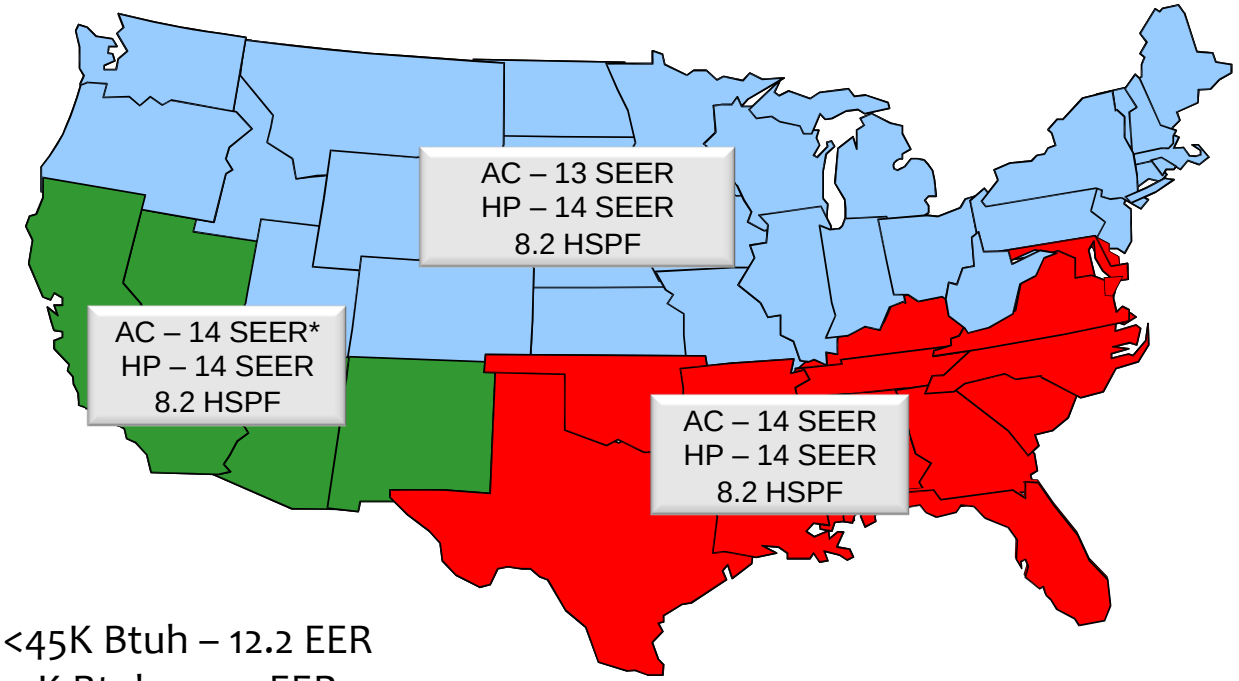
Goodman

Key Points of Installation, Service & Troubleshooting

Regional Efficiencies 2015

January 2015 – new DOE requirements



* <45K Btuh – 12.2 EER
>45K Btuh – 11.7 EER

Goodman Confidential – Not for re-distribution

Goodman Air Conditioning & Heating

Goodman Air Conditioning & Heating

Goodman Air Conditioning & Heating

Amana Heating & Air Conditioning LASTS AND LASTS AND LASTS.

Objectives

- Understand DOE Mandates
- Understand EPA mandates
- Understand Installation Considerations
- Understand Proper Condensate Removal
- Understand Proper Charging Techniques
- Basic trouble shooting
- Review Thermostat wiring
- Understand Start Up Considerations

13 SEER Dry Units.
No longer available

R-22 Refrigerant

- Will be completely phased out 2020



POE OIL in R22 Compressors

- Starting in Q2 of 2014, R22 compressors will transition to POE oil.
- **Same change to service compressors.**
- Serial number break will be used to track this change.
- R22 drop-in replacement not approved
- No warranty coverage
- Goodman will not be responsible for, any repairs or damages resulting from the use of unapproved refrigerant types or used or recycled refrigerant.
- Same procedure must be followed using these units as R410A units
- Existing lines and coils must be flushed to remove mineral oil and deposits.





Installation Tips

- No capillary tube evaporators
- Always utilize piston shipped with outdoor product
- When charging system validate superheat or subcooling based on metering device used on the indoor coil after weighing in additional charge per manufacturers specifications.
  - Fixed Orifice – Superheat
  - TXV - Subcooling

Refrigerant Piping Considerations

Refrigerant Tubing

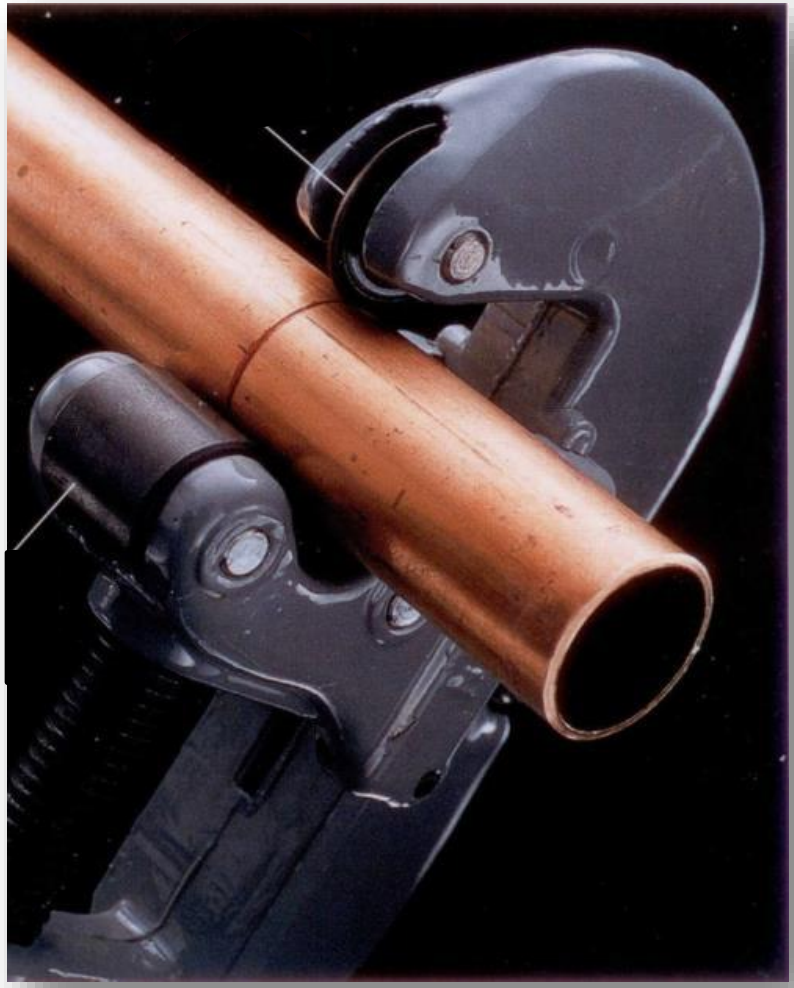
- Use only refrigerant grade copper (Clean, Dry, ACR)
- Suction line insulation is required to prevent additional heat gain
- Closed cell insulation with 1/2” wall thickness is satisfactory unless local codes require greater
- Liquid line insulation required when exposed to ambient temperatures of 120F or greater





Brazing the Line Set

- Tubing should be cut with a good tubing cutter (Sharp Wheel)
- Remove burrs
- Wrap a wet rag around the service valves and keep saturated to prevent overheating . Valve Core must be removed.
- Trickle a small amount of dry nitrogen (2-3 PSIG) through the line set. Flow Gauge Recommended.
- Braze with a minimum of 8% silver alloy (never use Flux)



Brazing The Line Set

When brazing, one should always be concerned about the capillary action.



Leak Testing

- Visually check all solder joints with an inspection mirror
- Add a trace amount of the appropriate refrigerant and then fill refrigerant tubing with 200 PSIG of dry nitrogen
- Test with leak solution or electronic leak detector
- If there are no leaks, evacuate line set to 500 microns and hold for 15 minutes (minimum)

Refrigerant Piping

- Adequate refrigerant charge for a matched evaporator coil and 15’ line set is supplied with the condensing unit. A line set exceeding 15’ in length requires refrigerant to be added per the installation instructions.
- Open the suction service valve first!
  - If the liquid service valve is opened first, oil from the compressor may be drawn into the indoor coil TXV, restricting refrigerant flow and affecting operation of the system. If it’s a heat pump the oil will log the reversing valve causing it to malfunction.

Recommended Tube Size – Single Stage

RECOMMENDED INTERCONNECTING TUBING						
COND UNIT TONS	0-24’		25’-49’		50’-79’	
	LINE DIAMETER (Inches Outside Diameter)					
	SUCT	LIQ	SUCT	LIQ	SUCT	LIQ
1.5	5/8	1/4	3/4	3/8	3/4	3/8
2	5/8	1/4	3/4	3/8	3/4	3/8
2.5	5/8	1/4	3/4	3/8	7/8	3/8
3	3/4	3/8	7/8	3/8	1 1/8	3/8
3.5	7/8	3/8	1 1/8	3/8	1 1/8	3/8
4	7/8	3/8	1 1/8	3/8	1 1/8	3/8
5	7/8	3/8	1 1/8	3/8	1 1/8	3/8

LINES GREATER THAN 79’. REFER TO LONG LINESET APPLICATION GUIDE.

Long Lineset

- Maximum Equivalent Length
  - 250’ Single Stage With Scroll Compressor
  - 150’ Two Stage Units or Single Stage Unit with Rotary Compressor*
- Maximum Linear Length
  - 200’ Single Stage With Scroll Compressor
  - 150’ Two Stage Units or Single Stage Unit with Rotary Compressor*

*The GSX13018 is the only product utilizing a rotary compressor.

Long Lineset

- Additional Refrigerant
  - Required when lineset exceeds 15’

LINE SET SIZE	ADDITIONAL REFRIGERANT
3/8” LIQUID ONLY	.60 OZ PER FOOT
3/8 LIQUID & 5/8 SUCTION	.63 OZ PER FOOT
3/8 LIQUID & 3/4 SUCTION	.67 OZ PER FOOT
3/8 LIQUID & 7/8 SUCTION	.74 OZ PER FOOT
3/8 LIQUID & 1 1/8” SUCTION	.78 OZ PER FOOT

Long Line Set Application R-410A

Guidelines for *Long Line Set Application R-410A* are established in technical publication TP-107 G.

This publication can be located:

www.goodmanmfg.com

go to bottom of page and left click “partnerlink” will take you to next page

User name---goodman

Password-----dealer,,,,,hit enter

Next page----infofinder left click------pick your query.

Electrical Overview

High Voltage!

- Disconnect ALL power before servicing.
- Multiple power sources may be present. Failure to open all power sources may cause property damage, personal injury or death due to electric shock.
- Wiring must conform with NEC and all local codes.
- Undersized wires could cause poor equipment performance, equipment damage or fire.

SAFETY FIRST

Checking Voltage

1. Remove power from unit utilizing disconnect or circuit breaker
2. Remove control panel cover from unit.
3. Apply power to unit and measure line voltage at contactor terminals L1 and L2
   - L1 to L2 = No voltage indicates no power (Open wire, open fuse/disconnect/circuit breaker)
4. With 220VAC (+ or – 10%) at line voltage lug connections energize the unit.
5. Measure the voltage with the unit starting. This will indicate the LOCKED ROTOR VOLTAGE.
6. Should voltage fall below the minimum voltage (~198VAC), check the line wire size. Long runs of wire can cause low voltage. If wire size is adequate, notify power company of high or low voltage.

Checking Wiring

1. Check wiring visually for signs of overheating, damaged insulation and loose connections.

2. Use an ohmmeter to check continuity of any suspected open wires.

3. If any wires must be replaced, replace with correct gauge and insulation thickness based on manufacturer recommendations.

