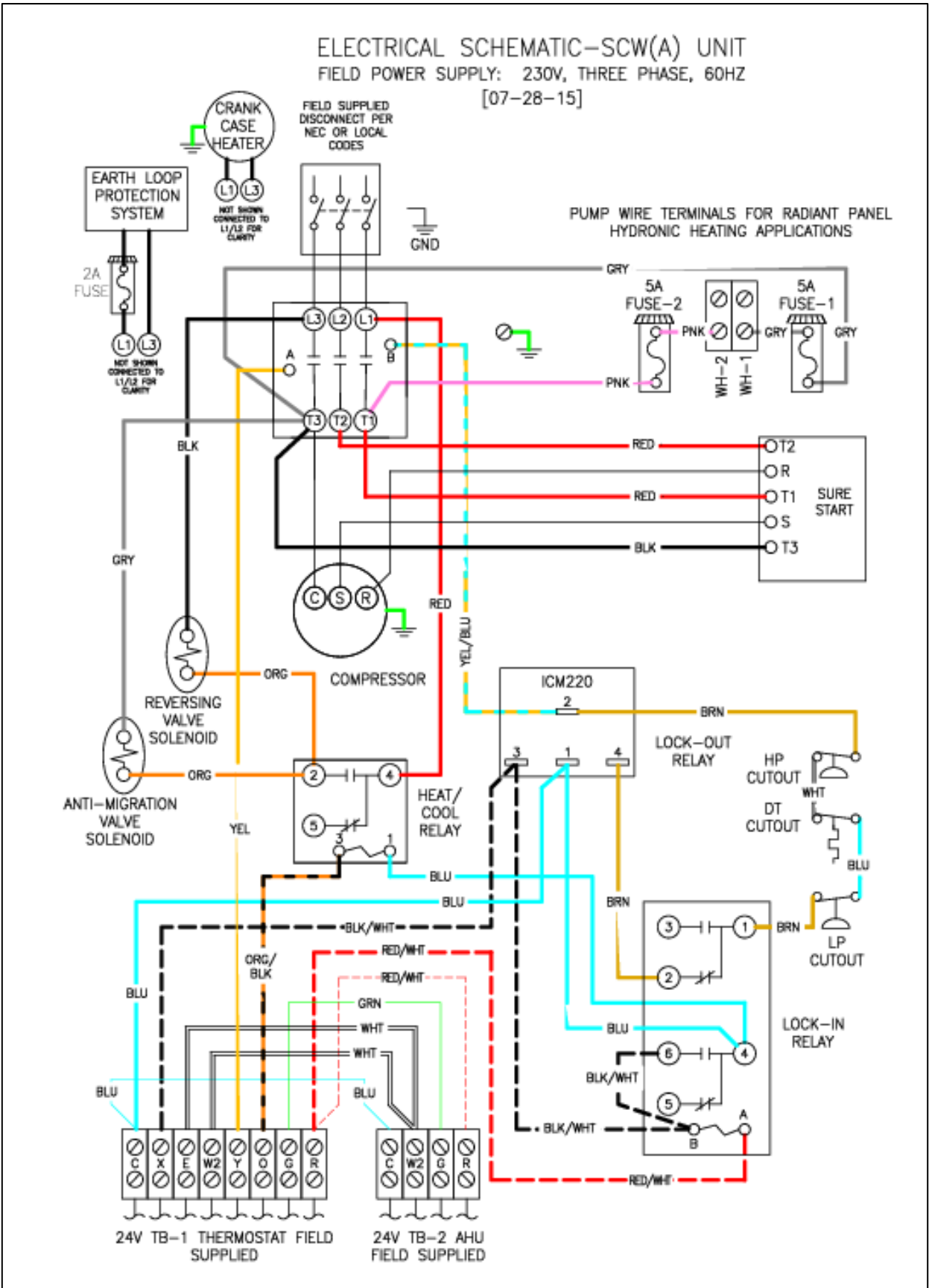
- SC - START CAPACITOR
- SV1 - SOLENOID VALVE #1
- SV2 - SOLENOID VALVE #2
- TR - TIME RELAY (DPDT)
- TR - TIME RELAY (DPDT)
- WH - WATER HEATER RELAY (DPDT)
- WH1 - HWHX LINE TERMINAL 1
- WH2 - HWHX LINE TERMINAL 2
- WH3 - HWHX LINE TERMINAL 1
- WH4 - HWHX LINE TERMINAL 2
- DT - DISCHARGE THERMOSTAT
- OR - OIL RELAY
- AM - ANTI MIGRATION SOLENOID
- FP - FREEZE PROTECTION

NOTE: SEE APPLICATION MANUAL FOR APPROPRIATE WIRE SIZES.
 --- UTILITY FEED
 — LINE CIRCUIT
 — CONTROL VOLTAGE
 - - - - FIELD INSTALLED

○ AIR HANDLER UNIT TERMINAL
 □ THERMOSTAT TERMINAL UNLESS NOTED OTHERWISE

ALL WIRING AND FIELD CONNECTIONS PER NEC OR LOCAL CODES

Figure 9a. SCW(A) Compressor Unit Electrical Ladder Diagram, 230-3-60



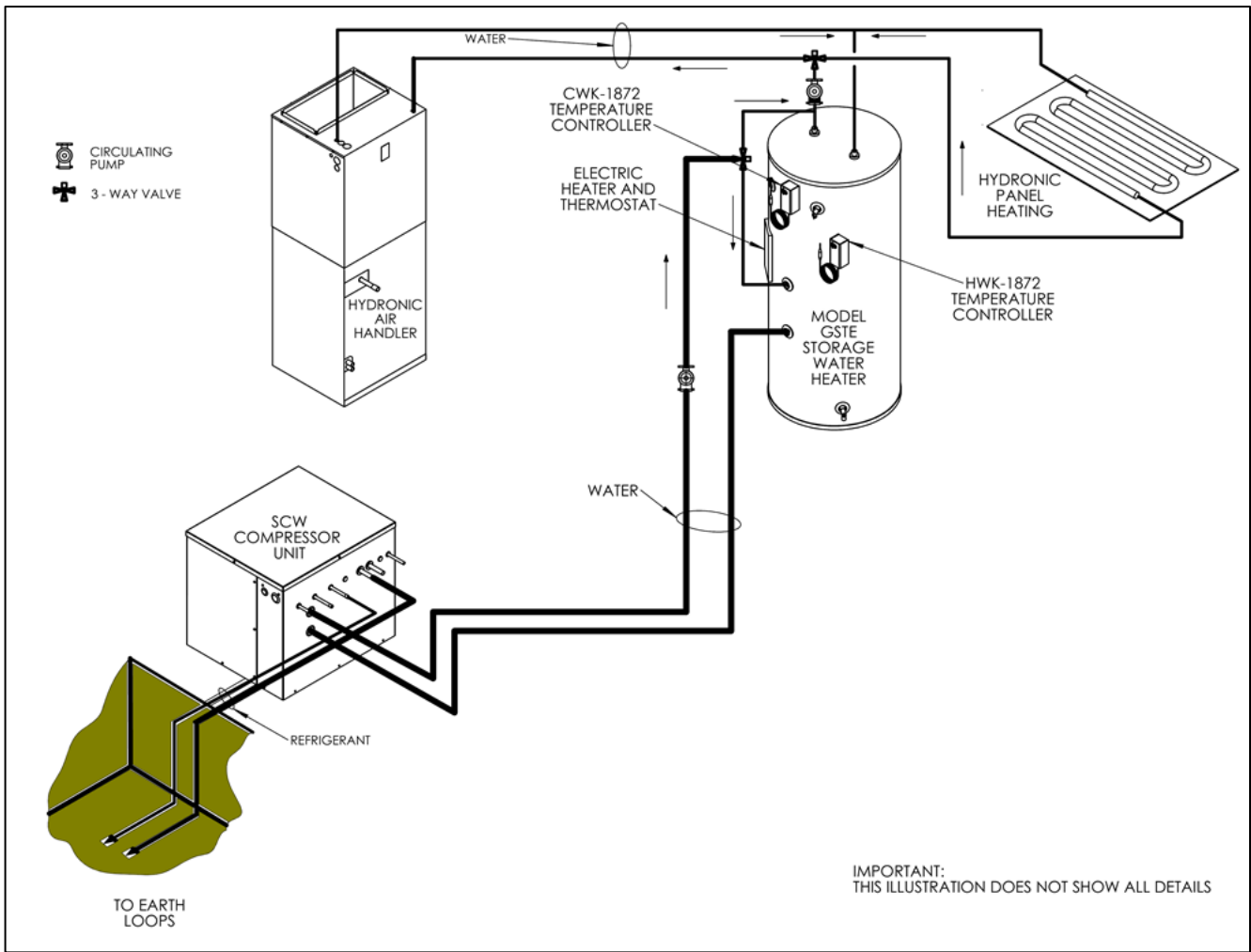


Figure 10a. SCW(A) Hydronic Heating/Cooling System Application

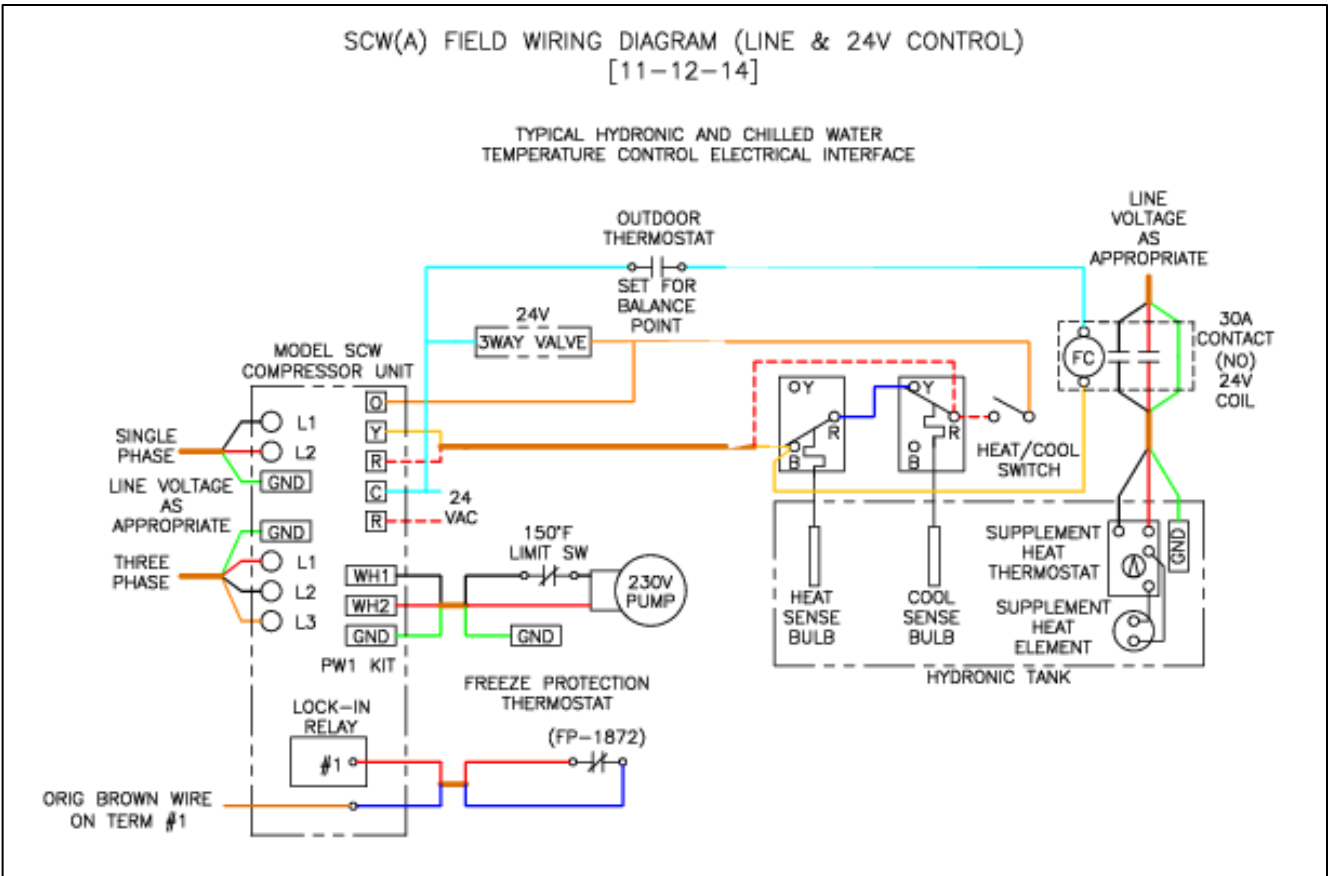


Figure 10b. SCW(A) Hydronic Heating/Cooling System Field Wiring Diagram

SureStart

Features

SureStart is a factory installed soft starter that reduces light flicker caused at start-up by scroll compressor motors. This control has the following features:

- 60 to 70% reduction in direct in-rush current
- Under voltage protection
- Motor reversal protection
- Self-adjusts for optimal start performance
- 50/60 Hz compatible
- ETL, CE, EMC and RoHs compliant
- Tolerant to “dirty power” conditions
- Fault LED
- Internal current limiting

SureStart is factory wired for the appropriate power supply.

Operation

When the system control calls for compression operation, the compressor contactor will energize. If the supply voltage is less than “minimum start-up voltage”, a 50 second delay is initiated. At the end of the delay, another attempt will be made to start the compressor unless the supply voltage remains unchanged. See Figure 10c for the SureStart Mode of Operation.

SureStart uses an optimized starting process that learns the starting characteristics of the compressor to further refine the starting cycle on each recurring start.

If the compressor fails to start, the module will terminate the start attempt after 1 second and initiate a 3 minute lockout before attempting a restart.

While the compressor is running,, if supply voltage falls below the “shutdown on low voltage” limit for 2 seconds, SureStart will stop the compressor and initiate a 3 minute lockout. A restart will be initiated after 3 minutes if the supply voltage is equal to or greater than the “minimum startup voltage”. This is done to protect the compressor against a sudden drop in supply voltage.

SureStart is able to detect an interruption in power, when the interruption is 0.1 seconds or longer. When a power interruption is detected, it will shut down the compressor for 3 minutes. A power interruption that is shorter than 0.1 seconds may result in the compressor running backwards.

SureStart is able to determine if the compressor is running backwards. If this condition is detected, the control will stop the compressor for 3 minutes before restart is initiated.

If the run capacitor is faulty or has failed, SureStart will shut down the compressor for 3 minutes before initiating a restart.

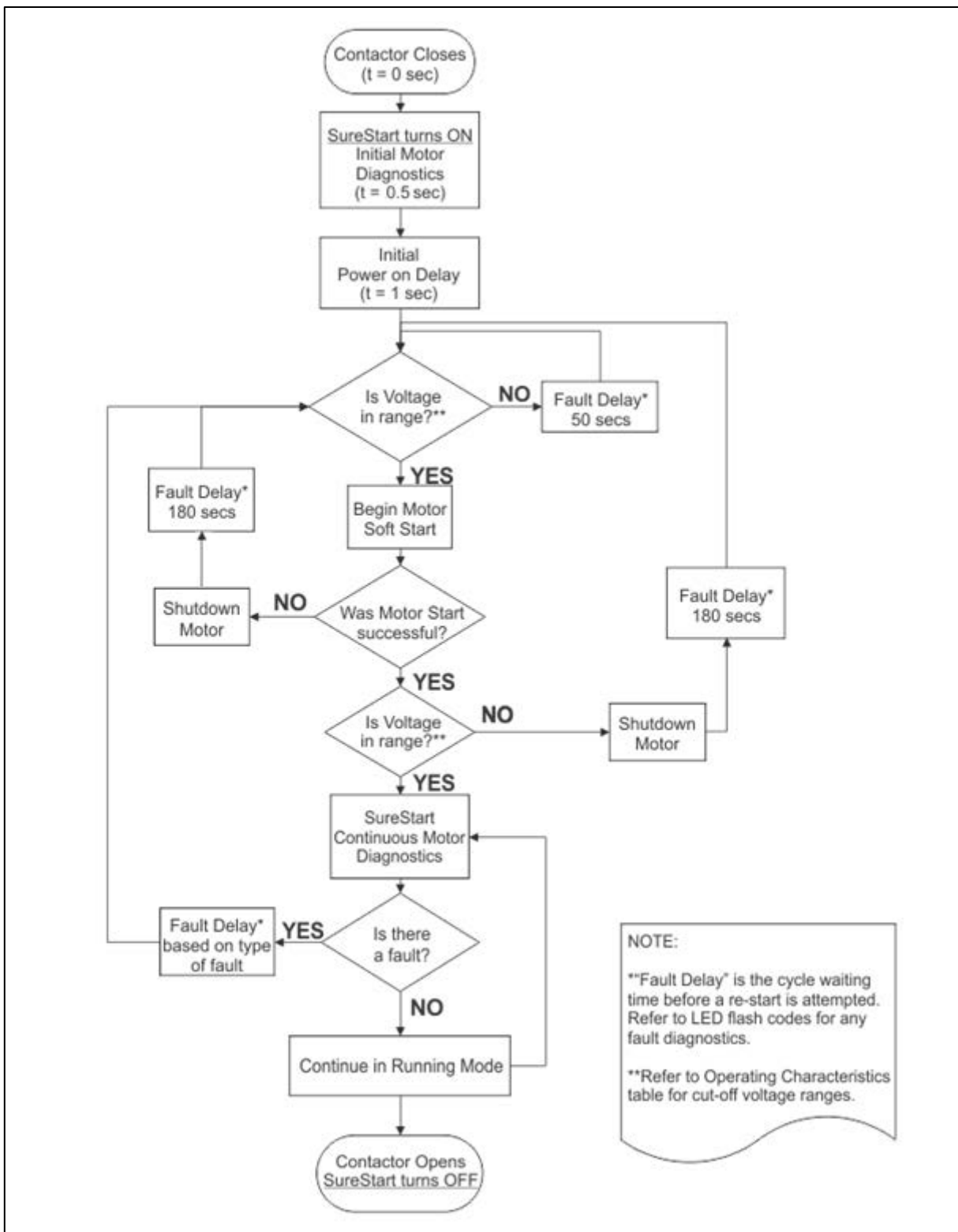


Figure 10c. SureStart Mode of Operation

Flash Codes – Single Phase

LED Flash Codes

A Red LED indicator will flash under the following conditions. [NOTE: LED fault indicator is turned off in normal running mode.]

