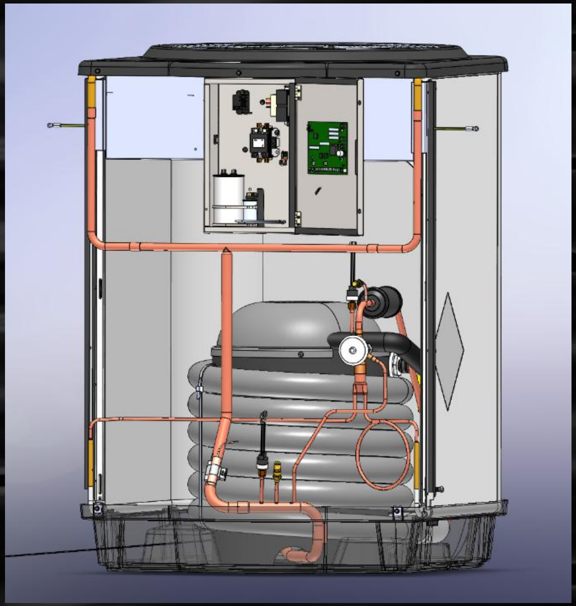
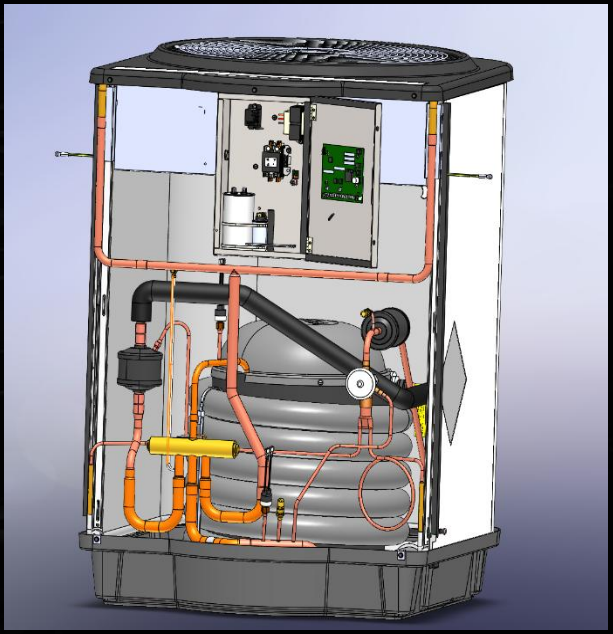
GENERATION 5 HEAT PUMP - MCHX

OFFICIAL TROUBLESHOOTING GUIDE





HAYWARD®

SINCE 1925

51301742901 REV A – JULY 2026

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MODEL NUMBERS

SKUS	A.K.A.
HP21105T	“110KBTU HEAT ONLY”
HP21205T	“120KBTU HEAT ONLY”
HP21405T	“140KBTU HEAT ONLY”
HP31105T	“110KBTU HEAT/CHILL”
HP31205T	“120KBTU HEAT/CHILL”
HP31405T	“140KBTU HEAT/CHILL”