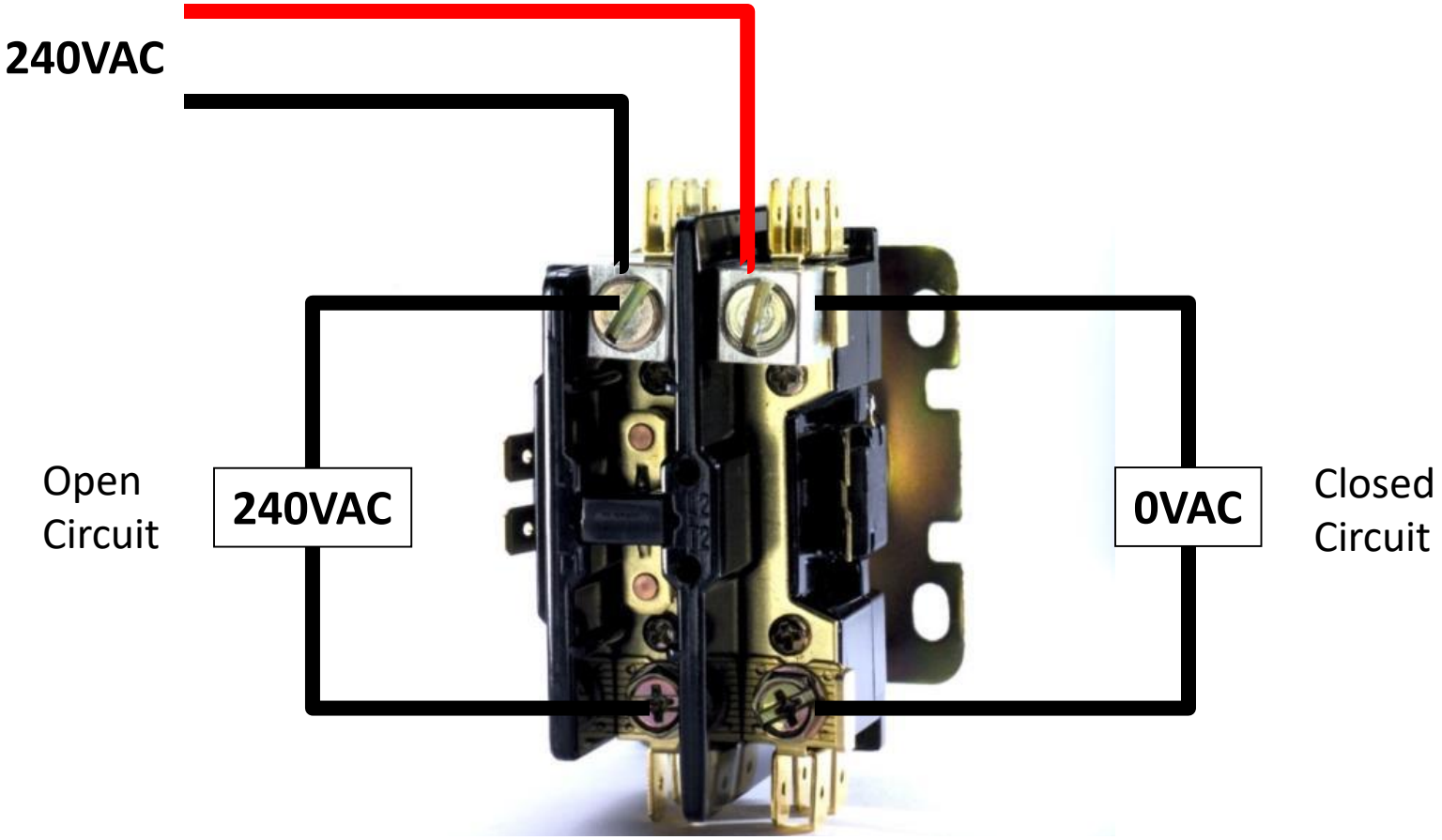
Checking Transformer and Control Circuit

1. Disconnect electrical power supply.
2. Remove control panel cover on furnace or air handler to gain access to the transformer.
3. Turn power ON: Line voltage is now present.
4. Check transformer primary voltage at incoming line voltage connections.
5. If line voltage available at primary voltage side of transformer wiring is 208 – 230VAC and ~24VAC is not present at transformer secondary the transformer coil has failed. Replace Transformer.

Checking Contactor Coil

1. Disconnect electrical power supply.
2. Remove the leads from the contactor coil.
3. Using an ohmmeter, test across the coil terminals.
4. If the coil does not test continuous or gives an incorrect resistance reading, replace the relay or contactor.

Checking Contactor Contacts



The contactor has 240VAC present between L1 and L2 and 24VAC at the contactor coil. The contacts have failed open and are not closing the circuit to energize the unit.

RLA: Rated Load Amps

- RLA or Rated Load Amps is often mistakenly called Running Load Amps
- Rated Load Amps establishes a value for each compressor
- This is 71% of the maximum continuous current allowed by the motor protection system

LRA: Locked Rotor Amps

- Locked Rotor Amps is defined as current drawn by a motor which is locked from motion
- This occurs briefly during motor start up
- The current to load the winding, overcome inertia and create the starting torque; is approximately 6 to 7 times the Rated Load Amps (RLA)

Electrical Connections

- The condensing unit rating plate lists pertinent electrical data necessary for proper electrical service and over current protection
- Wires should be sized to limit voltage drop to 2% (max.) from the main breaker or fuse panel to the condensing unit
- Consult the NEC and all local codes to determine the correct wire gauge and length
- Local codes often require a disconnect switch located near the unit; do not install the switch on the unit
- Refer to the installation instructions supplied with the indoor furnace/air handler for specific wiring connections and indoor unit configuration. Likewise, consult the instructions packaged with the thermostat for mounting and location information

R410A

Alternative Refrigerants / Stop Leak

- Emerson Climate Technologies DOES NOT Approve The Use Of “Drop-in” Refrigerants With Copeland Brand Compressors For Residential And Light Commercial Service Applications With Mineral Oil Lubricant.
- Neither Daikin Nor Our Compressor Vendors Approve Of The Use Of Stop-leak Products In Any Product Produced By Daikin.

R410A

- Refrigerant
  - The Fluid Utilized In A Refrigeration System That Allows Heat Transfer.
  - Absorbs Heat During Evaporation (Evaporator) And Rejects Heat During Condensation (Condenser)

R410A

- HFC Refrigerant
- Chlorine Free
- Ozone Depletion Potential = 0
- Global Warming Potential = 1610
- ASHRAE A1 Safety Rating (Non Flammable/Non Toxic)

R410A

- Zeotropic Blend
- Blend Of R32 (50%) And R125(50%)
- The Refrigerants Will Leak At A Different Rate But The Temperature Glide Is Extremely Low Resulting In Minimal Fractionation.
- Topping off is permitted, liquid form only

R410A

Operating Pressures Higher Than R22

TEMPERATURE	R22	R410A	% INCREASE
50°F	84PSIG	142.2PSIG	59%
110°F	226.3PSIG	365.0PSIG	62%

R410A Facts

- Ester Oil Will Absorb Moisture!
- The System Must Be Clean!
- System Must Be Charged With Liquid Refrigerant!
- If moisture is present within the system a drier replacement is required to separate the water from the oil.
- Whenever the refrigerant system is opened, the filter drier MUST be replaced.

R410A

- Non Condensable Will Cause Increased Condenser Pressure And Compression Temperature.
- Oxygen Will React With Ester Oil And Cause Premature Compressor Failure.
- Evacuation Decreases The System Pressure Which Reduces The Boiling Point Of Water Allowing Moisture Removal From System.

Airflow

The system cannot be charged with refrigerant properly unless the airflow has been measured and verified to meet the manufacturers specifications.

Requirement For Refrigeration Cycle Diagnostic or system charging

400 CFM/Ton

Airflow

Requirement For Refrigeration Cycle Diagnostic

- 1 Ton = 400cfm
  - 1.5 Ton = 600cfm
- 2 Ton = 800cfm
  - 2.5 Ton = 1000cfm
- 3 Ton = 1200cfm
  - 3.5 Ton = 1400cfm
- 4 Ton = 1600cfm
- 5 Ton = 2000cfm

Airflow

The Design Total External Static Pressure On Residential HVAC Systems Is Listed On The Manufacturers Nameplate And Is Typically :

.5”WC

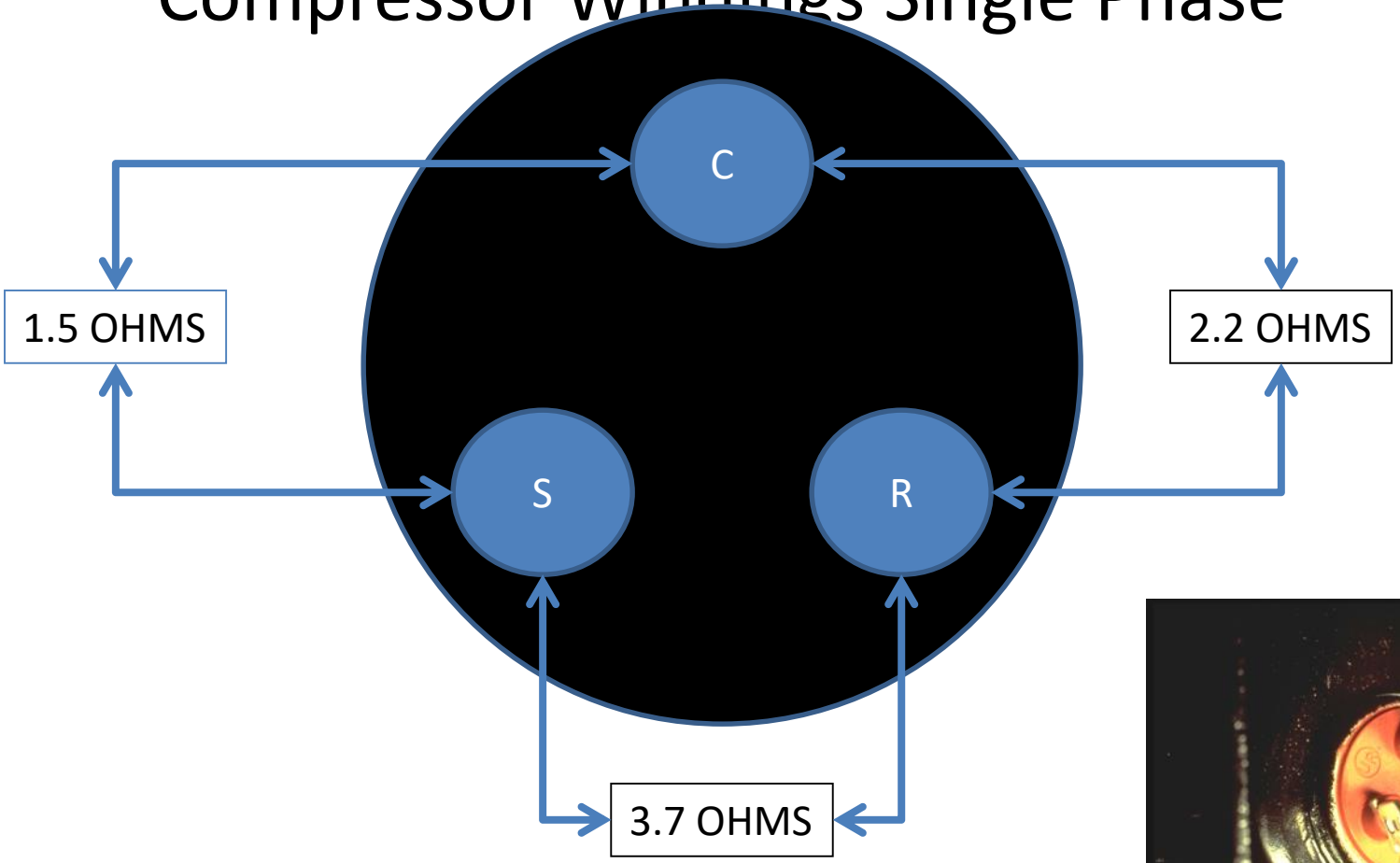
Airflow Tips

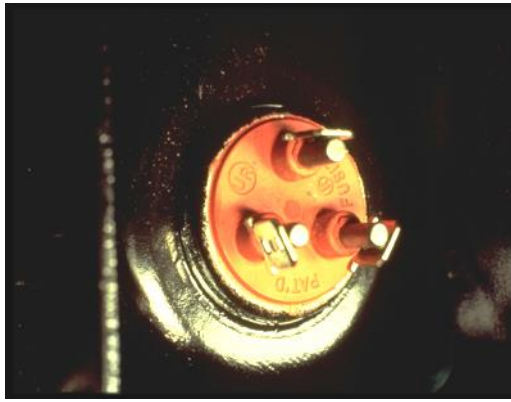
- Low Or Insufficient Airflow
  - Furnace Or Auxiliary Heat Cycles On Limit
  - Reduction In Throw From Registers
  - Refrigerant Charge Appears Low
  - Indoor Coil May Freeze Or Flood
  - Insufficient Cooling Delivered
  - Reduced Compressor Reliability
  - Increased Latent Cooling (Humidity Removal)
  - Decreased Sensible Cooling (Dry Bulb Temperature)

