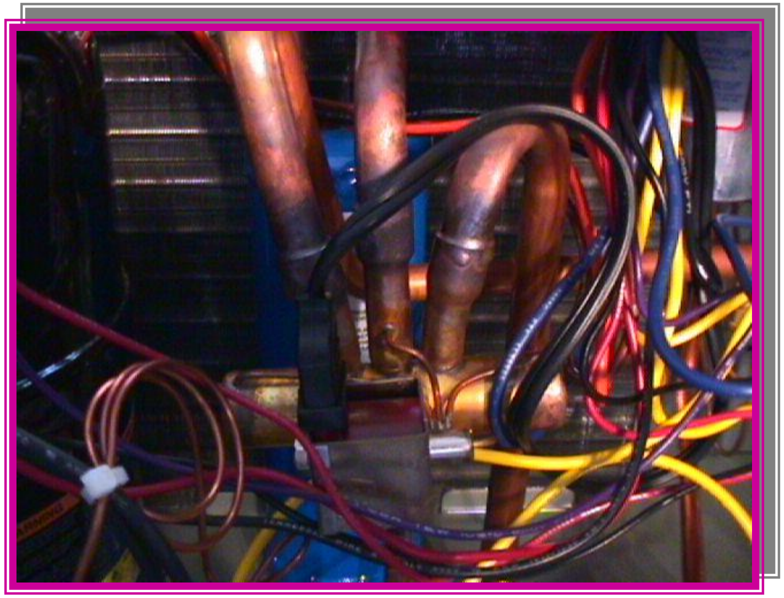
HEAT PUMPS SYSTEM AND ELECTRICAL

by Dennis W. Mayes

TENNESSEE VALLEY TECHNICAL PROGRAMS



HEAT PUMP

SYSTEM

Reversing Valves

REVERSING VALVE: **The reversing valve body contains the __slide valve,__ and a solenoid operated __pilot valve__. All heat pump models discussed here, will energize the reversing valve solenoid in the heating mode.**

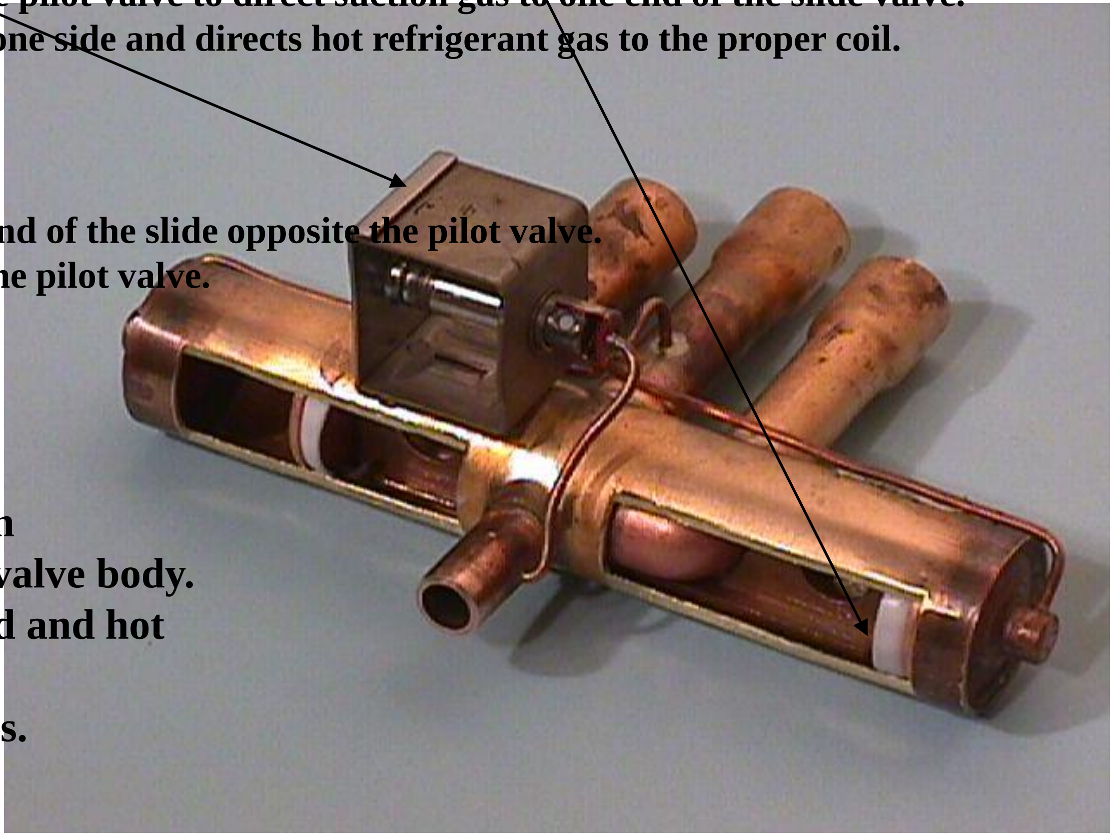
• A 24-volt solenoid shifts the position of the pilot valve to direct suction gas to one end of the slide valve. High pressure gas forces the slide valve to one side and directs hot refrigerant gas to the proper coil.

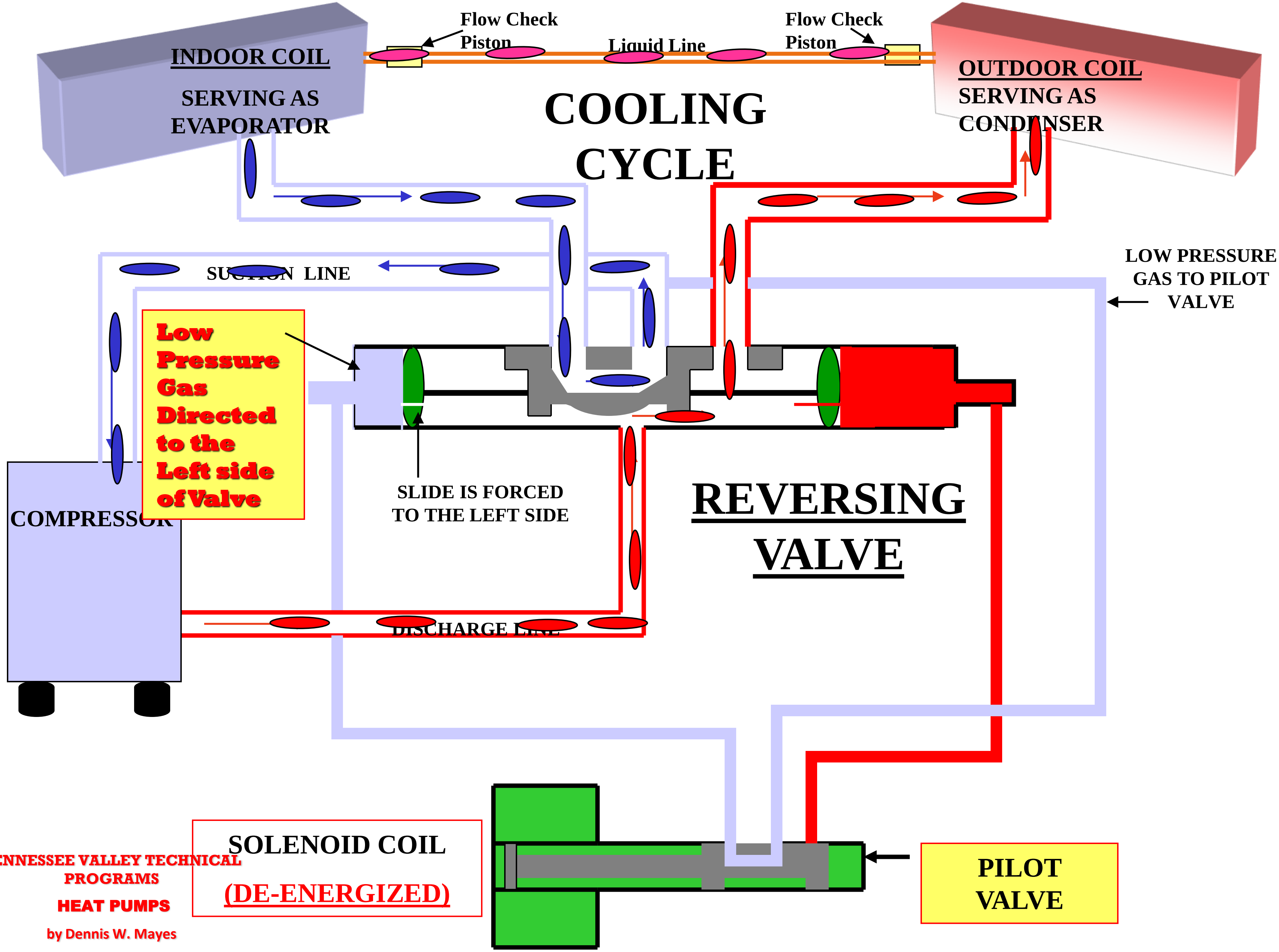
COOLING MODE:

- **The solenoid coil is de-energized.**
- **High pressure discharge gas flows to the end of the slide opposite the pilot valve.**
- **Forces the valve slide to the same end as the pilot valve.**
- **Hot gas then flows to the *outdoor coil.***

HEATING MODE:

- **The solenoid is energized.**
- **The pilot valve shifts and directs high pressure gas to the other side of the valve body.**
- **The slide is forced to the opposite end and hot gas to the indoor coil.**
- **The system now heats instead of cools.**



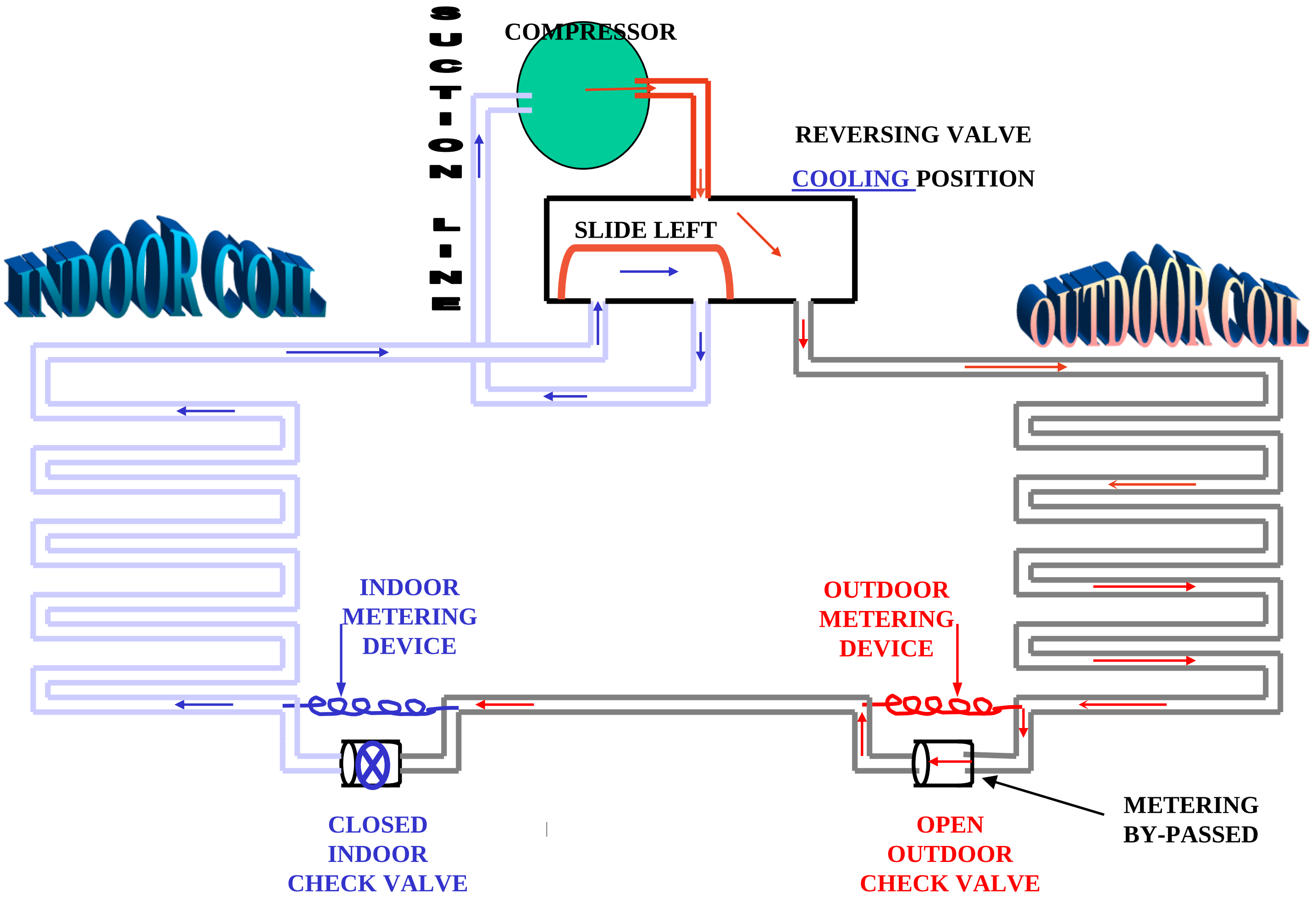


TENNESSEE VALLEY TECHNICAL PROGRAMS

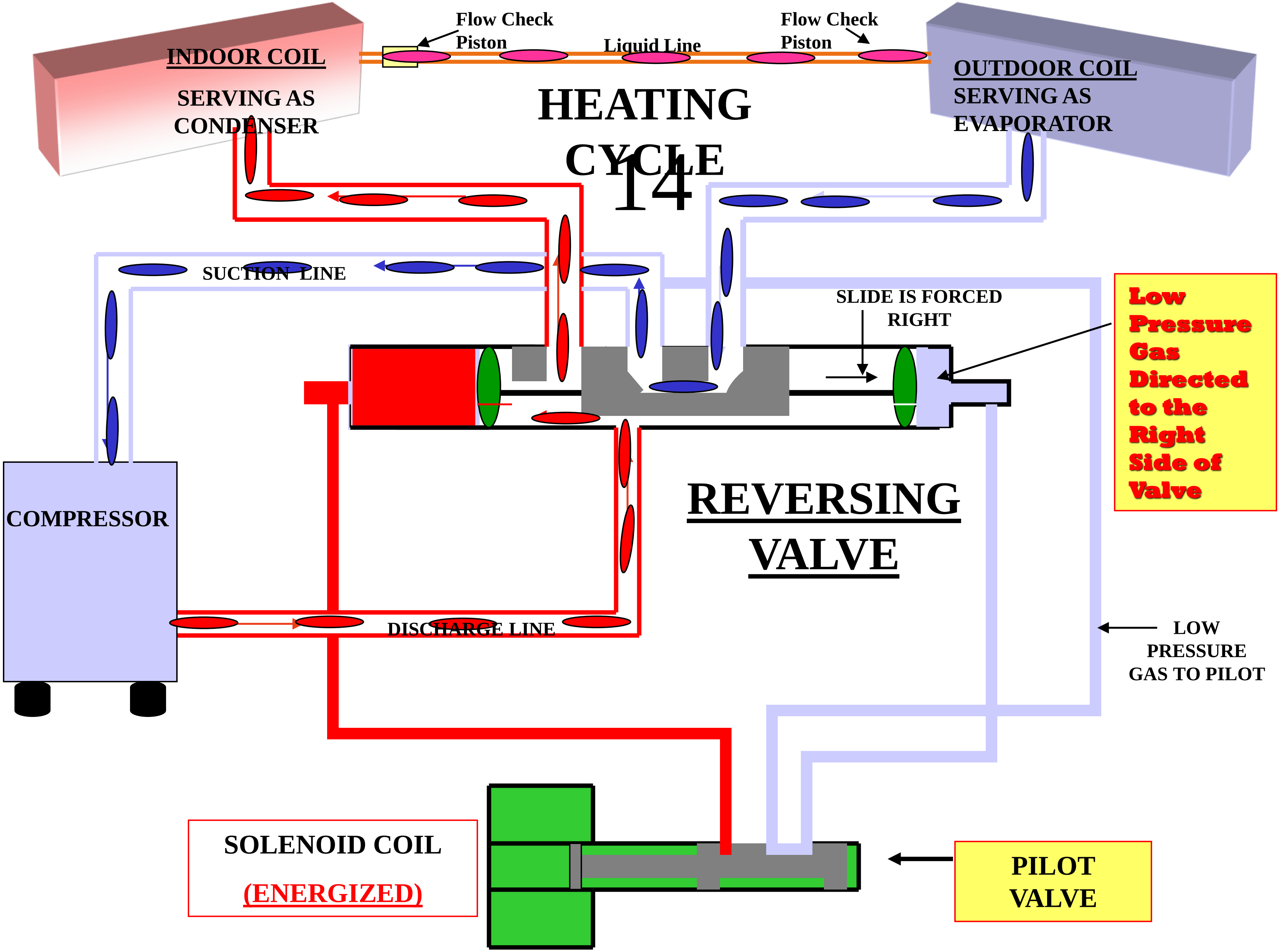
HEAT PUMPS

by Dennis W. Mayes

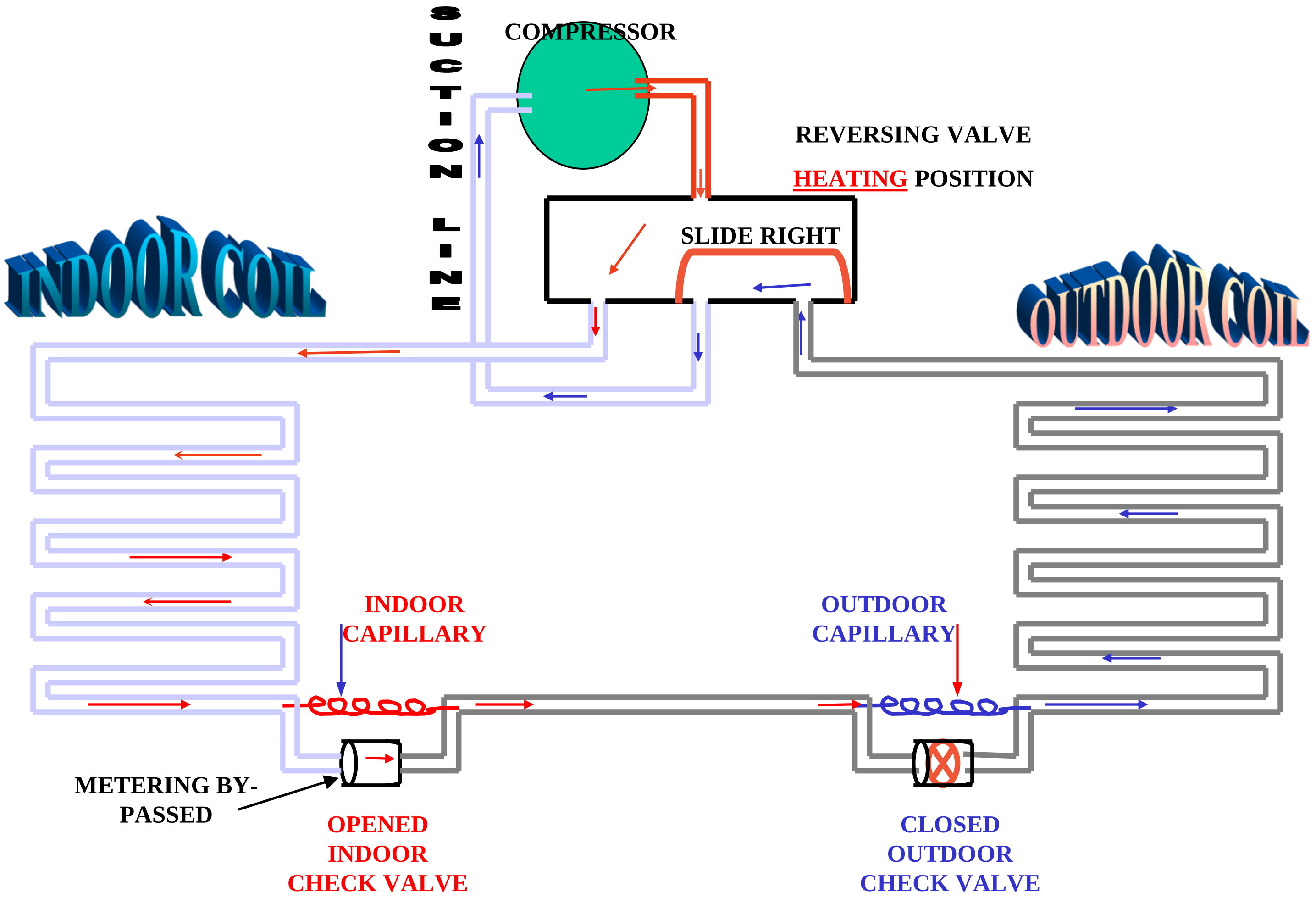
JANUARY 2000



BASIC HEAT PUMP CIRCUIT
COOLING MODE OF OPERATION



INDOOR COIL
SERVING AS CONDENSER
Flow Check Piston
Liquid Line
Flow Check Piston
OUTDOOR COIL
SERVING AS EVAPORATOR
HEATING CYCLE
14
SUCTION LINE
SLIDE IS FORCED RIGHT
Low Pressure Gas Directed to the Right Side of Valve
COMPRESSOR
REVERSING VALVE
DISCHARGE LINE
LOW PRESSURE GAS TO PILOT
SOLENOID COIL
(ENERGIZED)
PILOT VALVE



BASIC HEAT PUMP CIRCUIT
HEATING MODE OF OPERATION

METERING DEVICE

METERING DEVICE

FLOW CHECK PISTON

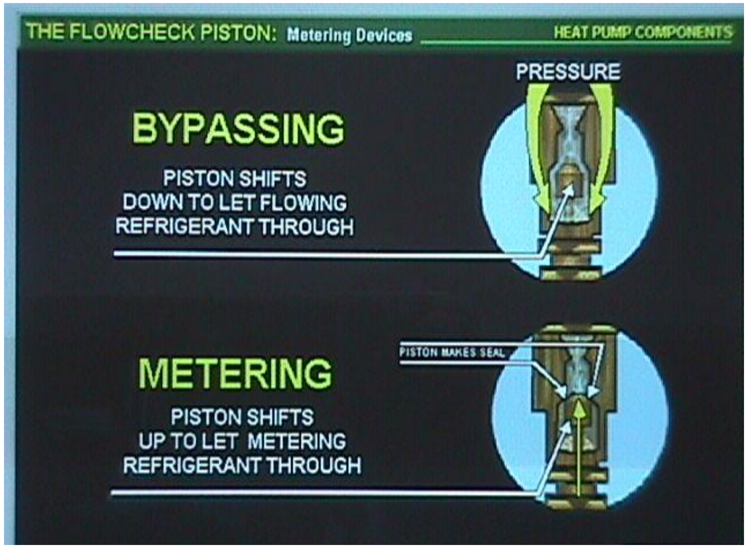
One heat pump metering device is the flowcheck piston. It has two functions.

•First, it acts as a refrigerant metering device controlling refrigerant flow into the evaporator.

•Second, it acts as an open check valve when refrigerant flows in the opposite direction.

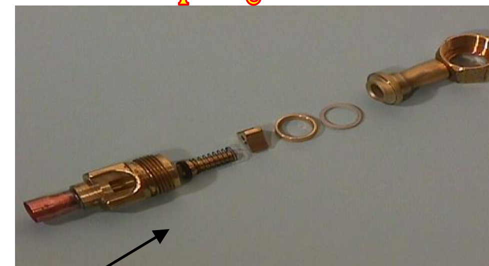
When refrigerant enters the device from the liquid line, the piston seats and forces all refrigerant through the center of the piston. It functions as a metering device controlling the amount of refrigerant flow.

With flow in the opposite direction, pressure moves the piston off the seat and liquid refrigerant flows around the piston.



METERING DEVICE

Spring Check Valve



THERMOSTATIC EXPANSION VALVES (TXV):

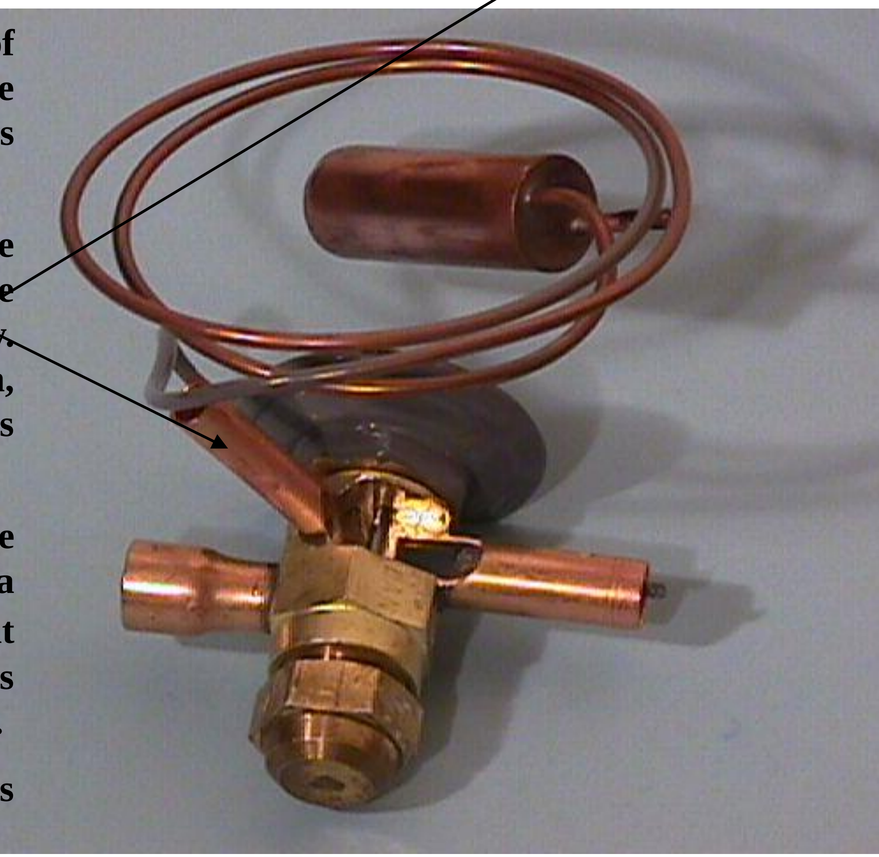
A thermostatic expansion valve is another refrigerant flow control device. Most expansion valves are externally equalized and have nonadjustable superheat settings.