- a) Rapid Flash (10 / sec) : Low Voltage
- b) Triple Flash Every Three Seconds (3 / 3 secs): Lockout on Three Failed Starts
- c) Slow Flash (1 / 3 secs): Lockout on Over Current
- d) Slow Steady Flash (1 / sec): Cycle Delay / Fault Mode

Flash Code (Rapid Flash (10 / sec) : Low Voltage)

- Displayed for “Low supply voltage” before or after a softstart.
- If Low voltage is detected before a start, a re-start is attempted after 50 seconds.
- If Low voltage is detected after a start, a re-start is attempted after 3 minutes.

Flash Code (Triple Flash every three seconds (3 / 3 secs): Lockout on Three Failed Starts)

- Displayed after failure to start on “Three consecutive start attempts”.
- Re-start is attempted after 50 minutes.
- Standard lockout period is revised to 3 minutes after a successful start.

In circumstances where the compressor may have seized or is unable to startup due to failure of other components in the HVAC system, the software will check for three consecutive failed starts. On the third sequential failed start, the program goes into Lockout for 50 mins. On failing to get a good start even after 50 mins, it will re-attempt start again after duration of 50 mins. Once a good start is eventually achieved, it will reset the hardstart counter and will require 3 failed starts again to force it back into Lockout mode. Lockout can be cleared anytime through a power reset of the SureStart device.

Flash Code (Slow Flash (1 / 3 secs): Lockout on Overcurrent)

- Displayed for “Overcurrent” in running mode of the compressor motor.
- Overcurrent limit is “25A for 08-16A version” and “50A for 16-32A rated version”.
- Also displayed, if internal Klixon of the compressor trips out on overheat.
- Re-start is attempted after 10 minutes.

To limit the current in compressors from extending abnormally beyond its stated capacities, SureStart is also equipped with Overcurrent limit protection. For models rated from 16-32A, SureStart is designed to trip out in overload conditions exceeding 50A. In smaller models, it is designed to cutoff power to the compressor if the current drawn exceeds 25A. On overcurrent lockout, SureStart attempts a re-start automatically after 10 minutes.

Both failed start lockout and overcurrent limit protection have been designed to prevent the compressor from drawing abnormal currents in conditions not feasible for the compressor operation.

Flash Code (Slow Steady Flash (1 / sec): Cycle Delay / Fault Mode)

- Displayed for “Cycle delay” between two consecutive softstarts or other faults mentioned below.
- Re-start is attempted after a default period of 3 minutes.
- Other possible reasons for this Fault mode indicator can be due to
 - incorrect wiring during installation,
 - a failed Softstart attempt,
 - intermittent power loss (duration longer than 100ms),
 - frequency out of range, or
 - failed run capacitor.

Flash Codes – Three Phase

A Red LED indicator will flash under the following conditions. [NOTE: LED fault indicator is turned off in normal running mode.]

- a) Reverse Phase: (1 / 2 secs)
- b) Fault Mode/Cycle Delay: (1 / 4 secs)
- c) Low Voltage/Over Voltage: 2 / 2 secs)

Flash Code (Reverse Phase: (1 / 2 secs))

- Displayed if the supply “Phase Sequence” gets reversed before or after a start.
- Re-start is attempted after 3 minutes.

Flash Code (Fault Mode / Cycle Delay: (1 / 4 secs))

- Displayed for “Cycle delay” between two consecutive softstarts or other faults mentioned below.
- Re-start is attempted after a default period of 3 minutes.
- Other possible reasons for this Fault mode indicator can be due to
 - a failed Softstart attempt,
 - intermittent power loss (duration longer than 100ms),
 - frequency out of range

Flash Code (Low Voltage / Over Voltage: (2 / 2 secs))

- Displayed for “Low supply voltage” or “High supply voltage” before or after a softstart.
- If voltage is out of range before a start, a re-start is attempted after 50 seconds.
- If voltage is out of range after a start, a re-start is attempted after 3 minutes.

Plumbing

A typical primary hydronic plumbing circuit for an SCW(A) system is illustrated in Figure 11..

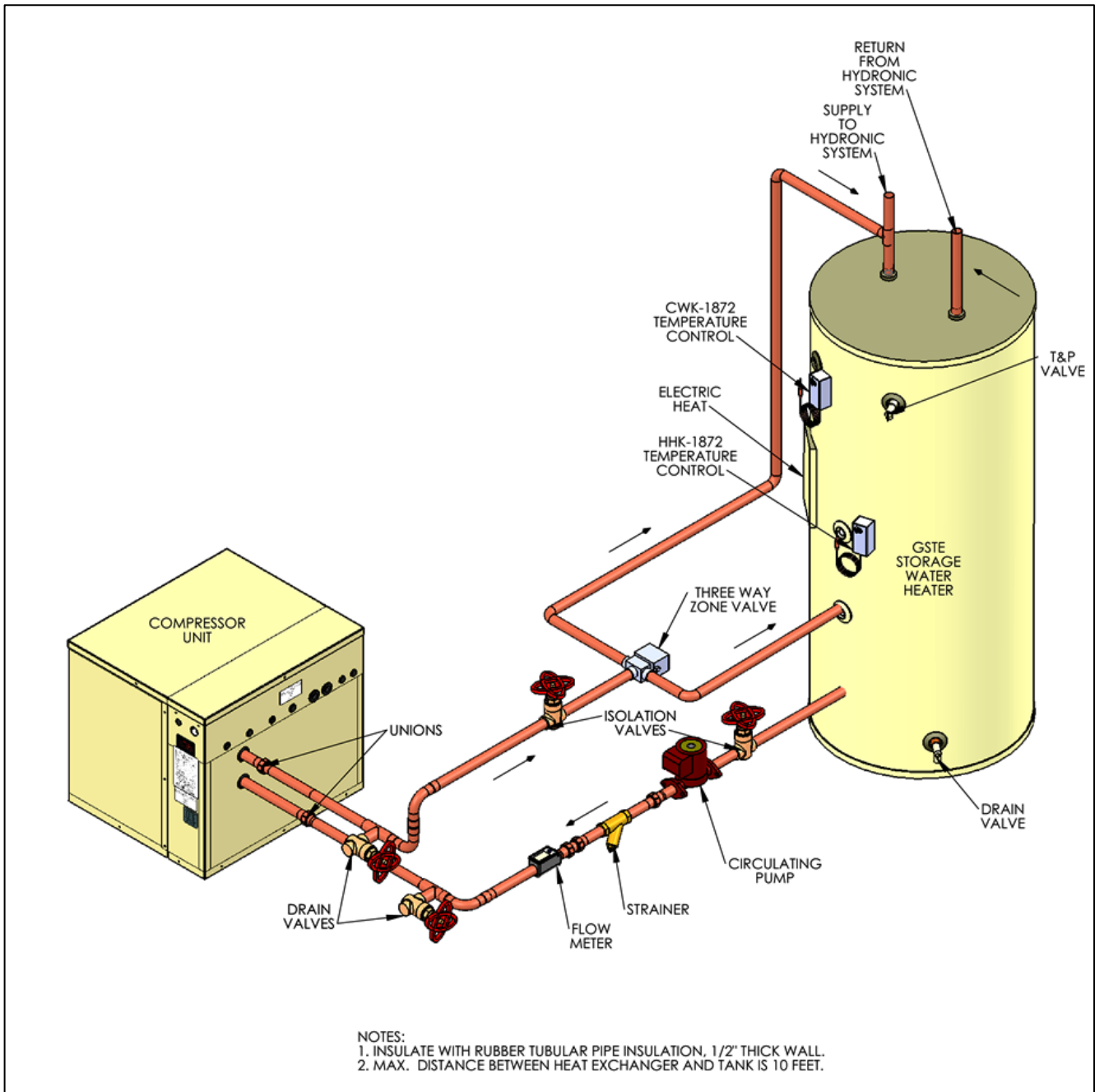


Figure 11. Typical SCW(A) Primary Hydronic Circuit Plumbing

The components are as follows:

1. **Circulating Pump:** The recommended field supplied circulating pump is a Grundfos model UP-26-116BF-60 Hz, and must supply a **design (minimum) water flow rate of 3 gpm per nominal ton** of refrigeration for the system to perform properly. This **flow rate will be adjusted upward** to maintain system heat transfer performance for the specific antifreeze mixture. See the section entitled **Anitfreeze Protection** for details.

2. **Flowmeter:** Model ETI-A1-116000-1 hydronic water/antifreeze solution flowmeter is available from ETI and is field calibrated for the specific antifreeze mixture. The kit includes calibration equipment.
3. **Three-Way Zone Valve:** This electrically operated zone valve is a commercially available hydronic system component that directs the hydronic fluid flow in response to the system operating mode, either heating or cooling.
4. **Strainer:** Models ST-1836 (for 1.5 thru 3.0 ton systems) and ST-4272 (for 3.5 thru 6.0 ton systems) are 20 mesh, brass, inline strainers, available from ETI and necessary to trap particles and maintain proper flow through the brazed plate heat exchanger channels.
5. **Temperature Controller:** Model HHK-1872 is a hydronic heating controller and Model CWK-1872 is a chilled water temperature controller. These controllers can be mounted remotely and come with a capillary tube 6 feet long, thermal bulb, thermal paste and the NPT thermal well insert and are available from ETI.
6. **Storage Water Heater:** The GSTE Series storage water heaters are available from ETI in 60, 80 and 119 US Gallon capacities, and are designed for use with the EarthLinked® geothermal systems. They are equipped with a 4.5 kW supplemental heater which satisfies the ETI requirement for a minimum of 20% supplemental heat.
7. **Other Plumbing Components and Parts:** Gate valves, unions, copper pipe, pipe insulation, etc. meeting USA industry and local code standards are commercially available through plumbing supply outlets.

All plumbing installations are to be in accordance with the applicable local and national codes.

To protect the brazed plate heat exchanger from damage during cooling operation when the heat exchanger is producing chilled water, a factory installed thermal switch at the outlet of the heat exchanger will turn the compressor OFF when the chilled water temperature drops to 38°F. An auxiliary lower temperature thermostat is available. It is field ordered and installed.




WARNING!

The heat exchanger must be isolated from the water system when the system undergoes a “superchlorination” or “shock chlorination” flushing process. Cleaning the isolation valves prior to initiating the system flushing process isolates the heat exchanger. The water entering the heat exchanger after the system flushing must not exceed a chlorine level consistent with the local municipal water purification standards. Failure to isolate the heat exchanger will damage the heat exchanger causing system failure. Allowing highly chlorinated water to enter the heat exchanger will void the EarthLinked® Limited Warranty.

Antifreeze Protection

When **SCW(A) Compressor Units** are applied to radiant panel hydronic heating and/or cooling systems, the water circulating system must be protected from potential damage due to freeze-up by utilizing an adequate antifreeze solution. The antifreeze protection is provided by the installer prior to the EarthLinked® system start-up.




IMPORTANT!

FAILURE OF THE INSTALLER TO PROVIDE ADEQUATE ANTIFREEZE SOLUTION PROTECTION IN EARTHLINKED® RADIANT PANEL HYDRONIC HEATING AND/OR COOLING SYSTEMS AT THE TIME OF SYSTEM START-UP WILL VOID THE EARTHLINKED® LIMITED WARRANTY FOR HEATING AND COOLING SYSTEMS.

Propylene-glycol antifreeze solution with an inhibitor is the type of antifreeze solution required for Earthlinked® products utilized in radiant panel hydronic heating and/or cooling systems. These systems shall be freeze protected consistent with the application -specific minimum temperature, as shown in the table below. Propylene-glycol antifreeze solutions should always be in the range of 20% to 50% by volume, as indicated in the table.


TEMPERATURE, °F	PROPYLENE GLYCOL, %	WATER SOLUTION MULTIPLIER FACTOR (WSMF)
18	20	x 1.03
8	30	x 1.07
-7	40	x 1.11
-29	50	x 1.16

Propylene Glycol Freeze Protection Table



IMPORTANT!

Because addition of propylene-glycol to water changes the specific heat of water, the required flow rate of propylene-glycol solution (for the same heat transfer as water) must be increased by the water solution multiplier factor shown in the table above.



WARNING!

ALWAYS REMOVE THE ANODE ROD(S) FROM THE STORAGE WATER TANK OR HEATER UTILIZED IN A RADIANT PANEL HYDRONIC HEATING AND/OR COOLING SYSTEM. IF THE ANODE ROD(S) ARE NOT REMOVED, THE PROPYLENE-GLYCOL SOLUTION WILL REACT WITH THE ANODE ROD(S) TO CREATE PARTICLES THAT BLOCK FLOW AND CAUSE SYSTEM FAILURE.

Propylene-glycol can be purchased in the straight form and mixed with an inhibitor prior to filling the system, or it can be purchased as inhibited propylene-glycol. The following are examples of manufacturers for the above:


Straight propylene-glycol: Chemical Specialties, Inc. (www.chemicalspec.com/spg.html)


Inhibitor: Nu-Calgon Products, Ty-Ion B20 (www.nucalgon.com/products)

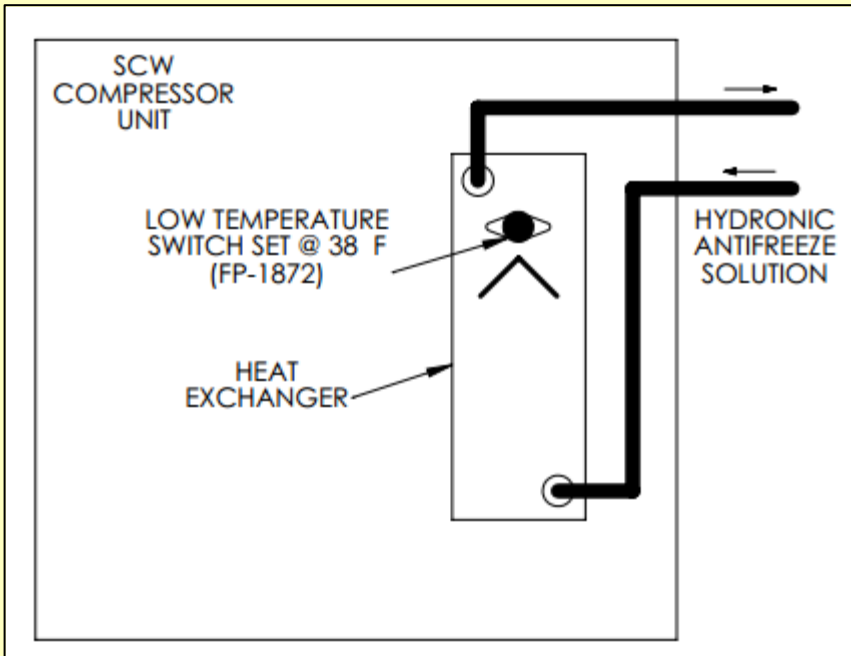
Inhibited propylene-glycol: Houghton Chemical Corp., SAFE-T-THERM®, www.houghton.com/fluids/safe-t-therm/index.html)

General guidelines for introducing propylene glycol into the water circulating system follow. The manufacturer's specific instructions and industry standards always take precedence when introducing propylene-glycol to the system.

- Calculate the quantity of inhibited propylene-glycol (fluid) required to achieve the desired results.
- Introduce a sufficient quantity of water to the system and pressure check to ensure a sealed system.
- Drain some water from the system to provide enough volume for the calculated amount of fluid.
- Add the correct amount of fluid and any water needed to completely refill the system, allowing for liquid expansion due to operating temperature.
- Circulate the inhibited propylene-glycol antifreeze solution for at least 24 hours to ensure complete mixing. Check the liquid concentration to assure that the correct mixture is obtained.

 **IMPORTANT!**
Always follow the propylene-glycol manufacturer's instructions concerning the water quality specifications before filling the water circulating system.

 **IMPORTANT!**
Freeze protection is provided on all SCW compressor units by means of a factory installed thermal switch that turns the system OFF when heat exchanger outlet water drops to 38°F.



The diagram illustrates the internal components of an SCW compressor unit. It shows a rectangular box labeled 'SCW COMPRESSOR UNIT'. Inside, a 'HEAT EXCHANGER' is depicted as a vertical rectangle. A 'LOW TEMPERATURE SWITCH SET @ 38 F (FP-1872)' is shown as a circular component with a stylized human figure icon, positioned to the left of the heat exchanger. Two thick black lines represent the 'HYDRONIC ANTIFREEZE SOLUTION' loop. One line enters the top of the heat exchanger and exits the top of the SCW compressor unit. The other line enters the bottom of the heat exchanger and exits the bottom of the SCW compressor unit. Arrows on these lines indicate the direction of flow.