Airflow

- High Airflow
  - Insufficient De-Humidification
  - Noise From Duct, Registers, And Grilles
  - Decreased Latent Cooling (Humidity Removal)
  - Increased Sensible Cooling(Dry Bulb Temperature)

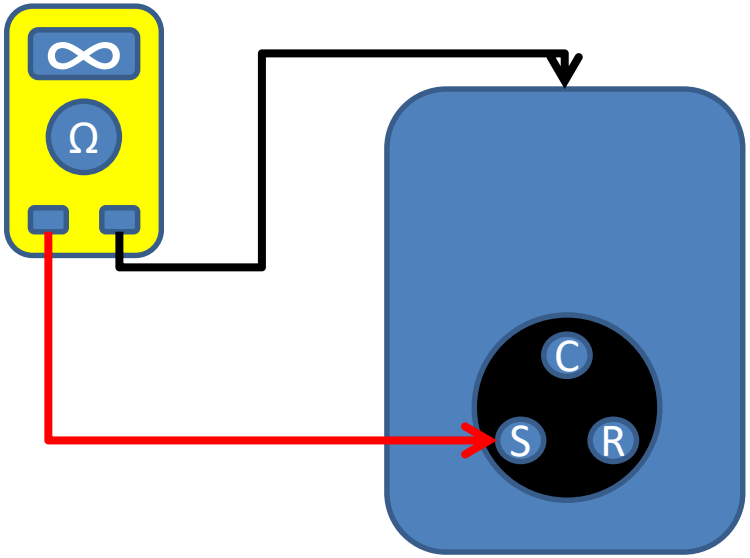
Compressor Windings Single Phase



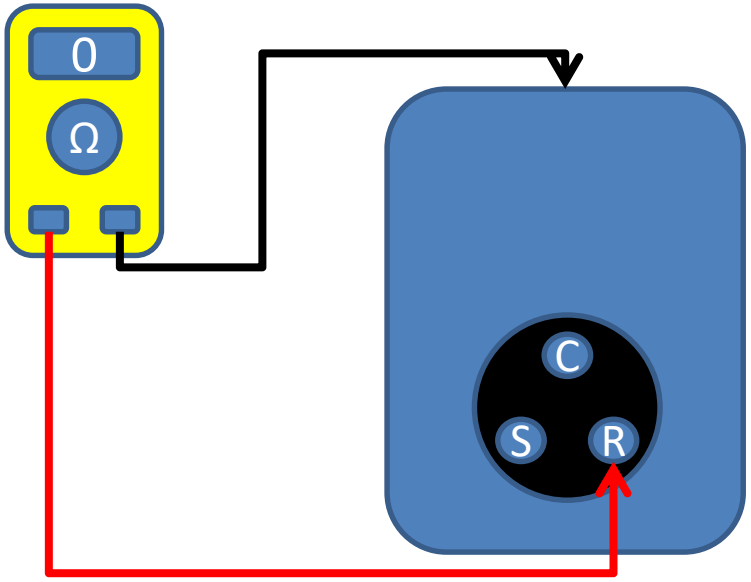


- **C to R …… The lowest amount of Ohms**
- **C to S ……. The next highest reading of Ohms**
- **R to S ……. The highest reading of Ohms**

Compressor Windings



∞ = Infinity (Not Grounded)



0 = Shorted to Ground

Motor Protection

Scroll compressors utilize a thermal overload (temperature operated disk) mounted near the compressor motor windings.

This protector is strapped to the winding or held in a specially designed clip on the motor winding.



Compressor Discharge Temperature

TEMPERATURE	EXPECTATION
350F	OIL CARBONIZATION
310F TO 330F	EXTREME WEAR
275F	FAILURE IMMINENT
250F	DANGER LEVEL
225F OR LOWER	DESIRED

High Pressure Switch

- Cut Out 610PSIG (R410A)

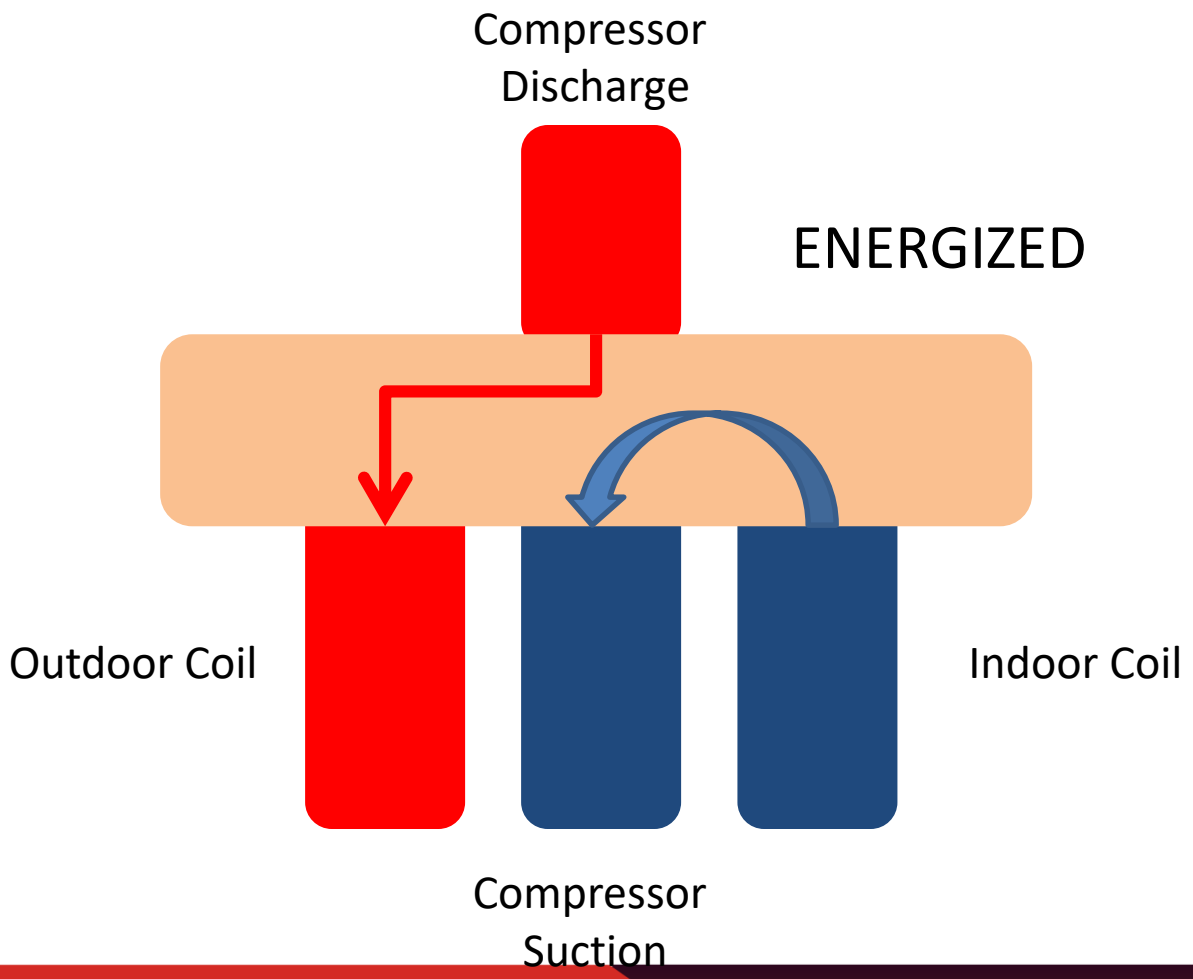


Low Pressure Switch

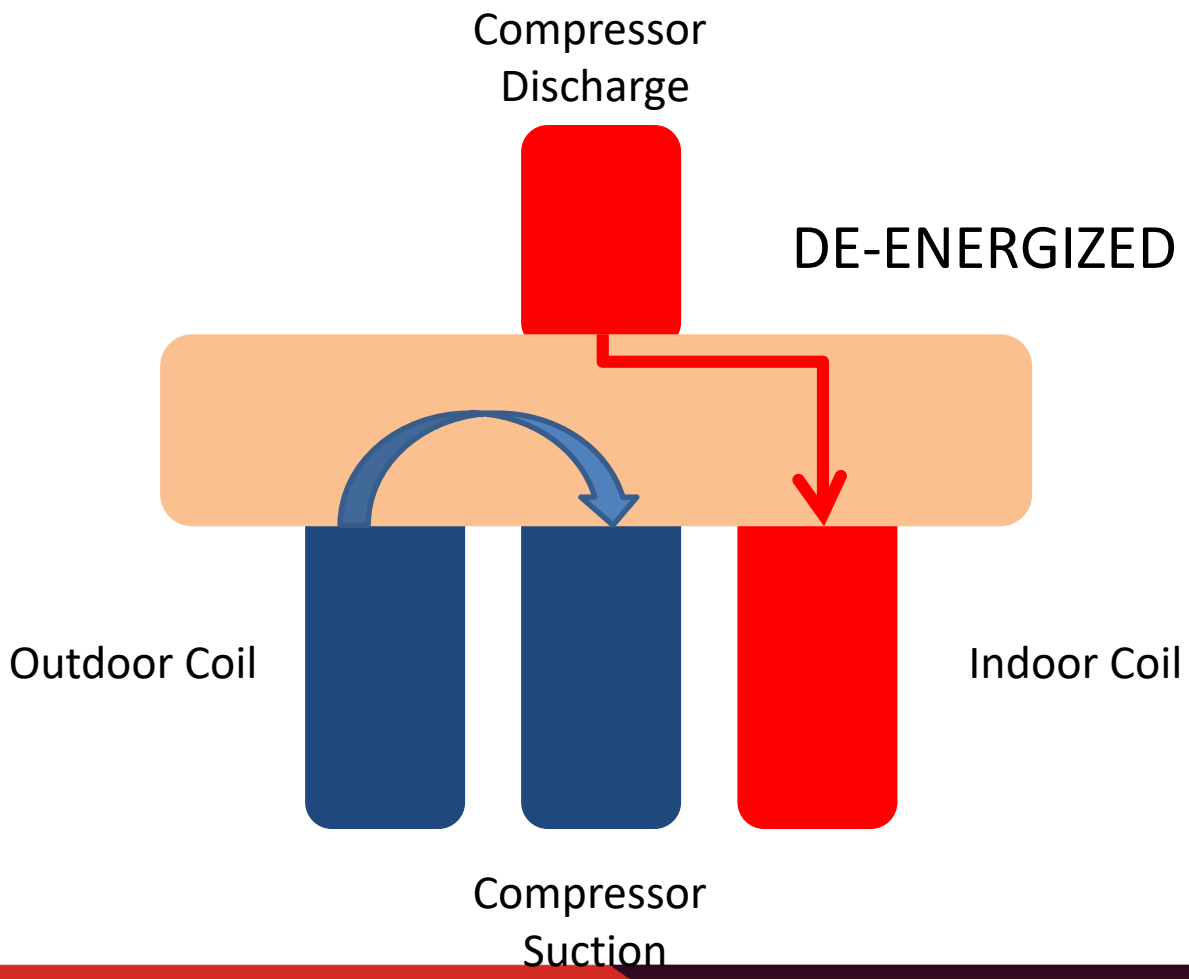
- Heat Pump Suction Line(R410A)
  - Cut Out = 21PSIG
  - Cut In = 50PSIG
- Air Conditioner (R410A)
  - Cut Out = 55PSIG
  - Cut In = 95PSIG



