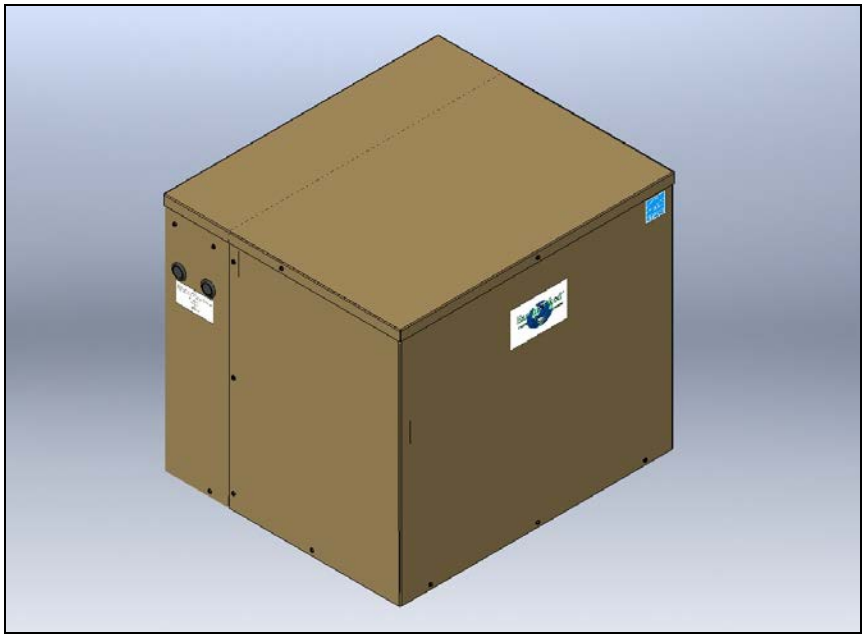
EarthLinked®

CHARGING PROCESS
for
R-407C
Heating and Cooling Systems



Disclaimer

Proper installation and servicing of the EarthLinked® Heating and Cooling System is essential to its reliable performance. All EarthLinked® systems must be installed and serviced by an authorized, trained technician who has successfully completed the training class and passed the final examination. Installation and service must be made in accordance with the instructions set forth in this manual and the current *EarthLinked Heating and Cooling Installation, Operation and Maintenance Manual.* Failure to provide installation and service by an authorized, trained installer in a manner consistent with the subject manuals will void the limited warranty coverage for the system.

READ THE CURRENT *EarthLinked Heating and Cooling Installation, Operation and Maintenance Manual* FOR COMPLETE INSTALLATION DETAILS.

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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System Start-up

Evacuation/Charging

IMPORTANT

Proper installation and servicing of the EarthLinked® Heating and Cooling System is essential to its reliable performance. All the EarthLinked® systems must be installed and serviced by an authorized, trained installer who has successfully completed the training class and passed the final examination. Installation and service must be made in accordance with the instructions set forth in this manual. Failure to provide installation and service by an authorized, trained installer in a manner consistent with the subject manual will void and nullify the limited warranty coverage for the system.

IMPORTANT

Prior to evacuating the EarthLinked® Heating and Cooling System, ensure the electrical power to all components of the system is "OFF".

SC, SD, SCW and SW Models

Refer to Figure 1 and the following description:

Evacuation and Initial Charge

1. Carefully vent the nitrogen charge from the compressor unit.
2. After installing and nitrogen brazing the HVAC system components and compressor unit service valves, turn the Service Valves to **FULL open** and pressurize the HVAC components 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.
3. After venting the pressurized system, connect the Gage Block, Refrigerant Container and Hoses as shown in Figure 1. LP and HP valves are fully open. Both Service Valves are fully opened.
4. As illustrated in Figure 1, connect a good quality Digital Micron Gage to the Liquid Line Service Valve Access Port with an Isolation Hose/Valve. Connect a quality Vacuum Pump (at least 6 CFM capacity) to the Gage Block.
5. Connect the Refrigerant Hose from the Refrigerant Container to the Charging Port.

IMPORTANT

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

6. Initiate the system evacuation. **<u>Evacuate the system down to 230 MICRONS</u>** as read on the digital micron gage. After 230 microns has been achieved, turn off the LP and HP valves and turn "OFF" the vacuum pump**. Reading the digital micron gage, the system pressure must not exceed 280 MICRONS WITHIN 5 MINUTES.** If pressure rises to greater than 280 microns, open LP and HP valves, crack the refrigerant valve and allow just enough refrigerant into the system until 20 inches of Hg vacuum is read on the LP gage. Close the refrigerant valve, and initiate the evacuation process again and until the above conditions are met.