Earth Loop Protection System

Anode Wire Installation

Prior to this, the below grade installation of the DIRECT AXCESS® Earth Loop System, including the Earth Loop Protection System anode and anode wire has been completed per the **Earth Loop Protection Kit Manual**, and at this point the anode wire is ready to be connected to the compressor unit.

The earth loop protection system connection to the anode wire is on the back side of the compressor cabinet as illustrated in Figure 12, showing the electrical **socket** with the **sealing cap**.

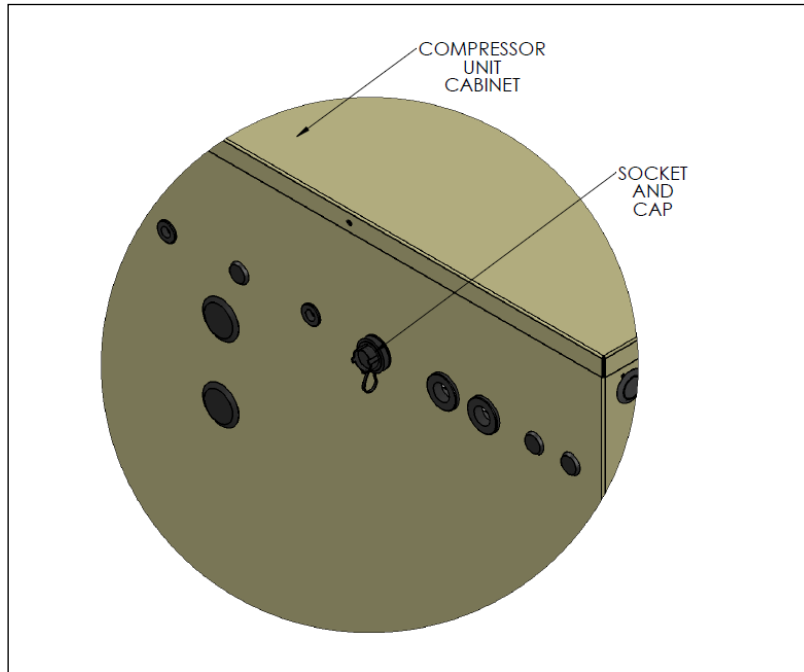


Figure 12. Compressor Cabinet Socket/Cap

The EPS-KIT contains the plug connector, which will be field assembled and connected to the anode wire.



WARNING!

All power of the EarthLinked® System is to be shut OFF at the disconnect while field wiring the Earth Loop Protection System. Failure to do so may result in serious injury or death, or equipment or property damage.

The steps to install the **anode wire** to the **plug connector assembly** are as follows.

Remove the **sealing cap assembly tool** from the compressor unit cabinet shown in Figures 12 and 13. Using the **sealing cap assembly tool**, as shown in Figure 13, unscrew the **locking ring** from the **plug connector assembly** to access the **plug insert**. Then, remove the **gland nut, gland cage, and gland** from the other end of the **plug body** as shown in Figure 13.



Figure 13. Disassembled Plug Connector

Strip the insulation from the multi-strand anode wire back approximately $\frac{3}{4}$ inch from the end and while keeping the strands together, push the anode wire through the **gland nut, gland cage, gland** and **plug body** as shown in Figure 14. Loosen one of the two screw terminals on the **plug insert** to receive all of the strands of anode wire on one terminal.

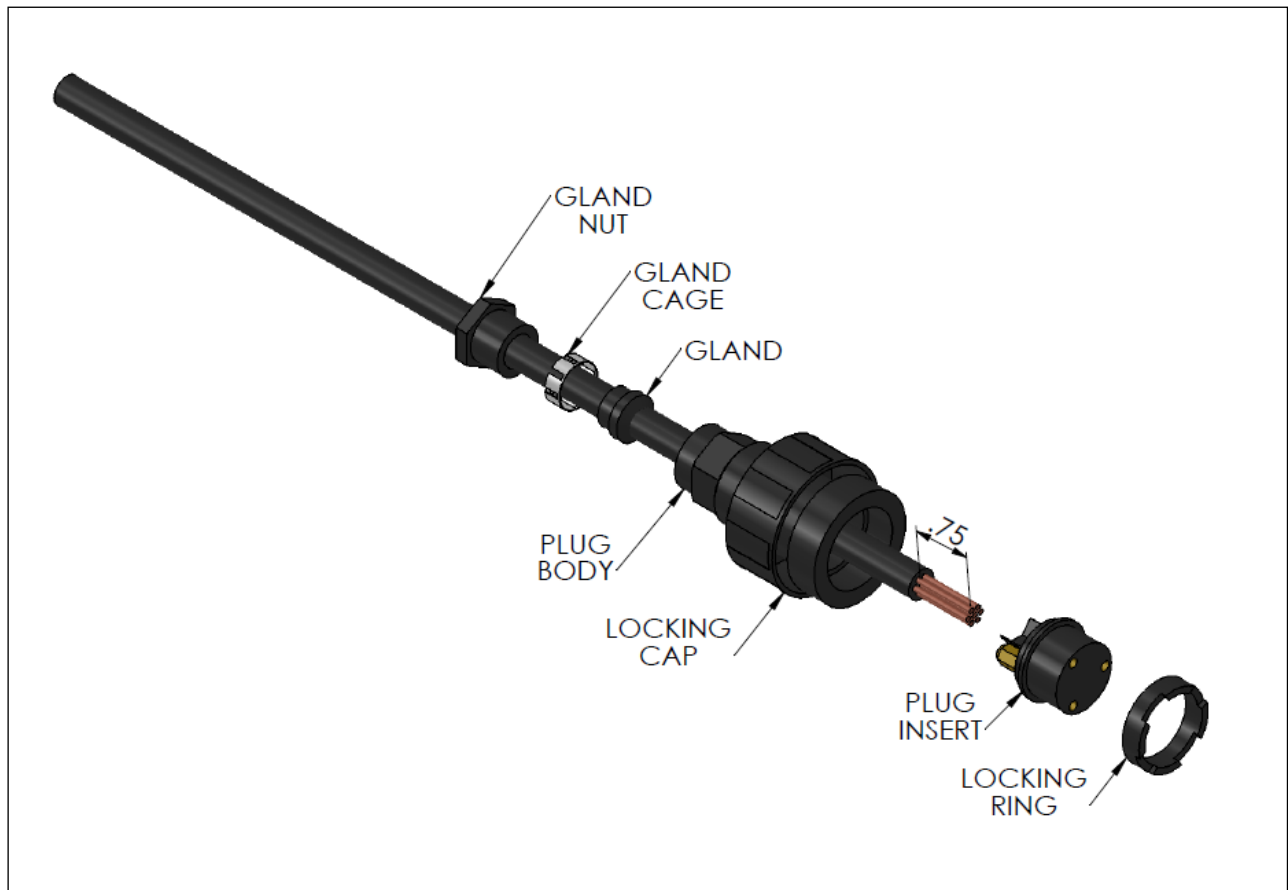


Figure 14. Anode Wire Insertion

After inserting all strands of the anode wire into one of the terminals on the **plug insert**, tighten the wire in place by tightening the screw on that terminal. Once tightened, push the **plug insert** back into the **plug body** as shown in Figure 15 until it is firmly seated. Engage the **locking ring** with threads in the **plug body** and turn clockwise with the **sealing cap assembly tool** until the **lock ring** is firmly seated and tight against the **plug insert**.

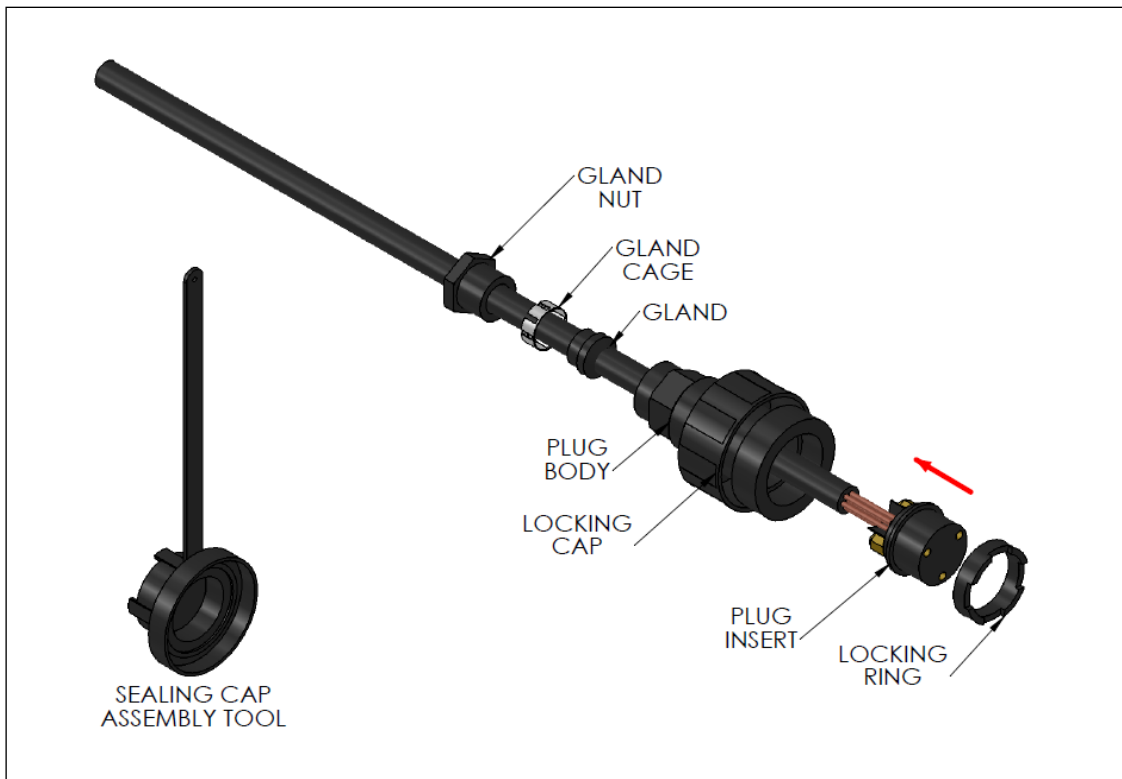


Figure 15. Install the Plug Insert

Slide the **gland** forward on the anode wire until it is firmly seated in the **plug body** as shown in Figure 16. Next, slide the **gland cage** over the **gland**, and slide the **gland nut** firmly against the **gland cage**, with the **gland nut** against the **plug body**. Engage the threads of the **gland nut** with those inside **the plug body** and manually thread the **gland nut** clockwise by hand.

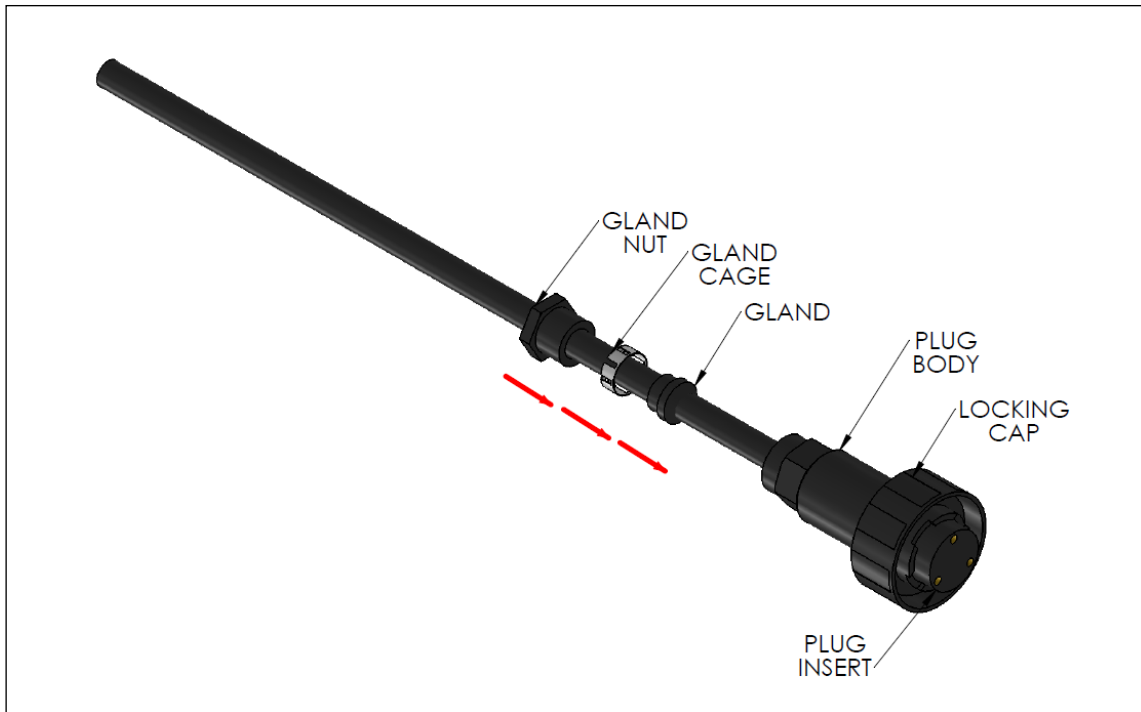


Figure 16. Engage the Gland Nut

Once the **gland nut** has been hand tightened into the **plug body**, use two adjustable wrenches to further tighten the **gland nut** until it is snug in the **plug body** as shown in Figure 17 and the anode wire is held firmly in the **plug body** and will not slip out. **Do not over-tighten the gland nut!**

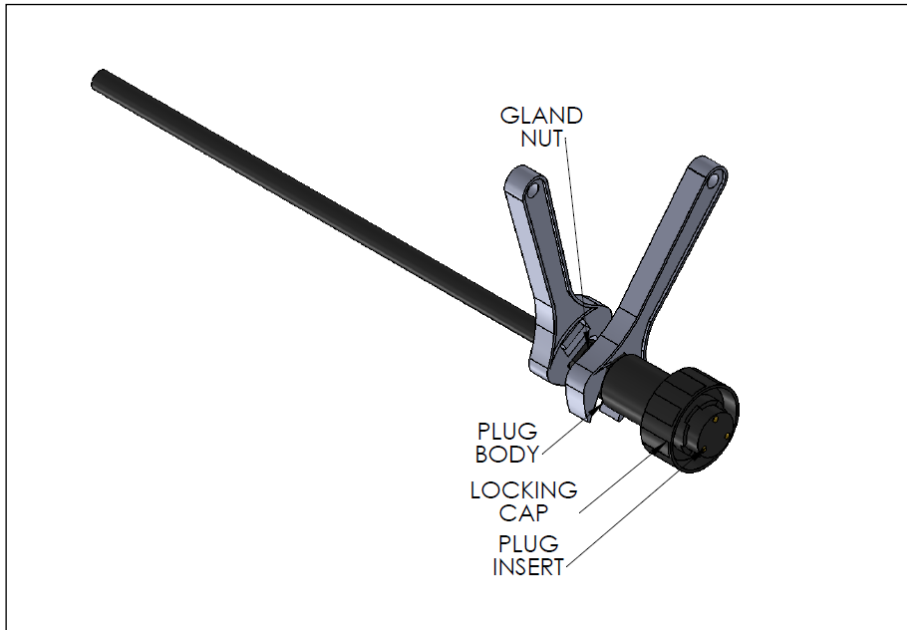


Figure 17. Secure the Anode Wire.

After the **plug** and anode wire have been assembled, re-connect the **sealing cap assembly tool** to the **socket** on the compressor unit cabinet. After aligning the electrical contact pins, manually engage the threads on the **plug locking cap** with the threads on the **socket** and turn clockwise until the **plug** is firmly hand-tightened to the **socket** as shown in Figure 18. **If the anode wire rises away from the compressor cabinet**, be sure to shape a drip loop into the contour of the anode wire near the **plug** and **socket**.

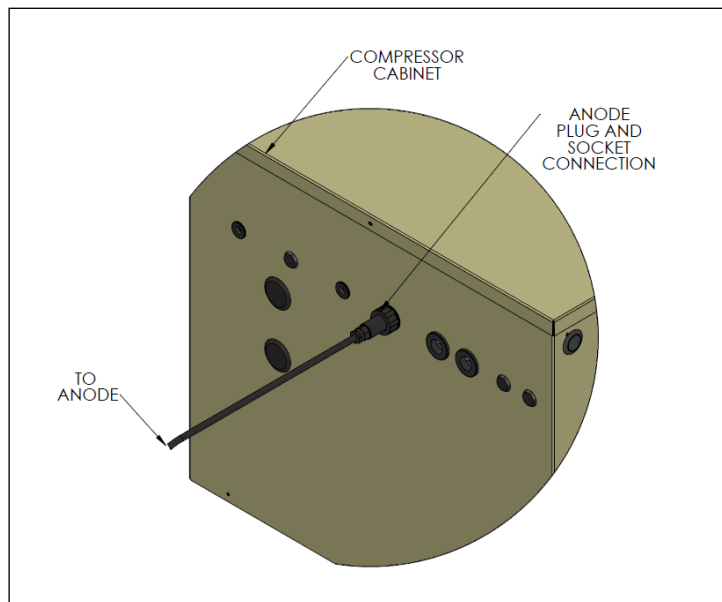


Figure 18. The Plug and Socket Joint

After the **plug** and **socket** joint is secured, the power may be turned **ON** at the disconnect.

EPS Operation and Service

Reference Figure 19 for the EPS components in the compressor unit electric box.