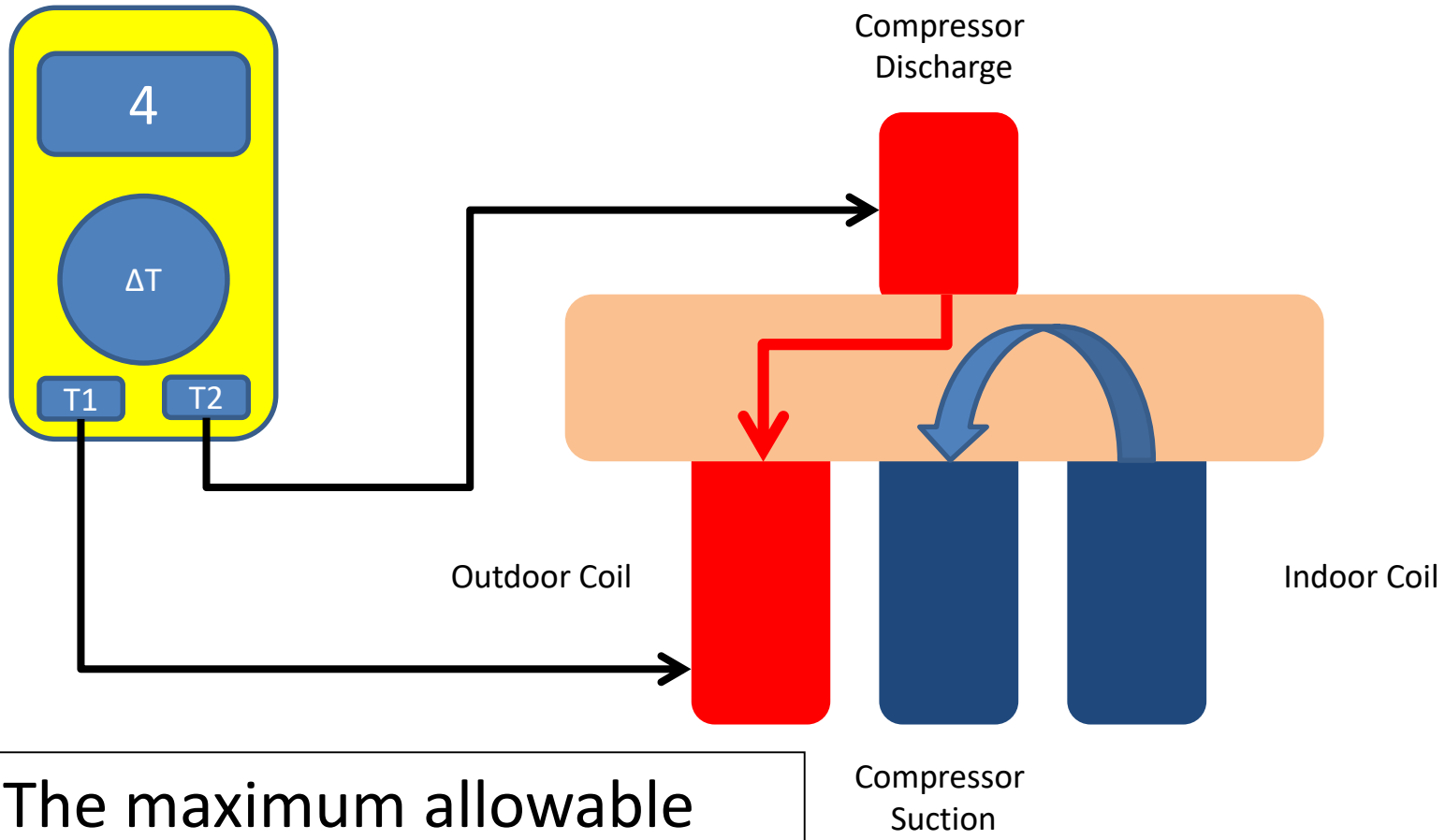
Reversing Valve Cooling



Reversing Valve Heating



Reversing Valve Diagnostic



The maximum allowable temperature difference is 4°F.

Suction Line Accumulator

- Protects the compressor from liquid refrigerant in the suction line during heat and changeover
- To prevent oil migration a small metering orifice sucks the oil from the base of the accumulator
- Orientation is critical



Superheat

Superheat

The measurement of superheat is utilized to properly charge fixed restrictor orifice refrigerant systems.

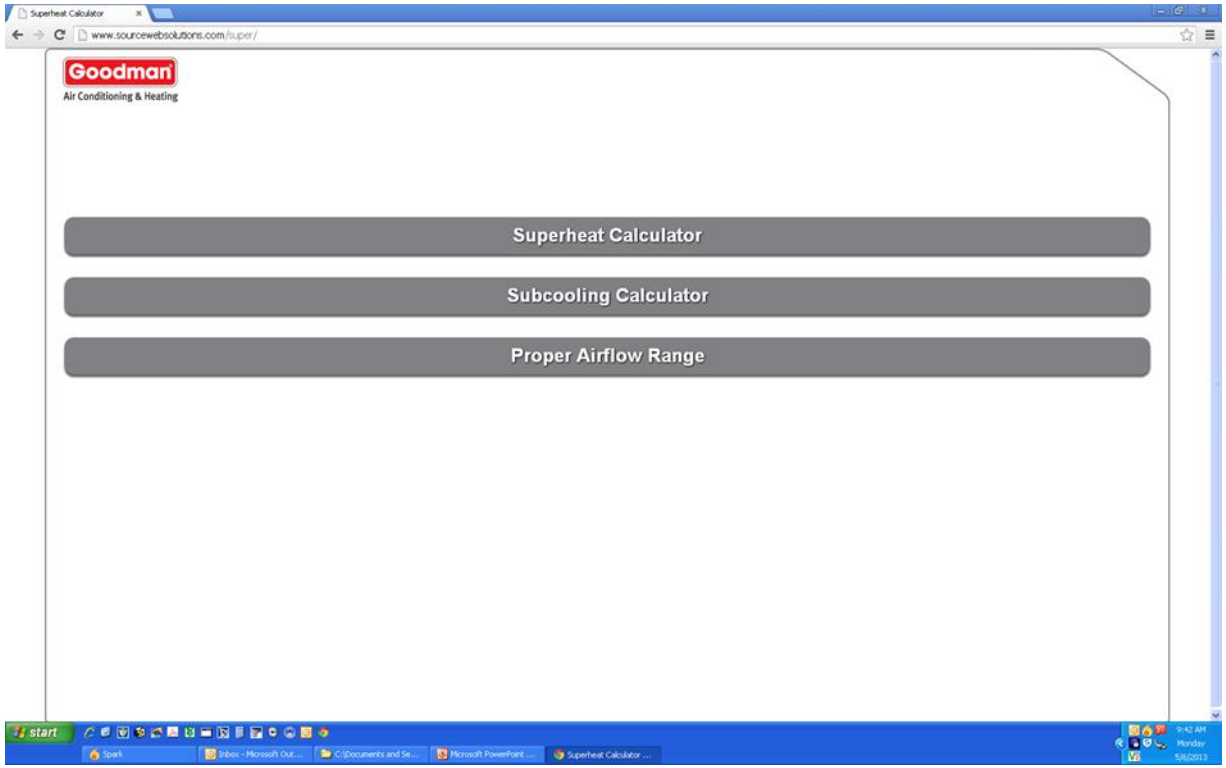


Superheat

- Superheat
  - The Temperature Of The Refrigerant Vapor Above Its Saturation Temperature (Boiling Point) At A Given Pressure.
  - High Superheat
    - Starved Evaporator
  - Low Superheat
    - Flooded Evaporator
    - Superheat = Suction Line Temperature – Suction Saturation

Superheat/Subcooling App for Phones

- App is available for Smart Phone and Android
- Here is the url: link for the Goodman Superheat app http://www.sourcewebsolutions.com/super/