•The external equalizer line connects the valve to the outlet of the evaporating coil. Its purpose is to allow suction line pressure to the underside of the power head diaphragm. This ensures accurate metering and stable superheat.

•Thermostatic expansion valves meter refrigerant to the evaporating coil to maintain an active coil under wide operating conditions. This improves heat pump efficiency. Fixed orifice metering devices, like the flowcheck piston, compromise system performance when operating conditions change.

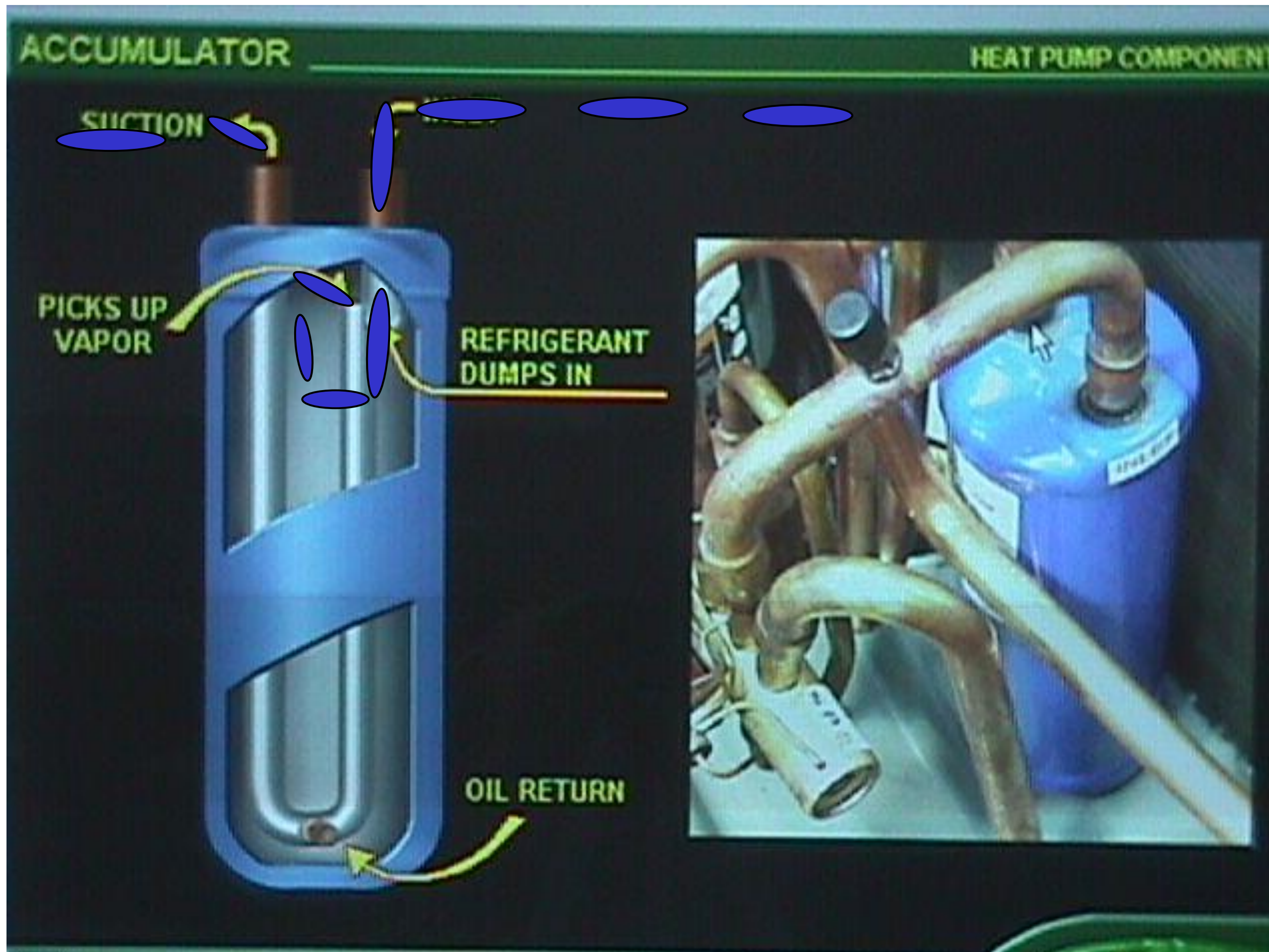
•Refrigerant flows through a standard expansion valve in one direction. When using a thermostatic expansion valve in a heat pump, a check valve provides a path for refrigerant flow around the valve in the reverse direction. Check valves can be either ball check valves or spring-loaded check valves.

•A number of Current thermostatic expansion valves incorporate an internal check valve.



ACCUMULATORS

SUCTION LINE ACCUMULATOR:



- **The suction line accumulator holds liquid refrigerant and controls its return to the compressor. It is in the suction line between the reversing valve and compressor.**
- **Accumulators are on most heat pumps using reciprocating compressors. They may be used on scroll compressor models. The internal design on the accumulator controls refrigerant liquid and refrigerant oil return to the compressor.**

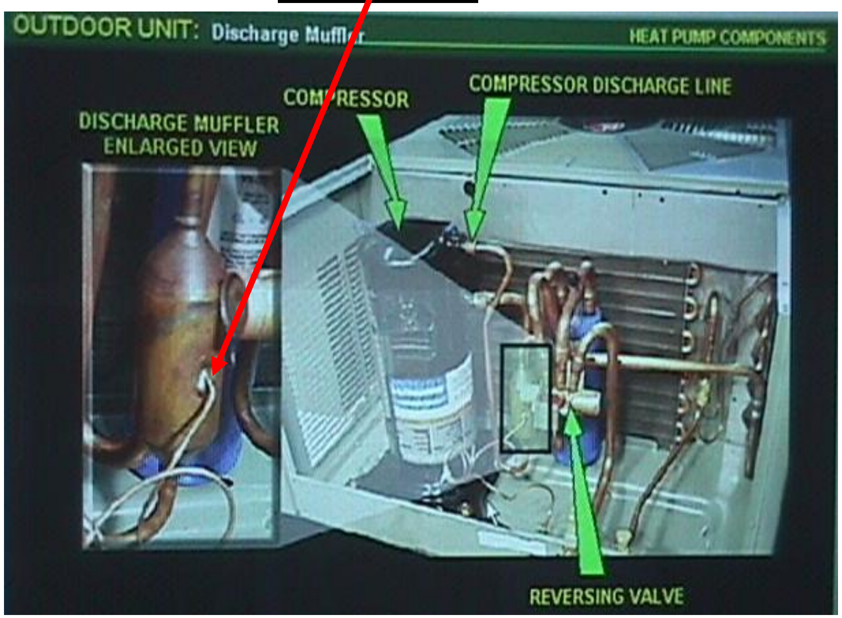
MUFFLERS

<u>MUFFLERS:</u> The discharge muffler is located in the discharge line between the compressor and the reversing valve. It reduces refrigerant pulsations from the line for quieter operation.

Be aware that some heat pumps have high pressure switches attached at the muffler.

NOTE: During the heating cycle, compressor discharge pulsations can sometimes be heard from the hot gas tubing within the walls of the building. Heat pumps are equipped with a discharge muffler to dampen these pulsations. An adjustable muffler may be required if pulsations are severe.

MUFFLER WITH THE HIGH PRESSURE <u>SWITCH</u> ATTACHED



THIS IS NOT A FILTER DRIER. DO NOT REPLACE THIS CONPONENT WITH A FILTR DRIER. DOING SO WILL ADVERSELY AFFECT UNIT PERFORMANCE

CHECKING REFRIGERANT CHARGE - Charge for all systems should be checked against the charging chart inside the access panel cover. Select the proper chart using appropriate outdoor unit/indoor coil model combinations. Before using any of the charts, the indoor conditions must be within 2 degrees (2 degrees wet bulb if cooling) of desired comfort conditions, and system must be run until operating conditions stabilize (15 to 30 min.). If the unit is in the heating mode and frost has formed on the outdoor coil, the unit should be run through a defrost cycle before checking the charge. Caution: Do not operate the compressor without charge in system. Addition of R-22 will raise pressures (Vapor, liquid and discharge) and lower Vapor temperature. Caution: If addition of R-22 raises both Vapor pressure and temperature, unit is overcharged.

CHARGING BY SUPER HEAT

CHARGING BY SUPERHEAT (HEATING OR COOLING) - **Superheat charging method is used for charging systems in the cooling mode when a flow check piston is used on the indoor coil. Superheat is also used in the heating mode when a flow check piston is used on the outdoor coil and the outdoor temperature is above 42 degrees. Pressure readings and charging is accomplished using the service port located between the reversing valve and accumulator. This service port provides vapor pressure in both the heating and cooling modes. Vapor temperature readings must be taken on the vapor line going from the accumulator to the compressor. A remote temperature indicator is most convenient. If this is not available a thermometer properly located and insulated (clamped to the Suction Line between the Compressor and the Accumulator) can be used. Measure and record the three values required (Outdoor Temperature, Vapor Pressure at the Accumulator and Temperature of the Suction Line). Find the intersection of Vapor line pressure and outdoor ambient on the appropriate chart. The Vapor line temperature should approximate the intersected value on the chart. The most likely causes for the intersection of Vapor pressure and ambient temperature in the open area to (left) or (right) of the table values are : (Left) Low charge, or Low air flow (indoor-cooling) (outdoor-heating) (Right): Overcharge or low airflow (indoor-heating) (outdoor-cooling).**

See page 15 & 16 for plotting temperatures

MODEL OUTDOOR UNIT 10 SEER-018 MODEL INDOOR UNIT/COIL 2453A

TOTAL SYSTEM CHARGE 62 OZ. WITH 25 FT. 1/4" O.D. LIQUID LINE

Super Heat Charging Method

Vapor Pressure at Vapor Service Port (Between Reversing Valve and Accumulator)

Vapor Line Temperature at Compressor Degrees F.

Mode	Outdoor Ambient Deg. F	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
Cool Mode	105+													39	42	42	43	45	46	47	49	50
Cool Mode	105												42	43	45	46	47	49	50	51	53	54
Cool Mode	100												46	47	49	50	51	53	54	55	57	58
Cool Mode	95											49	51	52	54	55	56	58	59	60	62	63
Cool Mode	90										51	52	54	55	57	58	59	61	62	63	65	
Cool Mode	85									56	58	59	61	62	64	65	66	67	69	70		
Cool Mode	80									61	63	64	66	67	69	70	71	72	74			
Cool Mode	75								63	64	66	67	69	70	71	72	74	76				
Cool Mode	70							65	67	68	70	71	73	74	76	77	78					
Cool Mode	65						67	68	70	71	73	74	76	77	79	80						
heat mode	62						55	56	58	59	61	62	64									
heat mode	57					49	51	52	54	55	57	58										
heat mode	52				43	45	47	48	50	51	53											
heat mode	47		36	38	39	41	43	44	46													
heat mode	42	30	32	34	35	37	39	40														

ADD REFRIGERANT

REMOVE REFRIGERANT

DISCHARGE PRESSURE CHECK

heat mode

Outdoor Ambient Deg. F	Discharge Press. At Service Valve (LG.) — Indoor Ambient Deg. F 60	70	80	Temp. Across Indoor Coil
37	182	208	234	23
32	170	196	222	21
27	158	184	210	19
22	147	173	200	17
17	137	163	190	15
12	129	155	182	13
7	123	149	176	10
2	118	144	170	8
-3	114	140	166	6
-8	110	136	163	4

MODEL OUTDOOR UNIT 10 SEER-018 MODEL INDOOR UNIT/COIL 2453A

TOTAL SYSTEM CHARGE 62 OZ. WITH 25 FT. 1/4' O.D. LIQUID LINE

Super Heat Charging Method

62

Vapor Pressure at Vapor Service Port (Between Reversing Valve and Accumulator)

Vapor Line Temperature at Compressor Degrees F.

Mode	Outdoor Ambient Deg. F	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
Cool Mode	105+													39	42	42	43	45	46	47	49	50
	105												42	43	45	46	47	49	50	51	53	54
	100												46	47	49	50	51	53	54	55	57	58
	95											49	51	52	54	55	56	58	59	60	62	63
	90										51	52	54	55	57	58	59	61	62	63	65	
	85									56	58	59	61	62	64	65	66	67	69	70		
	80									61	63	64	66	67	69	70	71	72	74			
	75								63	64	66	67	69	70	71	72	74	76				
	70							65	67	68	70	71	73	74	76	77	78					
	65						67	68	70	71	73	74	76	77	79	80						
heat mode	62						55	56	58	59	61	62	64									
	57					49	51	52	54	55	57	58										
	52				43	45	47	48	50	51	53											
	47		36	38	39	41	43	44	46													
	42	30	32	34	35	37	39	40														

ADD REFRIGERANT

REMOVE REFRIGERANT

DISCHARGE PRESSURE CHECK

heat mode

Outdoor Ambient Deg. F	Discharge Press. At Service Valve (LG.) — Indoor Ambient Deg. F 60	70	80	Temp. Across Indoor Coil
37	182	208	234	23
32	170	196	222	21
27	158	184	210	19
22	147	173	200	17
17	137	163	190	15
12	129	155	182	13
7	123	149	176	10
2	118	144	170	8
-3	114	140	166	6
-8	110	136	163	4

MODEL OUTDOOR UNIT 10 SEER-018 MODEL INDOOR UNIT/COIL 2453A

TOTAL SYSTEM CHARGE 62 OZ. WITH 25 FT. 1/4" O.D. LIQUID LINE

Super Heat Charging Method

Vapor Pressure at Vapor Service Port (Between Reversing Valve and Accumulator)

Vapor Line Temperature at Compressor Degrees F.

Mode	Outdoor Ambient Deg. F	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
Cool Mode	105+													39	42	42	43	45	46	47	49	50
Cool Mode	105												42	43	45	46	47	49	50	51	53	54
Cool Mode	100												46	47	49	50	51	53	54	55	57	58
Cool Mode	95											49	51	52	54	55	56	58	59	60	62	63
Cool Mode	90										51	52	54	55	57	58	59	61	62	63	65	
Cool Mode	85									56	58	59	61	62	64	65	66	67	69	70		
Cool Mode	80									61	63	64	66	67	69	70	71	72	74			
Cool Mode	75								63	64	66	67	69	70	71	72	74	76				
Cool Mode	70							65	67	68	70	71	73	74	76	77	78					
Cool Mode	65						67	69	70	71	73	74	76	77	79	80						
Heat Mode	62						55	56	58	59	61	62	64									
Heat Mode	57					49	51	52	54	55	57	58										
Heat Mode	52				43	45	47	48	50	51	53											
Heat Mode	47		36	38	39	41	43	44	46													
Heat Mode	42	30	32	34	35	37	39	40														

ADD REFRIGERANT

REMOVE REFRIGERANT

Outside Temp.

Temperature at Compressor

DISCHARGE PRESSURE CHECK

Heat Mode

Outdoor Ambient Deg. F	Indoor Ambient Deg. F 60 — Discharge Press. At Service Valve (LG.)	70	80	Temp. Across Indoor Coil
37	182	208	234	23
32	170	196	222	21
27	158	184	210	19
22	147	173	200	17
17	137	163	190	15
12	129	155	182	13
7	123	149	176	10
2	118	144	170	8
-3	114	140	166	6
-8	110	136	163	4

CHECKING THE DISCHARGE PRESSURE

DISCHARGE PRESURE CHECK (HEATING) - In the heating mode with the outdoor temperature below 42 degrees , units using a flow check piston on the outdoor coil can only be accurately charged using the weight method. At low outdoor temperatures, the accumulator holds refrigerant and adjusting the charge will change the liquid level in the accumulator with no apparent change in the system. Discharge pressure may be used only to verify system charge. The service port on the vapor service valve (large valve) is used for this purpose. Measure and record the three values required. (outdoor ambient, indoor ambient and discharge pressure at the large service valve, also note the temperature across the coil). Find the intersection of the outdoor ambient and indoor temperature on the appropriate chart. The discharge pressure should approximate the intersect value on the chart. (see the next page #18)

MODEL OUTDOOR UNIT 10 SEER-018 MODEL INDOOR UNIT/COIL 2453A
TOTAL SYSTEM CHARGE 62 OZ. WITH 25 FT. 1/4' O.D. LIQUID LINE

Super Heat Charging Method

Outdoor Ambient Deg. F	Vapor Pressure at Vapor Service Port (Between Reversing Valve and Accumulator)																				
	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82
	Vapor Line Temperature at Compressor Degrees F.																				
Cool Mode																					
105+													39	42	42	43	45	46	47	49	50
105												42	43	45	46	47	49	50	51	53	54
100												46	47	49	50	51	53	54	55	57	58
95											49	51	52	54	55	56	58	59	60	62	63
90										51	52	54	55	57	58	59	61	62	63	65	
85									56	58	59	61	62	64	65	66	67	69	70		
80									61	63	64	66	67	69	70	71	72	74			
75								63	64	66	67	69	70	71	72	74	76				
70							65	67	68	70	71	73	74	76	77	78					
65						67	68	70	71	73	74	76	77	79	80						
heat mode																					
62						55	56	58	59	61	62	64									
57					49	51	52	54	55	57	58										
52				43	45	47	48	50	51	53											
47		36	38	39	41	43	44	46													
42	30	32	34	35	37	39	40														

DISCHARGE PRESSURE CHECK

heat mode

Outdoor Ambient Deg. F	Indoor Ambient Deg. F — Discharge Press. At Service Valve (LG.) 60	70	80	Temp. Across Indoor Coil
37	182	208	234	23
32	170	196	222	21
27	158	184	210	19
22	147	173	200	17
17	137	163	190	15
12	129	155	182	13
7	123	149	176	10
2	118	144	170	8
-3	114	140	166	6
-8	110	136	163	4

CHARGING BY WEIGHT

<u>CHARGING WEIGHT</u> - For a new installation, evacuation of interconnecting tubing and indoor coil is adequate; otherwise, evacuate the entire system. Use the system charge shown on the charging chart for the approiate outdoor unit/indoor coil model combination. Note the chart value includes charge required for <u>25 feet</u> of standard size interconnecting liquid line. Calculate actual charge required with installed liquid line size and length using: (1/4" O.D. = .3 oz./ft), (5/16"O.D. = .4 oz,/ft.) (3/8" O.D. = .6 oz./ft.) (1/2" O.D. =1.2 oz./ft.). With an accurate scale (+/- 1oz.) or volumetric charging device, adjust charge difference between that shown on the unit data plate and that calculated for the new system installation. If the entire system has been evacuated, add the total calculated charge.

System Troubleshooting

Cooling Mode

COOLING MODE OF OPPERATION

LOW EVAPORATOR HEAT LOAD

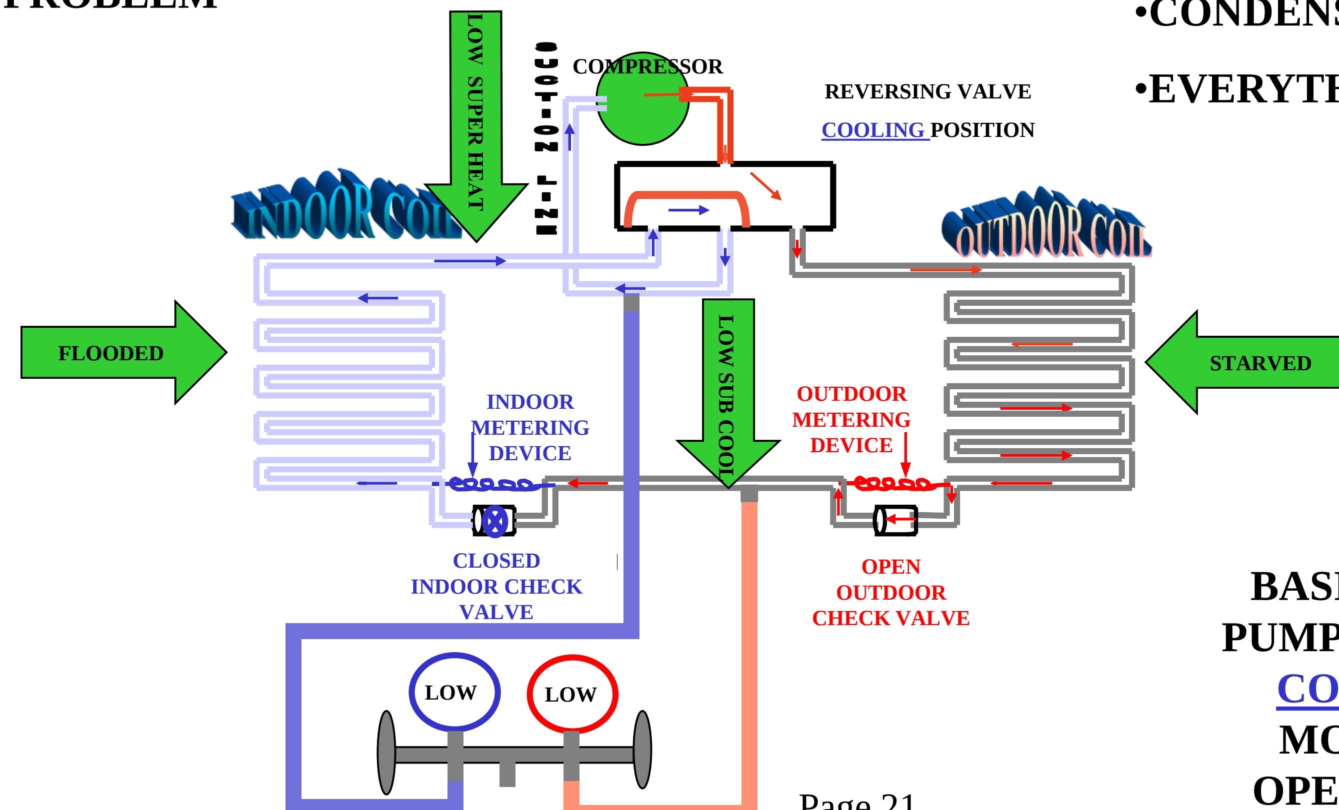
CAUSES

- LOW AIR FLOW
- DIRTY INDOOR COIL
- DIRTY FILTER
- DUCT PROBLEM

NOT ENOUGH HEAT ENTERING THE EVAPORATOR COIL

SYMPTOMS

- SUCTION LOW
- SUPER HEAT LOW
- LIQUID COULD BE IN SUCTION LINE
- CONDENSER STARVED
- EVERYTHING IS LOW



BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

HIGH EVAPORATOR HEAT LOAD

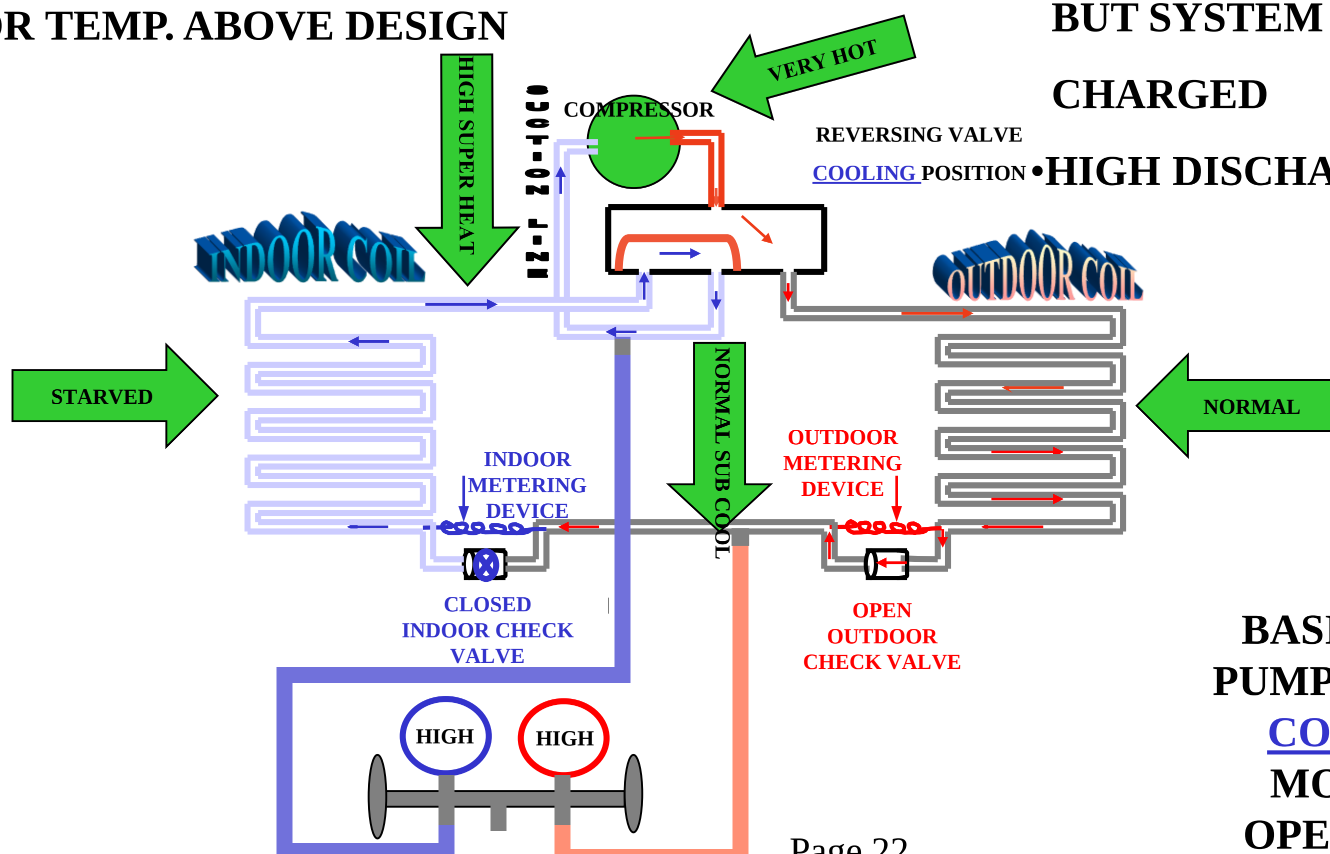
CAUSES

- HIGH AIR FLOW
- INFILTRATION AIR
- UNDERSIZED UNIT
- NEW START-UP
- OUTDOOR TEMP. ABOVE DESIGN

HIGH HEAT ENTERING THE EVAPORATOR COIL

SYMPTOMS

- SUCTION HIGH
- SUPER HEAT HIGH
- EVAPORATOR IS LOOKING FOR MORE REFRIGERANT BUT SYSTEM IS FULLY CHARGED
- HIGH DISCHARGE GAS TEMP.



BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

UNDERCHARGED SYSTEM

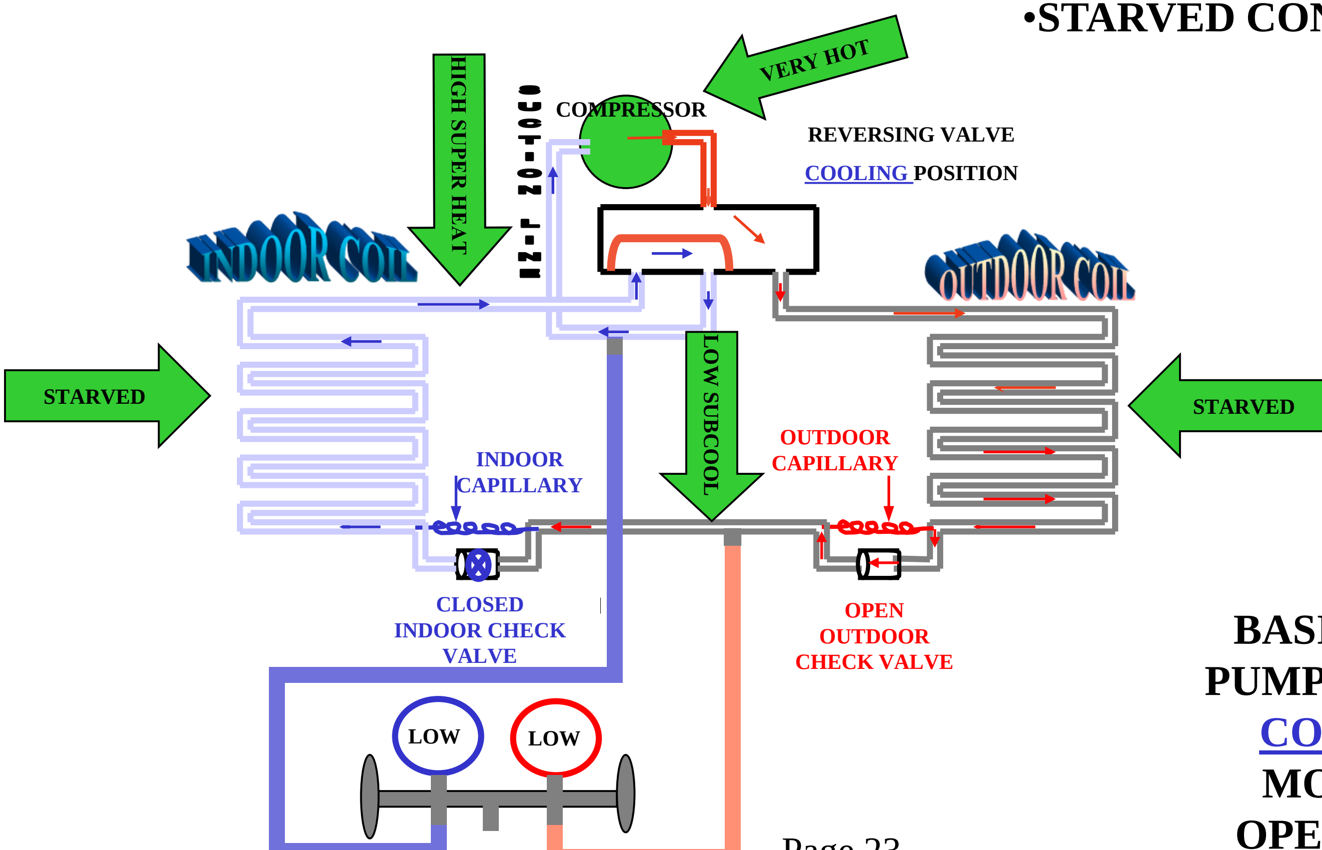
CAUSES

- LEAK

NOT ENOUGH REFRIGERANT IN THE UNIT(LEAK)

SYMPTOMS

- SUCTION LOW
- SUPER HEAT HIGH
- EVAPORATOR IS STARVED
- LOW SUBCOOLING
- STARVED CONDENSER



BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

OVERCHARGED SYSTEM

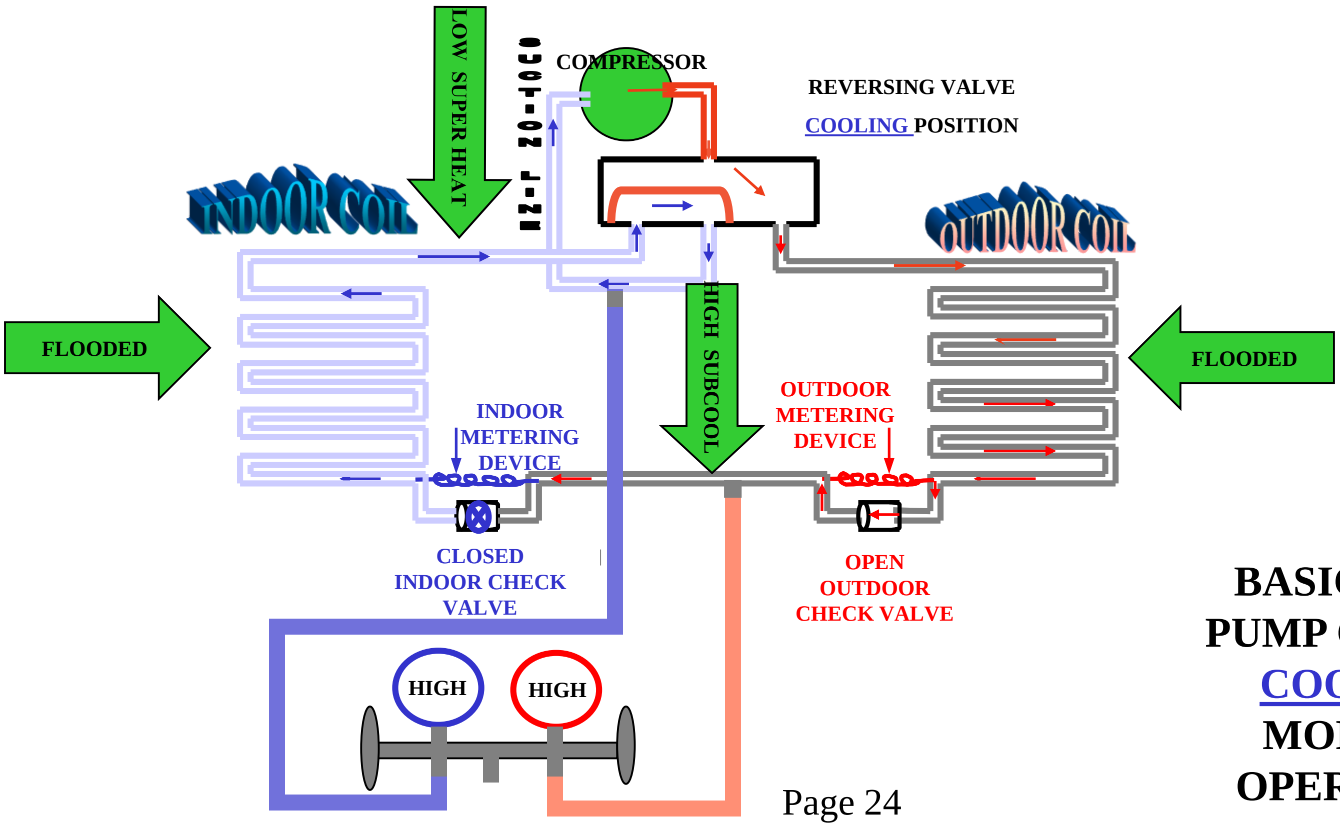
CAUSES

- TOO MUCH REFRIGERANT

TOO MUCH REFRIGERANT IN THE UNIT

SYMPTOMS

- SUCTION HIGH
- SUPER HEAT LOW
- EVAPORATOR IS FLOODED
- HIGH SUBCOOLING
- FLOODED CONDENSER



BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

RESTRICTED METERING DEVICE

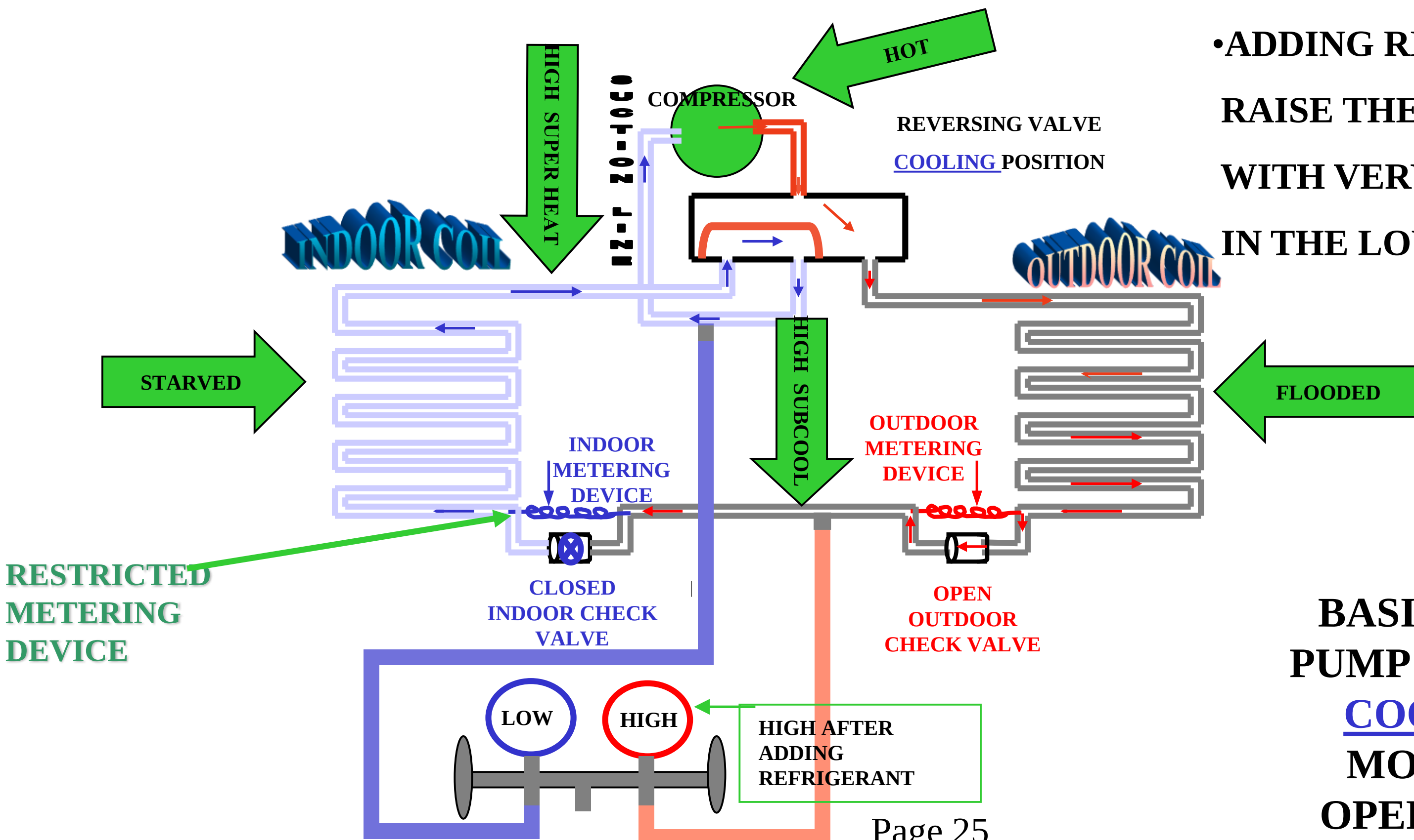
CAUSES

- DEBRIS IN ORIFICE
- INSTALLED WRONG DEVICE

METERING DEVICE RESTRICTED OR TOO SMALL

SYMPTOMS

- SUCTION LOW
- SUPER HEAT HIGH
- EVAPORATOR IS STARVED
- HIGH SUBCOOLING
- MOST REFRIGERANT IS SETTING IN THE CONDENSER
- ADDING REFRIGERANT WILL RAISE THE HEAD PRESSURE WITH VERY LITTLE CHANGE IN THE LOW SIDE PRESSURE



BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

RESTRICTED CHECK VALVE

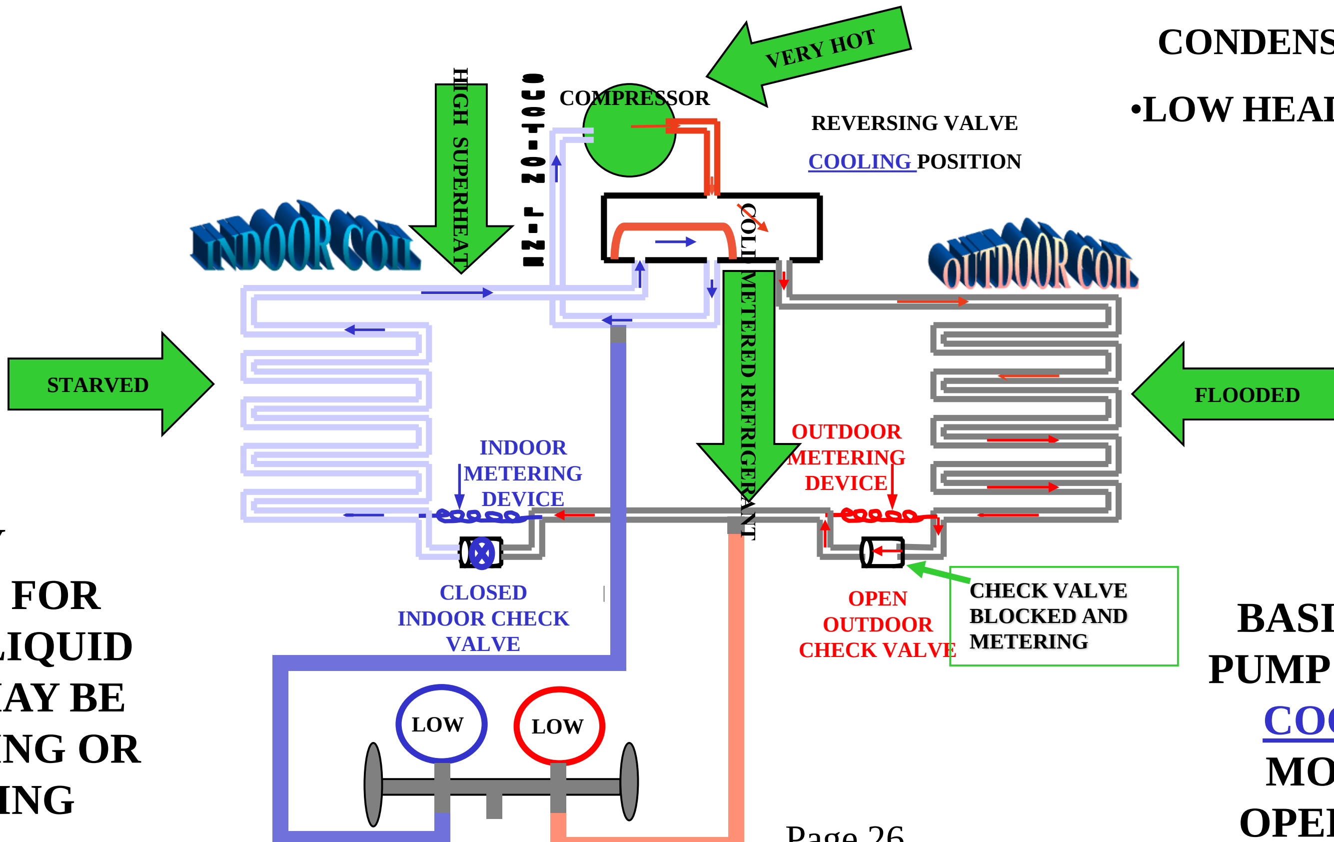
CAUSES

- DEBRIS IN ORIFICE
- INSTALLED WITH FLOW IN WRONG DIRECTION
- STICKING, WON'T UNSEAT

CHECK VALVE RESTRICTED OUTDOOR COIL COOLING MODE

SYMPTOMS

- SUCTION LOW
- SUPER HEAT HIGH
- EVAPORATOR IS STARVED
- COLD LIQUID LINE
- MOST REFRIGERANT IS SETTING IN THE CONDENSER
- LOW HEAD PRESSURE



SIMPLY CHECK FOR COLD LIQUID LINE-MAY BE FROSTING OR SWEATING

BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

BYPASSING FLOWCHECK PISTON (indoor coil)

CAUSES

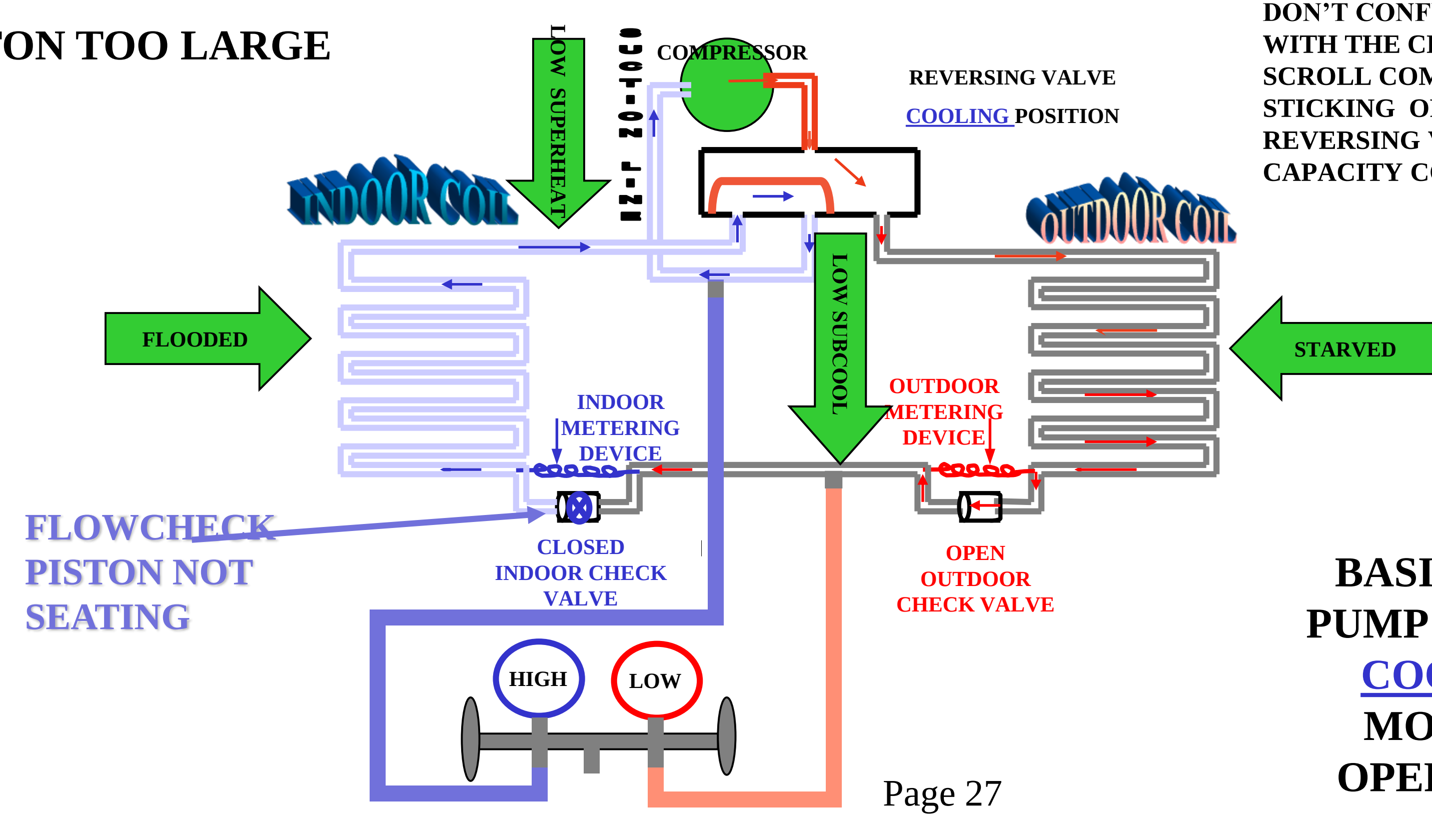
- DEBRIS IN ORIFICE
- INSTALLED WITH FLOW IN WRONG DIRECTION
- STICKING, WON'T SEAT
- PISTON TOO LARGE

FLOWCHECK PISTON IS CAUSING THE METERING DEVICE TO BE BYPASSED

SYMPTOMS

- SUCTION HIGH
- SUPER HEAT LOW
- EVAPORATOR IS FLOODED
- LOW HEAD PRESSURE
- CONDENSER STARVED

DON'T CONFUSE THIS PROBLEM WITH THE CHECK VALVE IN A SCROLL COMPRESSOR DISCHARGE STICKING OR A STICKING REVERSING VALVE OR A LOW CAPACITY COMPRESSOR



CONFIRM THE TEMPERATURE RISE THROUGH THE REVERSING VALVE *(MIDDLE PORT SHOULD NOT BE 7 DEG WARMER THAN THE INLET PORT)* AND ALLOW THE COMPRESSOR TO PUMP THE SYSTEM DOWN.

BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

COOLING MODE OF OPPERATION

REVERSING VALVE IS LEAKING

CAUSES

•INTERNAL SLIDE IS NOT SEATING AND ALLOWING HOT GAS TO BE DELIVERED INTO THE SUCTION SIDE.