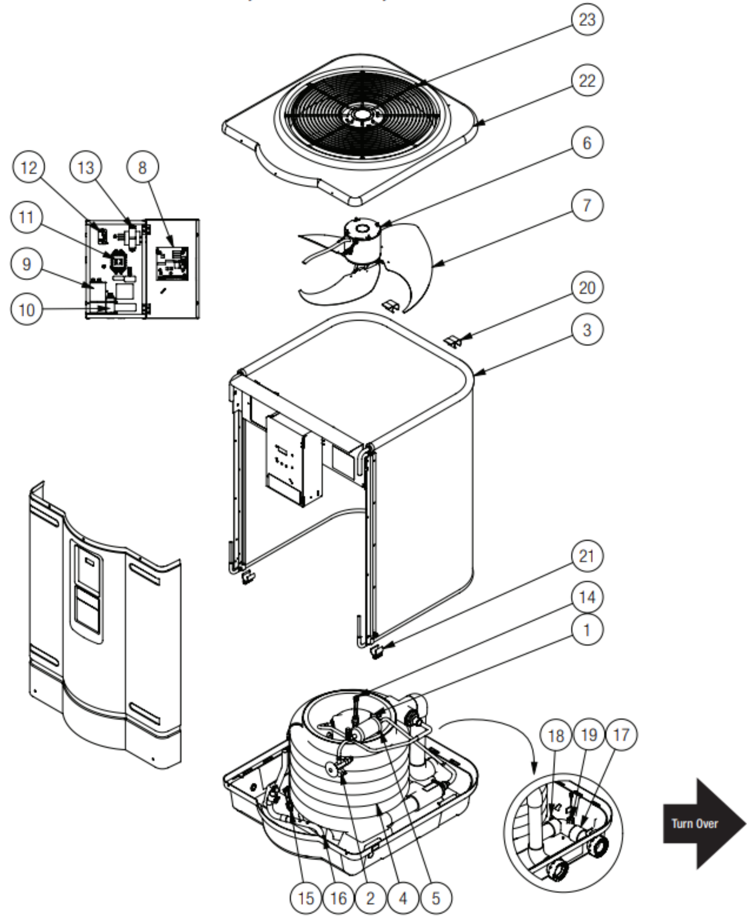
SERVICE PARTS LIST AND DIAGRAM PART 1

51300123201 Rev D

HAYWARD®

Service Parts

HP21405T, HP21205T, HP21105T
HP31405T, HP31205T, HP31105T



USE ONLY HAYWARD GENUINE REPLACEMENT PARTS / N'UTILISEZ QUE DES PIÈCES DE RECHANGE HAYWARD D'ORIGINE.

SERVICE PARTS LIST AND DIAGRAM PART 2

No.	Item Description	110k	120k	140k	110k H/C	120 H/C	140 H/C
1	COMPRESSOR	HPX51100101701	HPX51100101701	SMX11012755	HPX51100101701	HPX51100101701	SMX11012755
2	THERMAL EXPANSION VALVE (TXV)	HPX51701081801					
3	EVAPORATOR	HPX52400099501	HPX52400099401	HPX52400099401	HPX52400099501	HPX52400099401	HPX52400099401
4	HEAT EXCHANGER	HPX52400120301					
5	FILTER DRIER	HPX1462			SMX15022309		
6	FAN MOTOR	SMX300055036					
7	FAN BLADE	SMX303140003	HPX51700116101	HPX51700116101	SMX303140003	HPX51700116101	HPX51700116101
8	CONTROL BOARD	HPX51101076801			HPX51101076901		
9	CAPACITOR, COMPRESSOR	HPX51401591801					
10	CAPACITOR, FAN	HPX51401591801					
11	CONTACTOR	HPX1985					
12	FAN RELAY	HPX51100010301					
13	TRANSFORMER	HPX51100009901					
14	HP SWITCH	HPX11024258					
15	LP SWITCH	HPX51100118601					
16	DEFROST SENSOR	SMX306000023					
17	INSTRUMENT ELBOW ASSEMBLY	HPX52500098401					
18	WATER TEMPERATURE SENSOR	HPX51101047901					
19	WATER FLOW SWITCH	HPXG1068005E4					
20	BRACKET, TOP (QTY 2)	HPX50100099701	HPX50100099801	HPX50100099801	HPX50100099701	HPX50100099801	HPX50100099801
21	BRACKET, BOTTOM (QTY 4)	HPX50101042501					
22	PANEL-TOP KIT, BLACK	SMX30904754					
23	FAN GUARD	SMX0101711001					
NOT SHOWN	3 AMP FUSE KIT	FDXLFSKC30					
	WATER PRESSURE SWITCH	HPX2181					
	REVERSING VALVE	NOT USED			HPX51700122401		
	COMPENSATOR	NOT USED			HPX51700098901		
	PLUG, COMPRESSOR	SMX10022329					
	EVAPORATOR GUARD	HPX50100816601					
	FASTENER, TREE, 1/4 (QTY 10)	HPX50100817001					
	FASTENER, U-TYPE (QTY 25)	HPX50100122501					
	CONSUMER KIT	HPXCONSKTHP					

NOTICE TO SERVICER

Hayward Tech Support: 908-355-7995

- Heat pumps are ONLY be serviced by EPA 608 licensees with HVAC/R training or having completed Hayward technical training for this product line.
- Hayward microchannel heat pumps are designed to operate on **230/240VAC supply only.** Please use copper supply wires when connecting power to the contactor line-side.
- For troubleshooting electrical components, during which live energization of the heat pump is required, only qualified service personnel may perform the testing/troubleshooting.
- We recommend discharging the voltage from: the fan capacitor AND compressor capacitor prior to measuring capacitance and **ensure the unit breaker is OFF during this process.**
- **During diagnostic, Hayward recommends technicians shut off power to the breaker, unless unit power must remain for diagnostics like checking line voltage, measuring amp draw.**
- When in doubt, stop what you are doing, **consult with a professional service technician in your company or call Hayward technical support.**

All technicians performing work which involves any refrigerant circuit related access*, shall at minimum require:*

a) EPA 608 Type II Certification

Or

b) EPA 608 Universal Certification

ELECTRICAL WORK - WARNING

All wiring connections to the heater must be made in accordance with the latest edition of the NFPA 70, unless local code requirements specify otherwise.