IMPORTANT

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

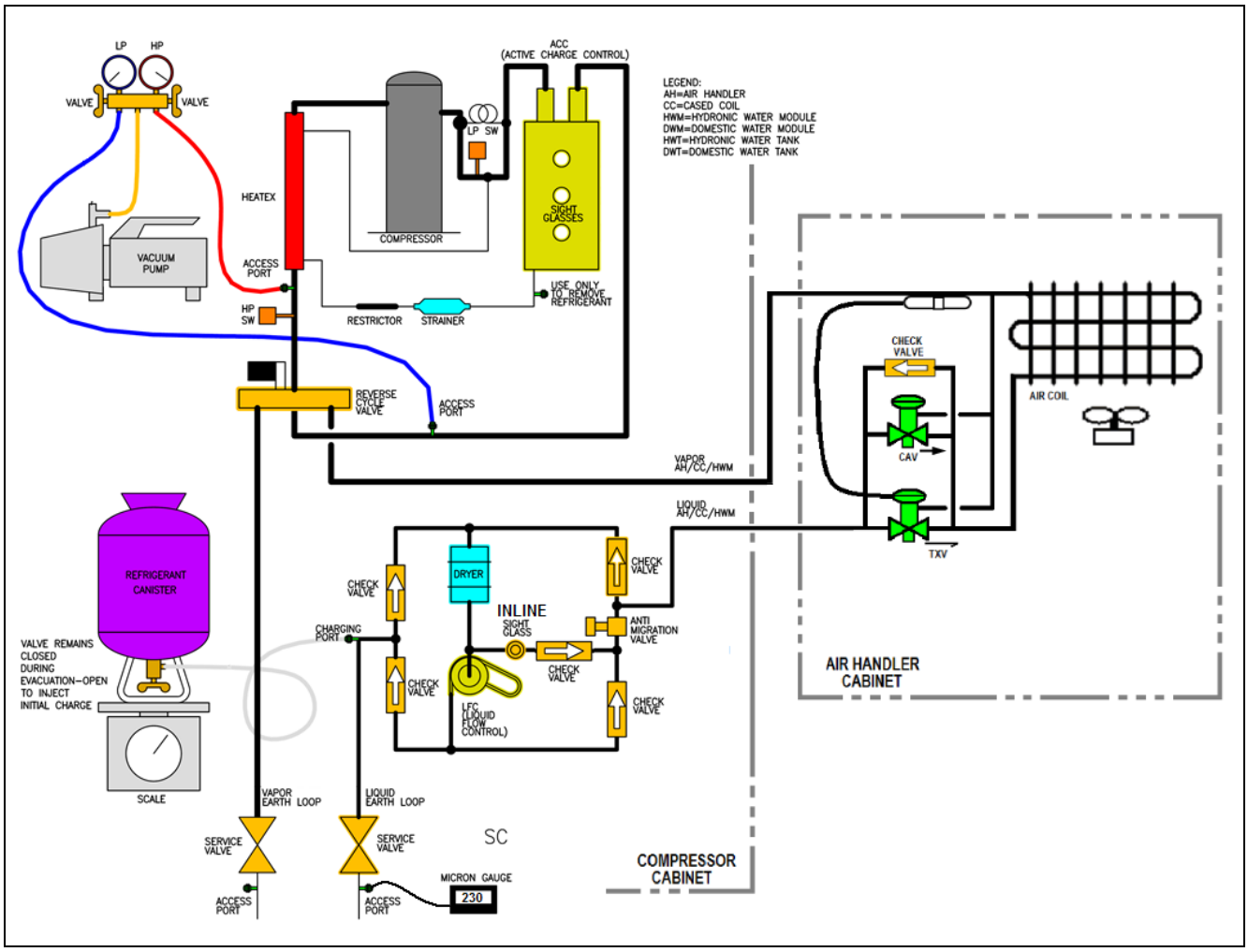

Figure 1. Typical Evacuation & Initial Charge Set-up for SC, SD, SCW and SW Compressor Models (SC model shown).

7. Close the LP and HP valves on the gage block. Disconnect the vacuum pump and the utility hose from the gage block. Isolate/protect the Digital Micron Gage from the liquid Earth Loop Service Valve until the initial refrigerant charge is complete.

WARNING!

Inhalation of high concentrations of refrigerant gas vapor is harmful and may cause heart irregularities, unconsciousness 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.

8. Open the refrigerant container valve and **inject liquid refrigerant into the charging port** as shown in Figure 1.
9. Charge with liquid refrigerant until **3 pounds** of refrigerant per ton of system capacity, has entered the system.

   Liquid entering the system at the charging port goes directly to the system earth loops. It does not go to the compressor. Should the pressures equalize and prevent the intended charge from entering completely, terminate the process of initial charging. Note and document the amount of refrigerant.
10. When the initial refrigerant charge (see step 9 above) has entered the system, close the refrigerant container valve and disconnect the refrigerant hose from the charging port. Note and document the amount of refrigerant.
11. The system has now been initially charged. Disconnect the Digital Micron Gage.

Final Charge

It is critical to control the conditions under which the compressor unit operates while final charging the system. **Final charging must be done in HEAT mode.**

Air Handler Systems

If AIR heating is provided by one of the following DX air handler systems, as listed in Figure 2, the return air to the air handler during the final charging is to be maintained in the range of 70°F to 80°F. If necessary, the air can be warmed with electric supplemental heat in the air handler. (Shunt "R" to "W2" at the terminal block.)

Item	Comp. Unit	Air Htg.	Hydronic Htg.	Air Clg	Domestic Wtr. Htg.	System Functions
1.	SC	Yes		Yes		Air heating and cooling
2.	SC	Yes		Yes	Yes[1]	Air heating and cooling, domestic hot water by field installed desuperheater
3.	SD	Yes		Yes	Yes[1]	Air heating and cooling, domestic hot water by desuperheater
4.	SW	Yes		Yes	Yes[2]	Air heating and cooling, domestic hot water by priority heating with DWM

[1]Includes Desuperheater Model DSH-1872 to supplement water heating.
[2]Priority water heating provided with separately purchased Domestic Water Module (Series DWM)

Figure 2. Systems with DX Air Handlers

Hydronic Systems

If heating is provided through the SCW compressor unit or a hydronic water module, HWM, as listed in Figure 3, the circulating water in the primary circuit (see Figures 4 and 5) for the hydronic system is to be maintained in the 95°F to 105°F range. Water from the main supply can be flushed through the primary circuit to maintain this water temperature range while final charging the compressor unit.

Item	Comp. Unit	Air Htg.	Hydronic Htg.	Air Clg	Domestic Wtr. Htg.	System Functions
1.	SC		Yes[3]	Yes[3]		Radiant panel hydronic heating and air cooling (chilled water handler)
2.	SC		Yes[3]	Yes[3]	Yes[1]	Radiant panel hydronic heating and air cooling (chilled water handler); and domestic hot water by field installed desuperheater
3.	SD		Yes[3]	Yes[3]	Yes[1]	Radiant panel hydronic heating and air cooling (chilled water handler); and domestic hot water by desuperheater
4.	SW		Yes[3]	Yes		Radiant panel hydronic heating and air cooling
5.	SW		Yes[3]	Yes[3]	Yes[2]	Radiant panel hydronic heating and air cooling (chilled water handler); and domestic hot water by priority heating with DWM
6.	SCW		Yes[4]	Yes[4]		Radiant panel hydronic heating and air cooling (chilled water air handler)

[1]Includes Desuperheater Model DSH-1872 to supplement water heating.
[2]Priority water heating provided with separately purchased Domestic Water Module (Series DWM)
[3]Hydronic (radiant floor) water heating provided with separately purchased Series HWM Hydronic Water Module.
[4]Has internal refrigerant/water heater exchanger. Requires field supplied water circulating pump.