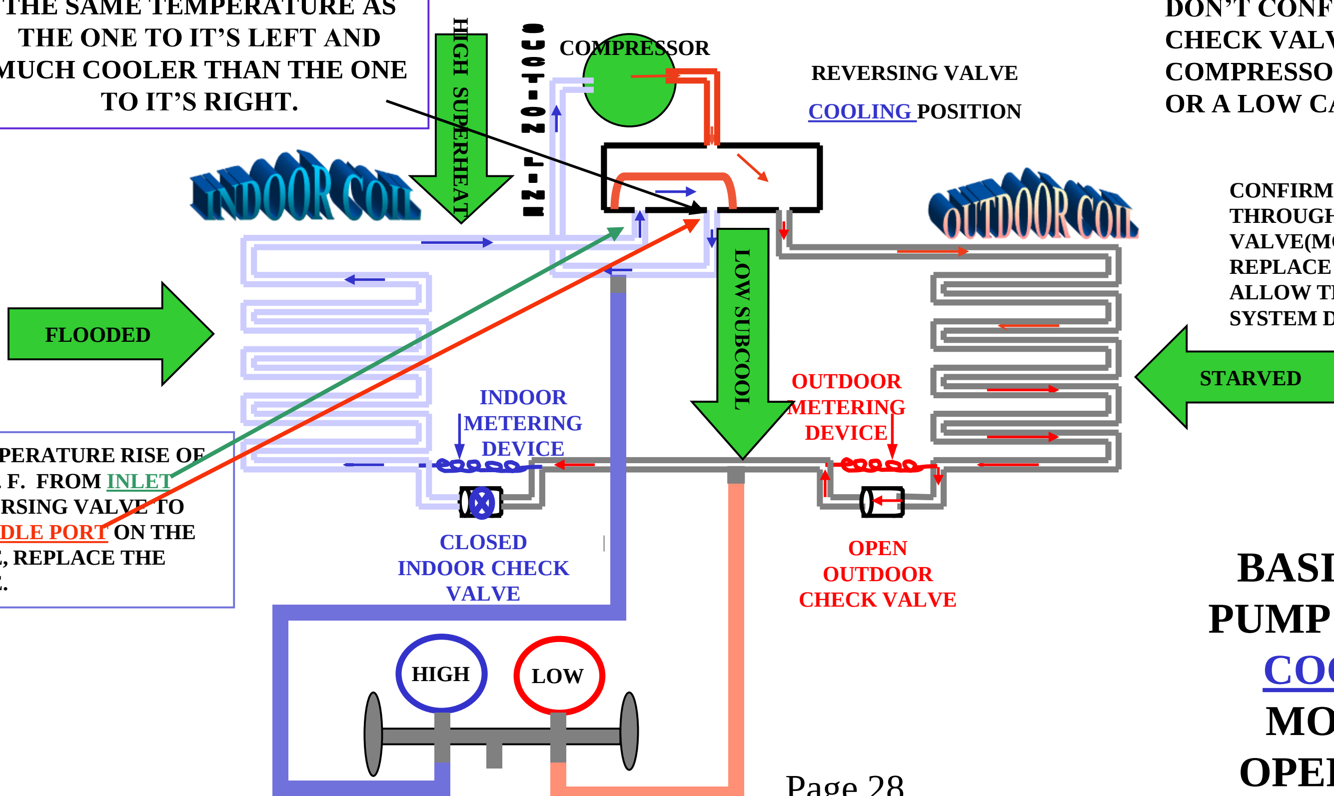
DIAGNOSING A LEAKING REVERSING VALVE

SYMPTOMS

- •SUCTION HIGH
- •SUPER HEAT HIGH
- •EVAPORATOR IS FLOODED
- •LOW HEAD PRESSURE
- •CONDENSER STARVED
- •LOW SUBCOOLING

DON'T CONFUSE THIS WITH THE CHECK VALVE IN A SCROLL COMPRESSOR DISCHARGE STICKING OR A LOW CAPACITY COMPRESSOR

THE MIDDLE LINE ON THE REVERSING VALVE SHOULD BE THE SAME TEMPERATURE AS THE ONE TO IT'S LEFT AND MUCH COOLER THAN THE ONE TO IT'S RIGHT.



CONFIRM THE TEMPERATURE RISE THROUGH THE REVERSING VALVE(MORE THAT A 7 DEGREES RISE REPLACE THE REVERSING VALVE) AND ALLOW THE COMPRESSOR TO PUMP THE SYSTEM DOWN.

IF THERE IS A TEMPERATURE RISE OF MORE THAN 7 DEG. F. FROM INLET LINE ON THE REVERSING VALVE TO THE COMMON MIDDLE PORT ON THE REVERSING VALVE, REPLACE THE REVERSING VALVE.

BASIC HEAT PUMP CIRCUIT COOLING MODE OF OPERATION

System Troubleshooting

Heating Mode

HEATING MODE OF OPPERATION

LOW HEAT LOAD (dirty outdoor coil)

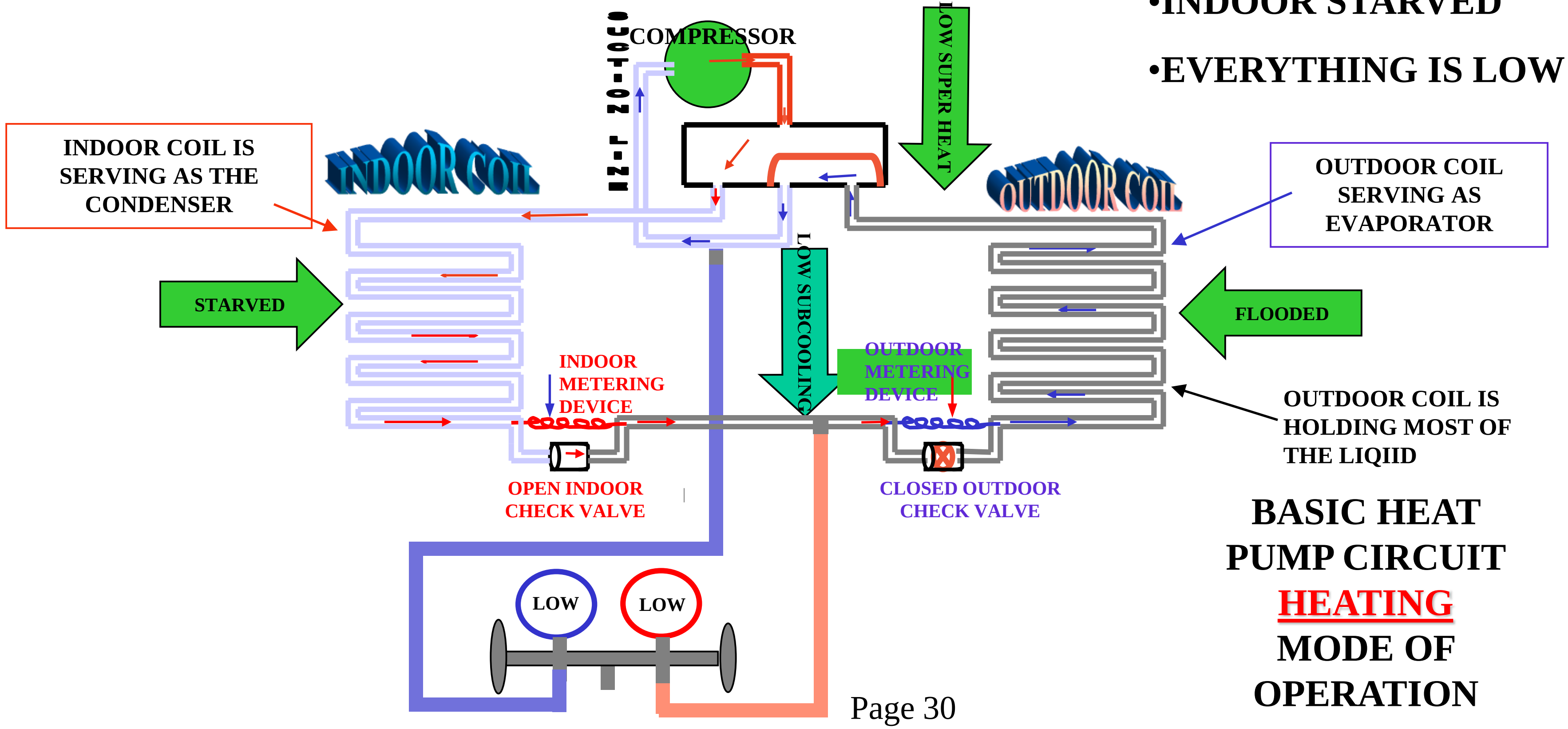
CAUSES

- DIRTY OUTDOOR COIL
- FAN OFF
- DEFROST NEEDED

NOT ENOUGH HEAT ENTERING THE OUTDOOR COIL

SYMPTOMS

- SUCTION LOW
- HIGHSIDE LOW
- LOW SUPERHEAT
- LOW SUBCOOLING
- INDOOR STARVED
- EVERYTHING IS LOW



BASIC HEAT PUMP CIRCUIT HEATING MODE OF OPERATION

HEATING MODE OF OPPERATION

MIS-MATCH/ (dirty indoor coil)

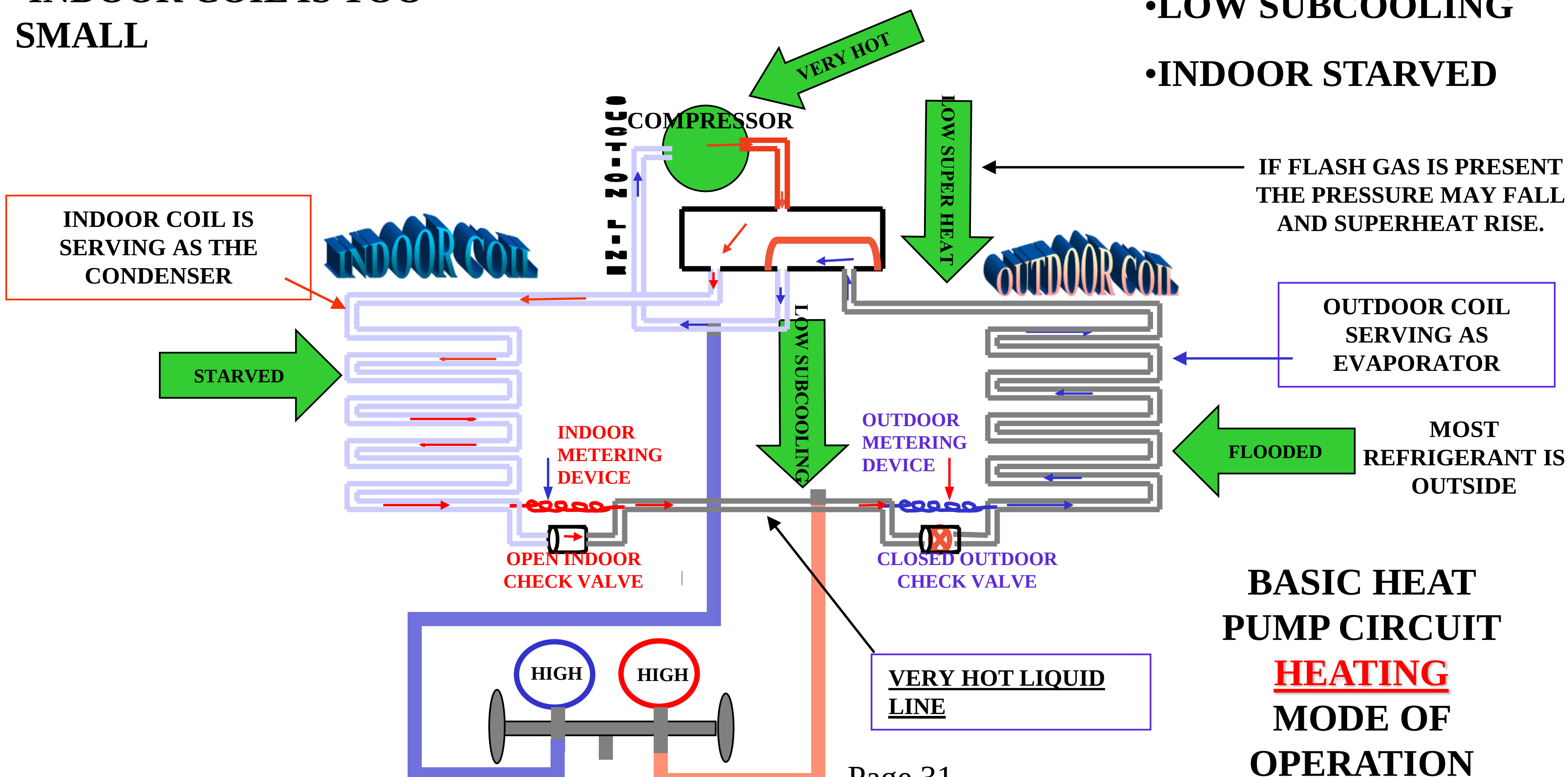
CAUSES

- DIRTY INDOOR COIL
- FAN OFF
- INDOOR COIL IS TOO SMALL

INDOOR COIL ACTING AS THE CONDENSER/TOO SMALL OR DIRTY

SYMPTOMS

- SUCTION HIGH
- HIGHSIDE HIGH
- LOW SUPERHEAT
- LOW SUBCOOLING
- INDOOR STARVED



HEATING MODE OF OPPERATION

LOW CHARGE

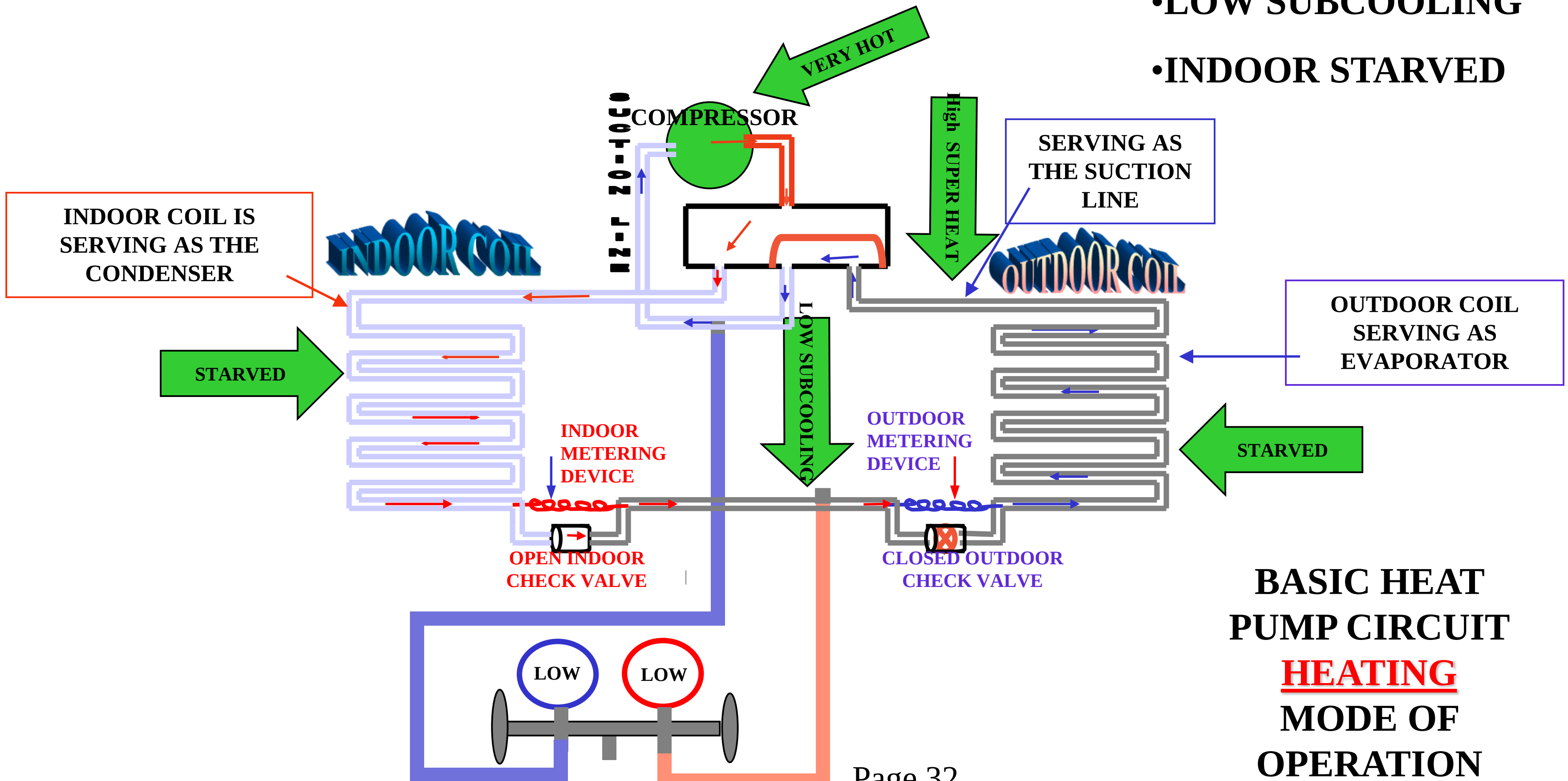
CAUSES

- LEAK

NOT ENOUGH REFRIGERANT

SYMPTOMS

- SUCTION LOW
- HIGHSIDE LOW
- HIGH SUPERHEAT
- LOW SUBCOOLING
- INDOOR STARVED



BASIC HEAT PUMP CIRCUIT **HEATING** MODE OF OPERATION

HEATING MODE OF OPPERATION

OVER CHARGED

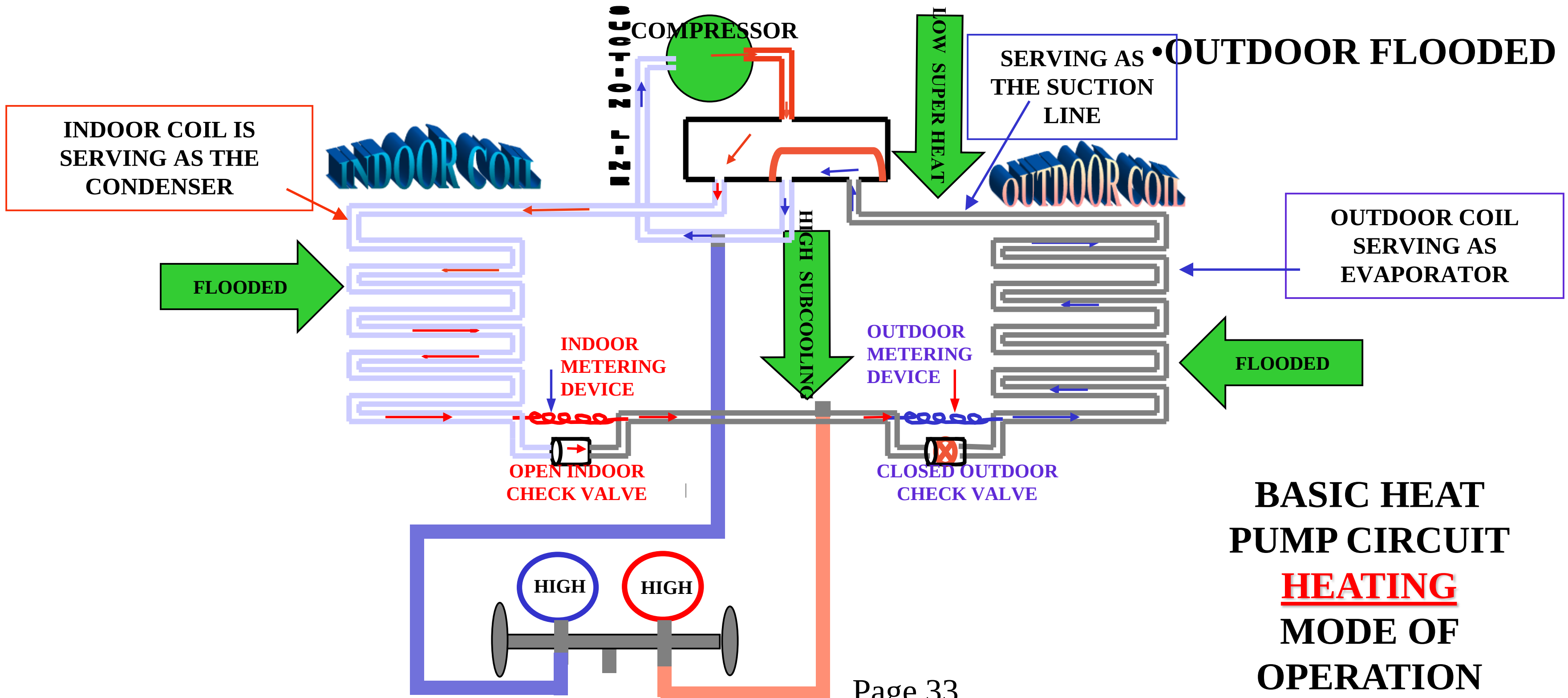
CAUSES

- OVERCHARGED UNIT

TOO MUCH REFRIGERANT

SYMPTOMS

- SUCTION HIGH
- HIGHSIDE HIGH
- LOW SUPERHEAT
- HIGH SUBCOOLING
- INDOOR FLOODED
- OUTDOOR FLOODED



BASIC HEAT PUMP CIRCUIT HEATING MODE OF OPERATION

RESTRICTED METERING DEVICE (indoor coil)

HEATING MODE OF OPPERATION

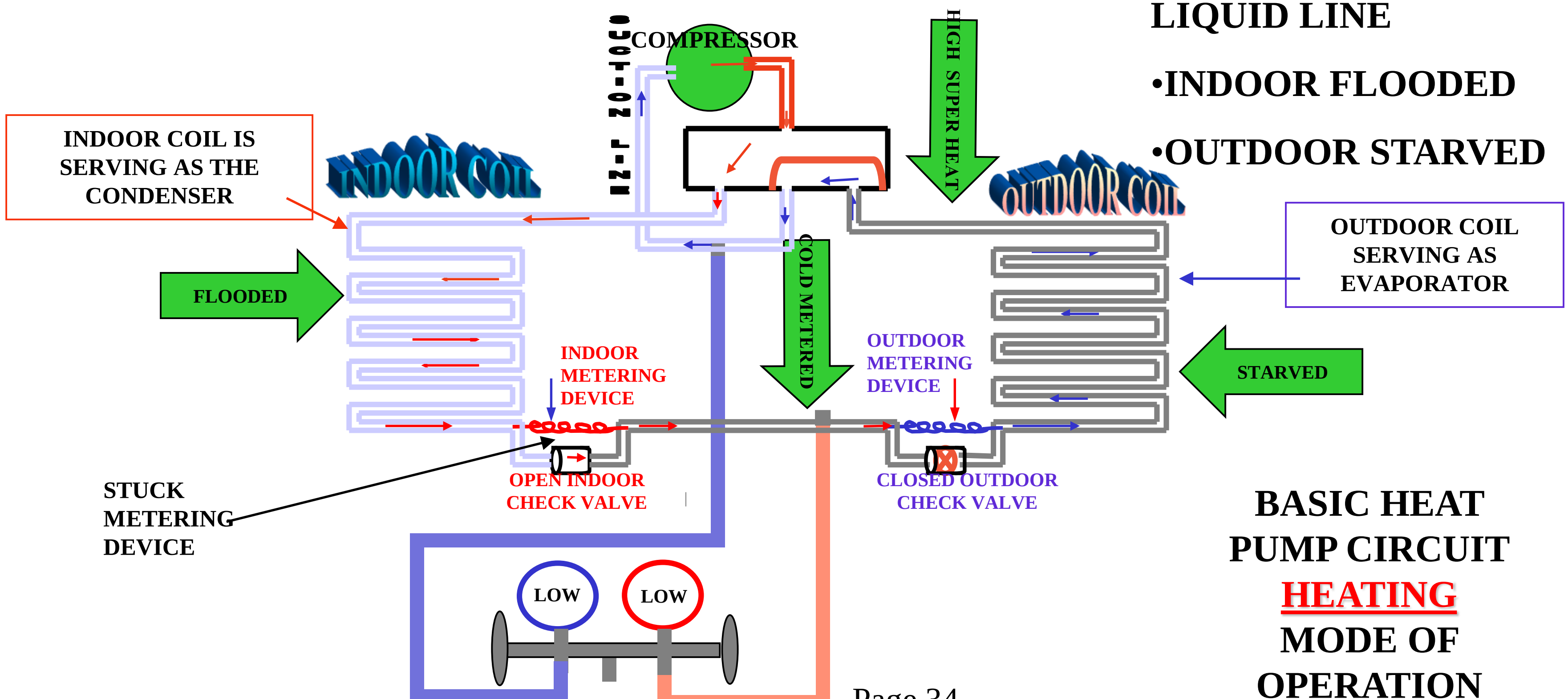
CAUSES

- DEBRI BLOCKING ORIFICE
- STUCK METERING DEVICE

RESTRICTED /STUCK METERING DEVICE IN THE INDOOR COIL

SYMPTOMS

- SUCTION LOW
- HIGHSIDE LOW
- HIGH SUPERHEAT
- COLD METERED REFRIGERANT IN THE LIQUID LINE
- INDOOR FLOODED
- OUTDOOR STARVED



BASIC HEAT PUMP CIRCUIT **HEATING** MODE OF OPERATION

RESTRICTED METERING DEVICE (outdoor coil)