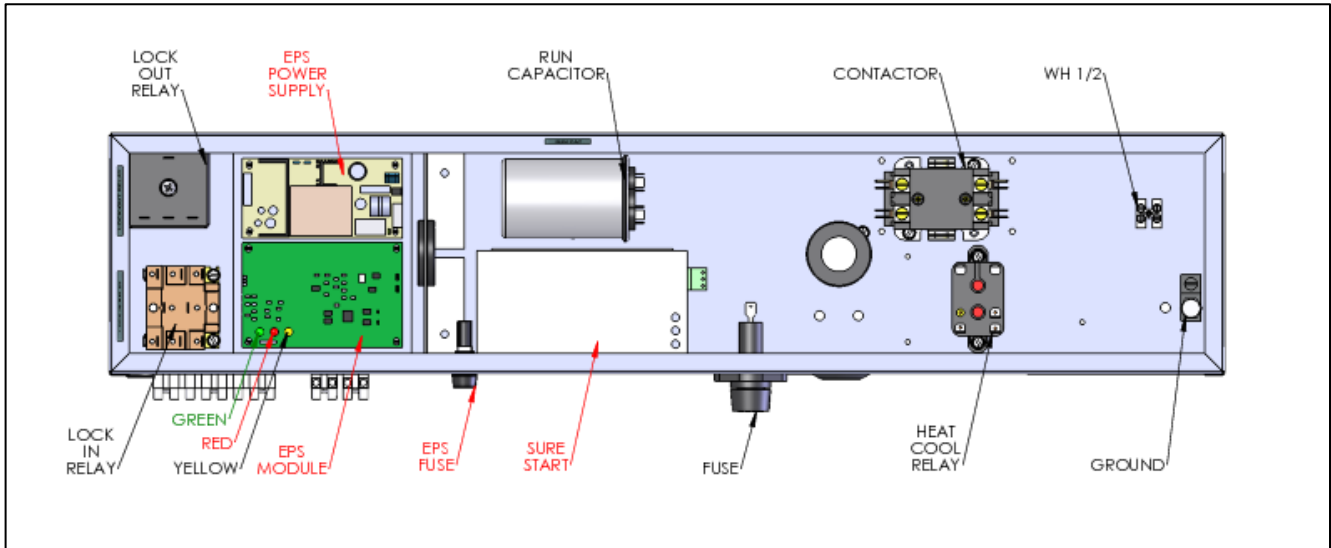


Figure 19. Electric Box with EPS Components

With power **ON**, and viewing the EPS Module in the compressor unit electric box, the EPS **green light** should be illuminated, indicating there is power to the EPS system.

If the **yellow light** is illuminated, **there is an opening** in the earth loop electrical circuit. The audible signal will also be heard. After shutting power **OFF**, all electrical connections from the EPS module to the earth loop system should be checked and adjusted as appropriate to ensure good electrical contact.

If the **red light** is illuminated, **there is a short** in the earth loop electrical circuit. The audible signal will be heard. Check and correct all wiring and connection as appropriate from the EPS module to the earth loop to ensure they are not shorting.

If **none of the lights** are illuminated, check and replace, as appropriate, the fuse for the EPS Power Supply as shown in Figure 19. For service purposes, a spare fuse has been factory supplied and is located in the electrical box. The replacement fuse is **Littlefuse 213 Series Slo-Blo®** rated at **250 Volts, 2 Amperes, P/N 0213002MXP**. This is also Allied Electronics Stock Number R1090710.

If it is necessary to operate the heating and cooling system while the EPS is down for service, the EPS power may be temporarily disengaged to eliminate the audible alarm, by removing the EPS Fuse shown in Figure 19. Upon completion of servicing the EPS, replace the fuse to energize the EPS system and maintain warranty coverage.



IMPORTANT!


DO NOT troubleshoot the EPS power supply or EPS module! If the above steps do not resolve the problem, call ETI for technical service assistance at 1-863-701-0096.

Current Verification

If it is necessary to verify the current flow through the EPS system, it can be checked with a digital DC ammeter set on the Milliampere scale. The correct currents for nominal system capacities are listed in Figure 20.

Nominal System Capacity, Tons	Current Rating
1.5 thru 2.5	80 mA +/- 10%
3.0 thru 3.5	120 mA +/- 10%
4.0 thru 6.0	240 mA +/- 10%

Figure 20. EPS Current Ratings



WARNING!

Use extreme caution when checking current through the EPS system. Turn OFF the main disconnect to the compressor unit when setting up the Ammeter for the current measurement. Turn the power supply on only after the Ammeter is in place for the measurement and hands and body are clear of all electrical circuit conductors. Turn OFF the main disconnect after the current measurement has been taken and before attempting to disengage the Ammeter and re-connect the EPS wiring. Failure to do this, could cause personal injury or death.

To check the current, disconnect the “**Loop**” wire from the EPS module as shown in Figure 21 and connect the DC ammeter as shown to measure and verify the current flow.

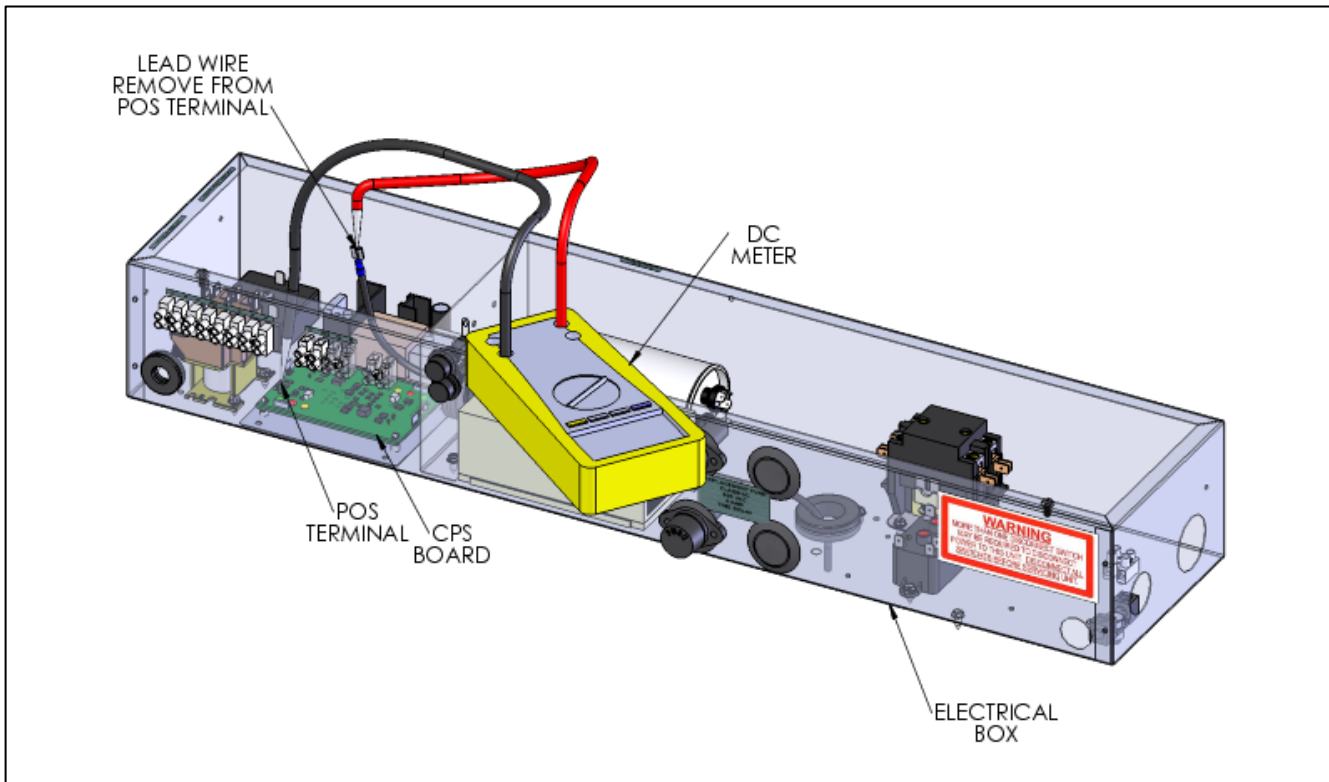


Figure 21. Test for DC Current

Start-Up Process

System Leak Check



CAUTION!

During the Evacuation and Initial Charging processes, be sure that **ALL** power to the EarthLinked® System is **OFF**. This includes the compressor unit, air handler and all other electrically powered system components. Failure to do so will cause lockout on start-up.

After all indoor and outdoor refrigerant bearing components of the system have been installed and joints have been nitrogen brazed, pressurize the system prior to evacuation to leak test the system.

Do not exceed 150 psig when pressure testing the compressor unit and indoor system components.

Test for leaks with a sensitive electronic leak detector and bubble solution.

Repair leaks as appropriate prior to evacuation.

Evacuation and charging of the system is done through the compressor unit. All of the refrigerant containing components in the compressor unit are illustrated in Figures 22 and 23.

The Start-up Process is illustrated in Figure 33.

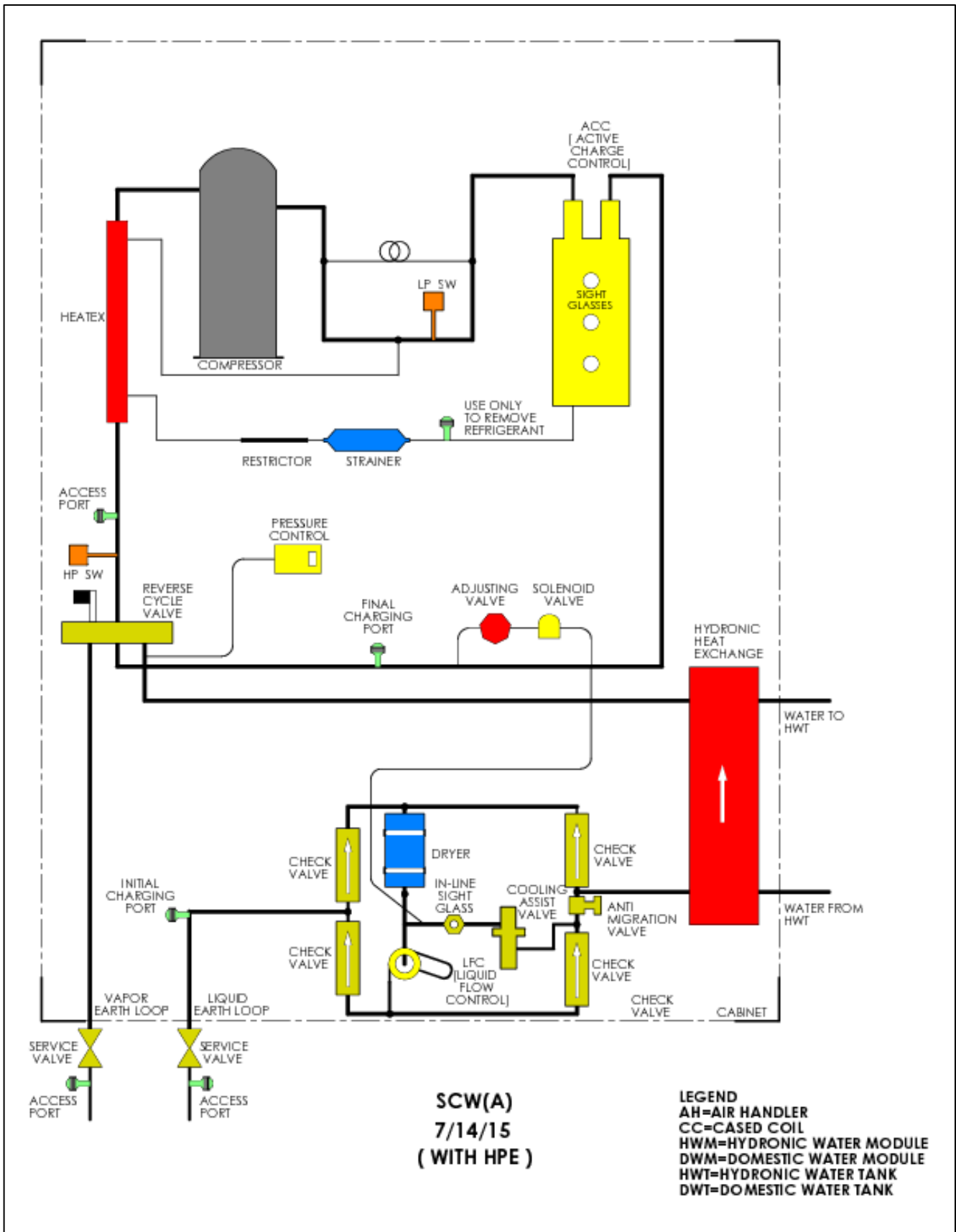


Figure 22. SCW(A) Internal Flow Schematic (with HPE control)

MODEL SCW(A) COMPRESSOR UNIT PIPING 7/27/15

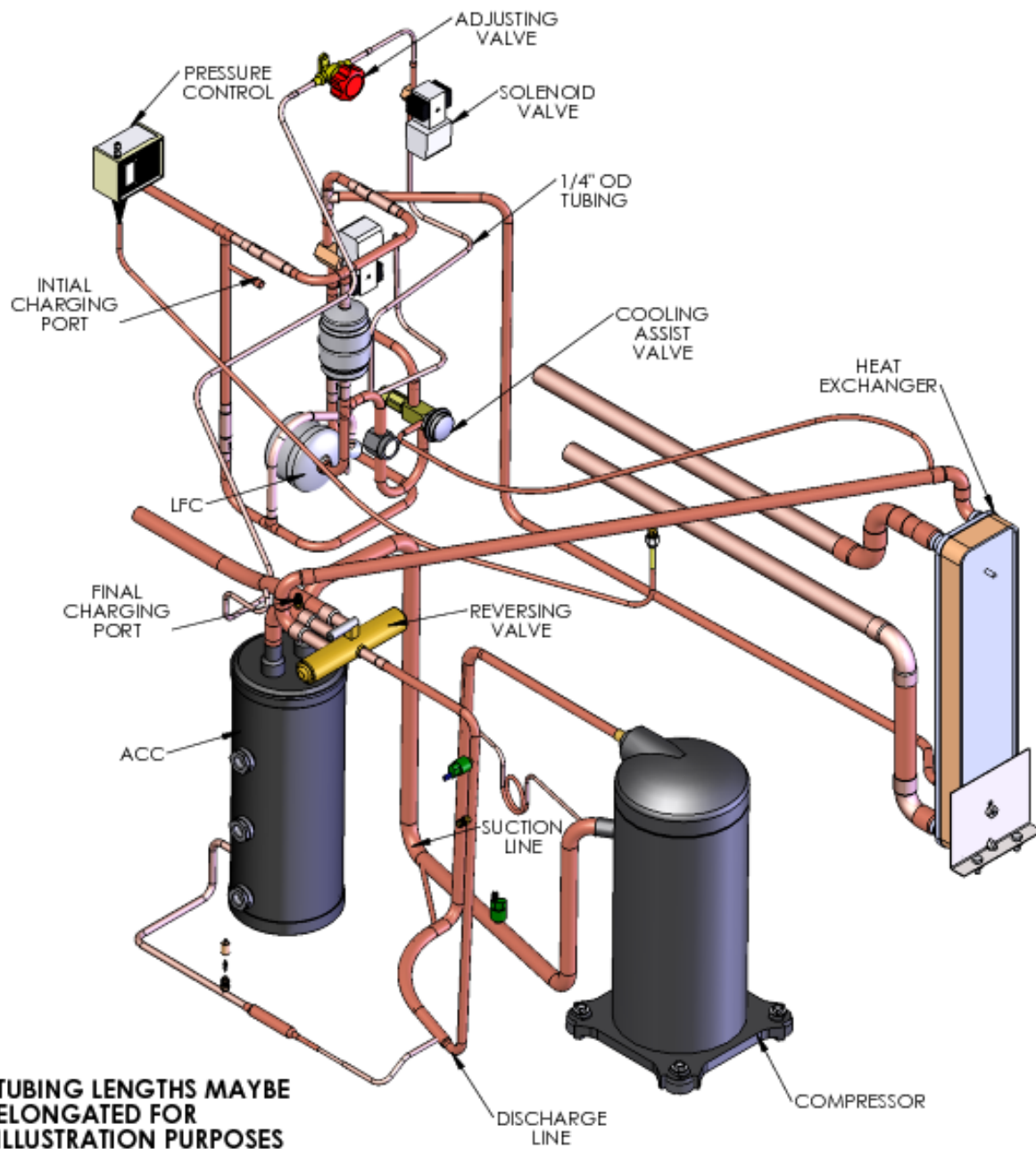


Figure 23. SCW(A) Piping (with HPE control)

Evacuation

Refer to Figure 24 and the following procedure:

1. Carefully vent any pressurized nitrogen charge from the compressor unit and system..
2. After venting the pressurized system, a good quality gage manifold and a non-permeable hose set as shown in Figure 24. If possible, use two Schrader core removal tools. Install one on the discharge line access port and the other on the initial charging port. Removal of the Schrader cores will reduce the time to achieve the desired vacuum.
3. Attached a good quality digital vacuum gage with an isolation valve to the liquid line service valve access port as shown in Figure 24.
4. Use a well maintained, high quality vacuum pump with an isolation valve, rated at 7 cfm or greater to the gage manifold. Ensure that the vacuum pump oil has been changed prior to initiating the evacuation process to avoid contamination.
5. Fully open the LP and HP valves and both service valves. Reference Figure 24.



IMPORTANT!

DO NOT ENERGIZE THE COMPRESSOR WHILE THE SYSTEM IS UNDER VACUUM. THIS WILL CAUSE DAMAGE TO THE COMPRESSOR.