Figure 3. Systems with Hydronic Heat Exchangers

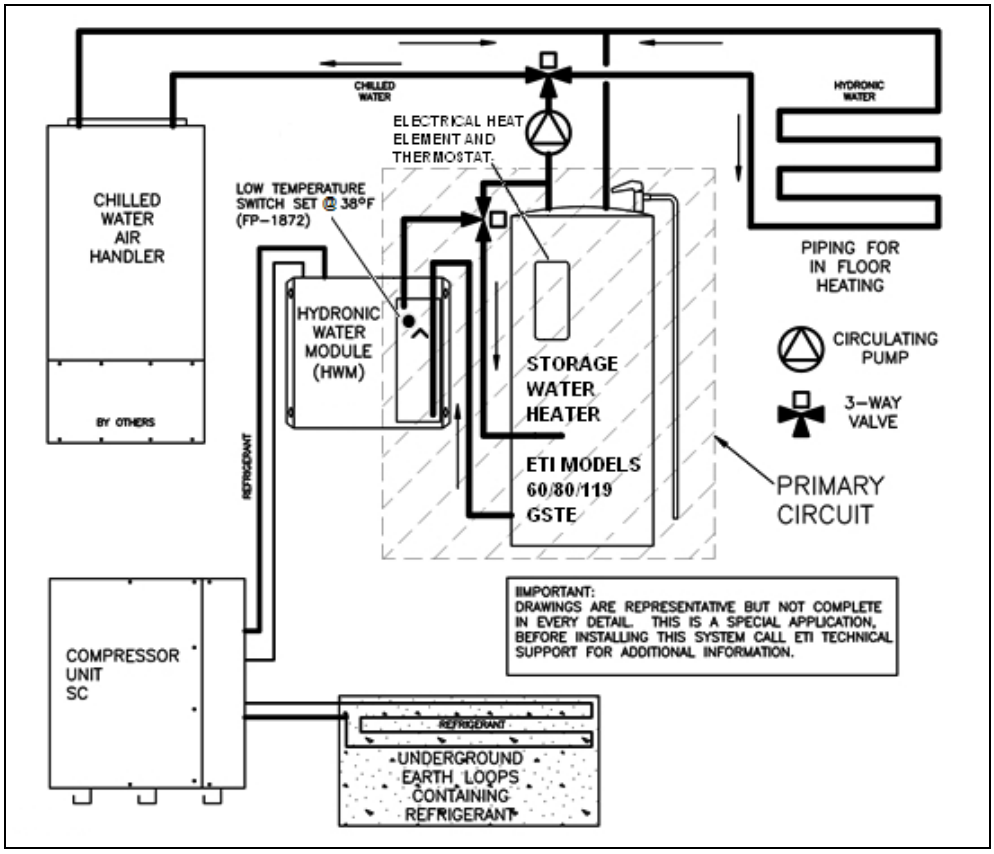

Figure 4. Primary Circuit with Hydronic Water Module (HWM)

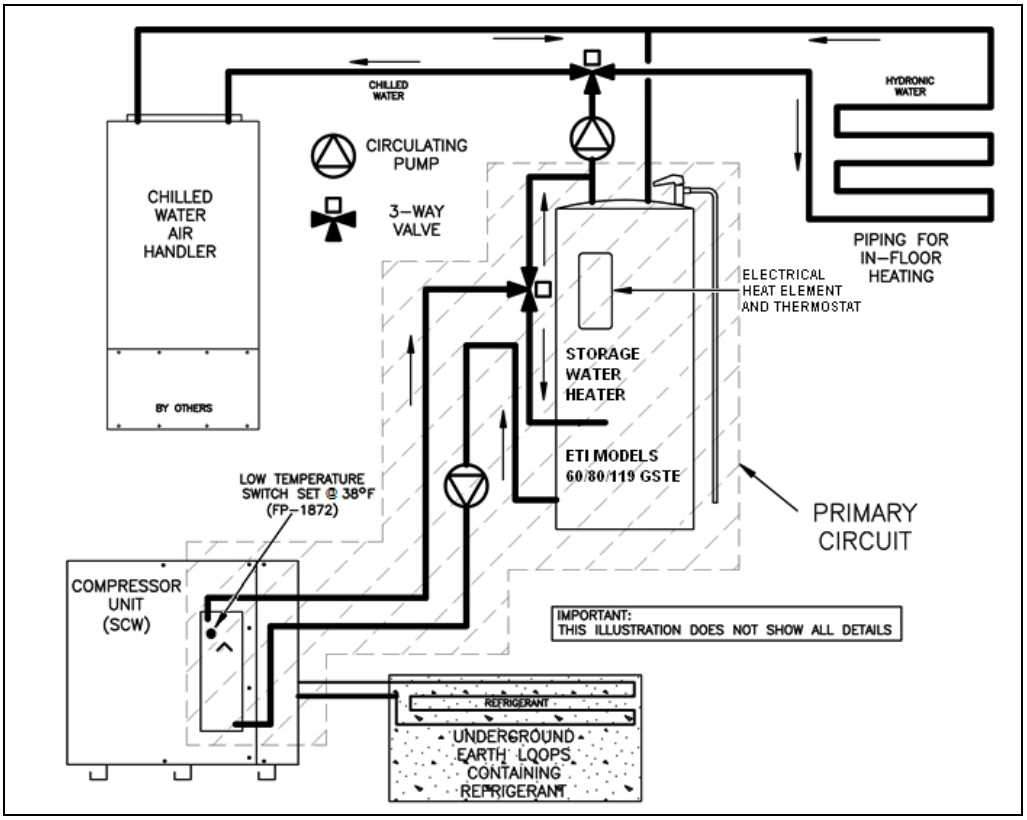

Figure 5. Primary Circuit with Compressor Unit Heat Exchanger

Final charging is done in the HEAT mode as follows, with the charging set up described in Figure 6:

1. Continue measuring the refrigerant charge weight as shown in Figure 6.

2. Be sure that air entering the air handler is between 70°F and 80°F. If the system is a hydronic primary circuit, circulating water is to be maintained between 95°F and 105°F.