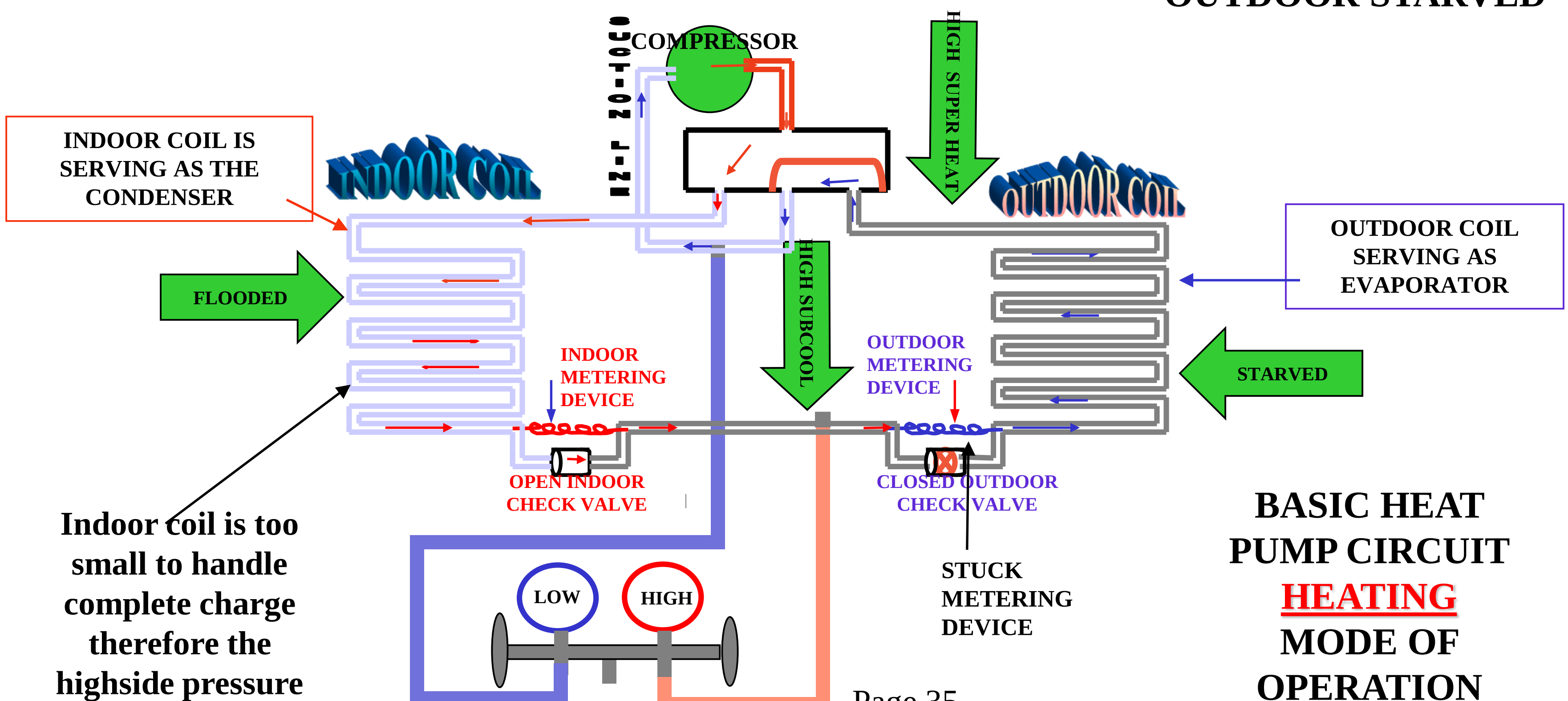
CAUSES

- DEBRI BLOCKING ORIFICE
- STUCK METERING DEVICE

RESTRICTED /STUCK METERING DEVICE IN THE OUTDOOR COIL

SYMPTOMS

- SUCTION LOW
- HIGHSIDE HIGH
- HIGH SUPERHEAT
- INDOOR FLOODED
- OUTDOOR STARVED



Indoor coil is too small to handle complete charge therefore the highside pressure goes up

BASIC HEAT PUMP CIRCUIT <u>HEATING</u> MODE OF OPERATION

HEATING MODE OF OPPERATION

BYPASSING METERING DEVICE (outdoor coil)

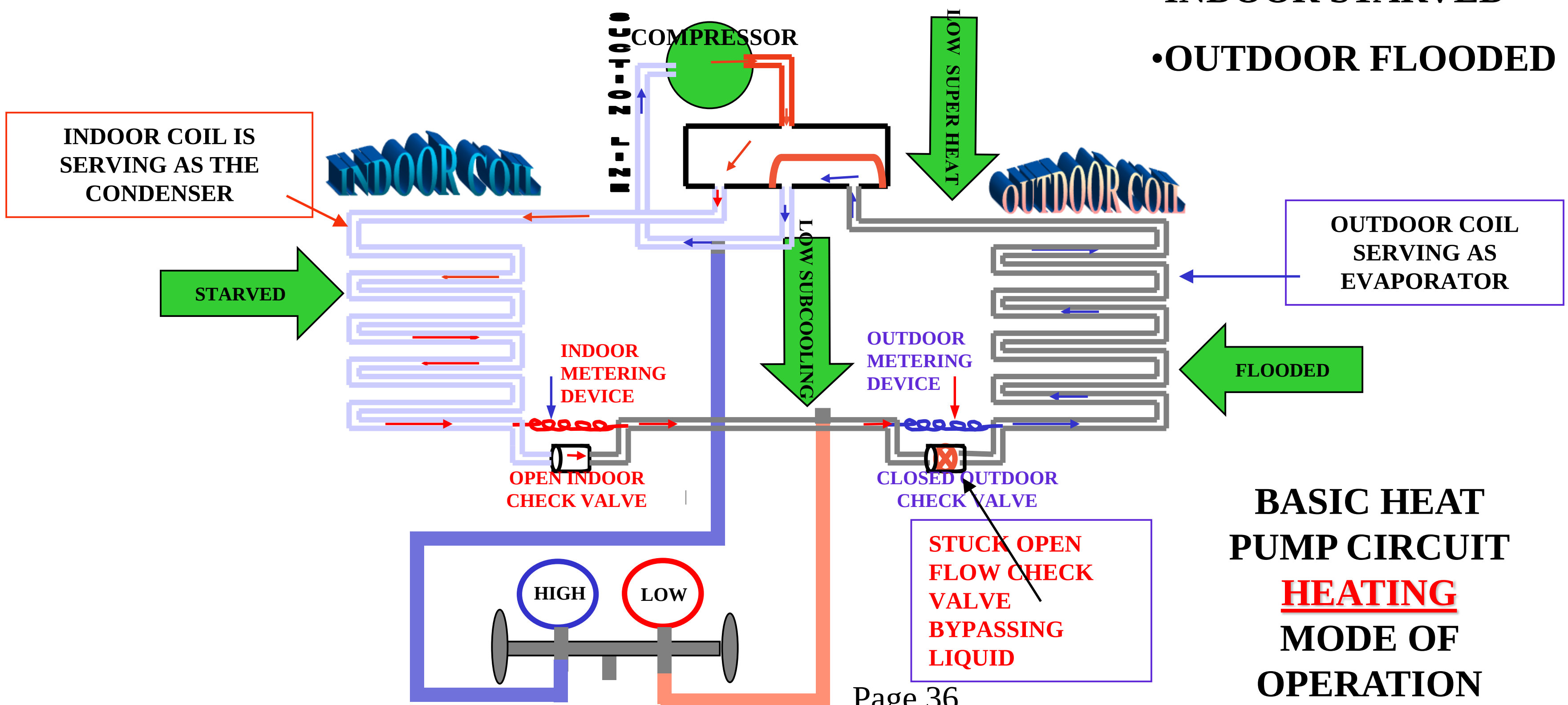
CAUSES

- DEBRI BLOCKING FLOWCHECK
- STUCK

FLOW CHECK IS STUCK OPEN IN THE OUTDOOR COIL

SYMPTOMS

- SUCTION HIGH
- HIGHSIDE LOW
- LOW SUPERHEAT
- LOW SUB COOLING
- INDOOR STARVED
- OUTDOOR FLOODED



BASIC HEAT PUMP CIRCUIT **HEATING** MODE OF OPERATION

HEATING MODE OF OPPERATION

LEAKING REVERSING VALVE

CAUSES

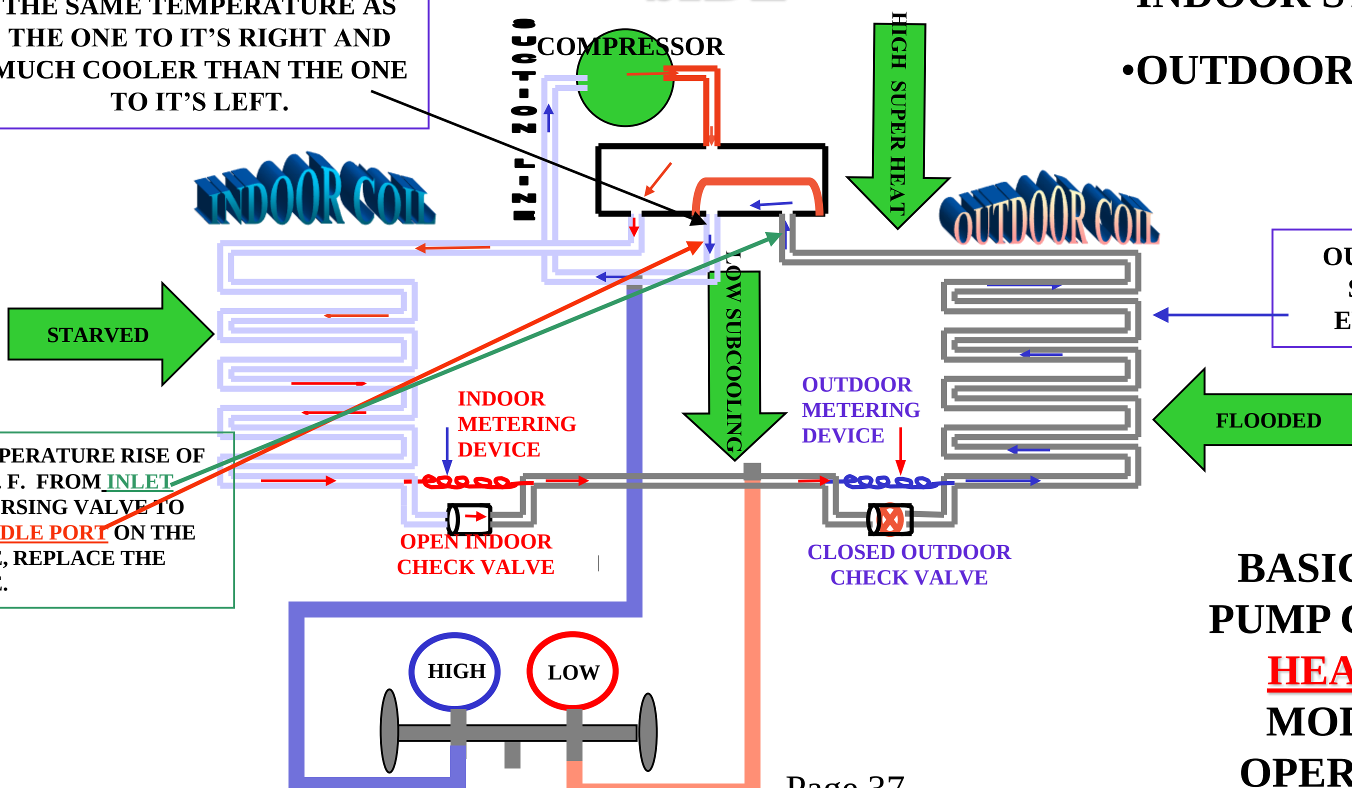
- SLIDE IS STICKING

REVERSING VALVE IS LEAKING HIGH PRESSURE GAS INTO SUCTION SIDE

SYMPTOMS

- SUCTION HIGH
- HIGHSIDE LOW
- HIGH SUPERHEAT
- LOW SUB COOLING
- INDOOR STARVED
- OUTDOOR FLOODED

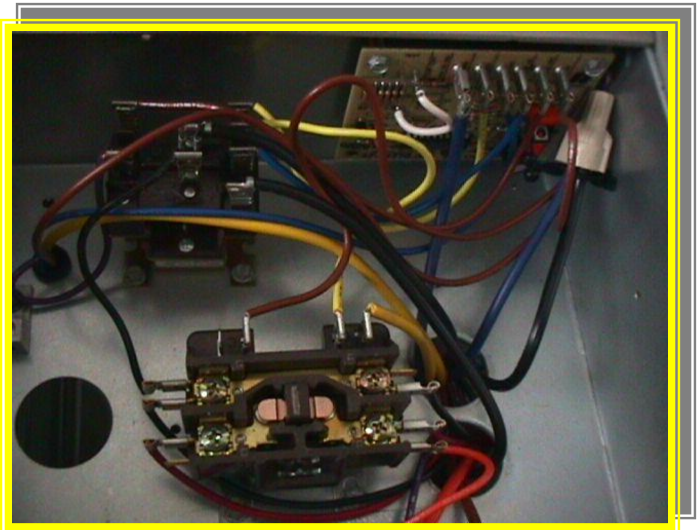
THE MIDDLE LINE ON THE REVERSING VALVE SHOULD BE THE SAME TEMPERATURE AS THE ONE TO IT'S RIGHT AND MUCH COOLER THAN THE ONE TO IT'S LEFT.



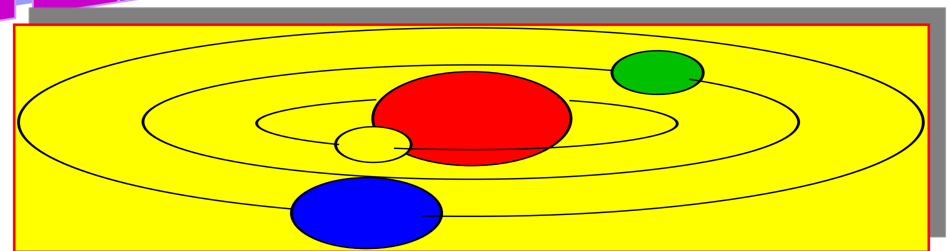
OUTDOOR COIL SERVING AS EVAPORATOR

IF THERE IS A TEMPERATURE RISE OF MORE THAN 7 DEG. F. FROM INLET LINE ON THE REVERSING VALVE TO THE COMMON MIDDLE PORT ON THE REVERSING VALVE, REPLACE THE REVERSING VALVE.

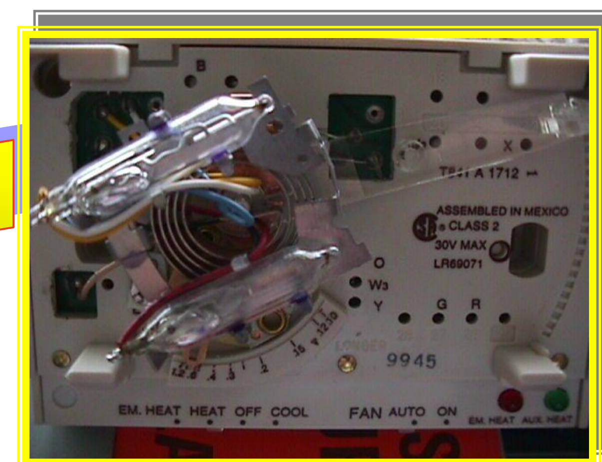
BASIC HEAT PUMP CIRCUIT **HEATING** MODE OF OPERATION



HEAT PUMP



ELECTRICAL

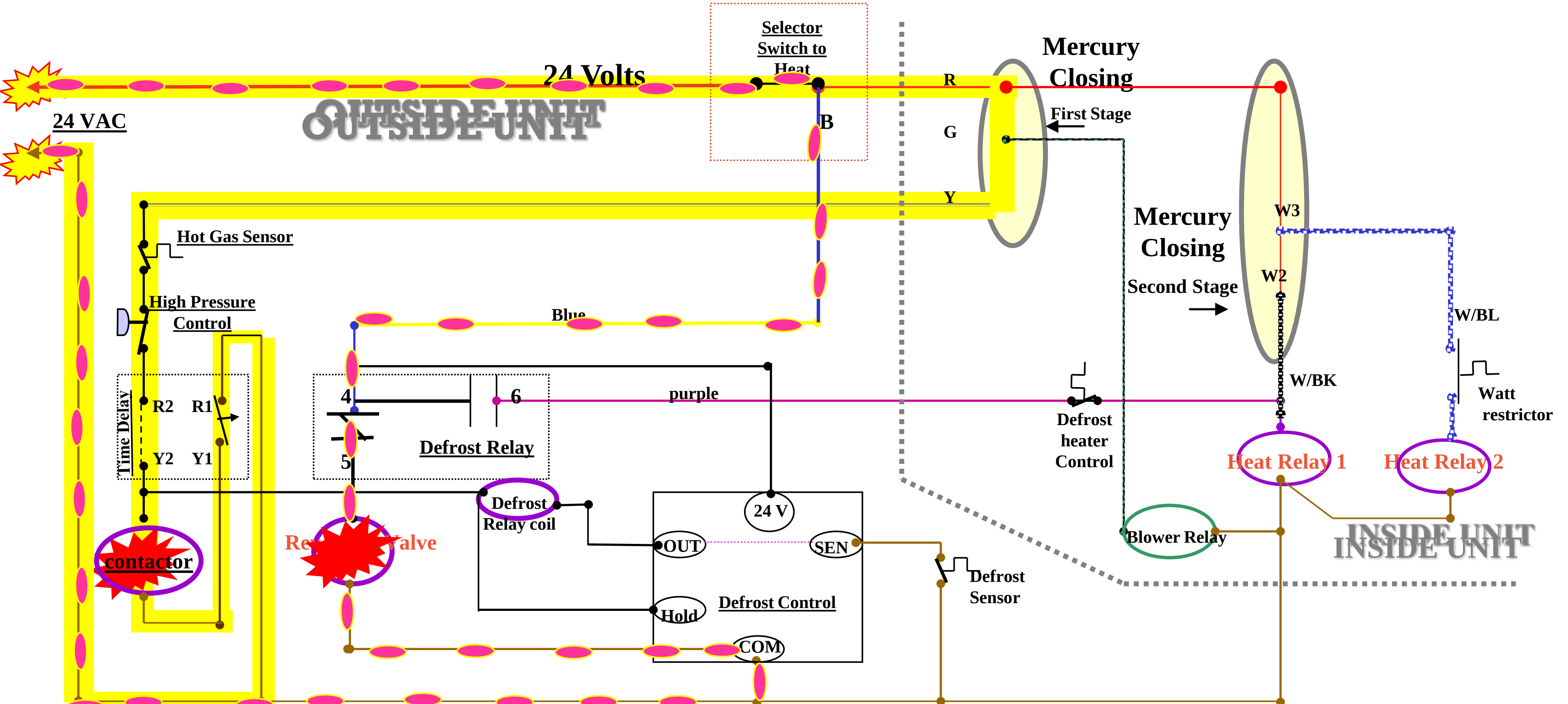


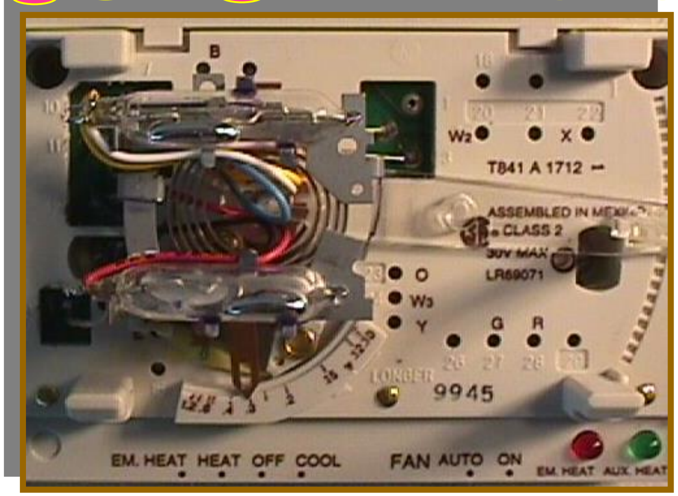
HEATING-CYCLE

View page 40 on screen while reading this page.

- **When the thermostat "calls for heat," the circuits between R and B, R and Y and R and G are completed. Circuit R and B energizes the reversing Valve (RV) switching it to the heating position (the reversing valve remains energized as long as the selector switch is in "heat" position). Circuit R and Y energizes the contactor (CC) starting the outdoor fan motor (OFM) and compressor (COMP). Circuit R and G energizes the blower relay (BR) starting the indoor blower motor (IBM).**

- **If the room temperature should continue to fall, circuit R and W_2 is completed by the second-stage heating room-thermostat. Circuit R-W_2 energizes a heat sequencer or Watt Restrictor. The completed circuit will energize supplemental electric heat. Units with a second heater sequencer can be connected with first sequencer to W_2 on the thermostat or connected to a third heating stage W_3 on the sub-base. A light on the thermostat indicates when supplemental heat is being energized.**