In **Canada**, all wiring connections must follow CSA C22.1 Canadian Electrical Code, Part 1.

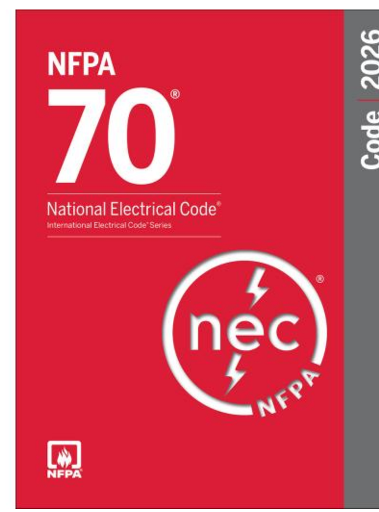
GROUNDING AND BONDING NOTICE

The heater must be electrically grounded and bonded in accordance with local codes or, in the absence of local codes, with National Electrical Code, ANSI/NFPA 70. Wiring connections must be made as shown in the wiring diagram found on the control box mounting bracket.

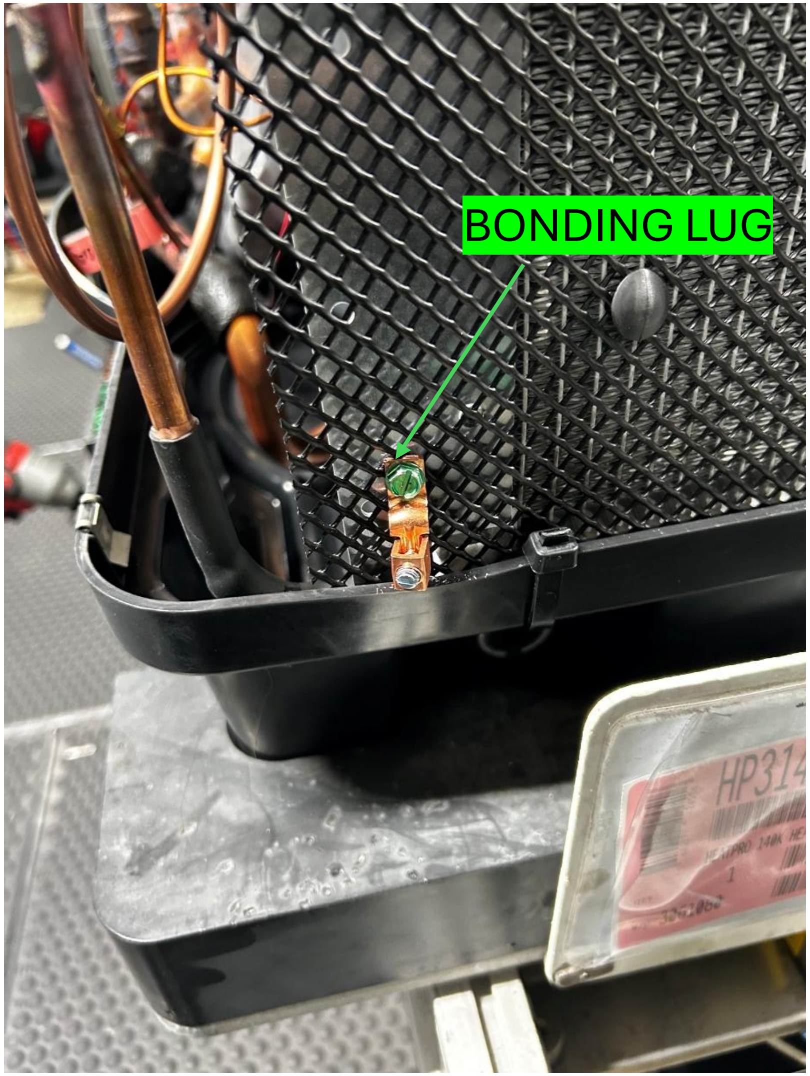
GROUND LUG: Located in electrical enclosure.

BONDING LUG: **Located on the right side bottom front side of the heat pump on the coil endsheet.** Connect a No. 8 AWG (8.4 mm2) solid copper bonding wire to the grounding lug provided on the heat pump and to all metal parts of swimming pool or spa, and to all electrical equipment, metal piping (except gas piping), and conduit within 5 ft. (1.5 m) of inside walls of swimming pool or spa.

Reference NEC codes for all wiring standards including, but not limited to, grounding, bonding and other general wiring procedures.