3. Close the HP valve. **Then turn the system on in the HEAT mode**.

4. Initiate final charging by opening the refrigerant container valve and the gage manifold LP valve to allow liquid refrigerant to enter the system **SLOWLY** as shown in Figure 6. The ACC will not allow liquid refrigerant to enter the compressor.

5. Adding liquid refrigerant will raise the liquid level in the ACC. Continue to add liquid refrigerant to the system until the liquid level has reached the middle sight glass, as shown in Figure 7.

6. **When the liquid level is at the middle sight glass, as shown in Figure 7, turn the refrigerant container valve OFF.**

7. When the system has run for 20 minutes (in HEAT mode), read the evaporating temperature and condensing temperature.

   The evaporating temperature can be read by attaching a thermocouple lead to the Earth Loop Vapor Line with electrical tape, then wrapped with ½" thick insulation. The condensing temperature can be read by attaching a thermocouple lead to the Air Handler/CC/HWM liquid line coming into the compressor unit with electrical tape, then wrapped with ½" thick insulation. Use an accurate temperature indicator.

   In Figure 8, locate the evaporating temperature on the horizontal axis. The corresponding condensing temperature reading should fall between the upper and lower parallel lines in Figure 8.

   The temperature profile in Figure 8 is valid for the air handler systems with an air flow of 400CFM per Ton. If condensing temperature is above acceptable range, the air flow is low. If condensing temperature is below the acceptable range, air flow is too high. **Adjust air flow as appropriate.**

IMPORTANT!

DO NOT ADJUST THE THERMOSTATIC EXPANSION VALVE (TXV) OR THE COOLING ASSIST VALVE (CAV)! THESE VALVES HAVE BEEN FACTORY SET AND ARE NOT TO BE ADJUSTED BY THE INSTALLER.

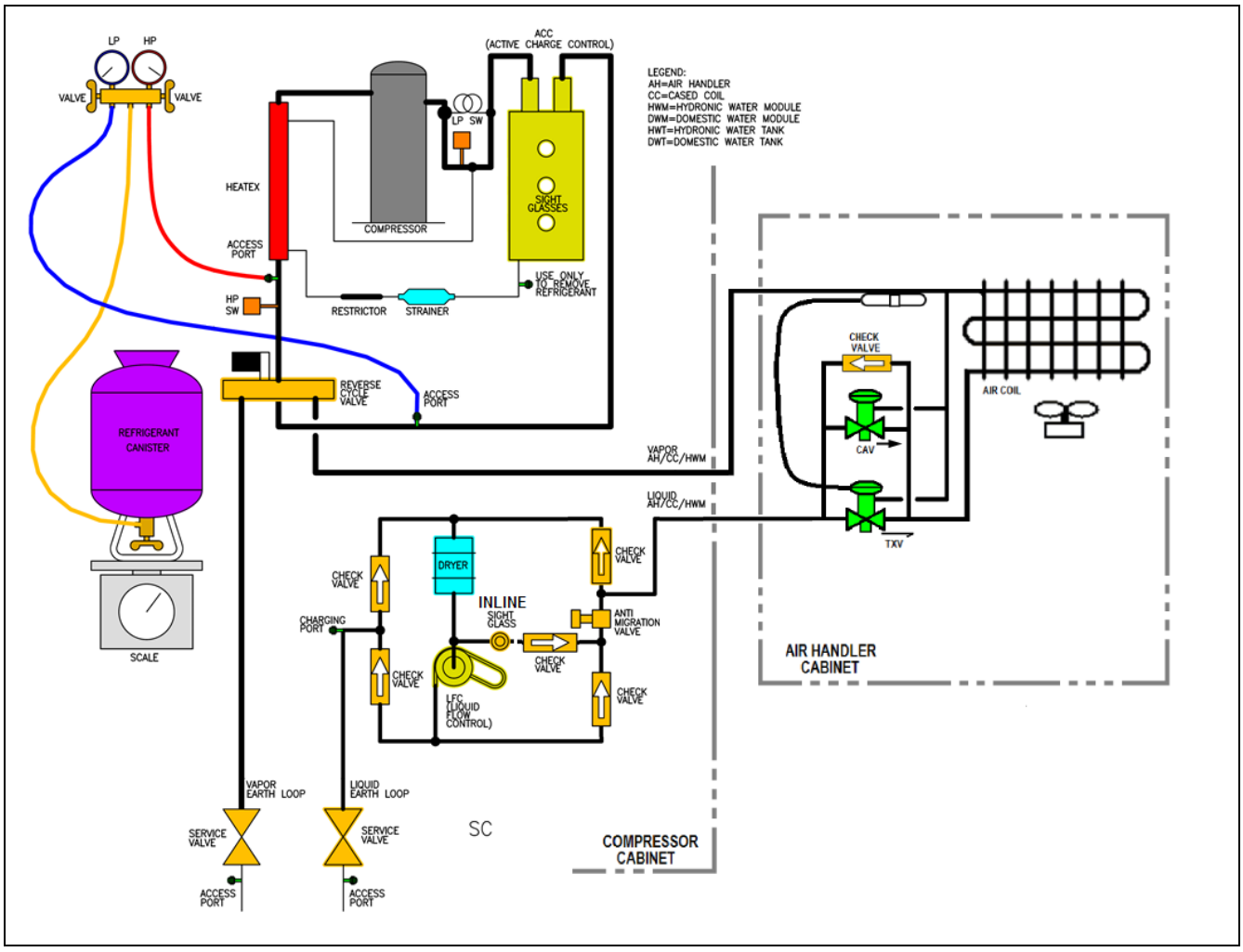

Figure 6. Typical Final Charge Set-up for SC, SD, SCW and SW Compressor Units (SC Model shown).