6. Open the vacuum pump isolation valve and start the pump. **Evacuate the system down to 400 MICRONS or less** as read on the digital vacuum gage. After 400 microns or less has been achieved, isolate the vacuum pump. Wait 5 minutes and read the digital vacuum gage. **The system pressure must not exceed 500 MICRONS WITHIN 15 MINUTES.** If it does, continue the evacuation to remove any remaining non-condensibles in the system. A dry system will hold 500 microns for 15 minutes.

A procedure often used to evacuate a system, known as the triple evacuation method, is detailed in the section of this manual entitled **Triple Evacuation**.

Local codes may require other evacuation criteria, in which case the local codes take precedence over the evacuation requirements described above.



IMPORTANT!

DO NOT CHARGE THE SYSTEM UNTIL THE CONDITIONS OF STEP #6 ARE COMPLETED!

7. When the system has been successfully evacuated, close the LP and HP valves on the manifold gage set. **Do not remove the manifold case or hoses as air will be drawn into the system and defeat the evacuation process.**

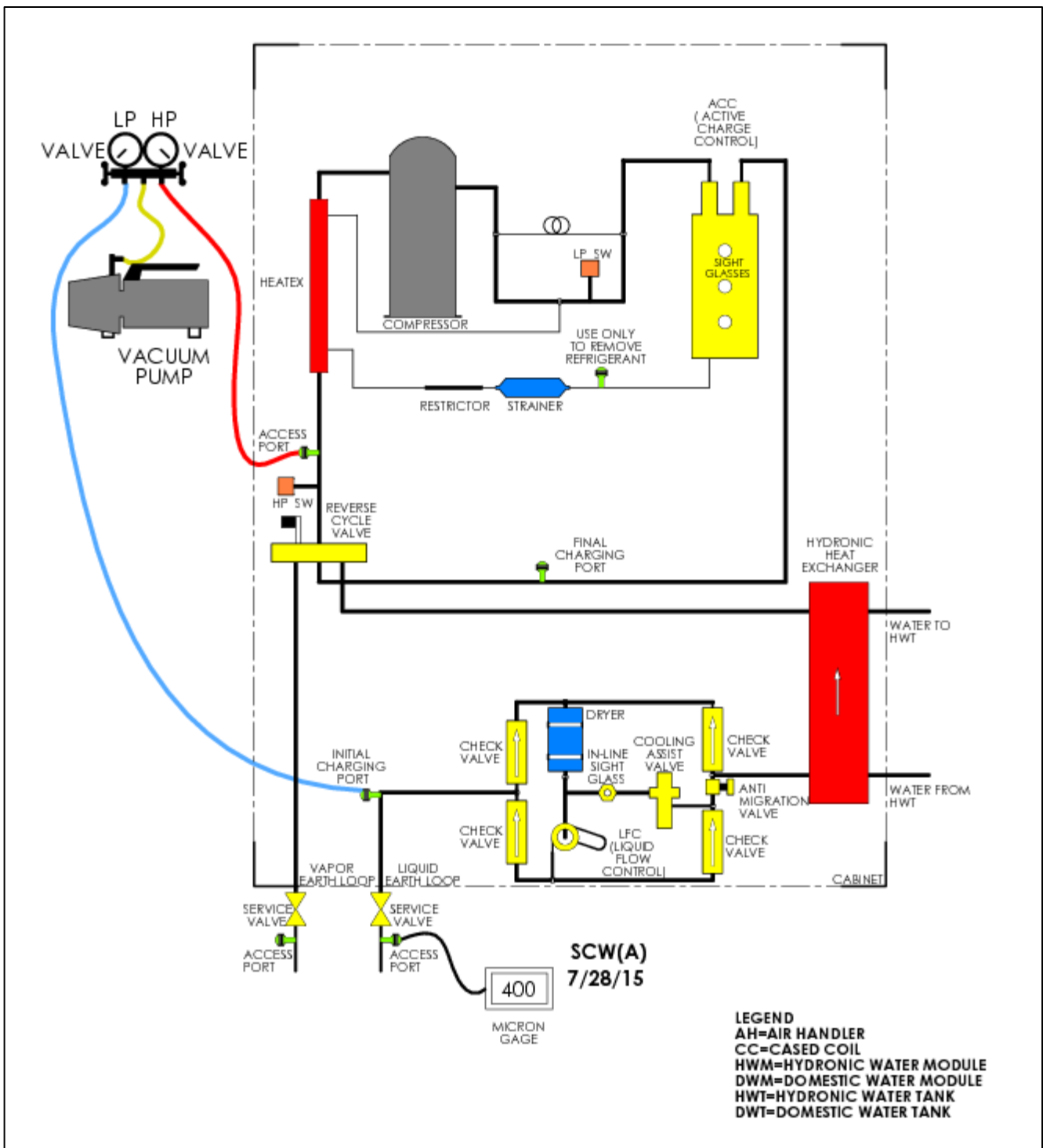


Figure 24. Evacuation of SCW(A) System

Initial Charge

1. Disconnect the vacuum pump and isolate the digital vacuum gage. Connect the refrigerant container to the charging hose of the manifold gage set as shown in Figure 25.



WARNING!

Inhalation of high concentrations of refrigerant gas vapor is harmful and may cause heart irregularities or death. Vapor reduces oxygen available for breathing and is heavier than air. Decomposition products are hazardous. Liquid contact can cause frostbite. Avoid contact of liquid with eyes and prolonged skin exposure. Liquid and gas are under pressure. Deliberate inhalation of refrigerant gas is extremely dangerous. Asphyxiation can occur without warning due to lack of oxygen. Before using, read the material safety data sheet. Use proper safety measures when charging the system, especially when warming the refrigerant container. Do not overheat.

2. Place the refrigerant container upside down, with the refrigerant valve at the bottom, on the scale, as shown in Figure 25. Purge the charging hose by loosening it at the manifold end, until refrigerant is released. Tighten the charging hose and zero out the refrigerant scale.
3. Open the LP valve on the manifold gage set. Opening the refrigerant container valve sends liquid refrigerant through the initial charging port into the system. **Continue to add refrigerant until 3 pounds per ton of system capacity has been added.** In cold weather, it may be necessary to warm the refrigerant container to charge to 3 pounds per ton.
4. After completing the initial refrigerant charge to the system, turn the LP valve off, re-install the Schrader valve core into the initial charging port, remove the tool, and install the Schrader valve cap firmly on the Schrader valve.

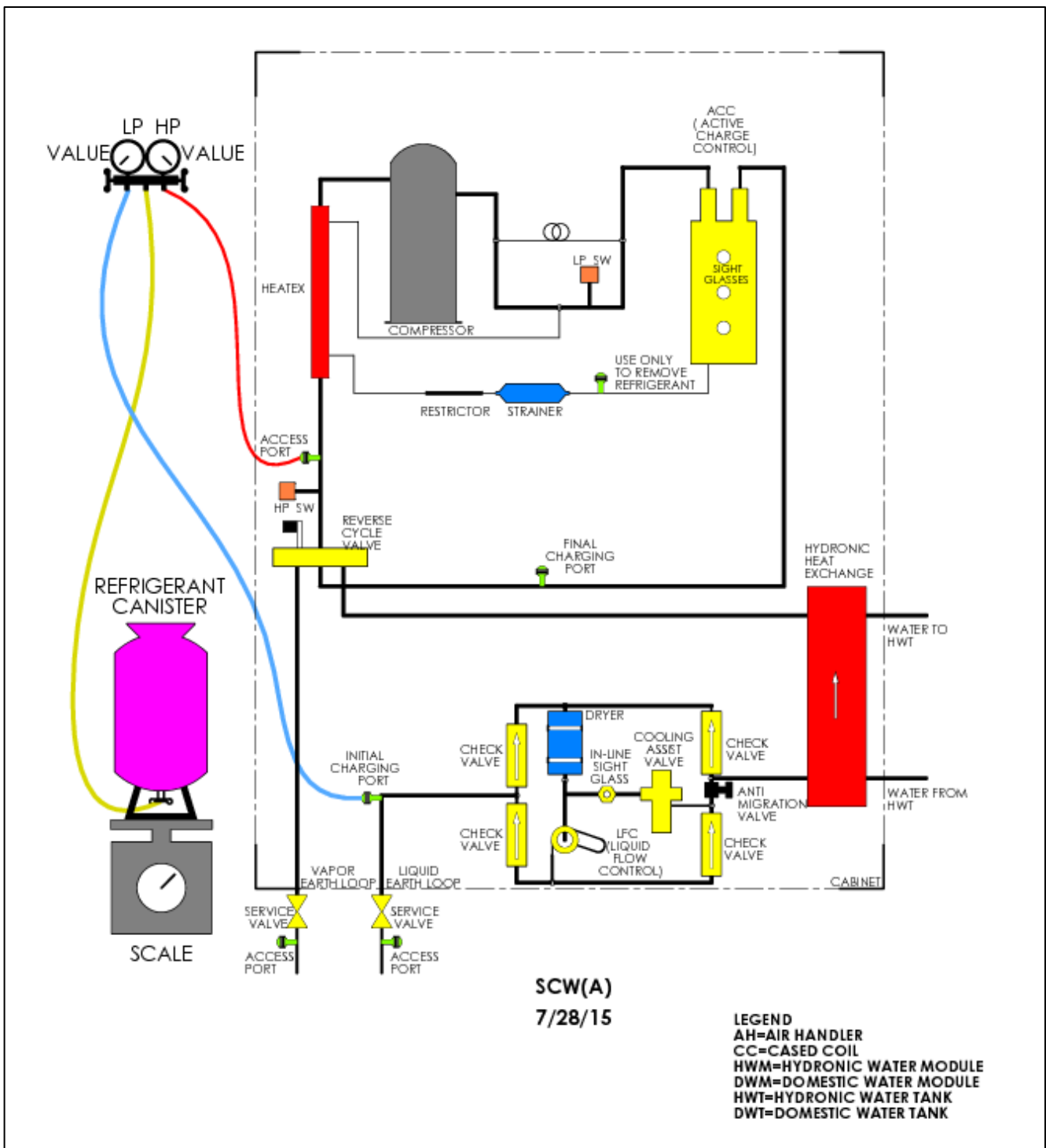


Figure 25. Initial Charge of SCW(A) System

Final Charge

1. Remove the Schrader core tool from the hose just taken off of the initial charging port.
2. Crack open the LP valve on the manifold gage set so that a small amount of refrigerant gas flows to purge the hose. Connect the hose to the final charging port, shown in Figure 26. Tighten the hose to the final charging port and turn off the LP valve when the hose connection is secure.
3. **Start the system in heat mode.** Disconnect the control wire from the “O” terminal to ensure the system remains in the heat mode during the final charging process. In an air system, the design (and minimum) air flow is 400 cfm per nominal ton. In a hydronic system, the design (and minimum) circulating water flow to 3 gpm per nominal ton. As installed, higher than design air and circulating water flows are acceptable, recognizing that this will cause greater power consumption by the air handler and circulating pump motors.
4. Slowly open the LP valve on the manifold gage set and add refrigerant just fast enough to maintain the suction pressure.
5. Slowly add refrigerant until liquid refrigerant is clearly seen in the middle sight glass of the ACC, as shown in Figure 27.
6. Shut the LP valve on the manifold gage set and run the system for 20 minutes to ensure that the refrigerant liquid level remains at the middle sight glass. If the liquid refrigerant level drops below the middle sight glass during this time, slowly add refrigerant until the liquid level stabilizes at the middle sight glass.
7. With the liquid refrigerant level at the middle sight glass, attach and insulate a temperature clamp or probe securely to the earth loop vapor line at the compressor unit service valve shown in Figure 26. Read the measured temperature. Also read the LP gage pressure on the manifold gage set. Use a pressure/temperature chart (Figure 32) to verify that the system is operating at saturation, meaning that no superheat is measured on the earth loop vapor line. To verify this, the measured vapor line temperature should be within $\pm 3^{\circ}\text{F}$ of the saturation temperature read from the chart for the measured LP gage pressure. If the measured temperature is out of this range, contact ETI technical support at 1/863-701-0096.
8. After verifying that the system is operating at saturation in heating mode, **and with the system still operating in heating mode**, slowly open the LP valve on the manifold gage set, and **slowly** add refrigerant to the system until **the refrigerant liquid level is at, but not above, the top ACC sight glass**, as shown in Figure 28. At no time should the refrigerant liquid level be above the top ACC sight glass.
9. **The system is now full charged. Document the weight of the refrigerant charge in the system.** Write it down on the **Warrant Registration Card** and inside the compressor unit on the electrical diagram, for future reference.