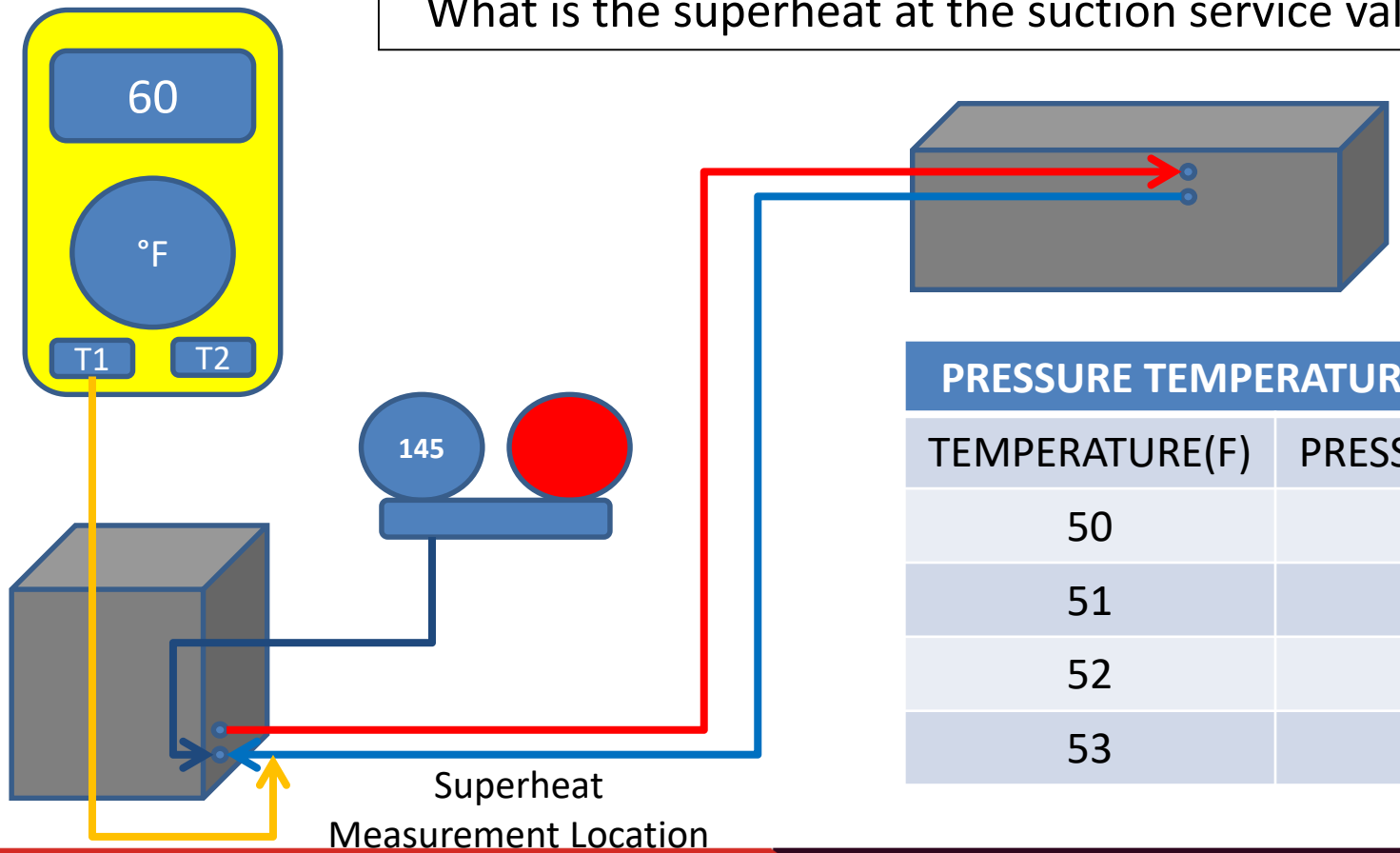
Superheat

REQUIRED SUPERHEAT ON NON TXV SYSTEMS													
INDOOR (WB)	OUTDOOR TEMPERATURE (DB)												
	55	60	65	70	75	80	85	90	95	100	105	110	115
50	9	7											
52	12	10	6										
54	14	12	10	7									
56	17	15	13	10	6								
58	20	18	16	13	9	5							
60	23	21	19	16	12	8							
62	26	24	21	19	15	12	8	5					
64	29	27	24	21	18	15	11	9	6				
66	32	30	27	24	21	18	15	13	10	8	5		
68	35	33	30	27	24	21	19	16	14	12	9	6	
70	37	35	33	30	28	25	22	20	18	15	13	11	9
72	40	38	36	33	31	28	26	24	22	20	17	15	14
74	42	40	38	36	34	31	30	27	25	23	22	20	18
76	45	43	41	39	37	35	33	31	29	27	26	25	23

Superheat

Superheat Measurements Will Vary Depending On Measurement Locations.

What is the superheat at the suction service valve?

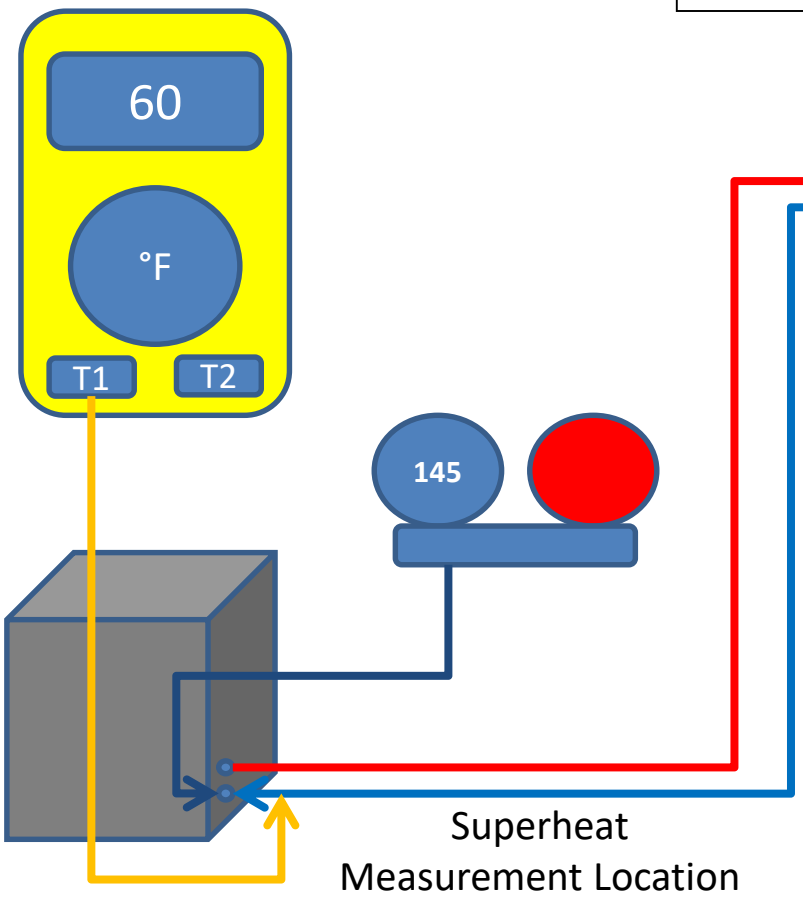


PRESSURE TEMPERATURE (R410A)	
TEMPERATURE(F)	PRESSURE(PSIG)
50	142.2
51	144.9
52	147.5
53	150.2

Superheat

Superheat Measurements Will Vary Depending On Measurement Locations.

Superheat at suction service valve = 9°F

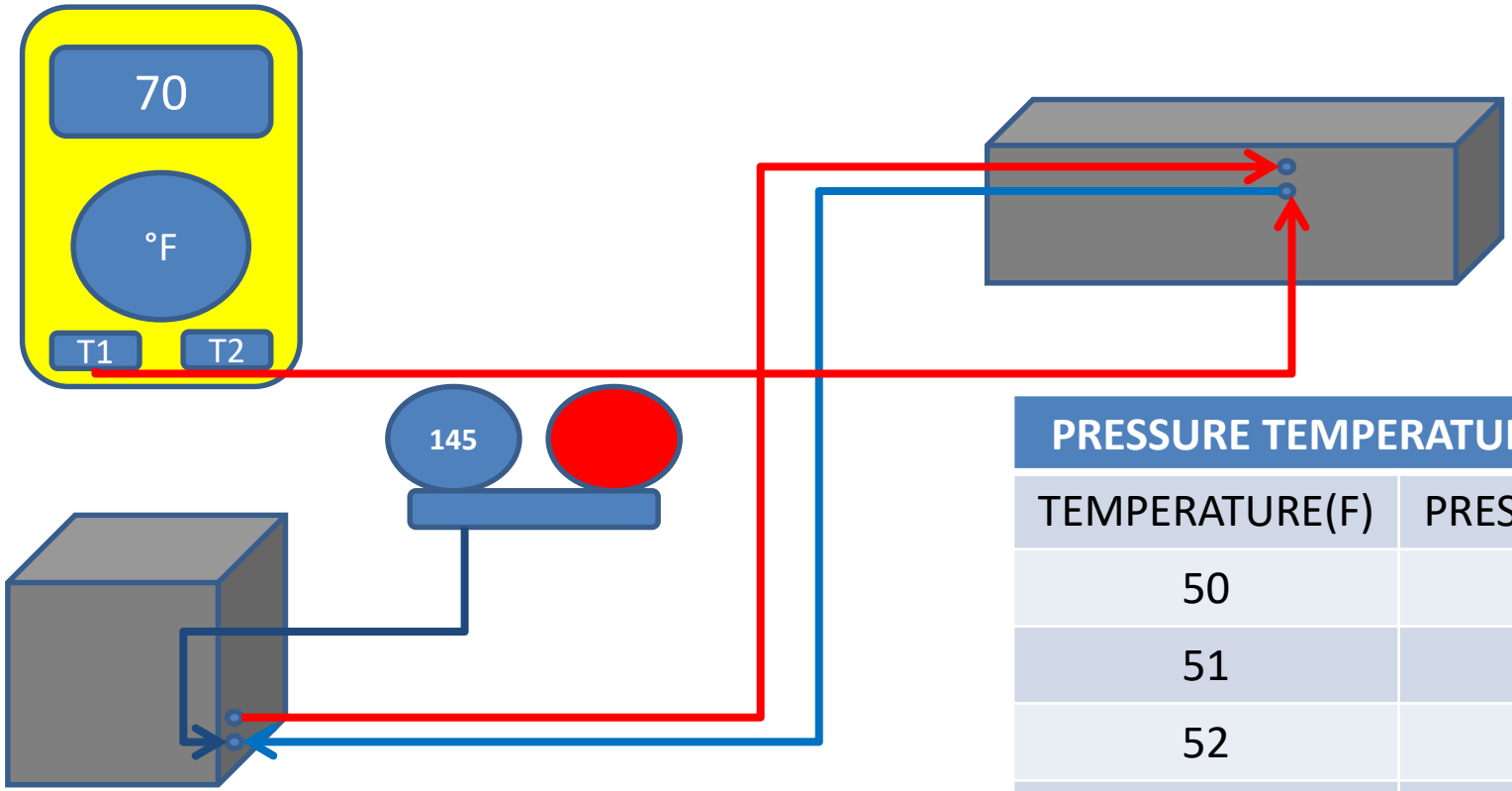


PRESSURE TEMPERATURE (R410A)	
TEMPERATURE(F)	PRESSURE(PSIG)
50	142.2
51	144.9
52	147.5
53	150.2

Superheat

Superheat Measurements Will Vary Depending On Measurement Locations.

What is the evaporator superheat of this system?

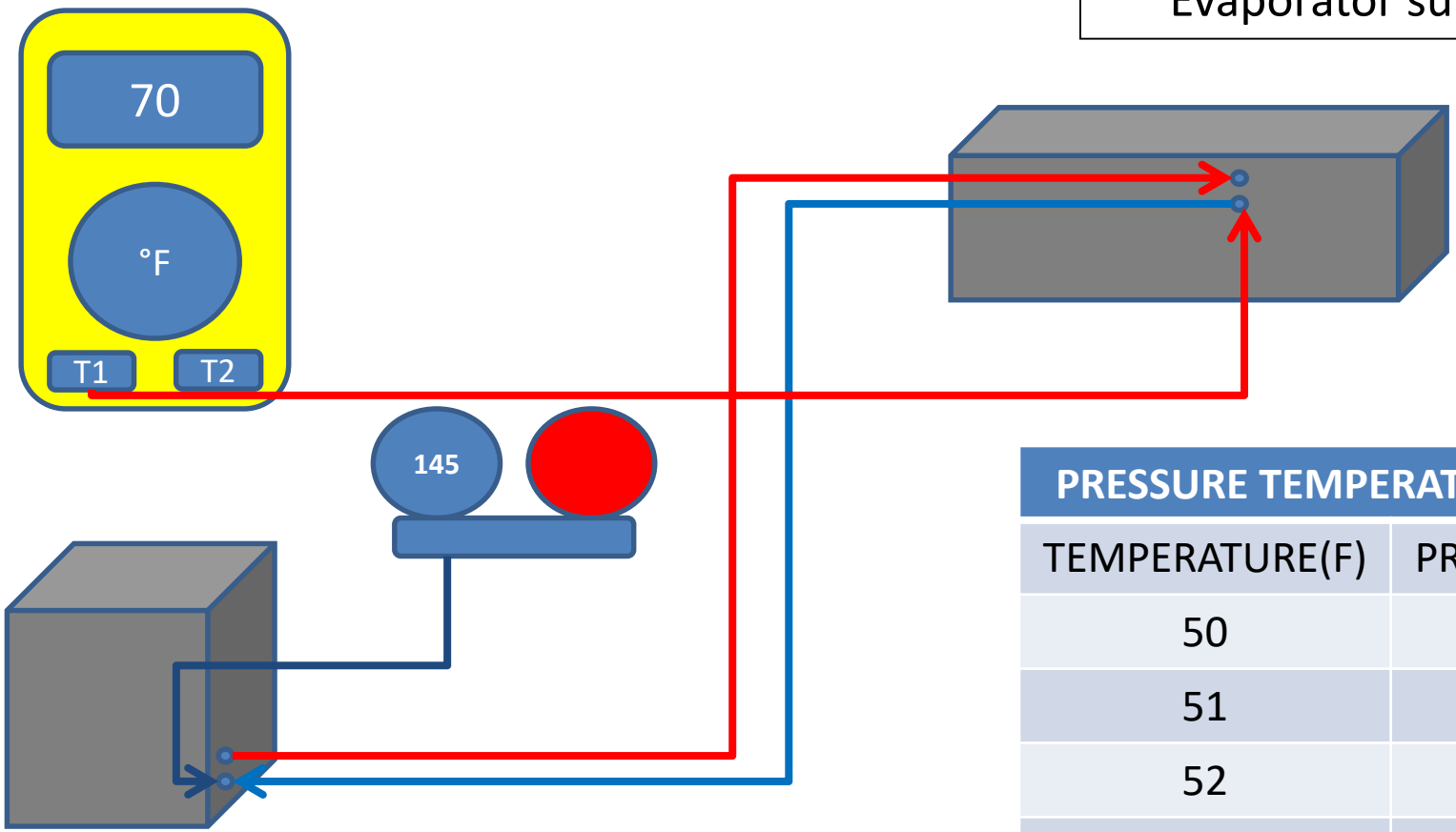


PRESSURE TEMPERATURE (R410A)	
TEMPERATURE(F)	PRESSURE(PSIG)
50	142.2
51	144.9
52	147.5
53	150.2

Superheat

Superheat Measurements Will Vary Depending On Measurement Locations.