8. Check the suction saturation temperature to verify that it is within ±3°F for the measured suction pressure. The suction temperature should be approximately 15 to 20°F lower than the local earth temperature.

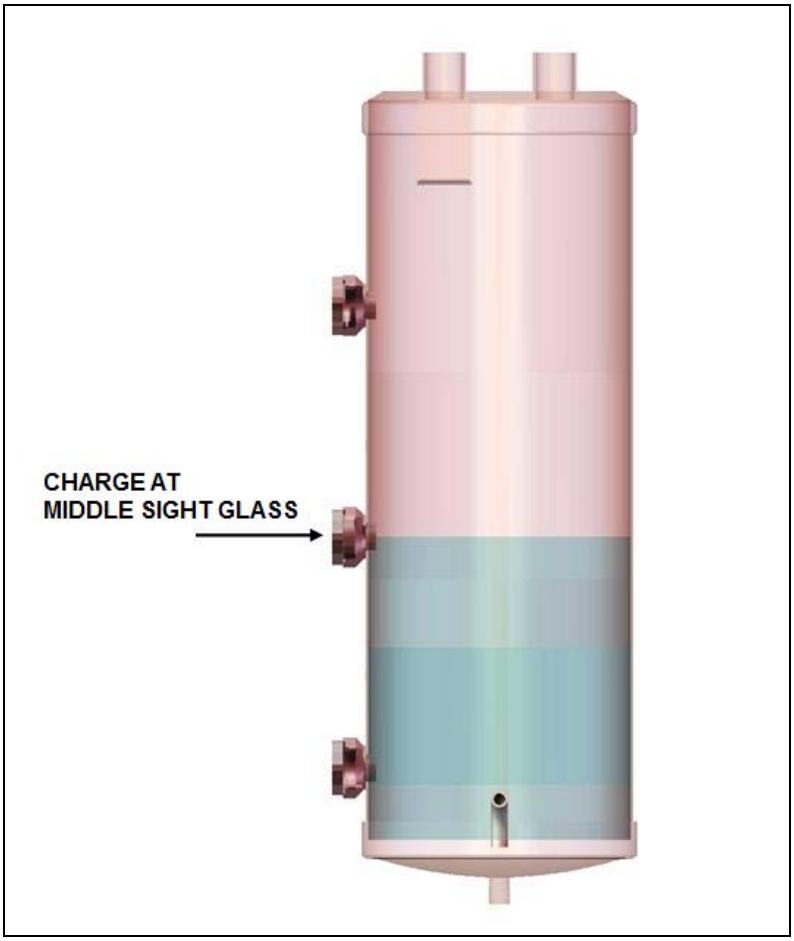

Figure 7. Charge at Middle Sight Glass

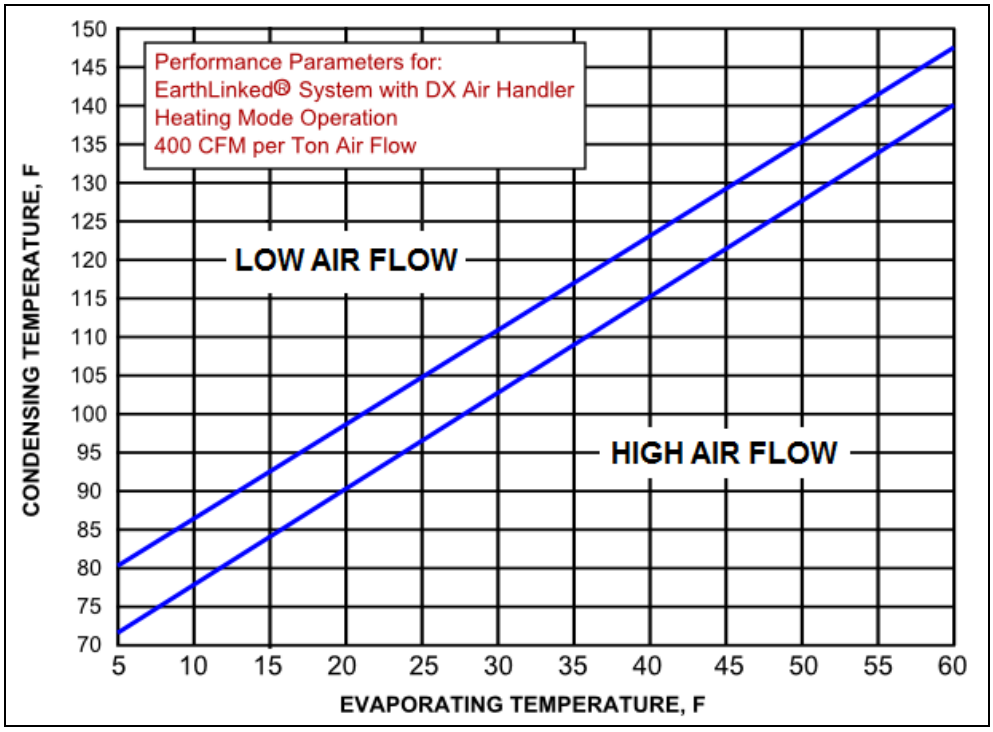

Figure 8. EarthLinked® Performance Parameters

9. **<u>If the system is to operate in Heat Only mode</u>**, write the final refrigerant charge on the **Warranty registration Card and on the inside of the compressor unit on the electrical diagram** for future reference. This is the full system charge. The system is fully operational and needs no further adjustment.

10. **<u>If the system is to operate in Heat/Cool or Cool Only mode</u>**: While the system is still operating in **HEAT** mode, add refrigerant to the system to bring the liquid refrigerant level up to the top sight glass on the ACC. See Figure 9. Document the total weight of refrigerant charge in the system.