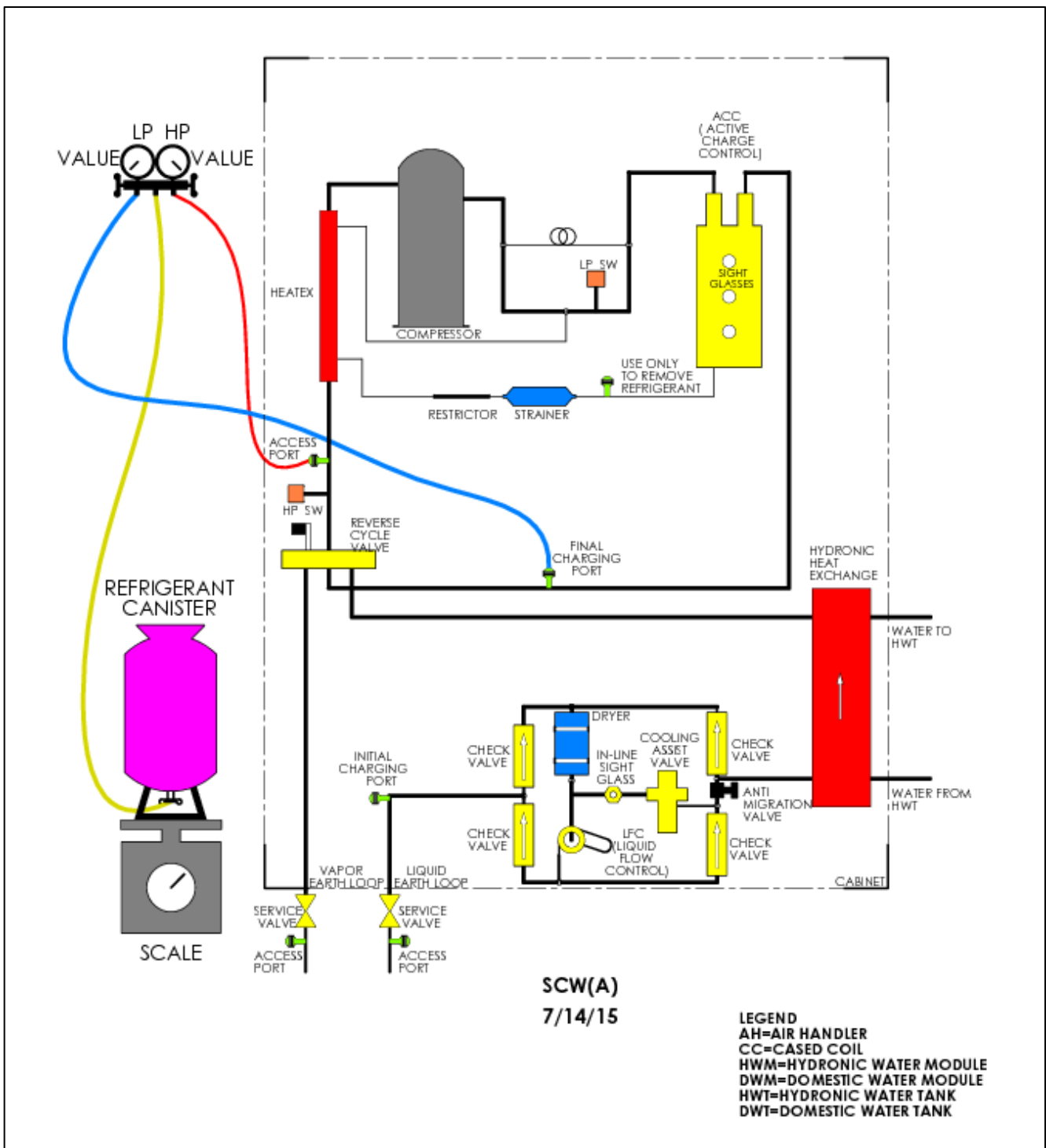


Figure 26. Final Charge of SCW(A) System

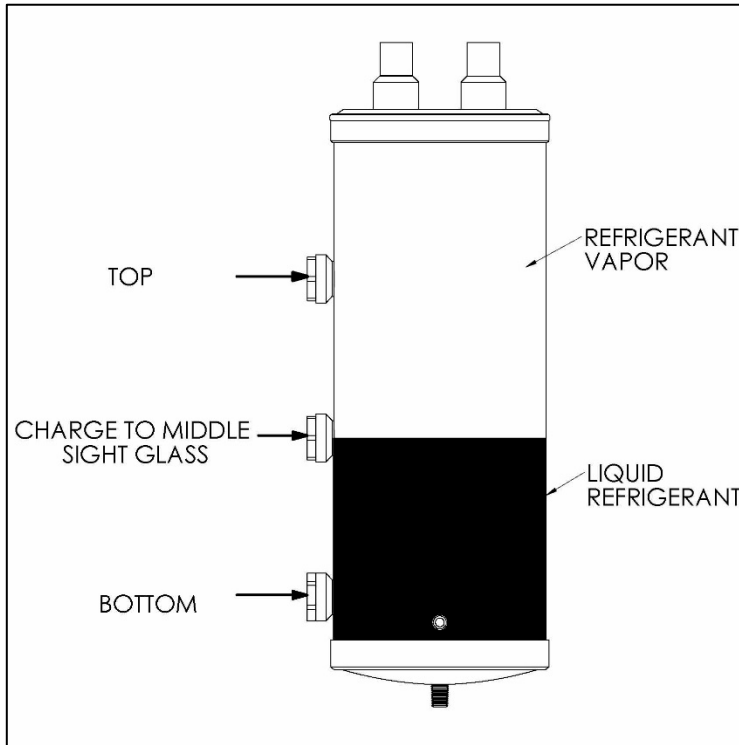


Figure 27. Charging to the Middle Sight Glass

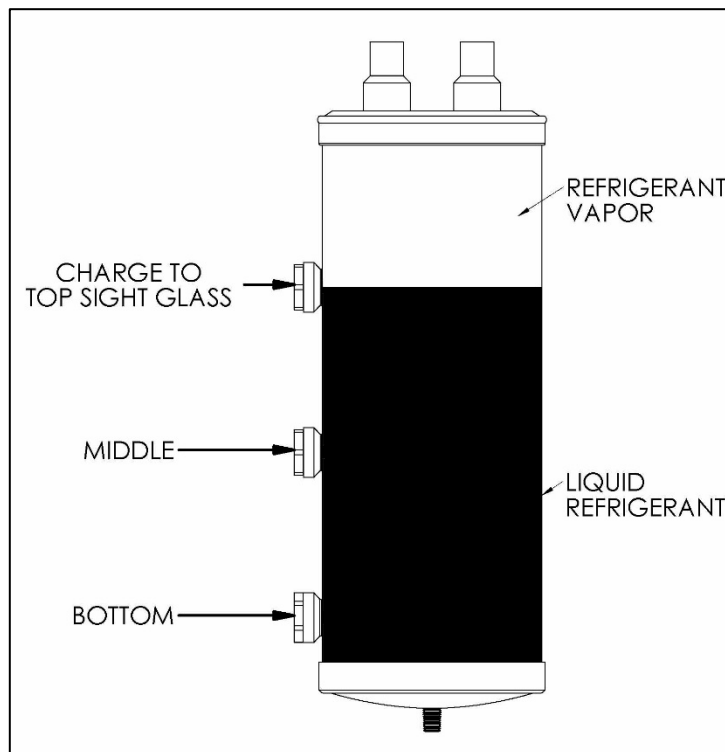


Figure 28. Charging to the Top Sight Glass

Cool Mode Start-Up

1. Start the system in cool mode and monitor the suction pressure on the LP gage as shown in Figure 29. The following steps indicate when the CAV (Cooling Assist Valve) closes. **Do not adjust the CAV!**
2. After suction pressure stabilizes, monitor the increasing compressor discharge pressure at the HP gage as shown in Figure 29.
3. As shown in Figure 30, when the **compressor discharge pressure reaches 320 psig (HP gage) and the suction pressure reaches 120 psig (LP gage) the CAV is closed.**
4. CAV closure is to be verified by checking the temperature of the earth loop liquid line just inside the compressor unit, as shown in Figure 29 **if this liquid temperature is 100°F or above, the CAV is closed.**
5. The subcooling is to be checked and adjusted if necessary to ensure that it is **no more than 5°F.** The subcooling is checked by first disconnecting the high side hose from the compressor discharge access port and reconnecting it to the initial charging port as shown in Figure 31. Read the liquid line pressure.
6. Read the liquid line temperature just inside the compressor unit at the same location as in step 4 and as shown in Figure 31.
7. Using the R-410A Pressure/Temperature chart (Figure 32), read the saturated temperature for the measured liquid pressure.
8. To determine the degrees of subcooling, subtract the liquid line temperature from the saturation temperature read from the table. The difference in the temperatures is the subcooling.
$$(\text{Subcooling, } ^\circ\text{F}) = (\text{Saturation Temp., } ^\circ\text{F}) - (\text{Liquid Line Temp., } ^\circ\text{F})$$
9. **Subcooling is to be no more than 5°F.** If it is higher than 5°F, **slowly** recover refrigerant from the initial charging port until 5°F or less subcooling is achieved. It is OK if the liquid line temperature is higher than the saturation temperature.
10. **Never add refrigerant to raise subcooling!** Doing so may damage the compressor while operating during heat mode.

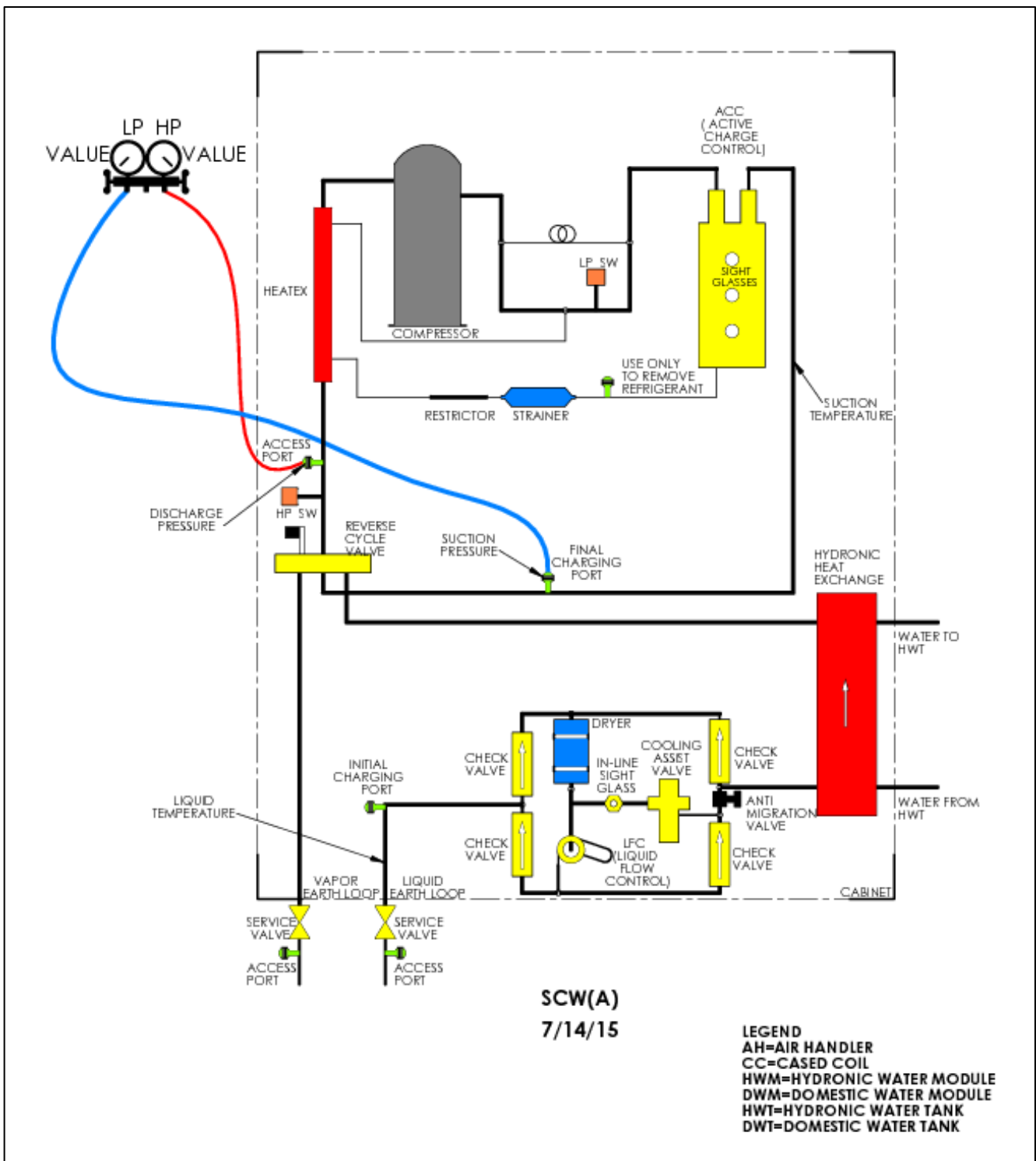


Figure 29. Pressure and Temperature Measurements

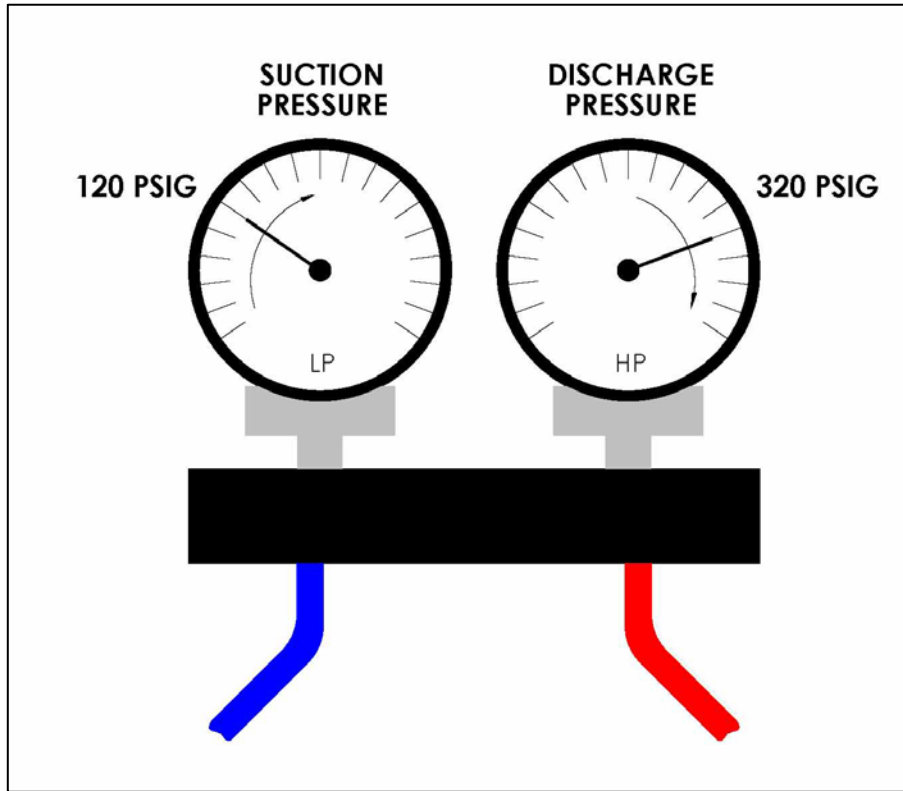


Figure 30. Minimum Suction and Discharge Pressures

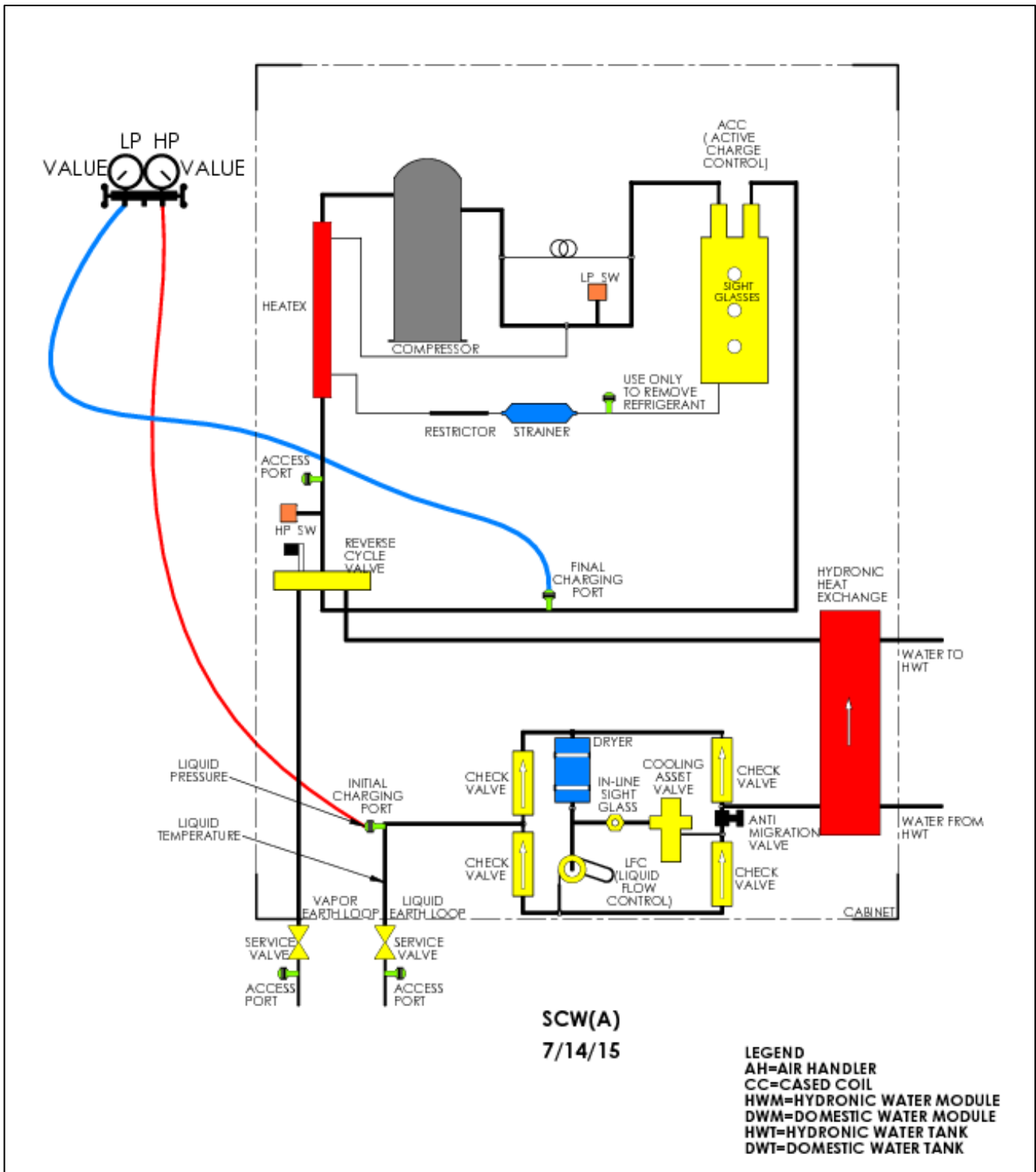


Figure 31. Subcooling Measurements

TEMPERATURE (°F)	PRESSURE (psig)	TEMPERATURE (°F)	PRESSURE (psig)
-20	26.1	70	199.2
-15	30.8	75	216.1
-10	35.9	80	234.0
-5	41.5	85	253.0
0	47.5	90	273.0
5	54.1	95	294.1
10	61.2	100	316.4
15	68.8	105	339.9
20	77.1	110	364.6
25	86.0	115	390.5
30	95.5	120	417.7
35	105.7	125	446.3
40	116.6	130	476.3
45	128.3	135	507.6
50	140.8	140	540.5
55	154.1	145	574.8
60	168.2	150	610.6
65	183.2		

Figure 32. Pressure-Temperature for R-410A

11. After adjusting for subcooling, reconnect the high side hose to the discharge access port as shown in Figure 31 and monitor discharge pressure. If refrigerant was recovered to adjust subcooling, the discharge pressure could have dropped to less than 320 psig, reopening the CAV. If so, allow the system to run for a period of time until the discharge pressure is 320 psig or higher, and the suction pressure is 120 psig or higher. Check the liquid line temperature again to ensure that is 100°F or higher.
12. This completes the start-up procedure.

CLASSIC SCW SYSTEM

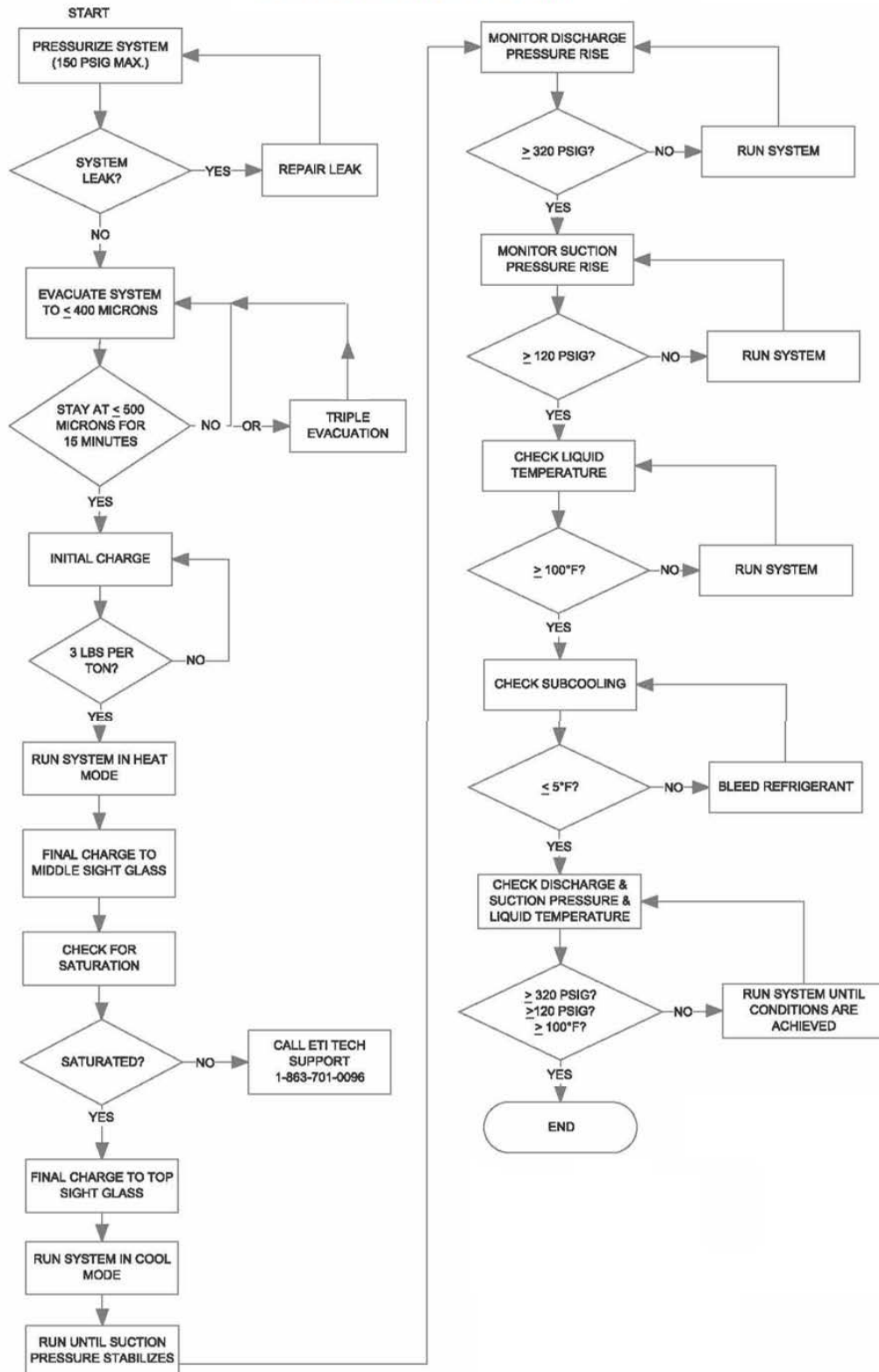


Figure 33. Start-Up Process

Troubleshooting

CAUTION!