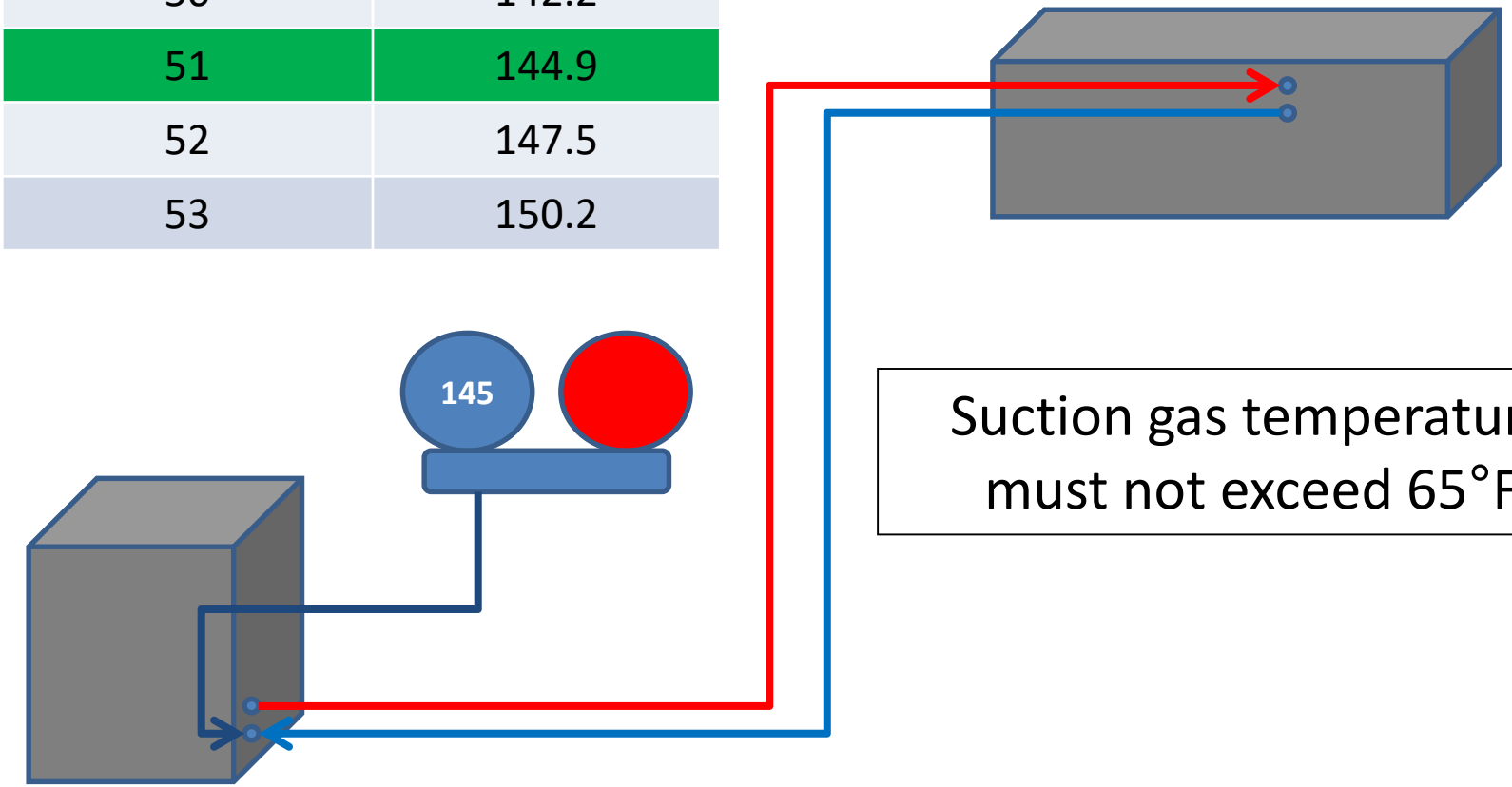
Evaporator superheat 19°F



PRESSURE TEMPERATURE (R410A)	
TEMPERATURE(F)	PRESSURE(PSIG)
50	142.2
51	144.9
52	147.5
53	150.2

Suction Gas Temperature

PRESSURE TEMPERATURE (R410A)	
TEMPERATURE(F)	PRESSURE(PSIG)
50	142.2
51	144.9
52	147.5
53	150.2

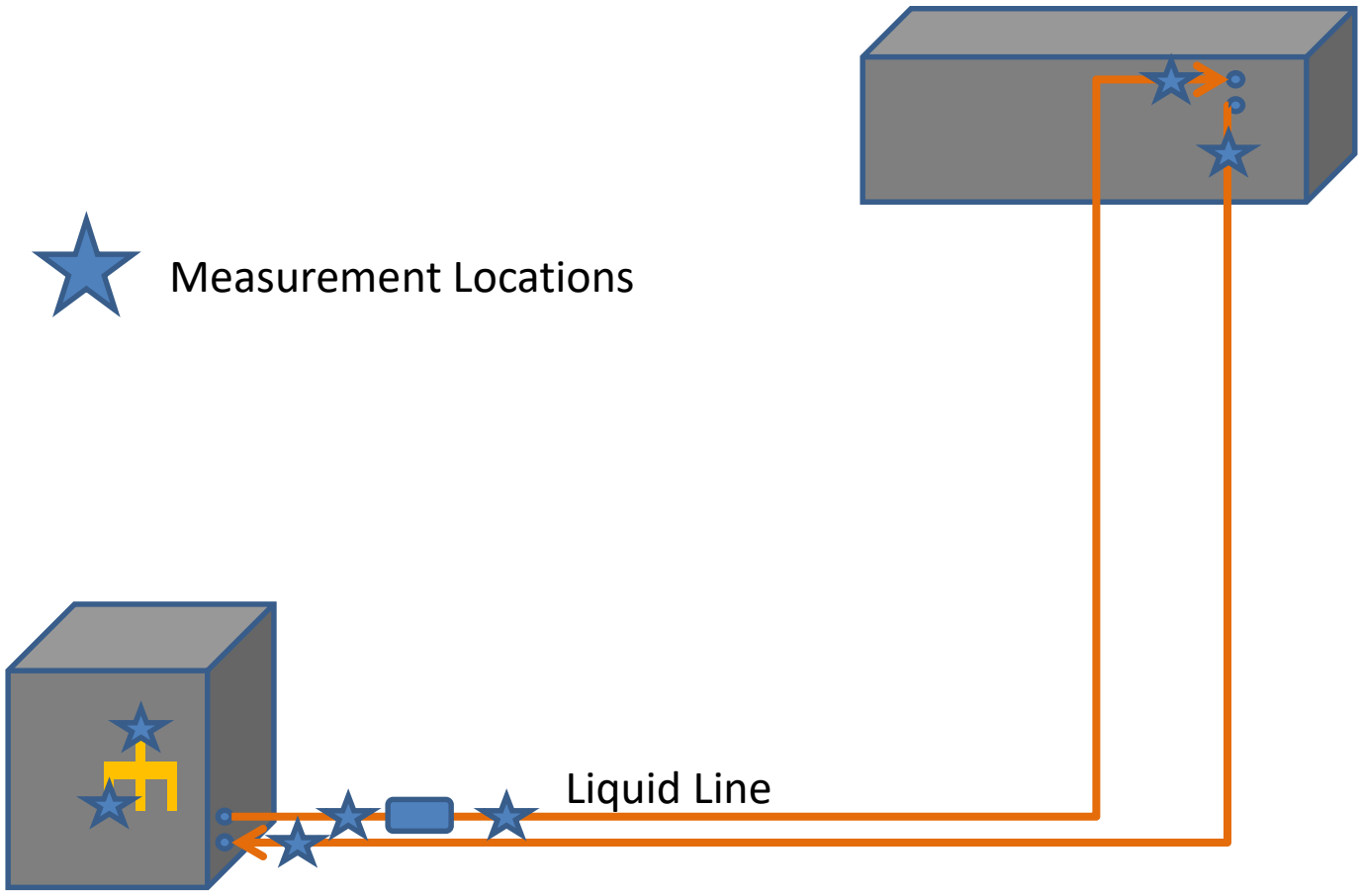


Suction gas temperature must not exceed 65°F

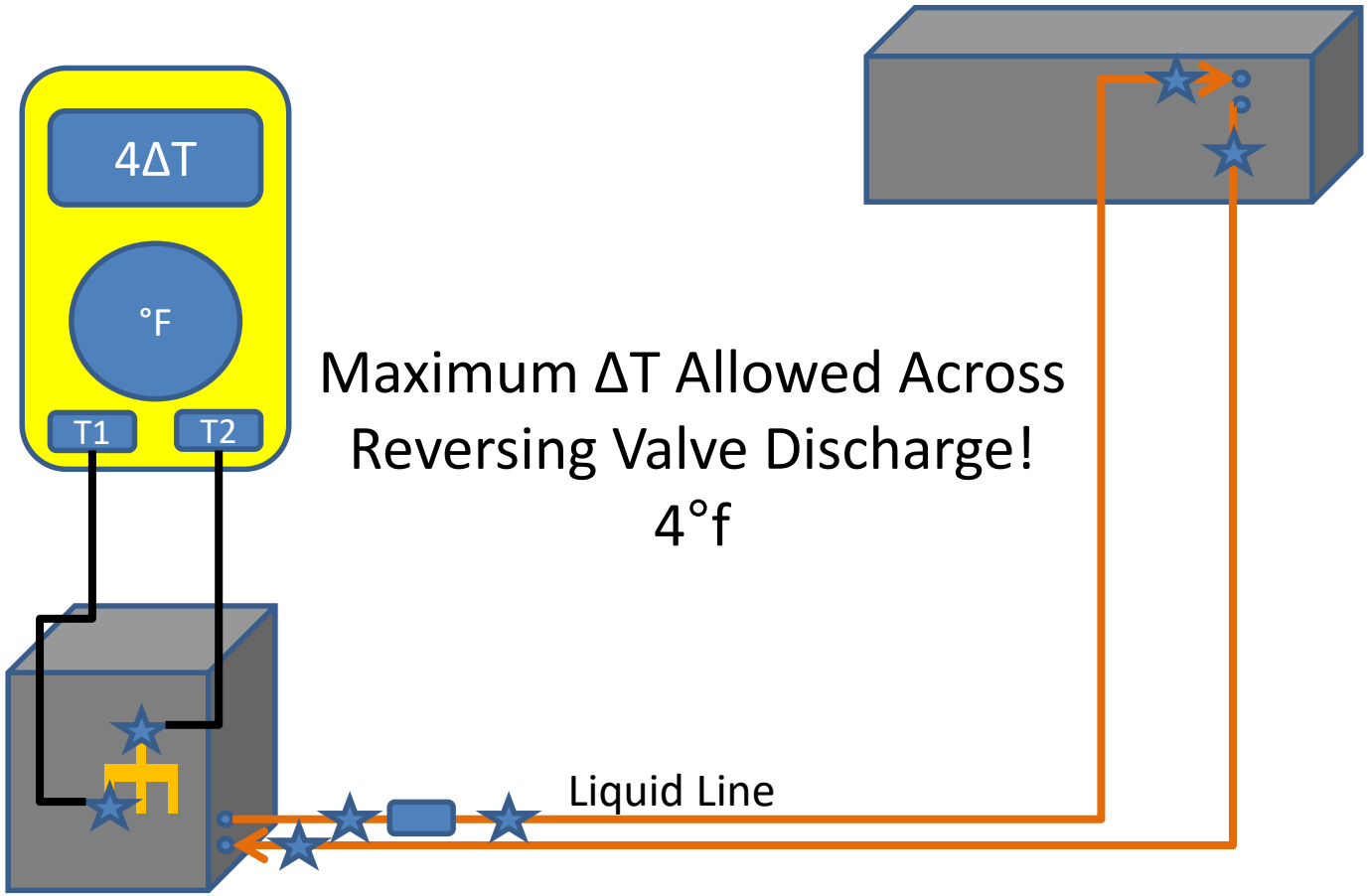
Temperature Diagnostics

- Temperature measurements will provide you insight into system problems.
- When you have an issue that seems difficult to resolve take measurements at multiple points in the system.