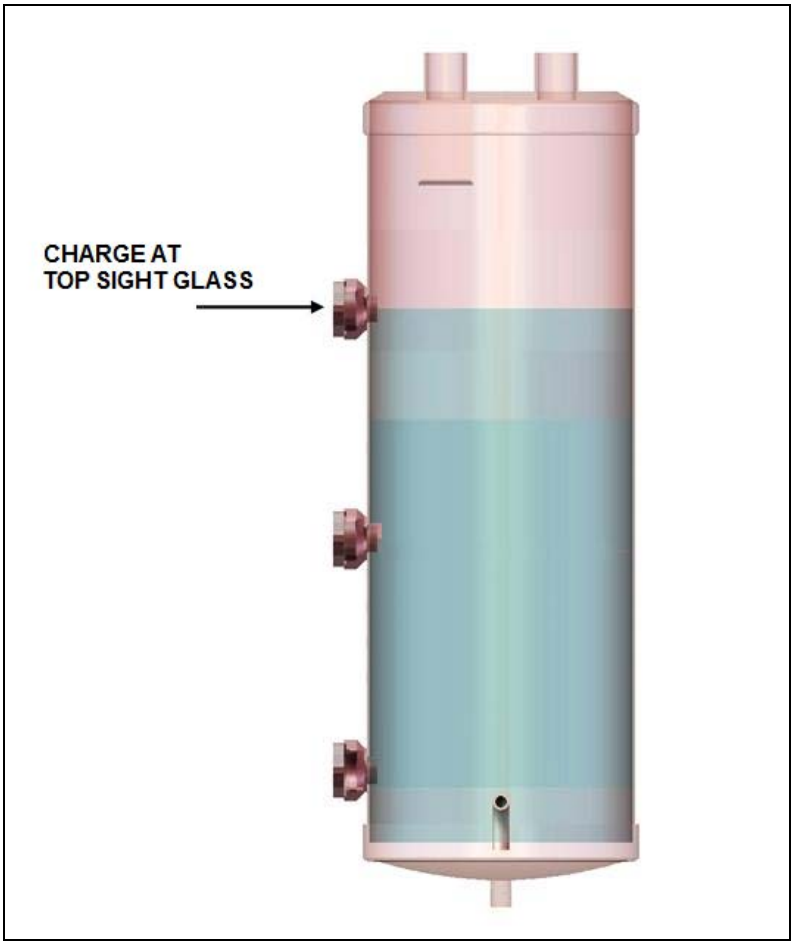

Figure 9. Charge at Top Sight Glass

11. The following additional steps in the system start-up process are required if the system is to operate in Heat/Cool or Cool Only modes. These following steps require that the system be run in the **COOL** mode.

IMPORTANT!

If site conditions prevent maintaining an air handler return air temperature between 70° F and 80° F, the cooling system start-up steps can be completed at a later time. If the cooling mode start-up process is delayed, the system can run in heat mode only and the cooling mode must be disable until the cooling mode start-up process is initiated.

Cooling Mode Start-Up Process

These following steps are to be followed if the system **is to be run in Heat/Cool or Cool Only**. **The process flow chart for these steps is illustrated in Figure 15**. Be sure the cooling mode for the system is enabled. Start the system in COOL mode and run system until the suction pressure stabilizes.

IMPORTANT!

Be sure the return air to the air handler is maintained in the range of 70° F to 80° F. If the system is hydronic maintain the return water temperature in the range of 95° F to 105° F.

1. After suction pressure has stabilized, determine the system superheat. This is done by utilizing the access port and LP gage in Figure 13 to measure suction pressure. **Next, apply a thermocouple at the compressor suction port** as shown in Figure 13 by attaching a thermocouple lead with electrical tape, and wrapping with ½" thick insulation.

2. **Using an accurate temperature indicator, read the suction temperature at the compressor suction port.** Read the suction pressure at the access port on the LP gage.

3. Enter the Pressure-Temperature Table in Figure 14 and for the suction pressure read on the LP gage, determine the saturation temperature (evaporating temperature) from the chart, interpolating if necessary.

4. To determine the degrees of Superheat, subtract the saturation temperature from the suction temperature read at the compressor suction port thermocouple. The difference in temperatures is the superheat.

   (Superheat, ºF) = (Suction Temp., ºF) – (Saturation Temp., ºF)

5. **If Superheat is less than 5ºF (<5ºF), adjust the CAV by turning it COUNTER-CLOCKWISE, until Superheat is in the range of 10ºF to 15ºF. Wait 5 minutes and go to step 6. If Superheat is greater than 5ºF (>5ºF), wait 5 minutes and go to step 6.**

6. Determine what the liquid level is in the ACC by viewing it through the sight glasses in the ACC. If the liquid level is at or above the lowest sight glass, repeat steps 1 through 5. The liquid level should be dropping with time. Repeat the observations of liquid level in the ACC sight glasses and the steps 1 through 5 until the liquid level has dropped below the lowest sight glass, or until 2 hours pass. After 2 hours, if the liquid level has not dropped below the lowest sight glass, call ETI Technical Services at 1-863-701-0096.

7. When the liquid refrigerant level drops below the ACC lowest sight glass, **observe the INLINE sight glass** (not the ACC sight glasses) for the status of the refrigerant flow. There are three possibilities:

   A. **INLINE** sight glass is **CLEAR**: As illustrated in Figure 10, a clear sight glass means the refrigerant flow is liquid. Remove 1 pound of refrigerant from the system, wait 10 minutes, and observe again. Continue this until bubbles appear in the sight glass.