SERVICE MAY BE PERFORMED ONLY BY AN EARTHLINKED TECHNOLOGIES AUTHORIZED PROFESSIONAL HVAC OR REFRIGERATION SERVICE PERSON. USE ONLY SAFE AND APPROVED SERVICE TECHNIQUES.

IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, MAINTENANCE OR SERVICE CAN CAUSE 1) THE EARTHLINKED® SYSTEM OR COMPONENTS TO MALFUNCTION AND OR FAIL, 2) PROPERTY DAMAGE, INJURY OR DEATH.

IMPORTANT!



EarthLinked® Refrigerant System Safety Switches

EarthLinked® compressor units are equipped with the following three safety switches that will turn the compressor off if the following limits are exceeded.

High Pressure Switch: Located between the compressor discharge port and the reversing valve, the **cut-out pressure is 600 psig.** This is a manual reset switch.

Low Pressure Switch: Located between the ACC and the compressor suction port, the **cut-out pressure is 25 psig.** This is an automatic reset switch.

Discharge Temperature Switch: Located at the compressor discharge, the **cut-out temperature is 240°F.** This is a manual reset switch.

If you experience difficulties with the EarthLinked® system, please review the appropriate section of the manual. It may be helpful to have another professional HVAC or refrigeration service person review and check it with you.

Time and expense can be saved by taking a thoughtful and orderly approach to troubleshooting. Start with a visual check: Are there loose wires, crimped tubing, missing parts, etc?

Compressor

After setting the remote (wall) thermostat system switch to the “OFF” position and the thermostat fan switch to the “AUTO” position, proceed to check the supply voltage at (1) the line terminals to the breaker/disconnect; 2) the system side of the breaker/disconnect, and 3) the line-side of the transformer. Verify the proper voltage rating for the system. Reference Figure 34.

SCW - 024 - 1 C

COMPRESSOR, VOLTS-PHASE-HZ

1 = 230 - 1 - 60

2 = 230 - 3 - 60

ACCEPTABLE VOLTAGE RANGES

Compressor Unit Nameplate Voltage	230	230
Phase	1	3
Frequency, Hz	60	60
Minimum Voltage	207	207
Maximum Voltage	253	253

Figure 34. Compressor Unit Voltage Information

The following compressor checklist is provided to analyze the compressor and determine if it is operating properly or if it is faulty:

1. **Electrical Service Panel** – turn power off.
 - a. Check circuit connections for tightness
 - b. Circuit breaker sized right?
 - c. Wire size correct? (check NEC or local codes)
2. **Check capacitors** or other start components for bulges, overheating or loose connections.
3. **Test capacitors** and start components and replace if necessary. Capacitors can be checked by substitution or with capacitance meter. Ok if reads $\pm 10\%$ of manufacturer's specification.
4. **Check incoming power supply voltage** to determine whether it is within acceptable voltage range. (See Figure 34)
5. **Check voltage at compressor unit terminals** to determine whether it is within acceptable voltage range. (See Figure 34)
6. **Running Amperage.** Connect a clip-on type ammeter to the (common) lead to the compressor. Turn on the supply voltage and energize the unit. The compressor will initially draw high amperage; it should soon drop to the RLA value (See Figure 7) or less. If the amperage stays high, check the motor winding resistance and/or run capacitor.

Note: Feel the top of the compressor to see if it has overheated. If it is hot, the internal overload may be open. You may have to wait several hours for it to reset before proceeding.

If the compressor draws a high amperage and does not start (amperage is approximately locked rotor amperage – LRA (See Figure 7)), the compressor is locked mechanically and should be removed from the system and replaced. Verify before removing!



IMPORTANT

Turn power OFF to the compressor unit before proceeding to the next step.

7. Motor Circuit Testing

Using a digital volt-ohmmeter (VOM), measure the resistance across the compressor windings as shown in Figure 35. The power leads to the compressor must be disconnected before taking an electrical measurement. A good rule of thumb for single phase compressors is that start winding resistance (R_2) is 3 to 5 times greater than run winding resistance (R_1).

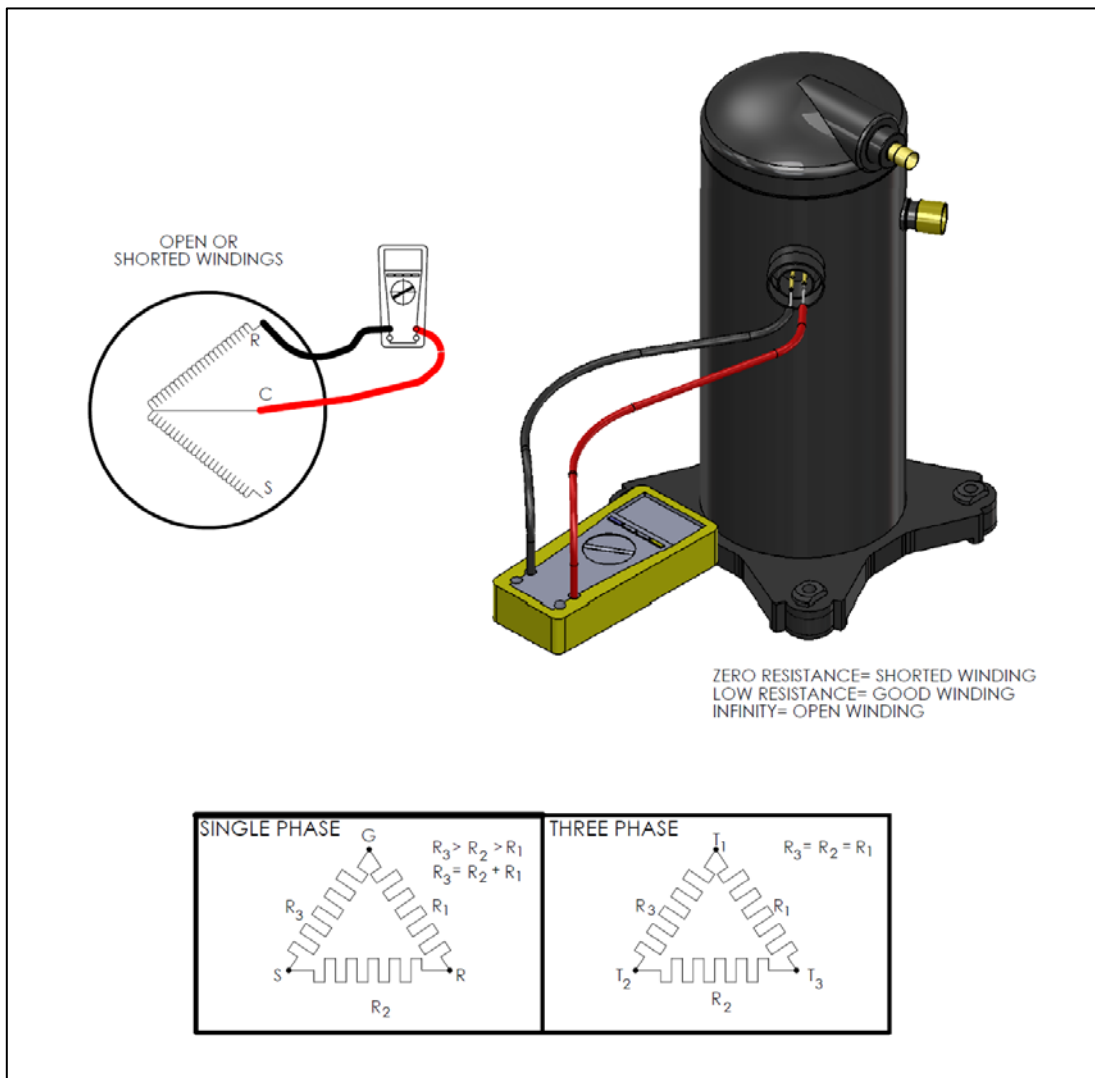


Figure 35. Compressor Motor Circuit Testing

8. Grounded Windings

Test the compressor motor for a grounded winding. The check should be made using an ohmmeter capable of measuring very high resistance on a VOM. The resistance between windings and the housing is one million to three million ohms for an **ungrounded** winding.

Attach one lead to the compressor case on a bare metal tube or ground terminal, and to each compressor terminal as shown in Figure 36. A short circuit at a high voltage terminal indicates a motor defect (grounded).



IMPORTANT

DO NOT do this test when the system is under vacuum.

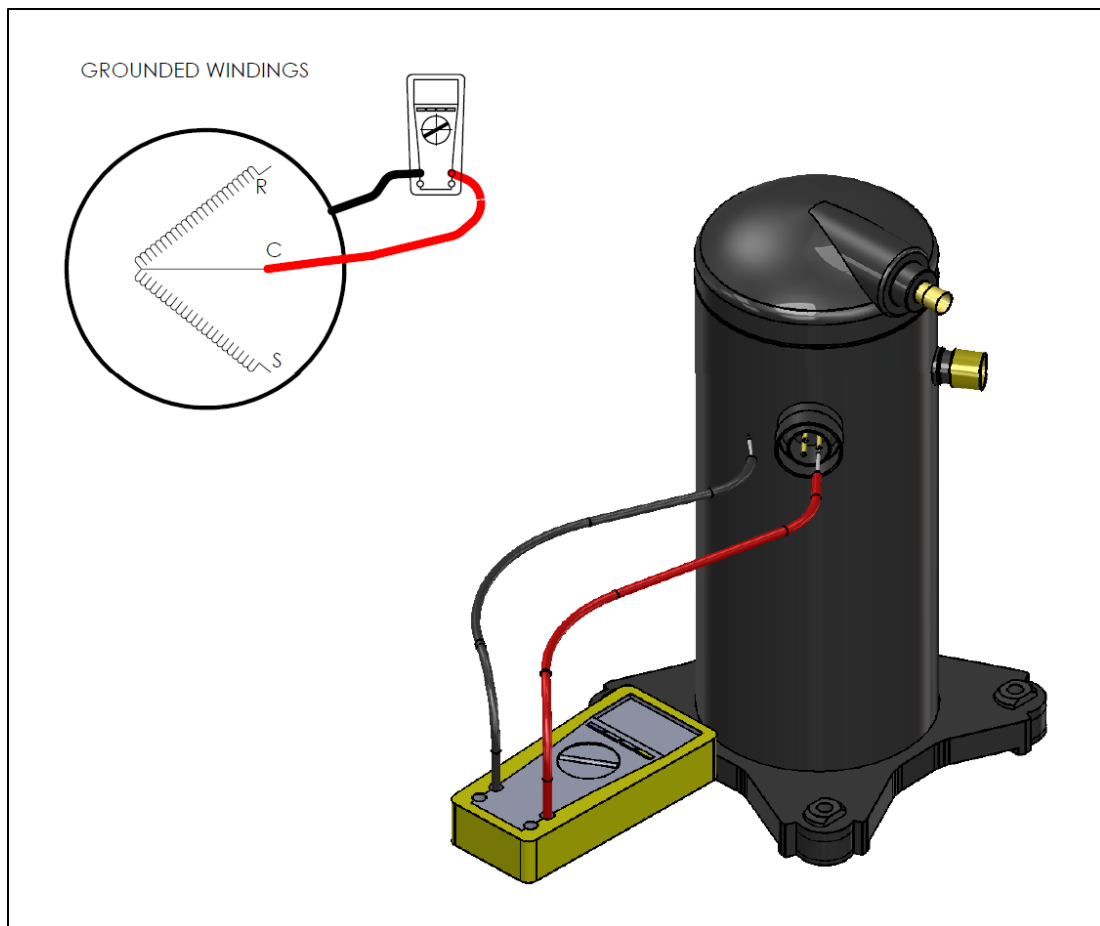


Figure 36. Compressor Motor Grounded Winding Test

9. Compressor not pumping.

Connect gage block hoses to the suction and discharge pressure ports in the compressor unit. Read pressure gages to affirm that system is pressurized with refrigerant. Turn on power to compressor unit and run unit. Observe pressure gages. If pressures on both gages remain the same, compressor is not pumping and there is a possible internal failure. See System Troubleshooting Chart.

System

Problem / Symptom	Likely Cause(s)	Correction
A. System does not run. <i>Note: Some digital thermostats have a built-in five-minute time delay.</i>	1. Thermostat fault.	1. Adjust thermostat settings. / Replace thermostat.
	2. Power supply problem (AHU / compressor unit).	2. Check power supply for adequate phase and voltage. Check wiring to system and external breakers or fuses.
	3. Control voltage problem.	3. Check for 24V on terminal strip between "R" and "C".
	4. Shut off by external thermostat or thermostat is defective.	4. Check operation of thermostat.
	5. System off on high pressure / low pressure switches or discharge temperature switch.	5. Reset limit switch. Analyze system for root cause. Check lockout relay. Reset if necessary.
	6. Internal component or connection failure.	6. Check for loose wiring. Check components for failure.
	7. Compressor contactor not pulling in.	7. Check for 24V across contactor. Trace 24V circuit and components between "Y" and "C" to locate fault. Repair or replace as necessary.
	8. Faulty run capacitor or start components.	8. Test each and replace as necessary.
	9. Compressor windings shorted or grounded.	9. See compressor diagram/ replace the compressor.
B. System runs for long period or continuously.	1. Thermostat fault.	1. Adjust thermostat settings / Replace thermostat.
	2. Refrigerant undercharged.	2. Repair leak. Evacuate and recharge system.
	3. Component failure (cooling mode).	3. Check pressures and electrical circuits for abnormalities.
	4. Outdoor thermostat not connected or failed (heating mode).	4. Check outdoor thermostat and electric supplemental heat operation. Confirm proper wiring.
	5. Reduced air flow.	5. Check air ducts for leaks and repair. Check blower operation. Check air filter(s). Remove air flow restrictions (min.400 CFM/ton).
	6. Four-way valve is short circuiting refrigerant and bypassing hot gas to suction.	6. Replace four-way valve, evacuate, recharge and start-up system.
	7. Unit undersized.	7. Contact ETI Technical Support at 863-701-0096.
C. System blows fuses or trips circuit breaker.	1. Inadequate circuit ampacity.	1. Note electrical requirement and correct as necessary.
	2. Short, loose or improper connection in field wiring.	2. Check field wiring for problems.
	3. Internal short circuit. Loose or improper connection in system.	3. Check wiring in system. See appropriate wiring schematics and diagrams. Test components, especially the compressor, for shorts and grounds.