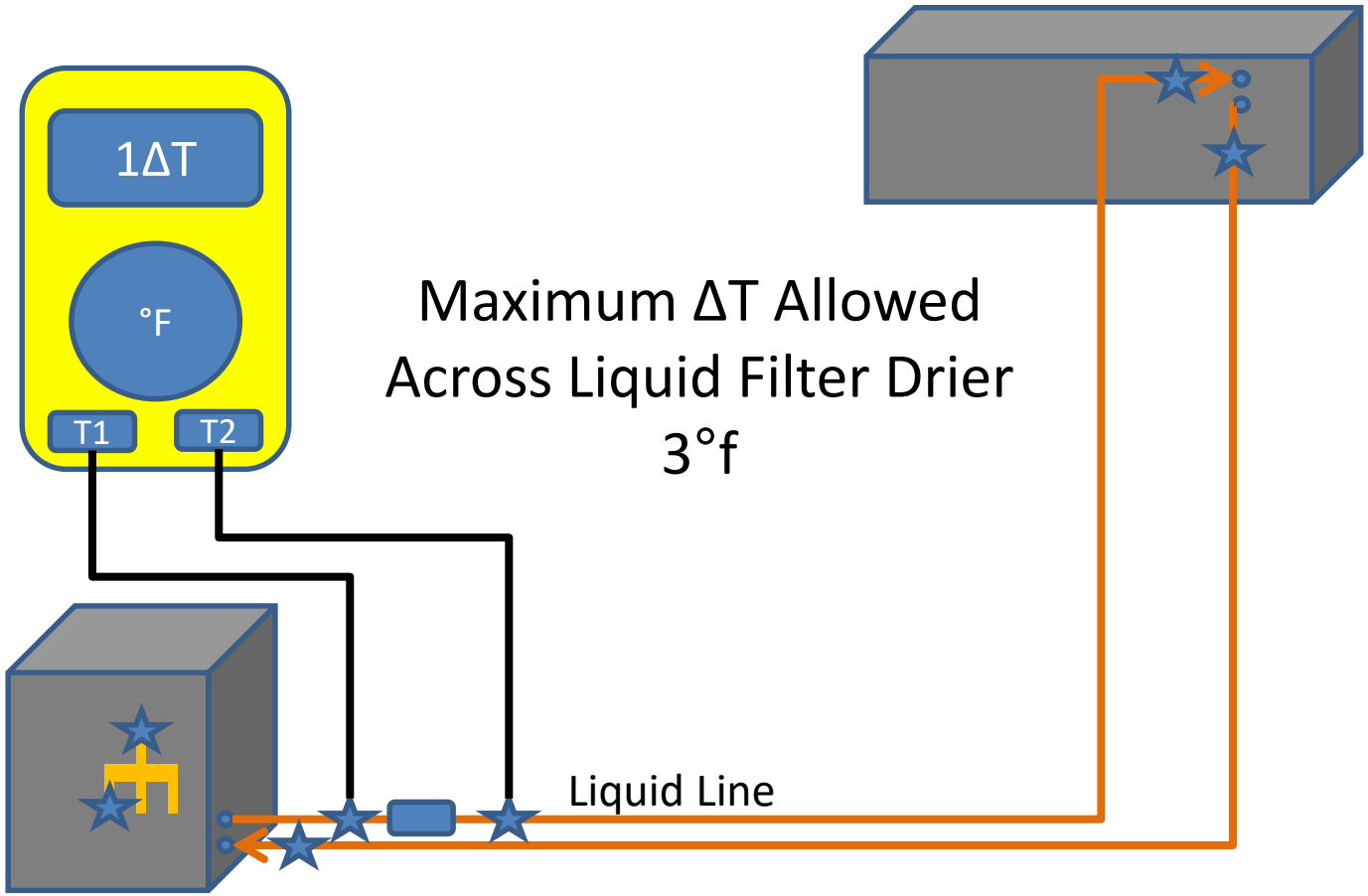
Temperature Measurements



Temperature Measurements

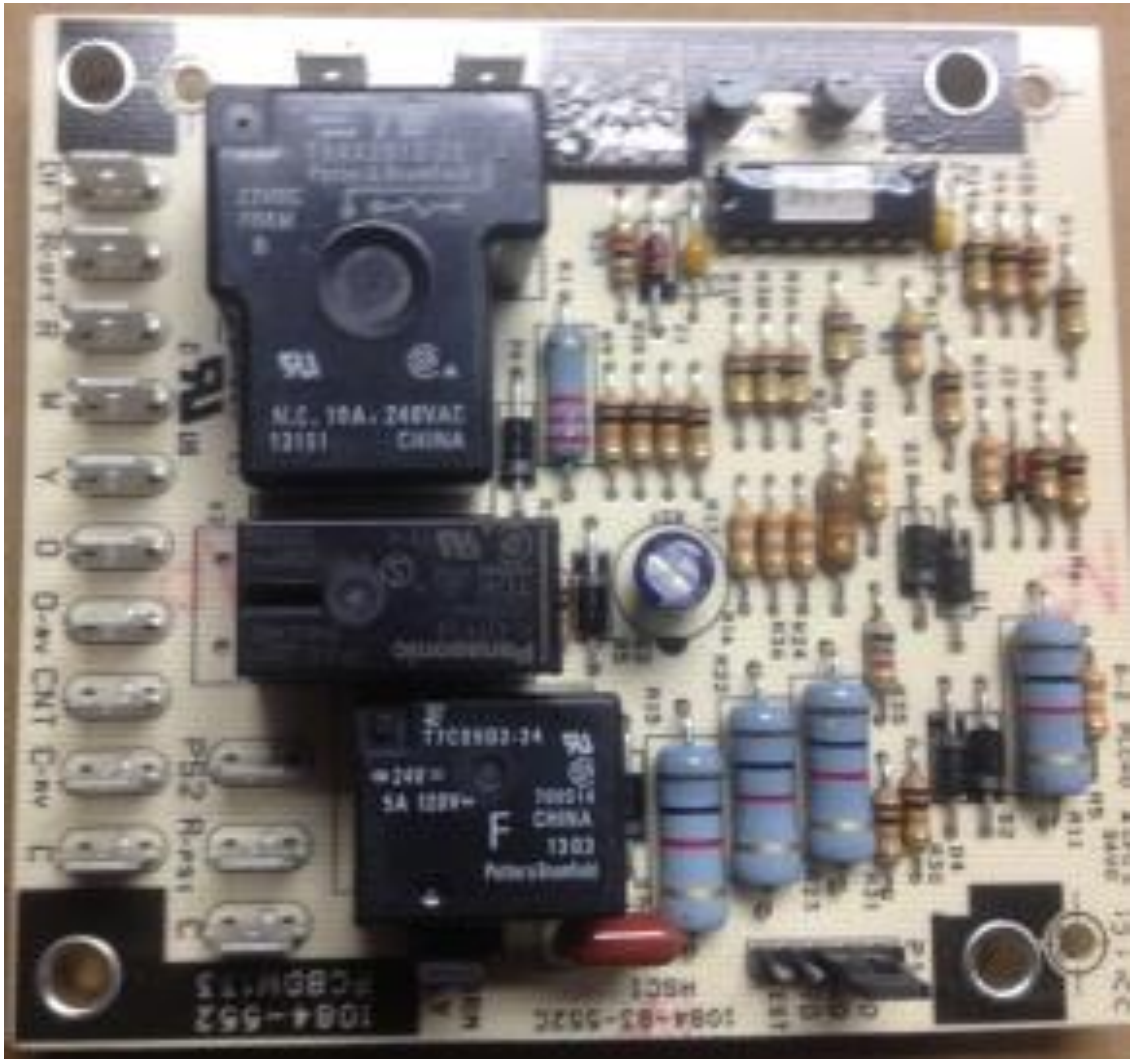


Temperature Measurements



Defrost Controls

Defrost Board



Check for 24 Volts to defrost control

System outdoor coil may be covered in ice if the system was not turned off.

The complaint may be the system does not provide enough heat after a long run time.

Defrost Timing

- During operation the power to the circuit board is controlled by a temperature sensor clamped to a return bend(3/8” Coil) or feeder tube(5mm Coil).
- Defrost Timing
  - 30, 60, or 90 Minute Field Selectable (Jumper)
  - Coil sensor closes 31°F plus or minus 3
  - At end of selected timing period defrost initiates
  - Sensor opens at 65°F plus or minus 3 and terminates defrost
  - If defrost does not terminate on temperature it will terminate on time (10-12 Minutes)