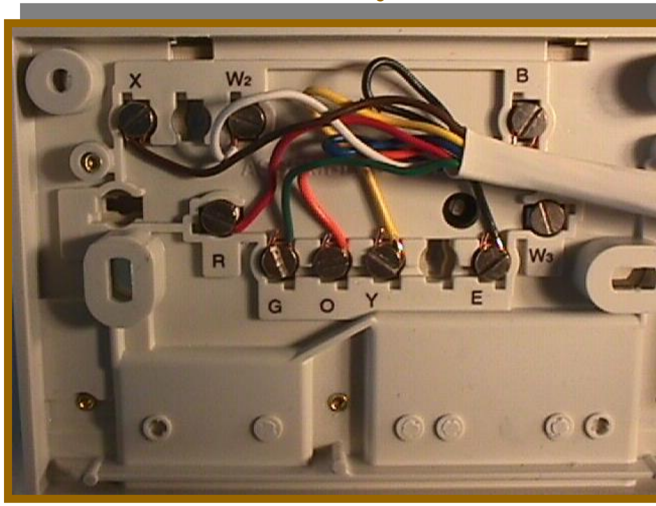


TENNESSEE VALLEY TECHNICAL PROGRAMS

HEAT PUMPS

by Dennis W. Mayes

JANUARY 2000

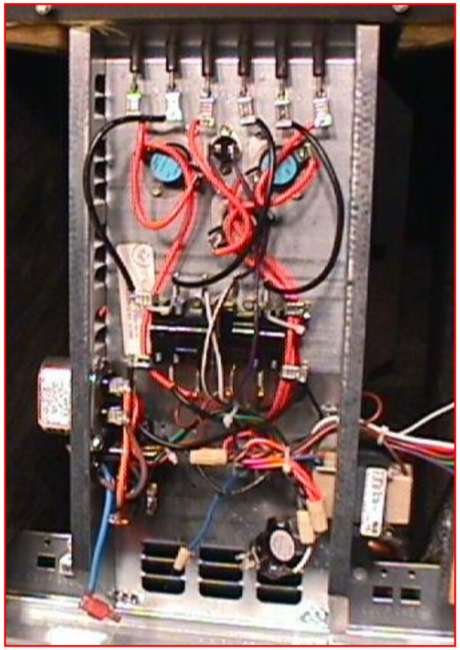


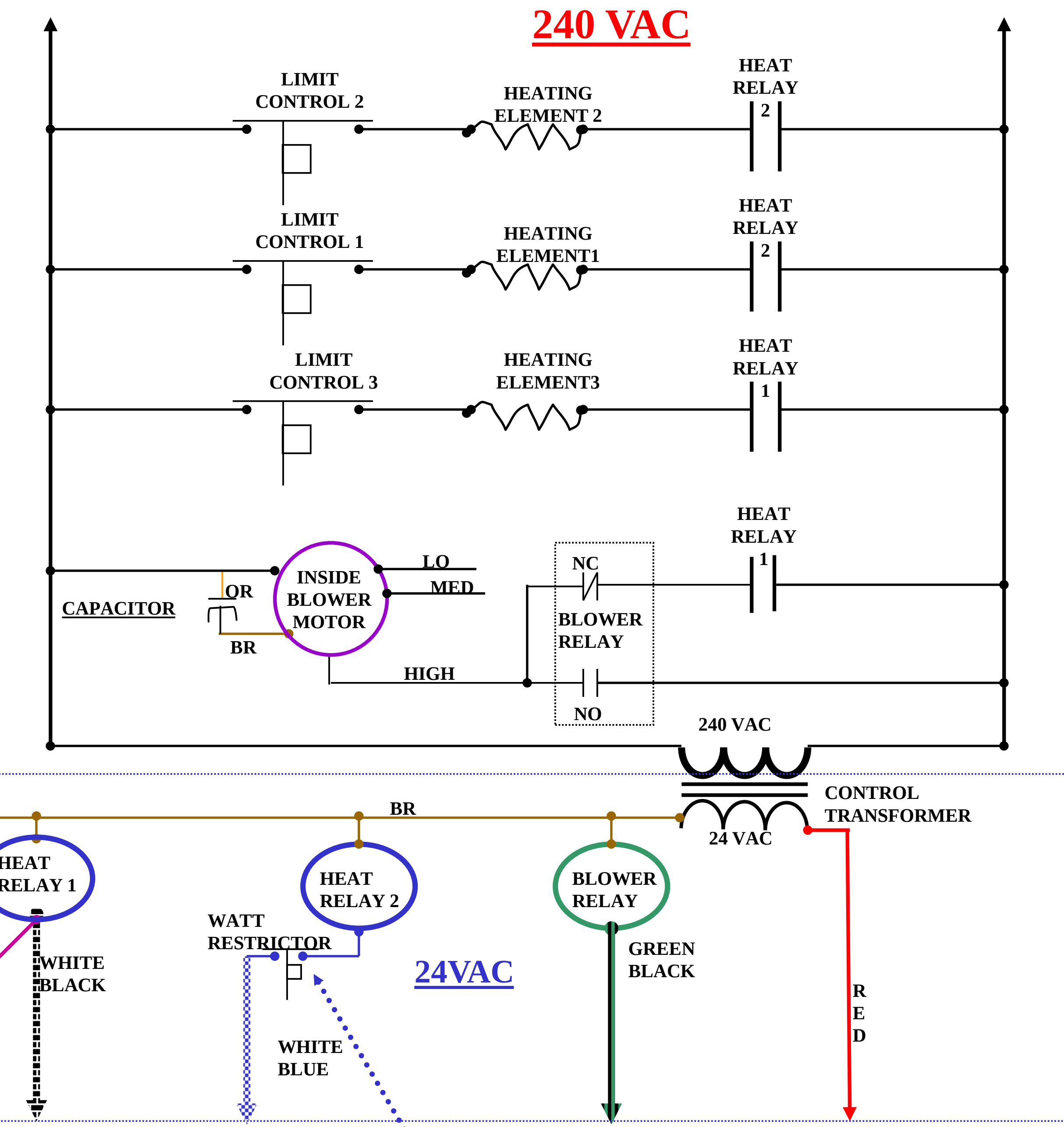
TENNESSEE VALLEY TECHNICAL PROGRAMS

HEAT PUMPS

by Dennis W. Mayes

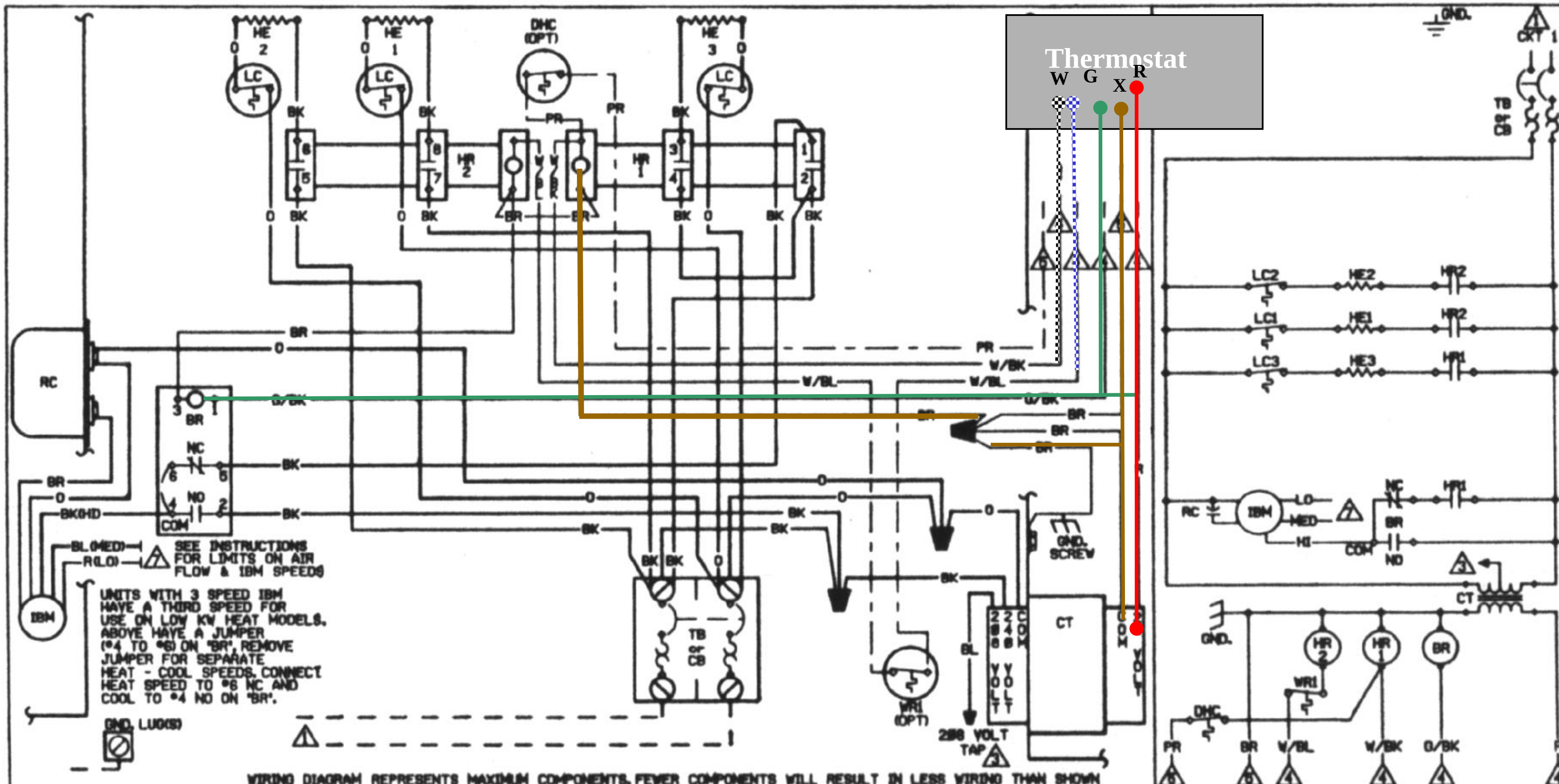
JANUARY 2000





SEE PG. 50

The Watt Restrictor will open between 90F and 95F and close between 70Fand 75F



COMPONENT CODE

BR	BLOWER RELAY
CB	CIRCUIT BREAKER
CT	CONTROL TRANSFORMER
DHC	DEFROST HEATER CONTROL
GND	GROUND
HE	HEATER ELEMENT
HR	HEATER RELAY
IBM	INDOOR BLOWER MOTOR
LC	LIMIT CONTROL
RC	RUN CAPACITOR
TB	TERMINAL BLOCK (HI VOLT)
WR	WATT RESTRICTOR
▲	WIRE NUT

DWG. NO. 90-26152-06 REV 00

NOTES:

1. CONNECT SUPPLY WIRING FOR VOLTAGE, PHASE AND HERTZ SHOWN ON RATING PLATE.
2. SUPPLY WIRE MUST BE RATED AT 75° C MIN. SEE INSTRUCTIONS FOR SIZE.
3. CT FACTORY WIRED FOR 240 VOLTS. USE O & BL FOR 208 VOLTS.
4. CONTROL WIRING TO THERMOSTAT SUB-BASE.
5. CONTROL WIRING TO OUTDOOR UNIT.
6. FOR USE WITH COPPER CONDUCTORS ONLY.
7. UNIT FACTORY WIRED FOR HIGH SPEED - UNUSED SPEED TERMINALS PLUGGED.
8. "N" CONTROL USES TERMINAL BLOCK INSTEAD OF CIRCUIT BREAKERS.

WIRING INFORMATION

LINE VOLTAGE
- FACTORY STANDARD
- FACTORY OPTION
- FIELD INSTALLED

LOW VOLTAGE
- FACTORY STANDARD
- FACTORY OPTION
- FIELD INSTALLED

REPLACEMENT WIRE
- MUST BE THE SAME SIZE AND TYPE OF INSULATION AS ORIGINAL (105° C MIN.)

WARNING
- CABINET MUST BE PERMANENTLY GROUNDED AND CONFORM TO N.E.C., (C.E.C.-CANADA) AND LOCAL CODES.

WIRE COLOR CODE

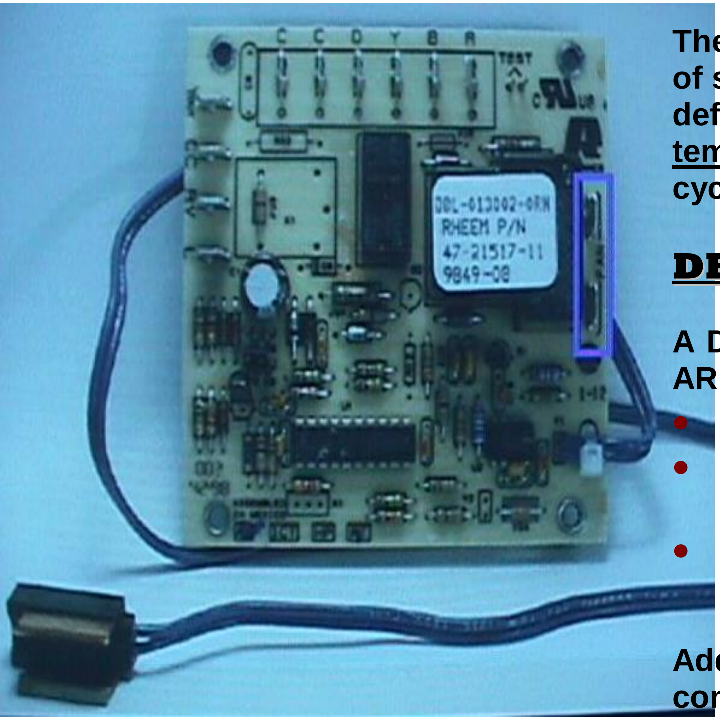
BK	BLACK	O	ORANGE
BR	BROWN	PR	PURPLE
BL	BLUE	R	RED
G	GREEN	W	WHITE
GY	GRAY	Y	YELLOW

ELECTRICAL WIRING DIAGRAM

DR. BY	APP. BY	DATE	DWG. NO.	REV
BJW	JBG	9-1-98	90-26152-06	00

Defrosting

DEMAND DEFROST CONTROL



See page 46 for testing Demand Defrost Models

DEMAND DEFROST CONTROL

The demand defrost control is a printed circuit board assembly consisting of solid state control devices with Electro-mechanical outputs. The demand defrost control monitors the <u>outdoor ambient temperature</u>, <u>outdoor coil temperature</u>, and the <u>compressor run-time</u> to determine when a defrost cycle is required.

DEFROST INITIATION

A DEFROST WILL BE INITIATED WHEN THE THREE CONDITIONS BELOW ARE SATISFIED:

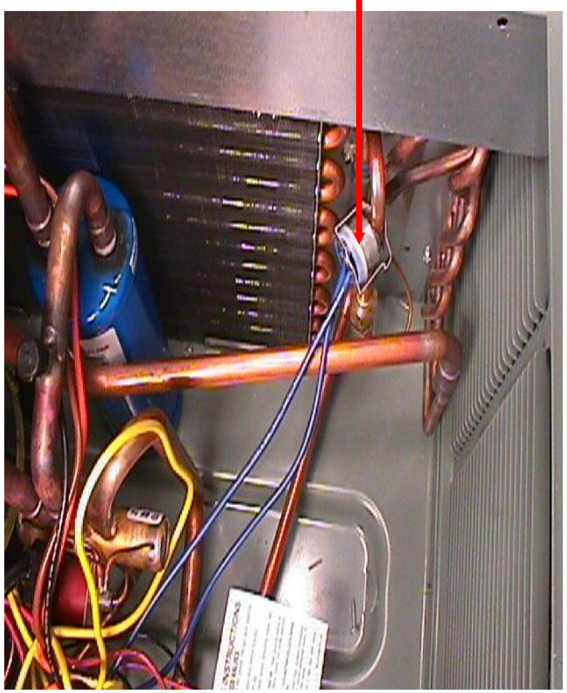
- **The outdoor coil temperature is below 35°F.**
- **The compressor has operated for at least 34 minutes with the outdoor coil temperature below 35°F.**
- **The measured difference between the ambient temperature and the outdoor coil temperature is greater than the calculated delta T.**

Additionally, a defrost will be initiated if six hours of accumulated compressor run-time has elapsed without a defrost with the outdoor coil temperature below 35°F.

DEFROST TERMINATION

Once a defrost is initiated, the defrost will continue until fourteen minutes has elapsed or the coil temperature has reached the terminate temperature. The terminate temperature is factory set at 70°F although the temperature can be changed to 50°F., 60°F., 70°F or 80°F, by relocating a jumper on the board.

TEMPERATURE SENSORS



TEMPERATURE SENSORS

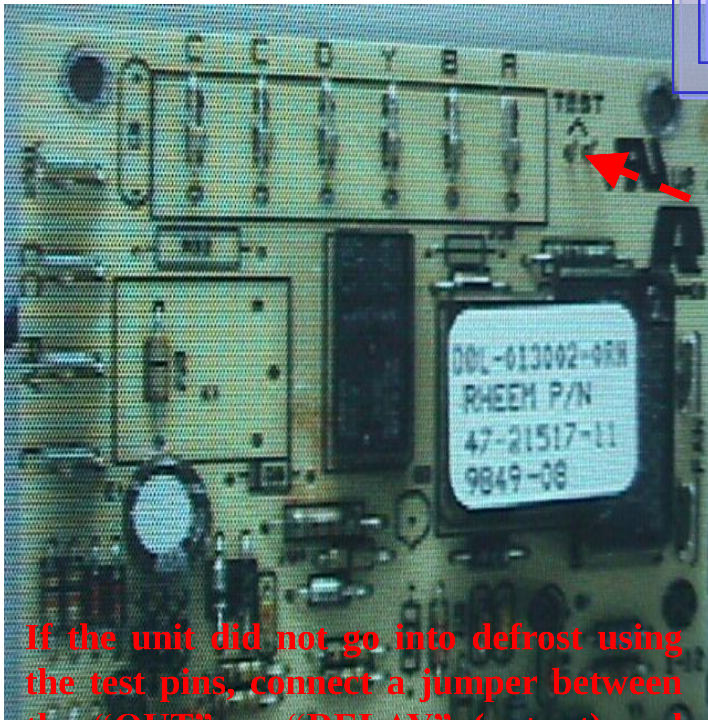
The coil sensor is clipped to the top tube on the outdoor coil at the point feed by the distribution tubes from the expansion devise (short 3/8" dia. tube).

The air sensor is located on the defrost control board.

If the air sensor fails the defrost control will initiate a defrost every 34 minutes with the coil temperature below 35°F.

If the coil sensor fails to close the defrost control will not initiate a defrost.

Defrost Test Mode



If the unit did not go into defrost using the test pins, connect a jumper between the <u>"OUT"</u> or "RELAY" (output) and <u>"COM"</u> (common) terminals on the control board. This bypasses the defrost sensor and the control board. The unit should immediately go into defrost. If it does not, the problem is <u>not</u> in the <u>defrost control</u> or <u>sensor switch.</u> If it goes into defrost, remove the jumper.

SEE PG. 40

On <u>Demand Defrost</u> models <u>only</u>, if the unit had gone into defrost with above step and will not go in using the test pins, replace the defrost control board and sensors. Sensor leads may not be cut and spliced.

Demand Defrost Models Only

<u>TEST MODE &Trouble Shooting Demand Defrost Models</u>

•Set the indoor thermostat select switch to heat and the thermostat lever to a call for heat.

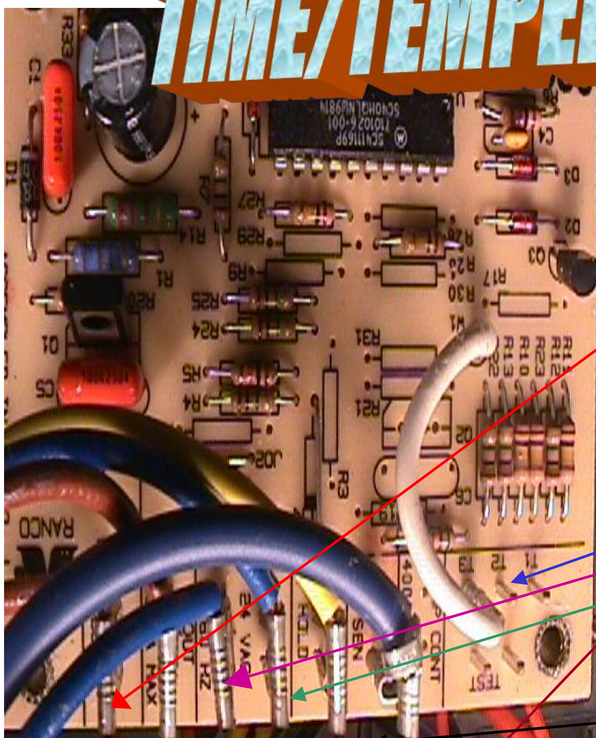
•The test mode is initiated by shorting the <u>TEST pins.</u> In this mode of operation, the <u>enable temperature is ignored</u> and all timers will speed up by a factor of 240. To initiate a manual defrost, short the TEST pins.

•Remove the short when the system switches to defrost mode. The defrost will terminate on time (14 minutes) or when the termination temperature has been achieved. *Short TEST pins again to terminate the defrost immediately.*

•If the unit goes into defrost and comes back out of defrost, the indication is that the control is working properly.

•If the unit did not go into defrost using the test pins, check to ensure that 24V is being supplied to the control board. If 24V is present then replace the control board.

TIME/TEMPERATURE DEFROST CONTROL



SEE DIAGRAM PG. 40

OPERATION: **In operation, power is provided to the circuit board when the thermostat selector switch is in the heat position through terminals marked "24 VAC and "COM". Timing periods of 50, 70, or 90 minutes between defrost may be selected by connecting the circuit board jumper wire to T1, T2, or T3, respectively.**

Accumulation of time for the timing period selected, starts and stops with the wall thermostat call for heating through "hold" or "H" terminal on the circuit board.

If the Defrost Sensor is not closed after the timing period, the control board is reset to zero and another timing period is started.

Defrost Initiation: the defrost sensor is closed, the defrost sensor will provide power from the common side of the transformer to the terminal on the circuit board marked "SEN" providing power to the defrost relay (DR) through the "OUT" terminal permitting defrost. The sensor closes at 28 °F +or- 3°F. See page 40 for diagram

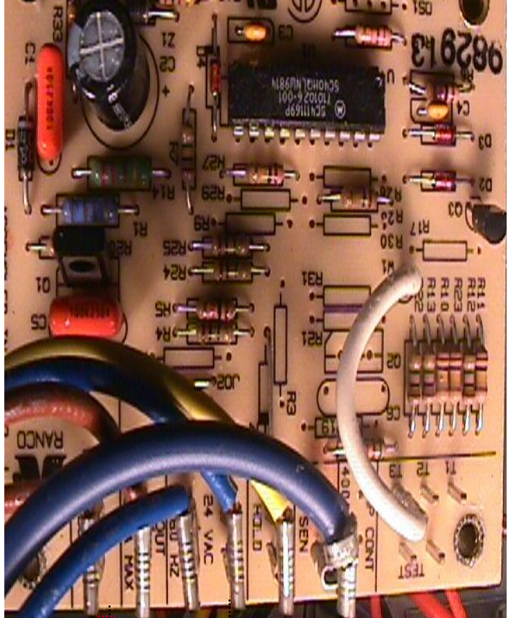
The defrost temperature sensor is clamped to the top tube on the outdoor coil at the point fed by the distribution tube from the expansion device (short 3/8" dia. Tube).

The defrost cycle is terminated and the timing is reset when the sensor opens at 50°F. + or - 5°F. If the defrost cycle is not terminated due to sensor temperature, a 10 minute override terminates the defrost period and resets the timing period.

To initiate a defrost cycle, the test pins should be shorted together until a defrost cycle is initiated. The sensor must also be closed or jumped to initiate a defrost. All timing functions are sped up by a factor of 256 from 50, 70, or 90 minutes to 11.7, 16.4, or 21.1 seconds. After defrost initiation, the short must be instantly removed or the defrost period will last only 2.3 seconds.

Defrost Test Mode

Time-temperature Models Only



By pass jumpers

•If the unit did not go into defrost using the test pins, connect a jumper between the <u>"OUT"</u> or "RELAY" (output) and <u>"COM"</u> (common) terminals on the control board. This bypasses the defrost sensor and the control board. The unit should immediately go into defrost. If it does not, the problem is <u>not</u> in the <u>defrost control</u> or <u>sensor switch.</u> If it goes into defrost, remove the jumper.

•On <u>Time Temperature Defrost models only,</u> if the unit had gone into defrost with above step and will not go in using the test pins, connect a jumper between <u>"COM" and "SEN"</u> terminals on the control board. This bypasses the defrost sensor only. Short the "TEST" terminals to put the unit into defrost. If the unit goes into defrost, the sensor switch was open and the defrost board is good: if not replace the defrost board.

•If the problem was determined not to be the defrost control or sensor switch, check for 24 volts between terminals "COM" AND "24V", THEN BETWEEN "COM"and "H" (hold). If you don't read 24 volts at both places check the transformer, thermostat and wiring. If you read 24 volts at both points check the defrost relay and relay wiring.

<u>TEST MODE &Trouble Shooting Time-Temperature Defrost Models</u>

•Set the indoor thermostat select switch to heat and the thermostat lever to a call for heat.

•Jump the <u>TEST pins</u> to put the unit into defrost. If the unit goes into defrost and comes back out of defrost the indication is that the control is working properly.

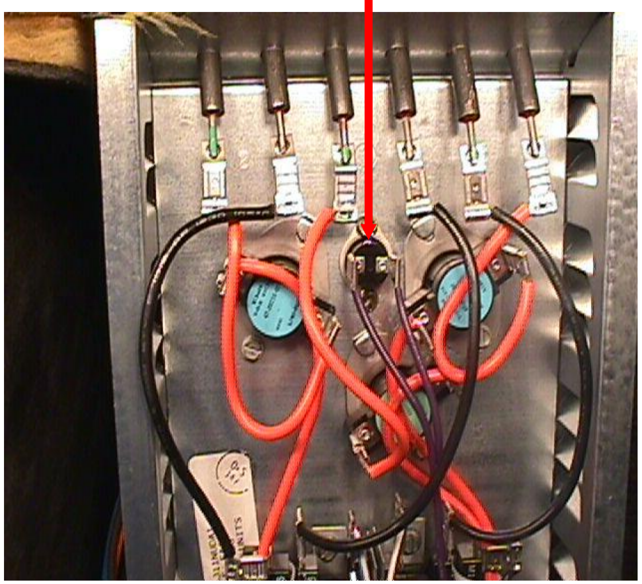
•If the unit did not go into defrost using the test pins, check to ensure that 24V is being supplied to the control board. If 24V is present then replace the control board.

•Remove the short when the system switches to defrost mode. *Short TEST pins again to terminate the defrost immediately.*

•If the unit goes into defrost and comes back out of defrost, the indication is that the control is working properly.

Defrost Heat Control

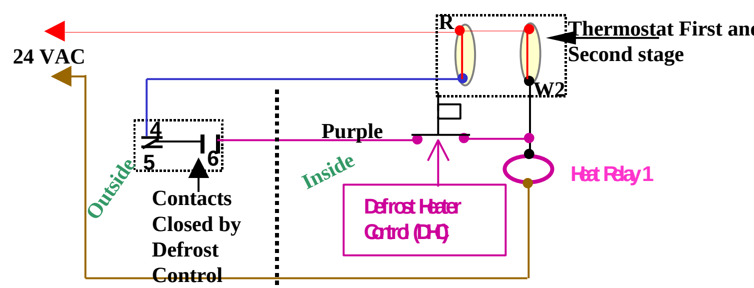
DHC



- Supplemental heat during defrost can be provided by connecting the purple (PU) pigtail in the outdoor unit to the purple pigtail in the indoor unit. This will complete the circuit between R and W through a set of contacts in the defrost relay (DR) when the outdoor heat pump is in defrost. This circuit, if connected, will help prevent cold air from being discharged from the indoor unit during defrost.

- Defrost heat control (DHC) is used in series on the circuit described above on units where the supplemental heat is more than would be required to offset the defrost cooling capacity. Defrost heat control (DHC) is provided on the same models described above having Watt Restrictors.

- When the outdoor unit goes into defrost, the circuit between R and W is completed through a set of contacts on the defrost relay (DR) in series with the contacts on the defrost heat control (DHC). Purple pigtails on the indoor unit and outdoor units must be connected to make circuit. During defrost, the defrost heat control senses the air temperature leaving the indoor unit and cycles the supplemental electric heat to maintain comfort (75F to 85F) air temperature and prevent objectionable cold air during defrost. This limits the electric heat output to the minimum required,, to conserve energy and prevent the thermostat from being satisfied with electric heat and preventing completion of the defrost cycle.



- For most economical operation, if cold air is not of concern during defrost, the purple wire can be left disconnected. Supplemental heat will then come on only when called for by second stage room thermostat

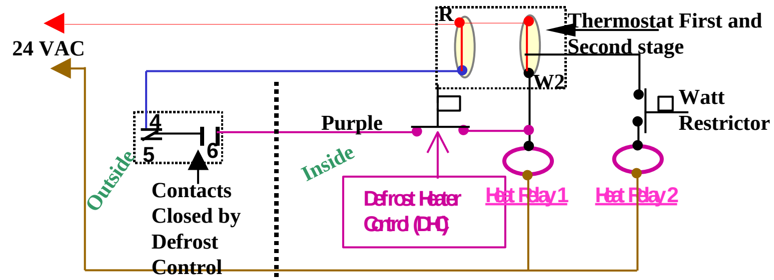
Components

WIRING

Diagrams

WATTAGE RESTRICTOR

WATT RESTRICTOR (Heating – Heat Pump) Heat pump air handlers with supplemental electric heat above a specified K.W. dependent on unit size and total heater K.W. are equipped with a patented Watt Restrictor. The Watt Restrictor may directly control a heater element in the heater circuit or may be in the control circuit controlling heater sequencer indirectly controlling two or three heater elements.