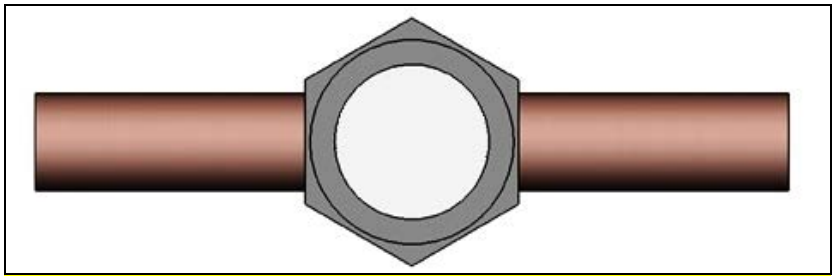

Figure 10. Clear-Inline Sight Glass

B. **INLINE** sight glass has **MANY BUBBLES**: This is illustrated in Figure 11. Wait 10 minutes and observe the sight glass again. If many bubbles are still present, repeat the 10 minute wait cycle until the bubbles become few, or you have waited 2 hours. After a 2 hour wait, and many bubbles still exist in the sight glass, the process is done. No further adjustment in cool mode is required, and the system is operational.

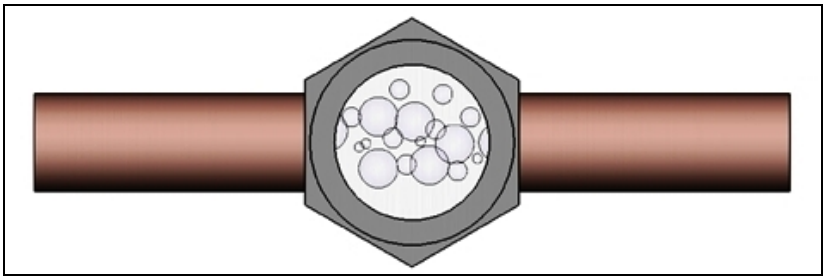

Figure 11. Many Bubbles-Inline Sight Glass

C. **INLINE** sight glass has **FEW BUBBLES**: This is illustrated in Figure 12. When this condition exists, the next steps are to check the superheat and adjust the TXV as necessary.

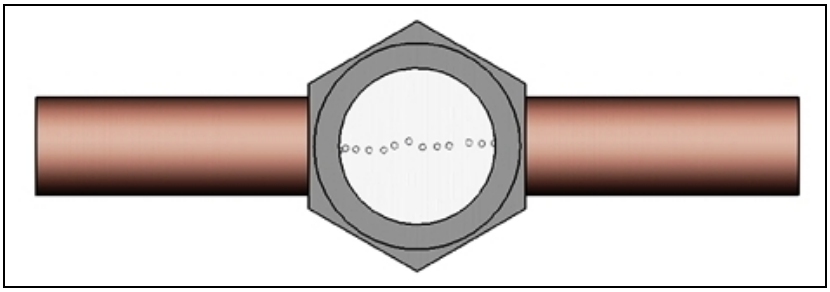

Figure 12. Few Bubbles-Inline Sight Glass

8. The TXV is to be adjusted to provide 10ºF to 15ºF superheat while running in cooling mode. Superheat is to be determined as detailed previously in steps 1 through 5.

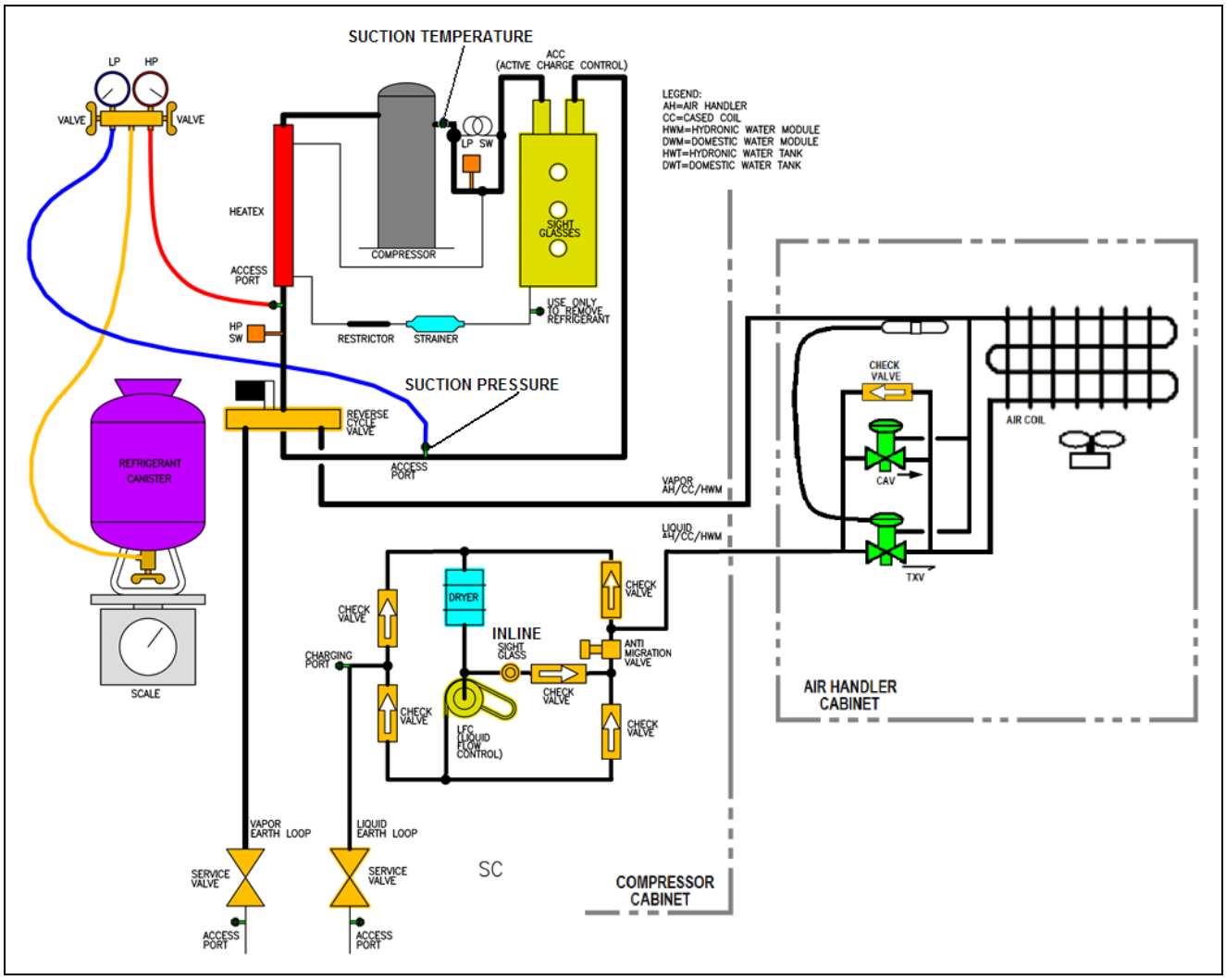

Figure 13. Superheat Measurements for SC, SD, SCW and SW Compressor Units (SC Model shown).