Defrost Tip

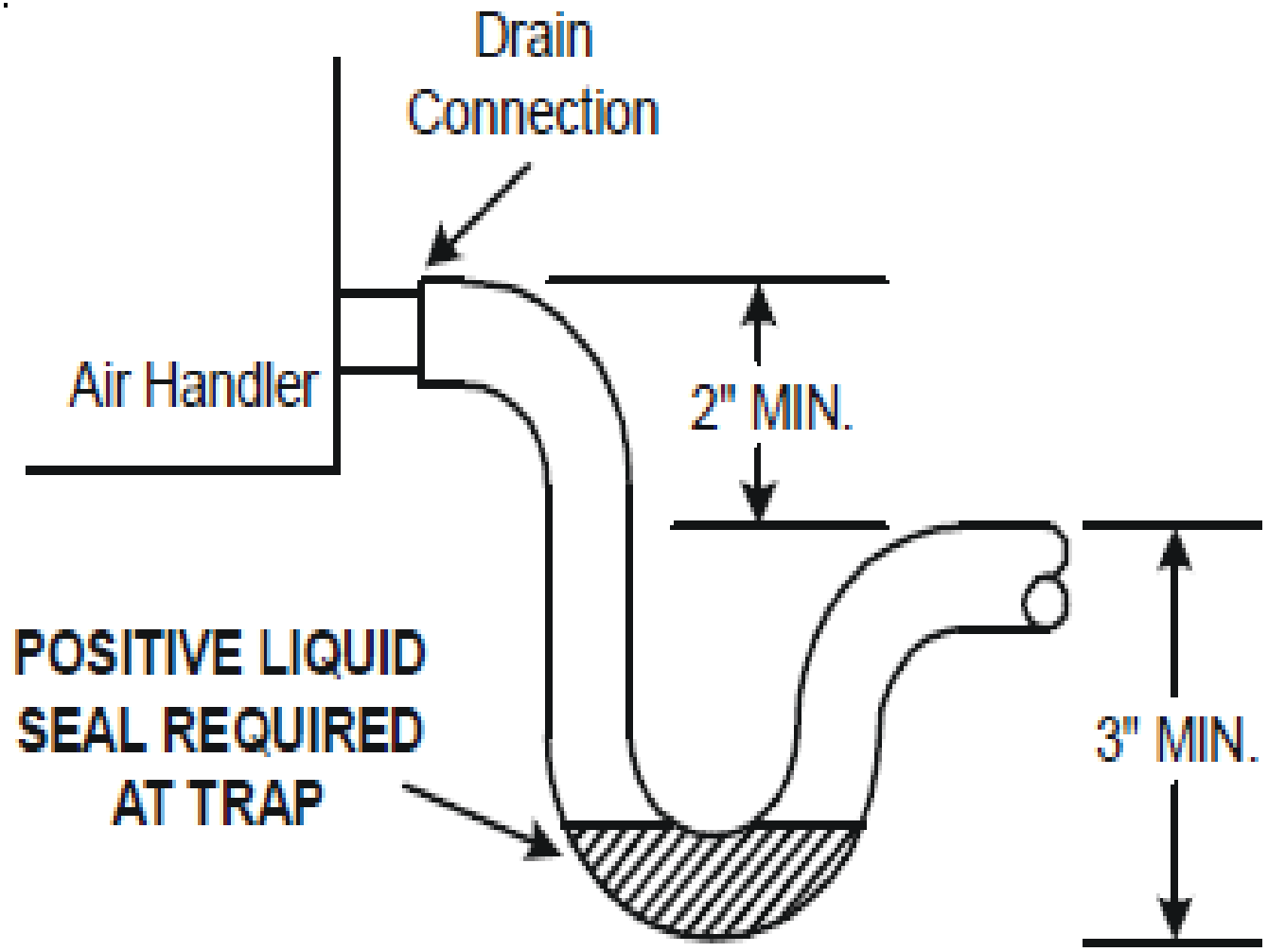
- During operation the timer is always running even in the cooling mode.
- If the defrost thermostat should fail closed, the unit will go into defrost mode when the timer completes its cycle.
- It will appear as if the condenser fan motor has failed because it stopped but you will also see a signal on W2 bringing on the electric heat.
- This is not a board failure it is a sensor failure.
- VERY COMMON FOR ALL BRANDS OF HEAT PUMPS.
- While you are at it make sure sequencers are not sticking

Condensate Considerations

Condensate Disposal

- ¾” NPT Female Connections (PVC Recommended)
- Hand Tighten 3-5 Turns (37” LBS)
- In High Humidity/Extreme Temperature Locations Insulate Condensate Line Utilizing Armaflex Or Similar Material
- Pitch ¼”Per Foot To Provide Free Drainage
- If Secondary Drain Is Not Installed, Secondary Drain Hole Must Be Plugged
- Installation Must Include A P Trap Located As Close As Practical To Indoor Coil
- Follow all local for drain water disposal

Condensate Trap



Thermostats

electro-mechanical

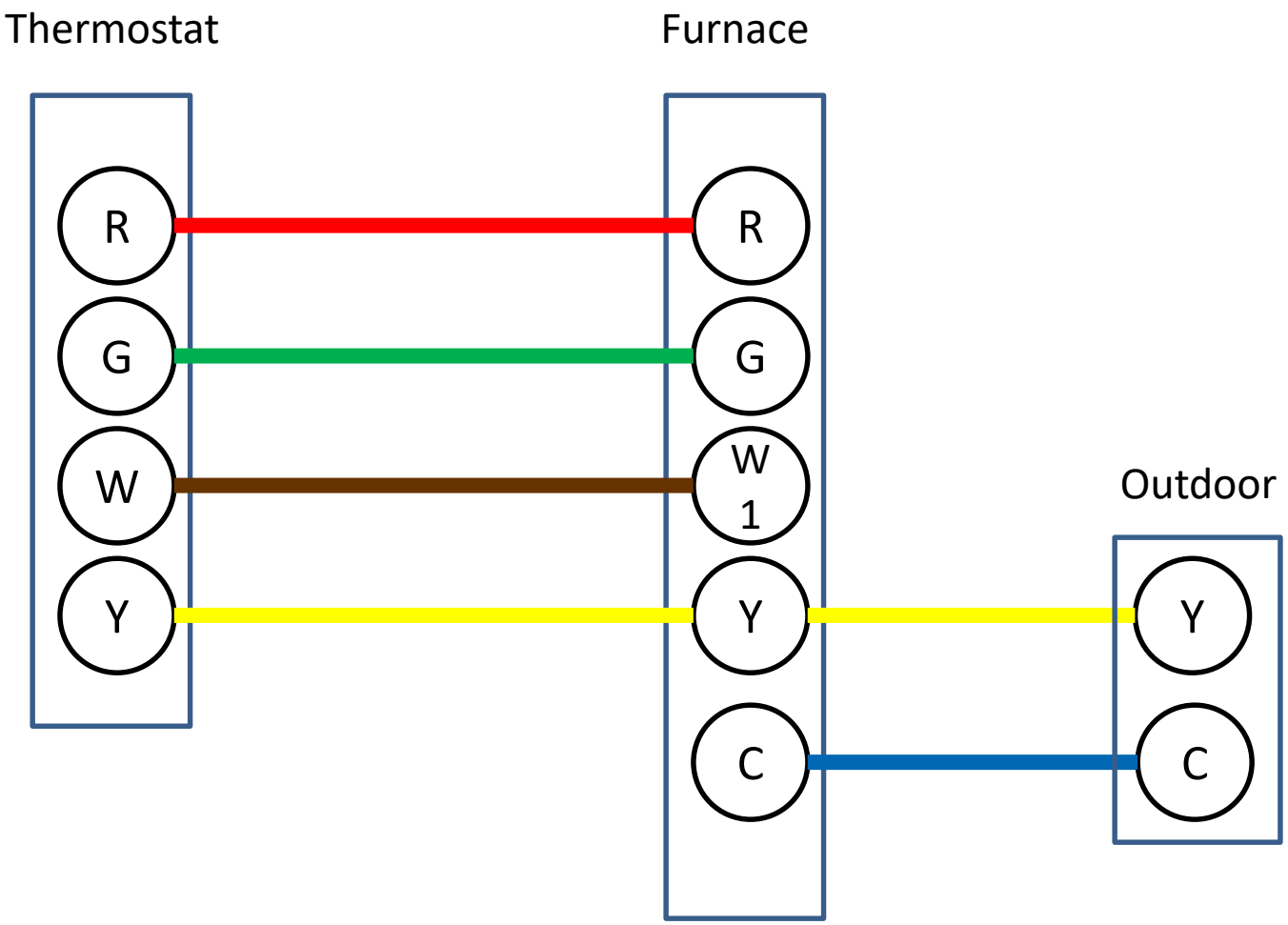
are no longer permitted and must be disposed of properly

digital-analog

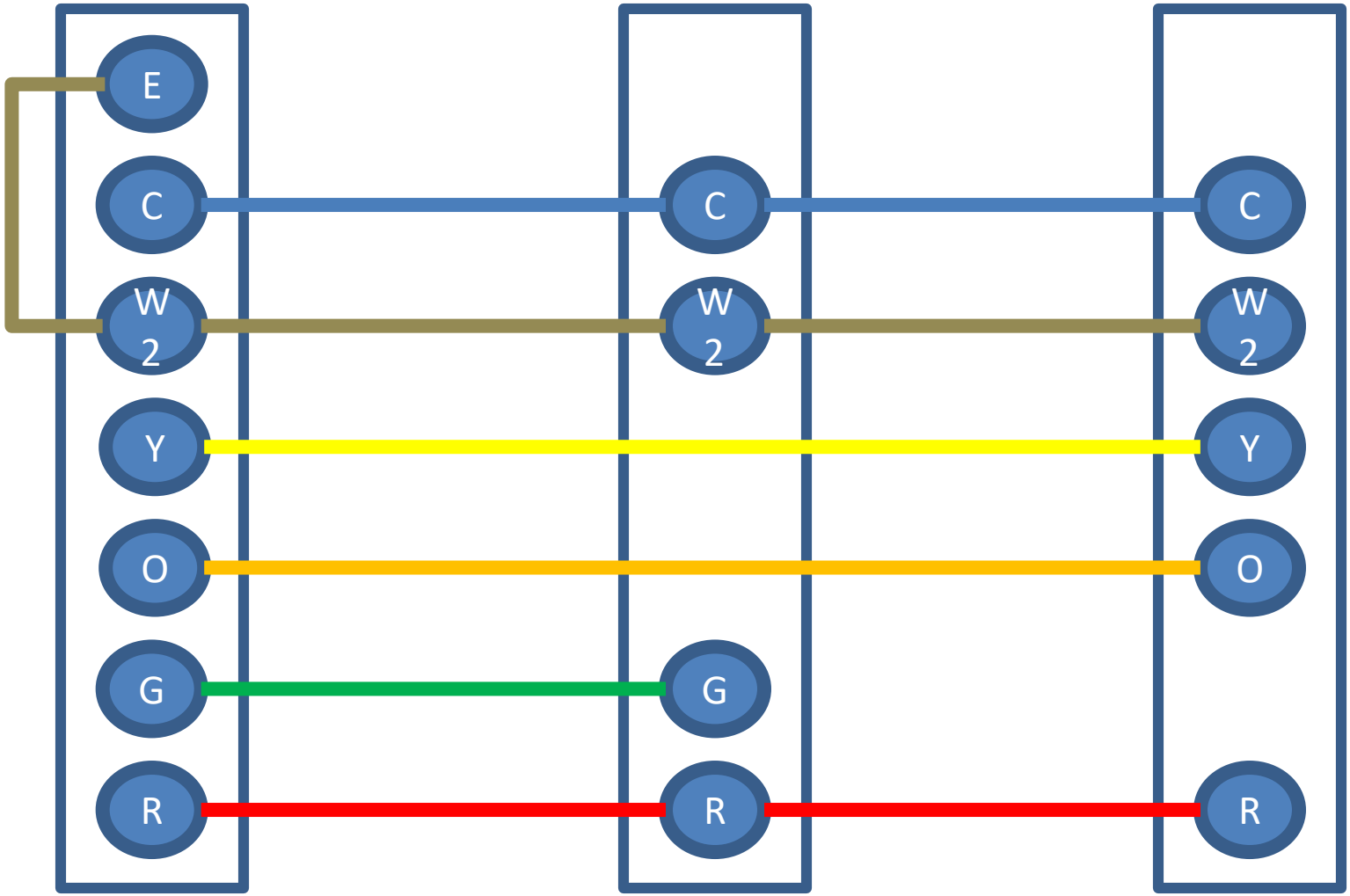
very popular

avoid power stealing thermostats

Single Stage Heating/Cooling



24VAC Control Wiring – Heat Pump



Start Up

Start Up Procedure

- On start up, ensure that all electrical wires are properly sized and all connections are properly tightened.
- All panels must be in place and secured. For “Air Tight” applications, gaskets must be positioned at locations to achieve 2% leakage.
- Tubing must be leak free.
- Condensate line must be trapped and pitched to allow drainage.

Start Up Procedure

- Low voltage wiring is properly connected.
- Allow sufficient time for crankcase heater to warm up.
- Turn system on and let run minimum 10 minutes before taking temperatures and pressures.
- Record findings on your service ticket or maintenance card.
- Compare with charts in installation instructions and adjust accordingly.