GROUNDING AND BONDING LOCATIONS



GROUNDING AND BONDING - INFORMATION

Equipment bonding is the intentional joining of metal parts to create a continuous electrical path. It ensures that exposed metal surfaces (like equipment housings or junction boxes) remain at the same electrical potential, preventing electric shock and providing a path to safely trip circuit breakers during a fault.

Key Concepts

- **Equalizing Potential:** Bonding connects exposed conductive parts together. If an electrical wire accidentally touches the metal casing of an appliance, the bonding ensures the casing does not become dangerously energized compared to its surroundings.

- **Creating a Fault Path:** By tying all metal parts to a continuous loop, bonding provides an effective path for electricity to flow back to the power source. This ensures that overcurrent devices, like fuses or circuit breakers, immediately trip and shut off the power.

- **Bonding vs. Grounding:** These terms are often used interchangeably but serve different roles.

  - **Bonding:** Connects equipment, enclosures, and metal parts together to establish electrical continuity.

  - **Grounding:** Connects those bonded systems to the earth to neutralize surges and lightning strikes

MODELS AND SPECS

	GENERATION 5					
PARAMETER	HEATPRO	HEATPRO	HEATPRO	HEATPRO	HEATPRO	HEATPRO
MODEL NUMBER	HP21105T	HP21205T	HP21405T	HP31105T	HP31205T	HP31405T
SERIAL NUMBER	See Note 5					
RATED VOLTAGE	230V~ 60Hz 1Ph					
MCA	38.9	38.9	42.5	38.9	38.9	42.525
RECOMMENDED BREAKER SIZE (AMPS)	40	40	50	40	40	50
MOP	65	65	70	65	65	70
COMPRESSOR RLA	29.2	29.2	32.1	29.2	29.2	32.1
COMPRESSOR LRA	185	185	185	185	185	185
FAN MOTOR RLA	2.4	2.4	2.4	2.4	2.4	2.4
FAM MOTOR HP	1/3	1/3	1/3	1/3	1/3	1/3
SHORT CIRCUIT CURRENT	5 AMPS					
RMS SYMMETRICAL VOLTAGE	240V AC					
RATED POWER INPUT(W)	5600	6100	8300	5600	6100	8300
MOISTURE RESISTANCE	IPX4					
REFRIGERANT TYPE	R-410A					
REFR. SAFETY GROUP	A1					
REFRIGERANT CHARGE	4lb 10oz	4lb 14oz	4lb 14oz	5lb 0oz	5lb 4oz	5lb 4oz
	2.1kg	2.24kg	2.21kg	2.27kg	2.27kg	2.27kg
MAX ALLOWABLE REFR PRESSURE	575psig					
	3.96MPa					
HIGH SIDE	340psig					
	2.34MPa					
LOW SIDE	236psig					
	1.63MPa					
MIN WATER FLOW	30GPM					
	114LPM					
MAX WATER FLOW	75GPM					
	284LPM					
MAX WATER INLET TEMPERATURE	104 °F					
	40 °C					