Figure 37. System Troubleshooting Chart

C. System blows fuses or trips circuit breaker (con't)	4. Excessively high or low supply voltage or phase loss (3Ø only).	4. Note voltage range limitations specific to the compressor.
	5. Faulty run capacitor or soft start components.	5. Replace as necessary.
D. Air handler fan will not run.	1. Thermostat defective.	1. Check for 24V power on eight-post terminal strip between "C" and "G".
	2. Defective fan relay in air handler.	2. Check relay operation and continuity of terminals.
	3. Faulty motor/capacitor.	3. Refer to ECM troubleshooting.
E. System will not switch to cooling mode (continues to run in heating mode).	1. Thermostat faulty.	1. Check operation of thermostat and replace if necessary.
	2. Open heat/cool circuit (orange wire).	2. Check for 24V on eight-post terminal strip between "O" and "C".
	3. Four-way valve solenoid not energized.	3. Check for magnetism at end of valve coil. Check for 240V at coil. Check Heat/Cool Relay.
	4. Four-way valve stuck in heat mode.	4. Contact ETI Technical Support at 863-701-0096.
F. Compressor turns off on thermal overload. (check until compressor's temperature reaches room temperature before determining the internal overload is defective)	1. Refrigerant leak.	1. Check for refrigerant level in ACC. Repair leak, evacuate system and recharge with refrigerant.
	2. System undercharged.	2. Charge system.
	3. Four-way valve is short circuiting refrigerant and bypassing hot gas to suction.	3. Replace four-way valve, evacuate, recharge and start-up system.
	4. Compressor valves are faulty/ bypassing.	4. Use Rubber Mallet on Scroll Comp's. before condemning. Replace compressor and evacuate, recharge and start-up system.
	5. Compressor contactor dirty or pitted. (> .5 Ohms Resistance across Contact points)	5. Replace as necessary.
	6. Faulty run capacitor or start components.	6. Replace as necessary.
	7. Compressor with locked rotor.	7. Replace as necessary.
G. Uncomfortable temperature. (Not enough heat/cold air)	1. Thermostat fault.	1. Adjust thermostat settings / Replace thermostat.
	2. Defective heating element(s). (Heating mode).	2. Check resistance element(s) for continuity.(Heating mode only)
	3. Defective heater relay. (Heating mode).	3. Check relay for proper operation. Replace if defective.
	4. Thermal limit is open. (heat kit)	4. Check continuity across thermal limit switch. (Heating mode only)
	5. Compressor fault.	5. To reset switch, turn primary power off then back on; turn thermostat system switch to OFF, then back on.
	6. Outdoor thermostat not connected or failed (heating mode).	6. Check outdoor thermostat and electric supplemental heat operation. Confirm proper wiring. (Heating mode only)

Figure 37. System Troubleshooting Chart (con't)

G. Uncomfortable temperature. (Not enough heat/cold air) (cont'd)	7. Refrigerant undercharged.	7. Check for refrigerant level in ACC.(Heating mode only). Level at top sight glass @ saturation. Repair leak, evacuate and recharge the system. Check In-line sight glass in cooling mode.
	8. Restriction in refrigerant circuit.	8. Check for blockage or restriction, especially in Liquid Flow Control. Assure that modification of non-ETI air handler is performed. Check valves, filter/dryer and anti-migration valve.
	9. System is locked out on high or low pressure.	9. Check low pressure and high pressure: Check limit cut-off pressures. Control is set to actuate at 5 (R-22 & 407C)/25psig (R-410A) (low pressure) and 400 (R-22 & 407C)/600 psig (R-410A) (high pressure) +10%. Check for continuity on both switches under normal pressure conditions. Refer to Unit performance table.
	10. Defective pressure control.	10. Check limit cut-off pressures. Control is set to actuate at 5 (R-22 & 407C)/25psig (R-410A) (low pressure) and 400 (R-22 & 407C)/600 psig (R-410A) (high pressure) +10%. Check for continuity on both switches under normal pressure conditions.
	11. Reduced air flow.	11. Check air ducts for leaks and repair. Check blower operation. Check air filter(s). Remove air flow restrictions (min.400 CFM/ton).
	12. Unit undersized/ oversized.	12. Contact ETI Technical Support at 863-701-0096.
H. Poor Compressor Performance (Runs, but Not pumping Refrigerant)	1. Reversing Valve stuck and Compressor will not create a pressure difference between high and low side of the system.	1a. Pinch closed the Discharge Line to verify the Compressor builds High Pressure, if so, replace Reversing Valve.
		1b. If High pressure does not build after pinching the Discharge Line closed, the Compressor has failed, replace Compressor.
	2. Bad Compressor	2. Replace after verification of Amp Draw below RLA and pinch closed the Discharge Line between the Compressor and the reversing Valve to verify pressure does not build on the high side.

Figure 37. System Troubleshooting Chart (con't)

Commissioning Document

The document that follows (LIT-170) enables verification and documentation of system component model numbers, location of underground system components and system performance for air and hydronic heating and cooling.



EARTHLINKED
TECHNOLOGIES

EarthLinked® Heating & Cooling System Commissioning Document

(Please print clearly)

Owner Name: _____ Date: _____
Address: _____ City: _____
Province / State: _____ ZIP: _____
Telephone: _____ Email: _____

Installer Name: _____ License: _____
Address: _____ City: _____
Province / State: _____ ZIP: _____
Telephone: _____ Email: _____

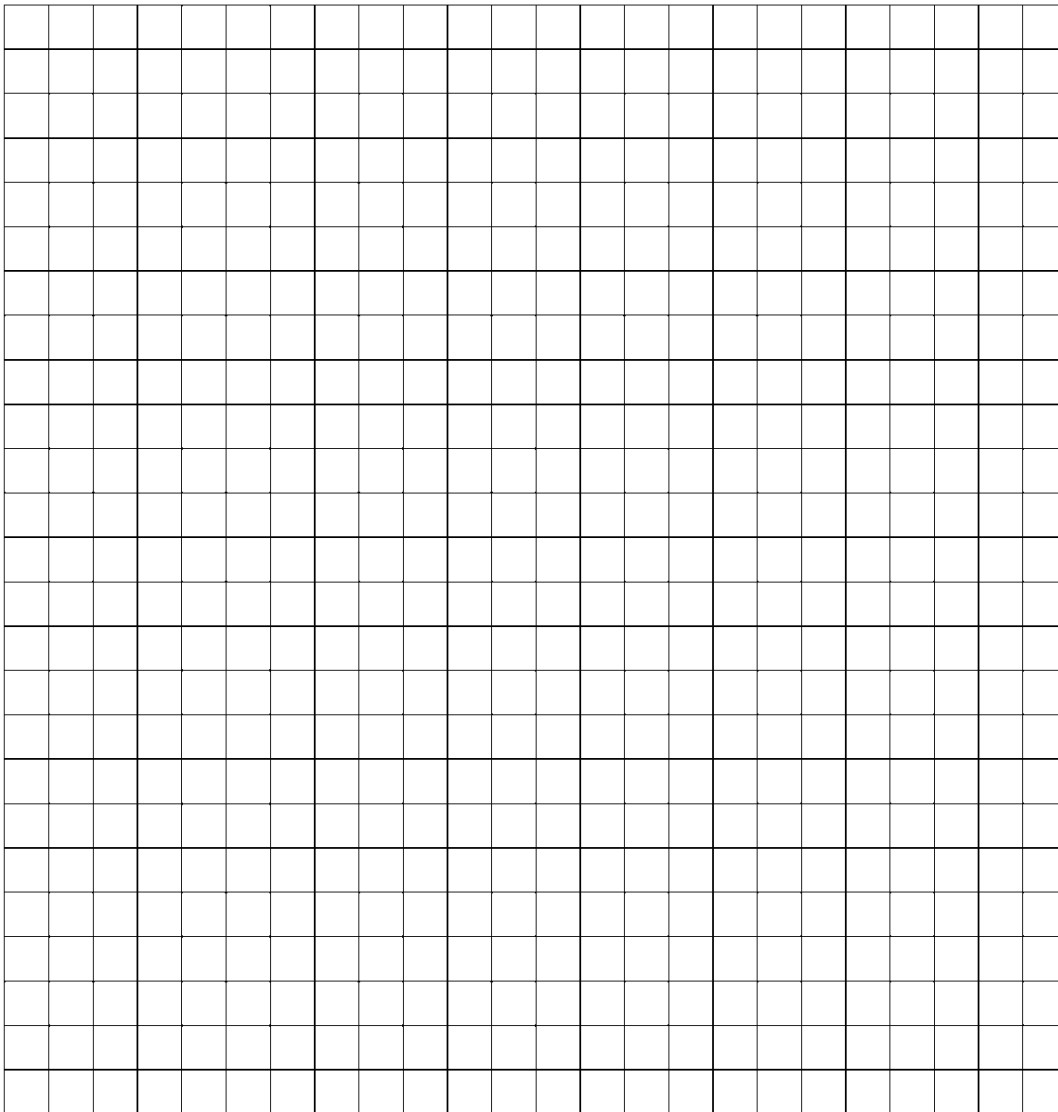
System Start-Up Date: _____
Compressor Unit Model: _____ Serial: _____
Refrigerant Type: _____ Charge _____ LB _____ Oz

Air handler / Cased Coil Model: _____
Earth Loop Model: _____
Desuperheater Model: _____
Domestic Water Module Model: _____
Hydronic Water Module Model: _____
Auxiliary Cooling Module Model: _____

Show the locations and dimensions of the Earth Loop Field, manifolds, distributors, cathodic protection system, underground refrigerant controls, earth loop to compressor unit connection, etc. Indicate the scale on the drawing. Reference the building with key dimensions. (next page)

IMPORTANT!

Be sure to identify and tag the vapor and liquid lines from the earth loop system where they enter the mechanical room, basement, etc. of the building.



System Air Flow Determination: Turn on electric heat in air handler and measure the average inlet and outlet air temperatures. Measure voltage and amperes to the electric heater.

Volts: _____ Amps: _____ Fan Speed: Low Med Hi

Power: $\frac{\text{Volts X Amps}}{1000} =$ _____ kW

Air Temperature In: _____ °F Air Temperature Out: _____ °F

CFM = $(\text{kW X } 3413) / 1.08 \text{ X (Air Temp Out - Air Temp In)} =$ _____ CFM

Air Heating Performance

Compressor Amps: _____ Air Handler Fan Amps: _____

Compressor Volts: _____ Air Handler Fan Volts: _____

Compressor Power: _____ Air Handler Power: _____

Single Phase:

$$kW_{\text{Comp}} = \frac{\text{Amps} \times \text{Volts}}{1000} = \text{_____} \quad kW_{\text{AH}} = \frac{\text{Amps} \times \text{Volts}}{1000} = \text{_____}$$

Three Phase:

$$kW_{\text{Comp}} = \frac{\text{Amps} \times \text{Volts} \times 1.732}{1000} = \text{_____}$$

Average Air Temperature out of Air Handler: _____ °F

Average Air Temperature into Air Handler: _____ °F

CFM = _____ (from above)

Heating Output = 1.08 X CFM (Air Temp Out – Air Temp In)

Heating Output = _____ BTU/Hr

$$\text{COP} = \frac{\text{Heating Output}}{\text{BTU/Hr Input}} = \frac{\text{Heating Output}}{3413 (kW_{\text{Comp}} + kW_{\text{AH}})} = \text{_____}$$

Note: When a cased coil is applied to an existing fossil fuel furnace, use kW_F in place of kW_{AH} , where kW_F is the power input to the furnace blower motor.

Hydronic Heating Performance

Compressor Amps: _____ Circulating Pump Amps: _____

Compressor Volts: _____ Circulating Pump Volts: _____

Compressor Power: _____ Circul. Pump Power: _____

Single Phase:

$$kW_{comp} = \frac{\text{Amps X Volts}}{1000} = \text{_____} \quad kW_{pmp} = \frac{\text{Amps X Volts}}{1000} = \text{_____}$$

Three Phase:

$$kW_{comp} = \frac{\text{Amps X Volts X 1.732}}{1000} = \text{_____} \quad kW_{pmp} = \frac{\text{Amps X Volts X 1.732}}{1000} = \text{_____}$$

Water Solution Temperature out of Heat Exchanger: _____ °F

Water Solution Temperature in to Heat Exchanger: _____ °F

Water Solution Flow Rate (from flow meter): _____ GPM

Water Solution Multiplier Factor (from table): _____ WSMF

Water Solution Propylene Glycol %	Water Solution Multiplier Factor (WSMF)
20	1.03
30	1.07
40	1.11
50	1.16

$$\text{Heating Output} = \frac{500 \times \text{GPM} (\text{HX Temp Out} - \text{HX Temp In})}{\text{WSMF}}$$

$$\text{Heating Output} = \text{_____} \text{ BTU/Hr}$$

$$\text{COP} = \frac{\text{Heating Output}}{\text{BTU/Hr Input}} = \frac{\text{Heating Output}}{3413 (kW_{comp} + kW_{pmp})} = \text{_____}$$

Air Cooling Performance

Compressor Amps _____ Air Handler Fan Amps _____

Compressor Volts _____ Air Handler Fan Volts _____

Compressor Power: _____ Air Handler Power: _____

Single Phase:

Watts_{Comp} = Amps X Volts _____ Watts_{AH} = Amps X Volts _____

Watts_{ACM} = Amps X Volts _____

Three Phase:

Watts_{Comp} = Amps X Volts X 1.732 = _____

Avg Air Temperatures Leaving Air Handler (Dry Bulb and Wet Bulb)

T_{LDB} = _____ °F T_{LWB} = _____ °F

Total Heat Leaving (from psychometric chart) = _____ BTU/Lb.

Avg. Air Temperatures Entering Air Handler (Dry Bulb and Wet Bulb):

T_{EDB} = _____ °F T_{EWB} = _____ °F

Total Heat Entering (from psychometric chart) = _____ BTU/Lb.

Total Cooling Capacity = 4.5 X CFM X (TH_E-TH_L) = _____ BTU/Hr

Where:

CFM = Air Flow Rate (from above)

TH_E = Total Heat Entering

TH_L = Total Heat Leaving

EER = $\frac{\text{Total Cooling Capacity}}{\text{Watts Input}}$ = $\frac{\text{Total Cooling Capacity}}{(\text{Watts}_{\text{COMP}} + \text{Watts}_{\text{AH}} + \text{Watts}_{\text{ACM}})}$ = _____

Chilled Water Cooling Performance

Compressor Amps: _____ Circulating Pump Amps: _____

Compressor Volts: _____ Circulating Pump Volts: _____

Auxiliary Cooling Module Model Power:

Watts_{ACM} = Amps X Volts = _____

Compressor Power:

Circulating Pump Power:

Single Phase:

Watts_{comp} = Amps X Volts = _____ Watts_{pmp} = Amps X Volts = _____

Three Phase:

Watts_{comp} = Amps X Volts X 1.732 = _____ Watts_{pmp} = Amps X Volts X 1.732 = _____

Water Solution Temperature out of Heat Exchanger: _____ °F

Water Solution Temperature in to Heat Exchanger: _____ °F

Water Solution Flow Rate (from flow meter): _____ GPM

Water Solution Multiplier Factor (from table): _____ WSMF

Water Solution Propylene Glycol %	Water Solution Multiplier Factor (WSMF)
20	1.03
30	1.07
40	1.11
50	1.16

Total Cooling Capacity = $\frac{500 \times \text{GPM} (\text{HX Temp In} - \text{HX Temp Out})}{\text{WSMF}}$

Total Cooling Capacity = _____ BTU/Hr

EER = $\frac{\text{Total Cooling Capacity}}{\text{Watts Input}} = \frac{\text{Total Cooling Capacity}}{(\text{Watts}_{\text{comp}} + \text{Watts}_{\text{pmp}} + \text{Watts}_{\text{ACM}})} = \underline{\hspace{2cm}}$

Tools and Equipment

The purpose of the following list is to highlight key pieces of equipment, tools and materials necessary for the installation, maintenance and servicing of EarthLinked® Heating and Cooling System HVAC (above ground) equipment.

The professional HVAC technician is expected to have a compliment of standard tools for the general servicing of refrigeration equipment.

Equipment, Tools and Materials

ITEM & DESCRIPTION

Vacuum Pump (7 CFM or greater capacity with isolation valve)
Evacuation Manifold (for vacuum pump)
Digital Vacuum (micron) Gauge and Isolation Valve
Schrader Valve Core Removal Tool (quantity of 2)
Charging/Evacuating Manifold for R-410A
Charging/Hi-Vacuum Hoses (black, quantity of 6)
Digital Refrigerant Scale
Digital Thermometer
Digital Sling Psychrometer
Air Flow Meter (for air handlers)
Nitrogen Tank with 0 – 600 psig Regulator and Handtruck
Oxy-acetylene Welding Torch Set
15% Silver Brazing Alloy
Refrigerant Recovery Unit (1/2 #/minute minimum vapor capacity)
Recovery Cylinder (50# capacity)
Halogen Leak Detector
Digital VOM
Digital Clamp-on Ammeter
Digital Water Flowmeter (3 to 30 gpm)
Tubing Cutters
Tubing Benders
Nut Driver
Cordless Drill (3/8")
Swaging Kit
Deburring Tool
Drill Bit Set
Inspection Mirror

Triple Evacuation

Triple evacuation is implemented to evacuate a system to a deep vacuum. It is accomplished by evacuating a system to a vacuum of 1500 microns, and then bleeding a small amount of dry nitrogen into the system. The nitrogen is then blown out to the atmosphere. The system is then evacuated until the vacuum is again reduced to 1500 microns. This procedure is repeated three times, with the last vacuum level reaching a deep vacuum of 400 microns, which is held for 10 to 15 minutes. The following is a detailed description of the triple evacuation.

1. Attach an electronic micron gage to the system. The best place is as far from the vacuum port as possible, which would be the access port on a service valve on the EarthLinked[®] compressor unit.
2. Let the vacuum pump run until the digital vacuum gage reaches **1500 microns**. After reaching 1500 microns, isolate the digital vacuum gage.
3. Allow a small amount of dry nitrogen to enter the system until the LP gage shows about 5 psig. This small amount of dry nitrogen will fill the system and mix with the other vapors.
4. Release system pressure to 0 psig and close the valve. Then open the isolation valve on the digital vacuum gage.
5. Open the vacuum pump valve and start the vapor removal process from the system again. Let the vacuum pump run until the vacuum is again reduced to **1500 microns**.
Repeat Step 3.
6. After nitrogen has been added to the system a **second time**, open the vacuum pump valve and again remove the vapor. Operate the vacuum pump until the vacuum on the electronic micron gage reads **400 microns**.
7. Once the micron gage reads **400 microns for 10 to 15 minutes**, isolate the micron gage. The system must not exceed 500 microns in 15 minutes. If it does, **repeat step 6**.
8. Then charge the system in accordance with the initial refrigerant charging procedure.