SATURATION TEMPERATURE (°F)	SUCTION PRESSURE (psig)	SATURATION TEMPERATURE (°F)	SUCTION PRESSURE (psig)
-20	6.5	70	117.3
-15	9.3	75	128.6
-10	12.3	80	140.5
-5	15.7	85	153.2
0	19.4	90	166.7
5	23.5	95	181.0
10	27.9	100	196.1
15	32.7	105	212.1
20	37.9	110	229.0
25	43.5	115	246.9
30	49.6	120	265.8
35	56.1	125	285.7
40	63.2	130	306.7
45	70.7	135	328.8
50	78.8	140	352.1
55	87.5	145	376.6
60	96.8	150	402.5
65	106.7		

Figure 14. Pressure-Temperature for R-407C

9. If superheat is greater than 20°F, **decrease the superheat by adjusting the setting on the TXV in the counter clockwise direction.**

10. See Figure 15 and follow the guidelines to bring the superheat into the 10^0F to 15^0F range. When superheat is adjusted to within this range, the system is fully operational and needs no further adjustment.

11. Document the **net weight** of the refrigerant charge in the system. **Net weight is equal to the final refrigerant charge minus refrigerant removed from the system.** Write it down on the **Warranty Registration Card** and inside the compressor unit on the electrical diagram, for future reference. **This is the full system charge.**

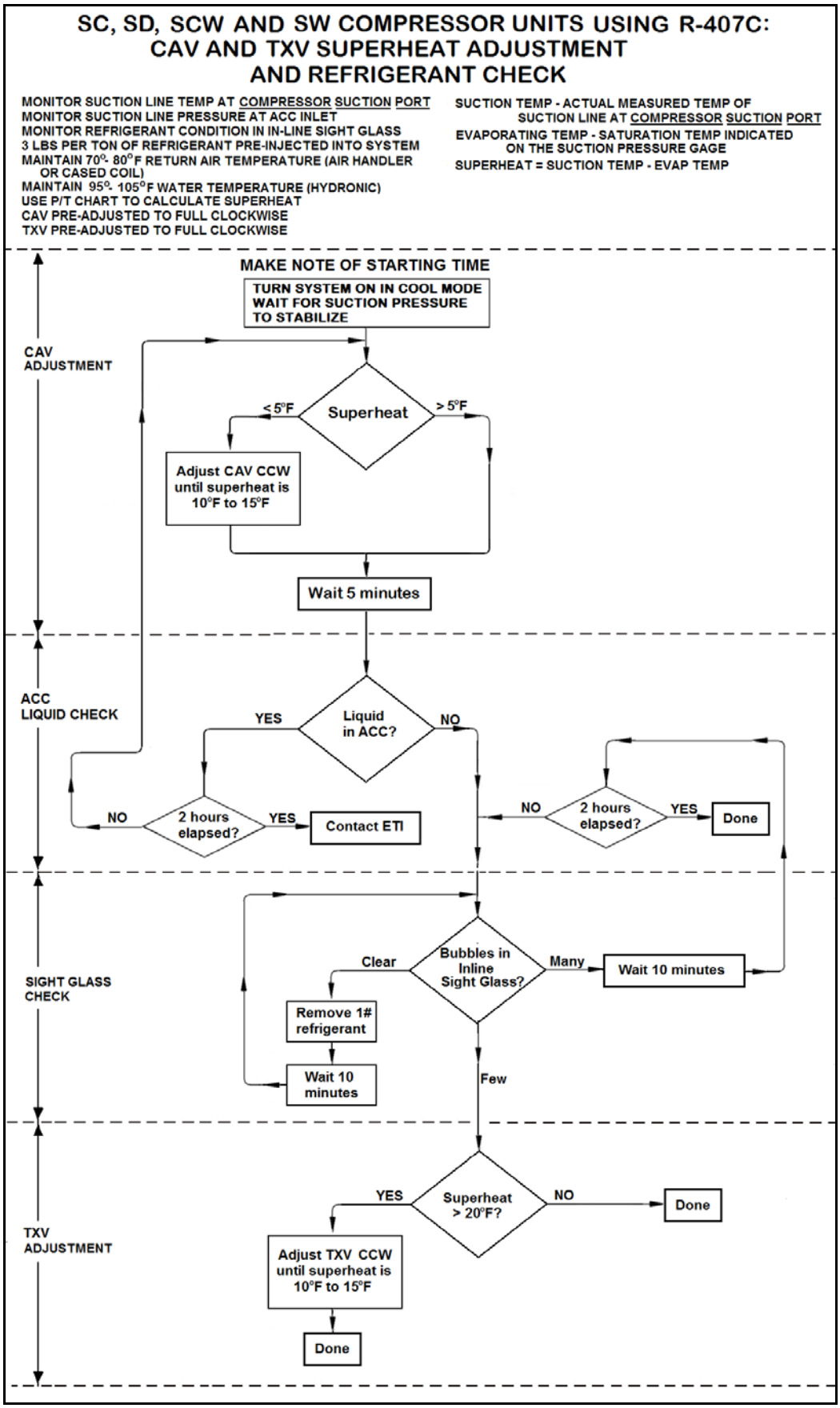

Figure 15. R-407C Cooling Mode Start-Up Process