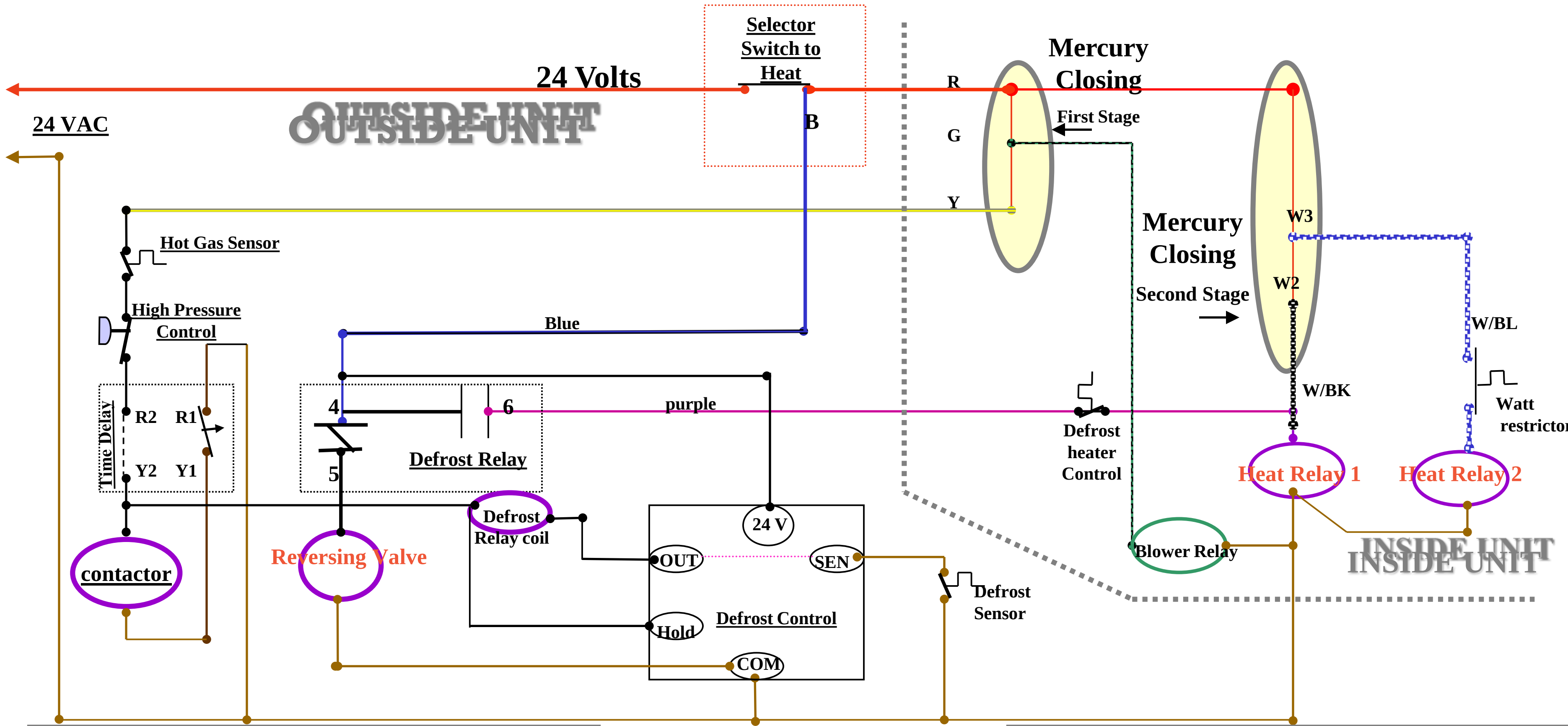


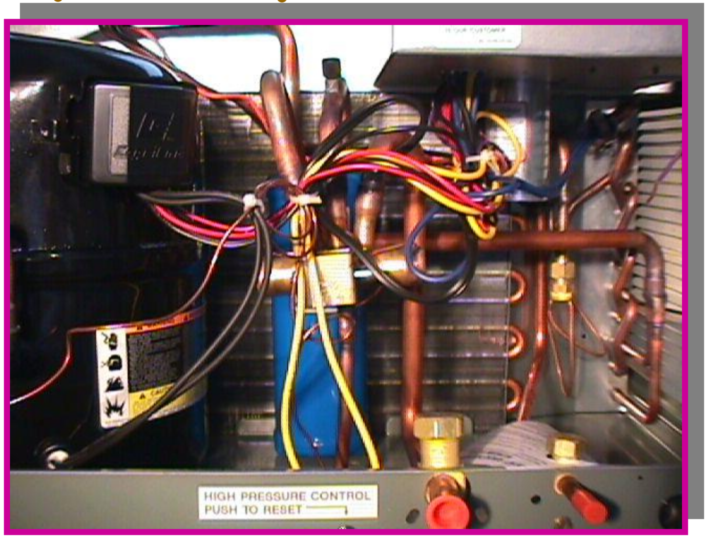
- The Watt Restrictor (WR) will restrict the amount of supplemental electric heat that can be energized dependent on the heat output of the heat pump (temperature of the air leaving the indoor heat pump coil).

Since the heat output of the heat pump is dependent upon the outdoor air temperature, this control performs the same function as a field installed outdoor thermostat.

An additional benefit of the Watt Restrictor is that it can sense a degradation in heat pump performance due to causes other that outdoor temperature and react accordingly to bring on more supplemental electric heat.

The Watt Restrictor will close between 70 ° F and 75°F and open between 90°F. and 95°F.



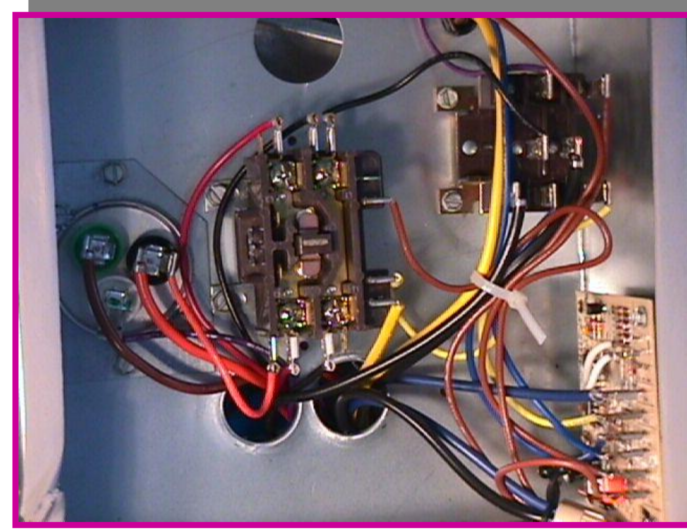


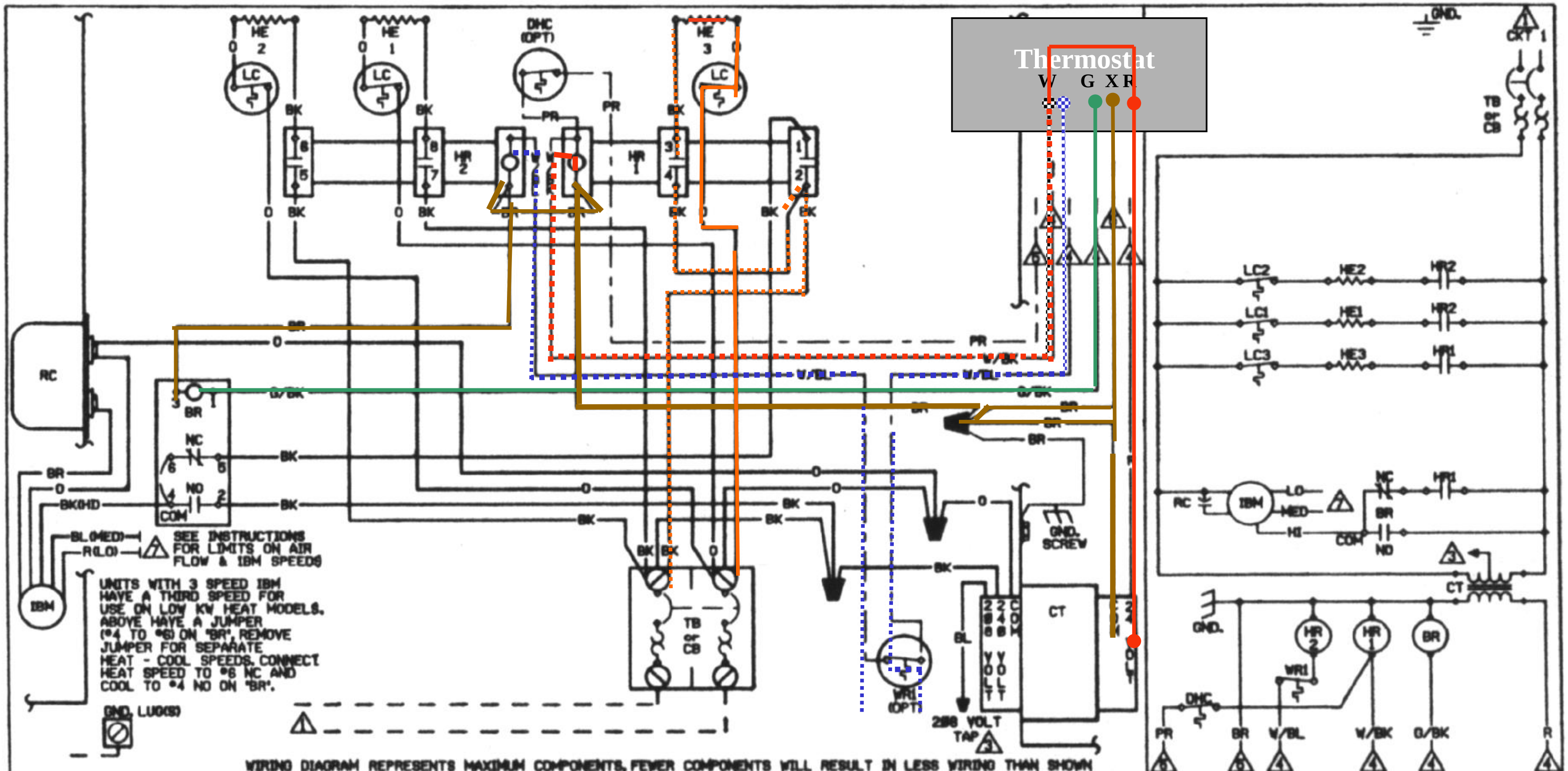
TENNESSEE VALLEY TECHNICAL PROGRAMS

HEAT PUMPS

by Dennis W. Mayes

JANUARY 2000





COMPONENT CODE

BR	BLOWER RELAY
CB	CIRCUIT BREAKER
CT	CONTROL TRANSFORMER
DHC	DEFROST HEATER CONTROL
GND	GROUND
HE	HEATER ELEMENT
HR	HEATER RELAY
IBM	INDOOR BLOWER MOTOR
LC	LIMIT CONTROL
RC	RUN CAPACITOR
TB	TERMINAL BLOCK (HI VOLT)
WR	WATT RESTRICTOR
▲	WIRE NUT

DWG. NO. 90-26152-06 REV 00

NOTES:

1. CONNECT SUPPLY WIRING FOR VOLTAGE, PHASE AND HERTZ SHOWN ON RATING PLATE.
2. SUPPLY WIRE MUST BE RATED AT 75° C MIN. SEE INSTRUCTIONS FOR SIZE.
3. CT FACTORY WIRED FOR 240 VOLTS. USE O & BL FOR 208 VOLTS.
4. CONTROL WIRING TO THERMOSTAT SUB-BASE.
5. CONTROL WIRING TO OUTDOOR UNIT.
6. FOR USE WITH COPPER CONDUCTORS ONLY.
7. UNIT FACTORY WIRED FOR HIGH SPEED - UNUSED SPEED TERMINALS PLUGGED.
8. "N" CONTROL USES TERMINAL BLOCK INSTEAD OF CIRCUIT BREAKERS.

WIRING INFORMATION

LINE VOLTAGE
- FACTORY STANDARD
- FACTORY OPTION
- FIELD INSTALLED

LOW VOLTAGE
- FACTORY STANDARD
- FACTORY OPTION
- FIELD INSTALLED

REPLACEMENT WIRE
- MUST BE THE SAME SIZE AND TYPE OF INSULATION AS ORIGINAL (105° C MIN.)

WARNING
- CABINET MUST BE PERMANENTLY GROUNDED AND CONFORM TO N.E.C., (C.E.C.-CANADA) AND LOCAL CODES.

WIRE COLOR CODE

BK	BLACK	O	ORANGE
BR	BROWN	PR	PURPLE
BL	BLUE	R	RED
G	GREEN	W	WHITE
GY	GRAY	Y	YELLOW

ELECTRICAL WIRING DIAGRAM

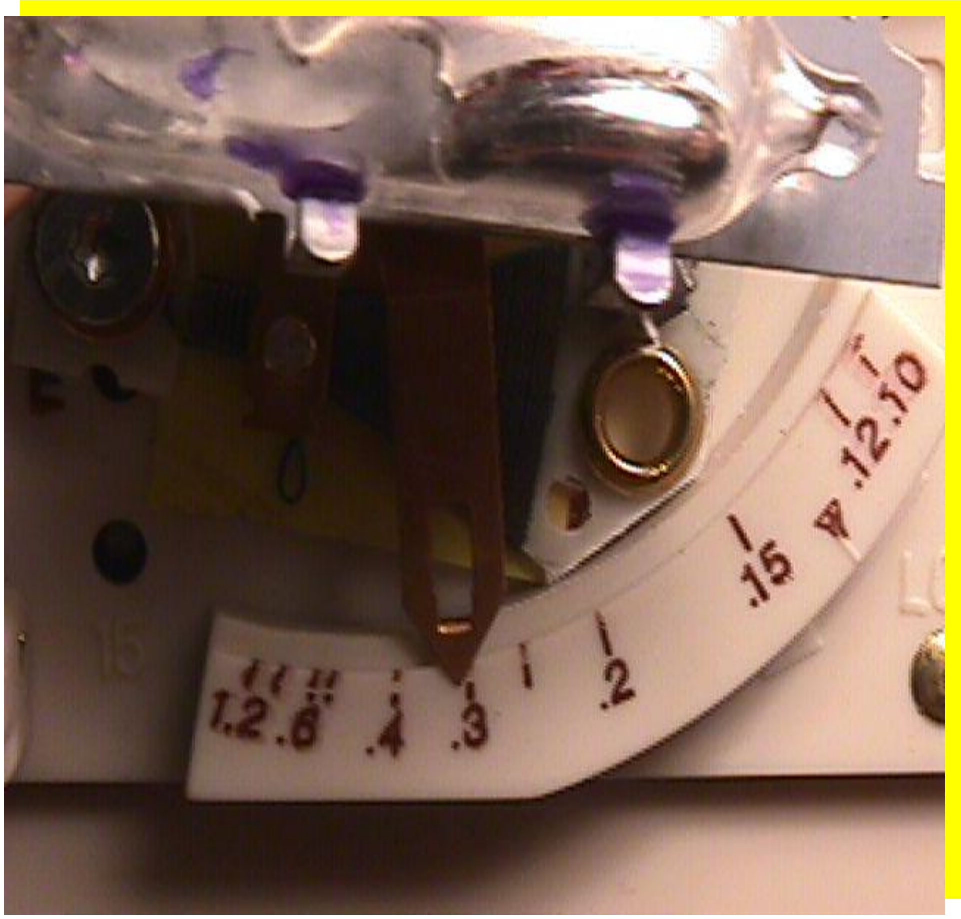
DR. BY	APP. BY	DATE	DWG. NO.	REV
BJW	JBG	9-1-98	90-26152-06	00

Anticipator Setting

<u>ROOM THERMOSTAT</u>
<u>(ANTICIPATOR SETTING)</u>

•On units with one electric heat sequencer (see wiring diagram on unit), the heat anticipator setting should be .16.

•On units with two electric heat sequencers, the heat anticipator setting should be .32 if both sequencers are connected to the same stage on the thermostat. The setting should be .16 if they are connected to separate stages.



Emergency Heat

EMERGENCY HEAT

•If the selector switch on the thermostat is set to the emergency heat position, the <u>heat pump will be locked out of the heating circuit,</u> and all heating will be electric heat. A jumper should be placed between W2 and E on the thermostat sub-base so that the electric heat control will transfer to the first stage heat on the thermostat, if the thermostat will not perform this operation on its on. This will allow the indoor blower to cycle on and off with the electric heat when the fan switch is in the auto position.

Calculating Temperature Rise

•The formula for calculating air temperature rise for electric resistance heat is:

$$\text{Temperature Rise } ^\circ F = \frac{3.16 \times \text{Watts}}{\text{CFM}}$$

Where:

3.16 = Constant, CFM = Airflow

Calculating Air Flow CFM

•The formula for calculating airflow using temperature rise and heating BTUH for units with electric resistance heat is:

$$\text{CFM} = \frac{\text{Heating BTUH}}{1.08 \times \text{Temp. Rise}}$$

F O R M U L A S

Calculating BTUH Heating Capacity

•The formula for calculating BTUH heating capacity for electric resistance heat is:

BTUH Heating = Watts x 3.412

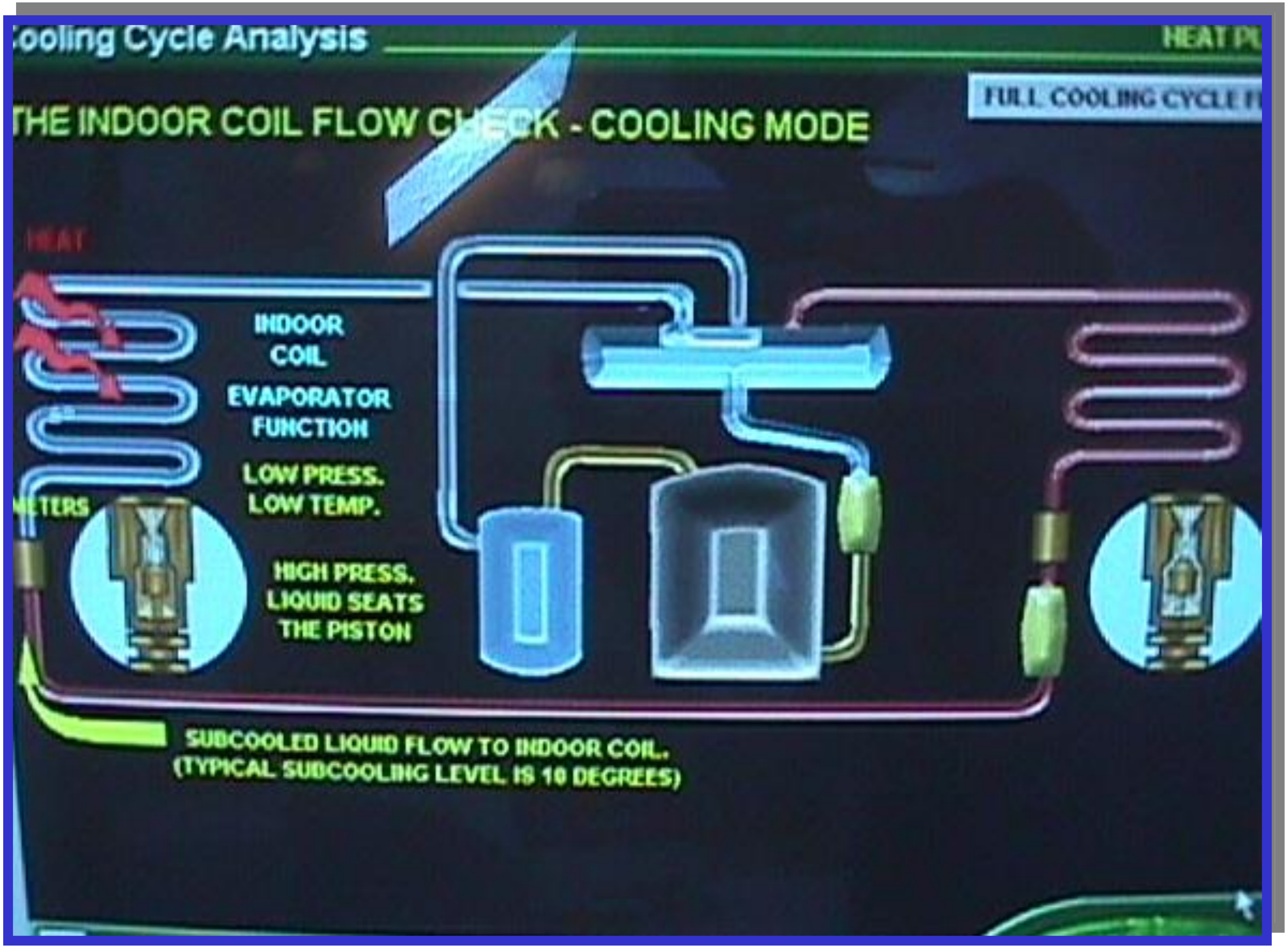
Where:

1 KW = 1000 Watts, 3.412 = Btuh/Watt

Calculating Correction Factor

•For correction of electric heat output (KW or BTUH) or temperature rise at voltages other than rated voltage multiply by the following correction factor:

$$\text{Correction Factor} = \frac{\text{Applied Voltage}^2}{\text{Rated Voltage}^2}$$



ooling Cycle Analysis
HEAT PU
FULL COOLING CYCLE F
THE INDOOR COIL FLOW CHECK - COOLING MODE
INDOOR
COIL
EVAPORATOR
FUNCTION
LOW PRESS.
LOW TEMP.
HIGH PRESS.
LIQUID SEATS
THE PISTON
SUBCOOLED LIQUID FLOW TO INDOOR COIL.
(TYPICAL SUBCOOLING LEVEL IS 10 DEGREES)

VAPOR PRESSURE OF REFRIGERANTS

TEMP.		CYLINDER COLOR CODE								
		Purple	Gray	Orange	Blue	Lt. Blue	White	Yellow	Green	Orchid
Deg. F	Deg. C	113	123	11	114	134a	12	500	22	502
-50	-45.6			***28.9***	***27.2***	***18.7***	***15.4***			0.0
-45	-42.8			***28.7***	***26.7***	***16.9***	***13.3***			2.0
-40	-40.0			***28.4***	***26.1***	***14.8***	***11.0***	***7.9***	0.5	4.3
-35	-37.2			***28.1***	***25.5***	***12.5***	***8.4***	***4.8***	2.5	6.7
-30	-34.4	***29.3***		***27.8***	***24.7***	***9.8***	***5.5***	***1.4***	4.8	9.4
-25	-31.7	***29.2***		***27.4***	***23.9***	***6.9***	***2.3***	1.1	7.3	12.3
-20	-28.9	***29.1***	***27.8***	***27.0***	***22.9***	***3.7***	0.6	3.1	10.1	15.5
-15	-26.1	***28.9***	***27.4***	***26.5***	***21.8***	0.0	2.4	5.4	13.1	19.0
-10	-23.3	***28.7***	***26.9***	***26.0***	***20.6***	1.9	4.5	7.8	16.4	22.8
-5	-20.6	***28.5***	***26.4***	***25.4***	***19.3***	4.1	6.7	10.4	20.0	26.9
0	-17.8	***28.2***	***25.9***	***24.7***	***17.8***	6.5	9.2	13.3	23.9	31.2
5	-15.0	***27.9***	***25.2***	***24.0***	***16.1***	9.1	11.8	16.4	28.1	36.0
10	-12.2	***27.6***	***24.5***	***23.1***	***14.3***	12.0	14.6	19.8	32.7	41.1
15	-9.4	***27.2***	***23.8***	***22.1***	***12.3***	15.0	17.7	23.4	37.7	46.6
20	-6.7	***26.8***	***22.8***	***21.1***	***10.1***	18.4	21.0	27.3	43.0	52.4
25	-3.9	***26.3***	***21.8***	***19.9***	***7.6***	22.1	24.6	31.6	48.7	58.7
30	-1.1	***25.8***	***20.7***	***18.6***	***5.0***	26.1	28.5	36.1	54.8	65.4
35	1.7	***25.2***	***19.5***	***17.2***	***2.1***	30.4	32.6	41.0	61.4	72.6
40	4.4	***24.5***	***18.1***	***15.6***	0.5	35.0	37.0	46.2	68.5	80.2
45	7.2	***23.8***	***16.6***	***13.9***	2.2	40.0	41.7	51.8	76.0	87.7
50	10.0	***22.9***	***14.8***	***12.0***	4.0	45.3	46.7	57.8	84.0	96.9
55	12.8	***22.1***	***13.0***	***10.0***	6.0	51.0	52.0	64.1	92.5	109.7
60	15.6	***21.0***	***11.2***	***7.7***	8.1	56.9	57.7	71.0	101.6	115.6
65	18.3	***19.9***	***8.9***	***5.3***	10.4	63.7	63.8	78.1	111.2	125.8
70	21.1	***18.7***	***6.5***	***2.6***	12.9	70.7	70.2	85.8	121.4	136.6
75	23.9	***17.3***	***4.1***	0.1	15.5	78.5	77.0	93.9	132.2	147.9
80	26.7	***15.9***	***1.2***	1.6	18.3	86.4	84.2	102.5	143.6	159.9
85	29.4	***14.3***	0.9	3.2	21.4	95.3	91.8	111.5	155.6	172.5
90	32.2	***12.5***	2.5	5.0	24.6	104.2	99.8	121.2	168.4	185.8
95	35.0	***10.6***	4.3	6.8	28.0	114.1	108.3	131.3	181.8	199.7
100	37.8	***8.6***	6.1	8.9	31.7	124.3	117.2	141.9	195.9	214.4
105	40.6	***6.4***	8.1	11.1	35.6	135.4	126.6	153.1	210.7	229.7
110	43.3	***4.0***	10.3	13.4	39.7	146.8	136.4	164.9	226.3	245.8
115	46.1	***1.4***	12.6	15.9	44.1	159.2	146.8	177.4	242.7	266.1
120	48.9	0.7	15.1	18.5	48.7	171.9	157.7	190.3	259.9	280.3
125	51.7	2.2	17.8	21.3	53.7	185.7	169.1	204.0	277.9	298.7
130	54.4	3.7	20.6	24.3	58.8	199.8	181.0	218.2	296.8	318.0
135	57.2	5.4	23.6	27.4	64.3	215.0	193.5	233.2	316.5	338.1
140	60.0	7.2	26.8	30.8	70.1	230.5	206.6	248.8	337.2	359.2
145	62.8	9.2	30.2	34.4	76.3	247.3	220.3		358.8	381.1
150	65.6	11.2	33.9	38.2	82.6	264.4	234.6		381.5	404.0

PSIG for pressures in regular numerals.

Inches Hg below 1 atm in bold italicized numerals.

bryant

COOLING

REQUIRED SUBCOOLING

MODEL SIZE	°F	MODEL SIZE	°F
		036	10
018	10	042	11
024	11	048	12
030	9	060	12

COOLING ONLY PROCEDURE

1. Operate unit a minimum of 10 minutes before checking the charge.
2. Measure liquid service valve pressure by attaching an accurate gauge to the service port.
3. Measure the liquid line temperature by attaching an accurate thermistor type or electronic thermometer to the liquid line near the outdoor coil.
4. Refer to cooling table to find required subcooling temperature.
5. Find the point where the required subcooling temperature intersects the measured liquid service valve pressure.
6. To obtain the required subcooling temperature at a specific liquid line pressure, add refrigerant if liquid line temperature is higher than indicated or remove refrigerant if temperature is lower. Allow a tolerance of ±3°F.

REQUIRED LIQUID LINE TEMPERATURE

Liquid Pressure at Service Valve (PSIG)	Required Subcooling Temperature (°F)			
	5	10	15	20
134	71	66	61	56
141	74	69	64	59
148	77	72	67	62
156	80	75	70	65
163	83	78	73	68
171	86	81	76	71
179	89	84	79	74
187	92	87	82	77
196	95	90	85	80
205	98	93	88	83
214	101	96	91	86
223	104	99	94	89
233	107	102	97	92
243	110	105	100	95
253	113	108	103	98
264	116	111	106	101
274	119	114	109	104
285	122	117	112	107
297	125	120	115	110
309	128	123	118	113
321	131	126	121	116
331	134	129	124	119
346	137	132	127	122
359	140	135	130	125

⚠ WARNING

Service valve gauge port may not be equipped with Schrader valve (valve core). To prevent personal injury, make sure valve stem is back-seated (counterclockwise) before removing cap. Wear safety glasses and gloves when handling refrigerant.

⚠ CAUTION

Compressor damage may occur if system is overcharged.

ACCESSORY TXV KIT NUMBER

018	KHATX0901HSO
024	KHATX1001HSO
030	KHATX1101HSO
036	KHATX1201HSO
042	KHATX1201HSO
048	KHATX1301HSO
060	KHATX1401HSO

322850-101 REV. B

heat pump

bryant

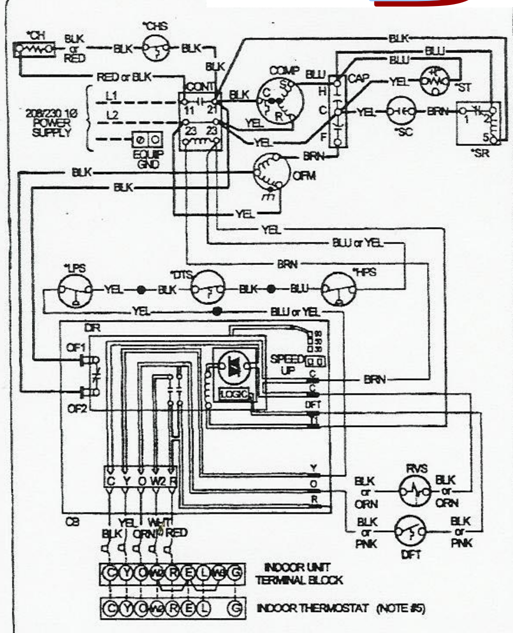
TABLE I-SUPERHEAT CHARGING TABLE (SUPERHEAT °F AT LOW-SIDE SERVICE PORT)														
OUTDOOR TEMP °F	EVAPORATOR ENTERING AIR °F WB													
	50	52	54	56	58	60	62	64	66	68	70	72	74	76
55	9	12	14	17	20	23	26	29	32	35	37	40	42	45
60	7	10	12	15	18	21	24	27	30	33	35	38	40	43
65	–	8	10	13	16	19	21	24	27	30	33	36	38	41
70	–	–	7	10	13	16	19	21	24	27	30	33	36	39
75	–	–	–	6	9	12	15	18	21	24	28	31	34	37
80	–	–	–	–	5	8	12	15	18	21	25	28	31	35
85	–	–	–	–	–	–	8	11	15	19	22	26	30	33
90	–	–	–	–	–	–	5	9	13	16	20	24	27	31
95	–	–	–	–	–	–	–	6	10	14	18	22	25	29
100	–	–	–	–	–	–	–	–	8	12	15	20	23	27
105	–	–	–	–	–	–	–	–	5	9	13	17	22	28
110	–	–	–	–	–	–	–	–	–	6	11	15	20	25
115	–	–	–	–	–	–	–	–	–	–	8	14	18	23

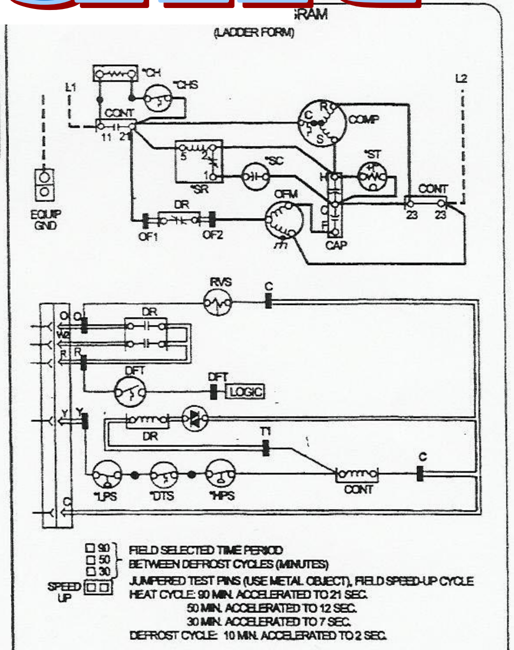
COOLING ONLY PROCEDURE

1. Operate unit a minimum of 10 minutes before checking charges.
2. Measure suction pressure by attaching a gage to suction valve service port.
3. Measure suction temperature by attaching an accurate thermistor type or electronic thermometer to the suction line at service valve.
4. Measure outdoor air dry-bulb temperature with a thermometer.
5. Measure indoor air (entering indoor coil) wet bulb temperature with a sling psychrometer.

heat pump

bryant





-LEGEND-

———	FACTORY POWER WIRING
- - -	FIELD POWER WIRING
———	FACTORY CONTROL WIRING
———	FIELD CONTROL WIRING
═══	CONDUCTOR ON CIRCUIT BOARD
○	COMPONENT CONNECTION
▬	1/4-INCH QUICK CONNECT TERMINALS
	FIELD SPLICE
—●—	JUNCTION
CAP	CAPACITOR (DUAL RUN)
*CH	CRANKCASE HEATER
*CHS	CRANKCASE HEATER SWITCH
COMP	COMPRESSOR
CONT	CONTACTOR
CB	CIRCUIT BOARD
DFT	DEFROST THERMOSTAT
DR	DEFROST RELAY AND CIRCUITRY
*DTS	DISCHARGE TEMP. SWITCH
*HPS	HIGH PRESSURE SWITCH
*LPS	LOW PRESSURE SWITCH
OFM	OUTDOOR FAN MOTOR
RVS	REVERSING VALVE SOLENOID
*SC	START CAPACITOR
*SR	START RELAY
*ST	START THERMISTOR

* FACTORY OR FIELD INSTALLED

NOTES:

1. COMPRESSOR AND FAN MOTOR FURNISHED WITH INHERENT THERMAL PROTECTION.
2. TO BE WIRED IN ACCORDANCE WITH NATIONAL ELECTRIC CODE (N.E.C.) AND LOCAL CODES.
3. N.E.C. CLASS 2, 24 V CIRCUIT, MIN. 40 VA REQUIRED.
4. USE COPPER CONDUCTORS ONLY FROM DISCONNECT TO UNIT.
5. MUST USE THERMOSTAT AND SUB-BASE AS STATED IN PRE-SALE LITERATURE.
6. IF INDOOR SECTION HAS A TRANSFORMER WITH A GROUNDED SECONDARY, CONNECT THE GROUNDED SIDE TO "C" ON THE CIRCUIT BOARD.
7. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED, MUST BE REPLACED, USE THE SAME OR EQUIVALENT WIRE.
8. CHECK ALL ELECTRICAL CONNECTIONS INSIDE CONTROL BOX FOR TIGHTNESS.
9. DO NOT ATTEMPT TO OPERATE UNIT UNTIL SERVICE VALVES HAVE BEEN OPENED.
10. WHEN DTS, LPS AND HPS ARE NOT REQUIRED, A JUMPER WILL BE INSTALLED BETWEEN Y AND T1 ON THE DEFROST BOARD.
11. USE CONDUCTORS SUITABLE FOR AT LEAST 75°C (167°F).

325637-101 REV. C

heat pump

bryant

heat pump

Heat Check Chart

HEATING CHECK CHART

FIELD OPERATING PRESSURE CHARGING TABLE FIXED RESTRICTOR (HIGH PRESSURE @ VAPOR VALVE, SUCTION PRESSURE @ SUCTION SERVICE PORT)

UNIT	INDOOR DRY BULB		OUTDOOR TEMP. °F DRY BULB/WET BULB 60/57	50/47	40/38	30/28	20/18	10/9	0/-1
018	60°	HIGH	195	185	175	164	154	144	133
		SUCT	66	58	50	42	34	27	19
	70°	HIGH	225	213	201	189	177	165	153
		SUCT	69	60	52	44	35	27	18
	80°	HIGH	256	243	229	216	203	189	176
		SUCT	71	62	53	45	36	27	18
024	60°	HIGH	209	195	181	166	152	138	124
		SUCT	71	62	53	44	35	26	17
	70°	HIGH	235	220	205	190	175	160	145
		SUCT	73	64	55	45	36	27	17
	80°	HIGH	265	249	233	217	201	186	170
		SUCT	75	65	56	46	37	27	18
030	60°	HIGH	223	207	191	175	159	143	127
		SUCT	68	59	51	43	34	26	18
	70°	HIGH	251	234	217	200	183	165	148
		SUCT	70	61	52	44	35	26	17
	80°	HIGH	281	263	245	226	208	190	171
		SUCT	72	63	53	44	35	26	17
036	60°	HIGH	243	222	202	182	162	141	121
		SUCT	71	62	53	44	35	26	16
	70°	HIGH	264	244	224	204	184	163	143
		SUCT	72	63	54	45	35	26	17
	80°	HIGH	289	269	249	228	208	188	168
		SUCT	73	64	54	45	36	26	17
042	60°	HIGH	236	217	199	180	162	143	125
		SUCT	68	60	51	42	34	25	16
	70°	HIGH	265	245	225	205	185	166	146
		SUCT	70	61	52	43	34	25	16
	80°	HIGH	294	273	253	232	211	191	170
		SUCT	71	62	53	44	35	26	16
048	60°	HIGH	257	237	216	196	175	155	134
		SUCT	67	59	50	44	33	24	16
	70°	HIGH	283	262	241	219	198	177	156
		SUCT	68	59	50	42	33	24	15
	80°	HIGH	293	275	257	239	221	203	185
		SUCT	68	59	51	42	33	24	15
060	60°	HIGH	242	225	207	189	174	153	135
		SUCT	61	53	45	38	30	22	14
	70°	HIGH	281	260	240	219	198	178	157
		SUCT	67	58	49	41	32	23	15
	80°	HIGH	312	290	268	247	225	203	181
		SUCT	67	59	50	41	33	24	15

⚠ CAUTION

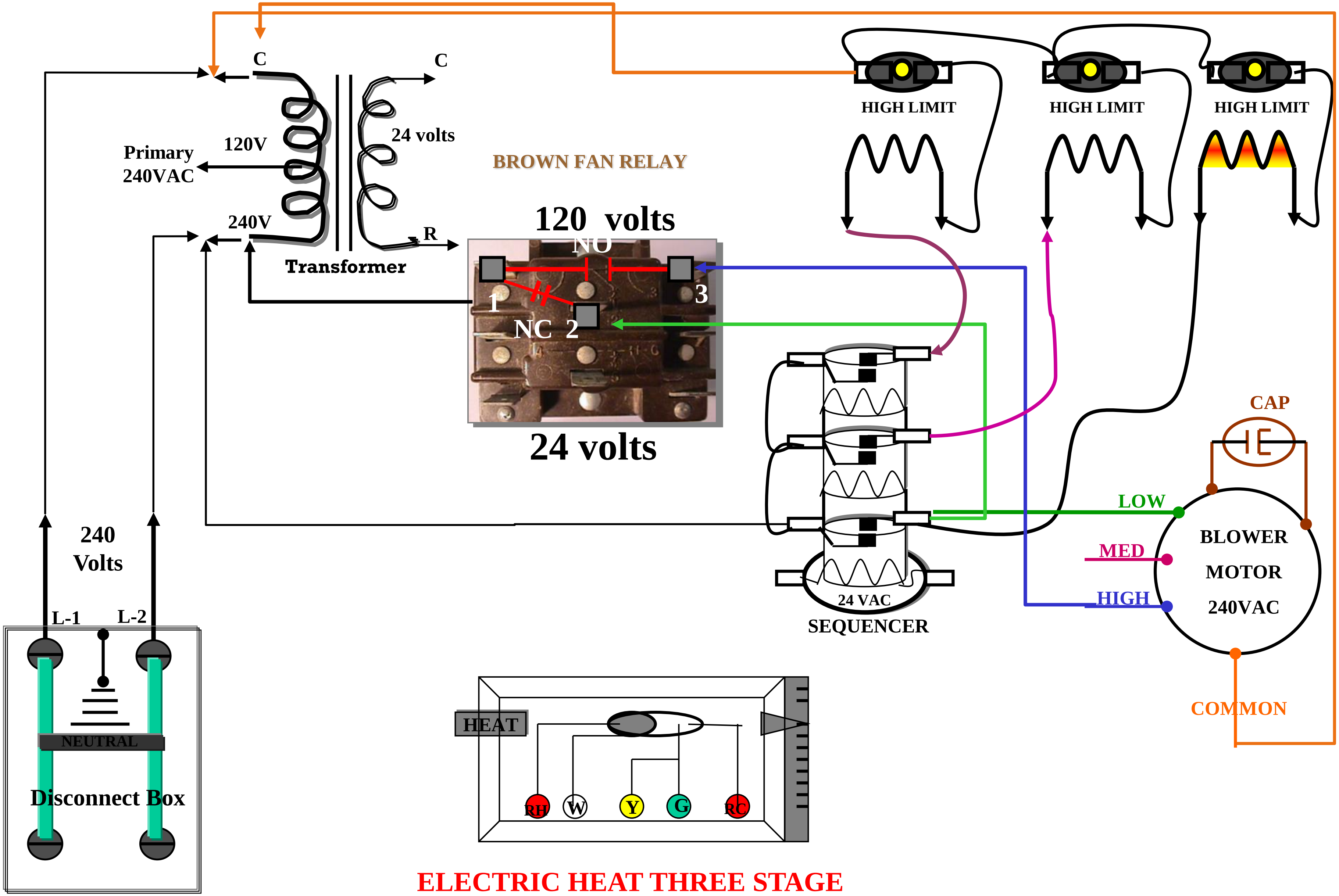
Compressor damage may occur if system is over-charged.

OPERATION

To check system operation during heating cycle, use this table. Table indicates whether a correct relationship exists between system operating pressure and air temperature entering indoor and outdoor units. If pressure and temperature do not match on chart, system refrigerant charge may not be correct or other system abnormalities may exist. Do not use table to adjust refrigerant charge.

When charging is necessary during heating season, weigh in total charge as indicated on unit rating plate. Rating plate charge is for systems with 15 ft. line-set. Adjust charge at rate of 0.6 oz/ft of 3/8" liquid line above or below 15 ft. Remove any refrigerant remaining in system before recharging. If the system has lost complete charge, evacuate and recharge by weight.

320347-101 REV. C

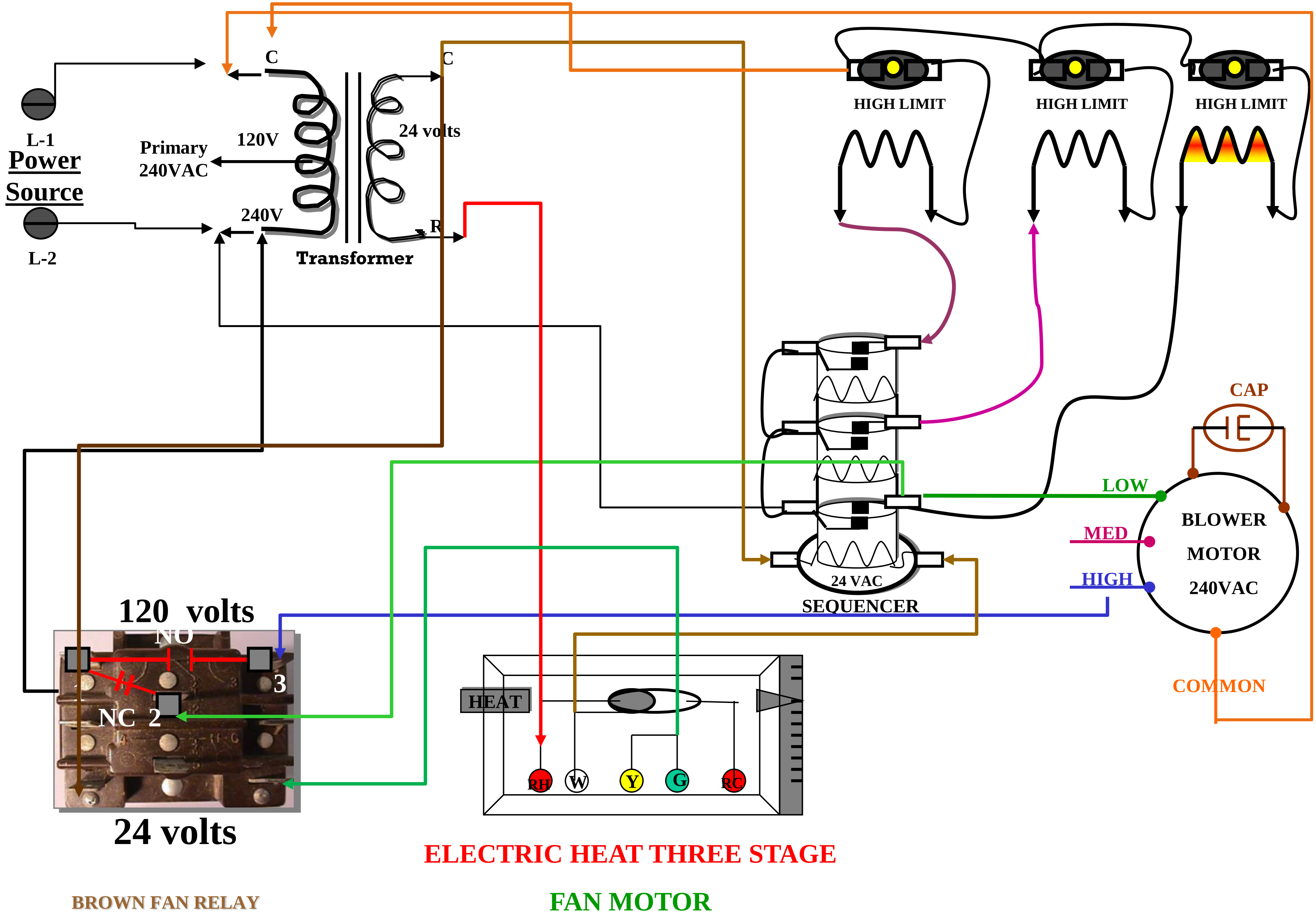


Power Source

ELECTRIC HEAT THREE STAGE

FAN MOTOR

HIGH VOLTAGE



ELECTRIC HEAT THREE STAGE

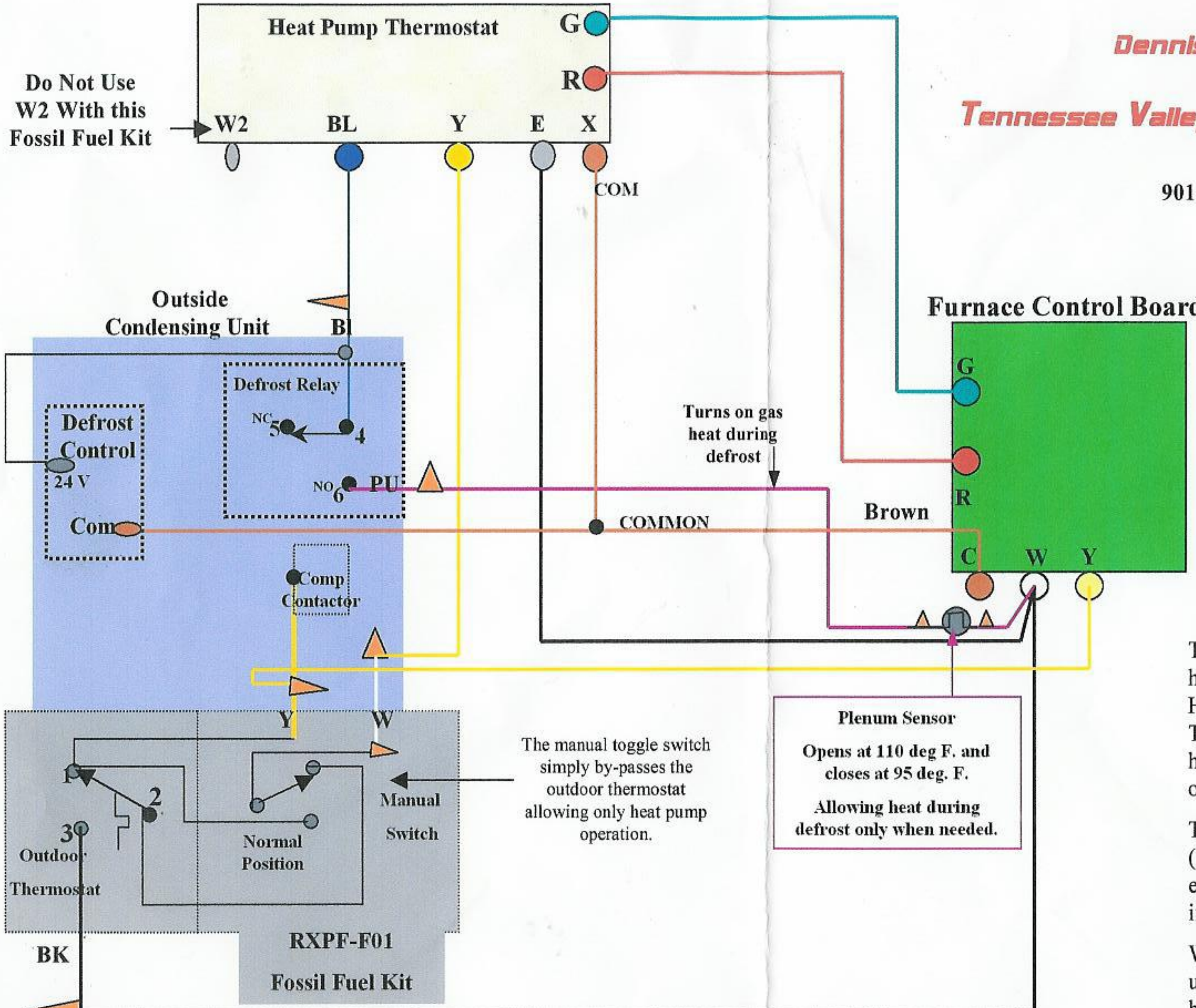
FAN MOTOR

HIGH VOLTAGE and LOW VOLTAGE

Dennis W. Mayes

Tennessee Valley Technical Programs

901-373-3992



Note:

When the yellow terminal at the control board is hot (as with the heat pump), the fan motor will be running on high speed. When the white terminal at the control board is hot (as with auxiliary gas heat), the fan motor will be running at the lower speed.

The Fossil Fuel Kit is used on heat pumps when the "Auxiliary Heat" is Gas instead of Electric. The fuel kit will insure that the heat pump and gas heat are not operating at the same time.

The high temperature of gas heat, (150deg. or higher), will cause excess pressure on the heat pump if they are running together.

W-2 on the thermostat will not be used because W-2 will bring on both heats by way of the second stage.

When the outdoor temperature drops below the heat-pump drop-out setting of the outdoor thermostat. *(Technician setting, at 30 to 35 degrees or higher)*

The outdoor thermostat will then break *(between terminals 1 and 2)* this is the yellow terminal from the the wall thermostat, which goes to the compressor contactor, and will then send this 24volts to the gas heat *(closes between 2 & 3)*.

△ *Wire Nut*

RXPF-F01

FOSSIL FUEL KIT

No monitor

By Dennis W. Mayes 2005

LAB
Heat Pump

- ☐ **1.** **Connect Guages**
- ☐ **2.** **Connect a temperature probe to the suction line, a second probe sensing the ambient air.**
- ☐ **3.** **Using the Sling Psychrometer obtain a wet bulb temperature.**
- ☐ **4.** **Turn the unit on.**
- ☐ **5.** **Log the following:**

Low-side pressure ________	**Suction Line temperature** ________
High-side pressure ________	**Ambient Dry- bulb temp.** ________
Wet bulb temp. ________	**Super-heat at service valve** ________

- ☐ **6.** **Using the Charging-Charts, determine if the unit is correct. If it is not correct, determine the problem.**
- ☐ **7.** **With the Amp Meter check to determine if the electric heat is on. Using the thermostat, cycle the electric heat off leaving only the Heat-pump operating.**
- ☐ **8.** **Execute a defrost cycle. (by-pass the out-door coil temp. sensor) Determine if the Aux. Heat came on while in defrost.**
- ☐ **9.** **Terminate defrost.**
- ☐ **10.** **Shut the unit down.**