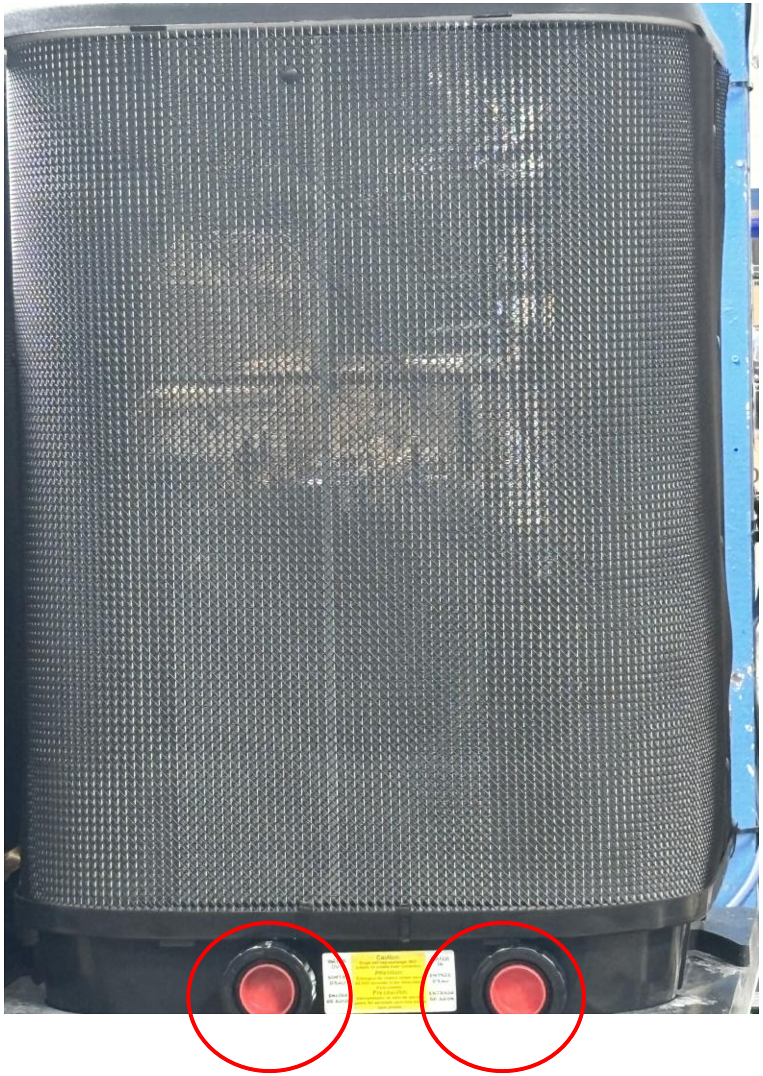
SIZE, DIMENSIONS, RATINGS, AND CHARGE OF REFRIGERANT

HEATPRO® MCHX SERIES SPECIFICATIONS

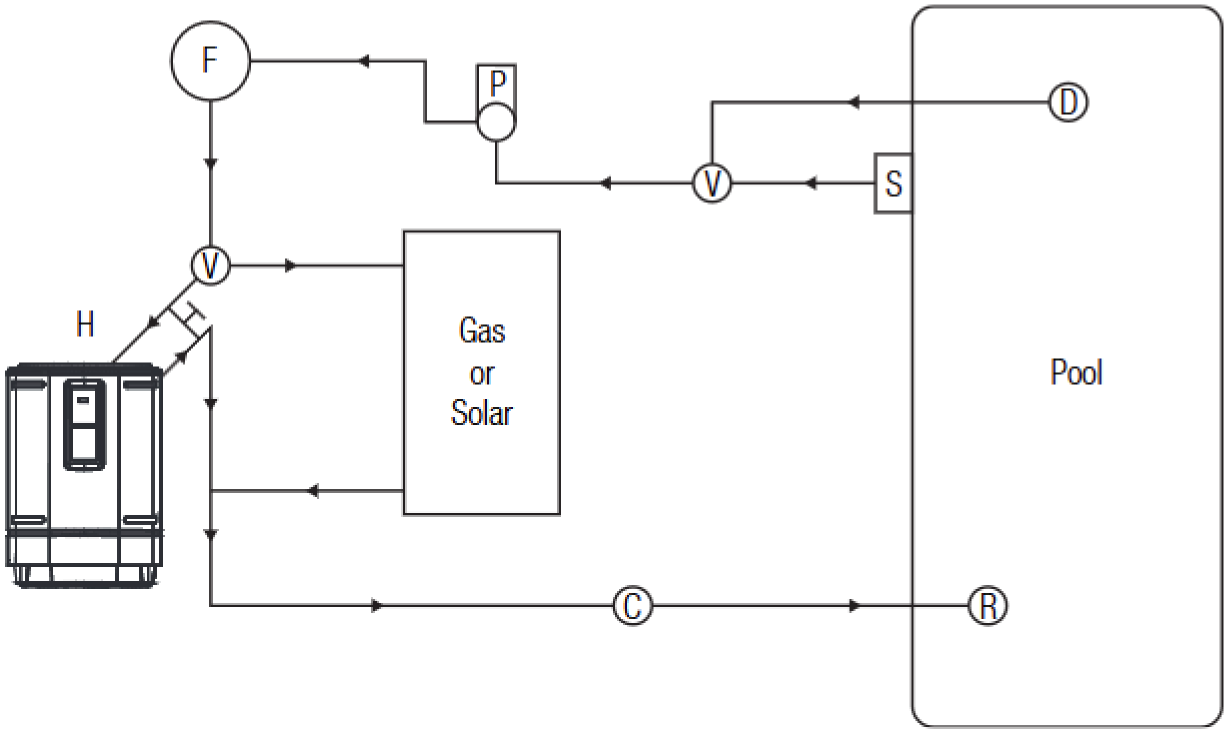
	HEAT ONLY			HEAT + CHILL		
MODEL NUMBER	HP21105T	HP21205T	HP21405T	HP31105T	HP31205T	HP31405T
BTU HEATING CAPACITY						
80 / 80 / 80 *	110,000	120,000	138,000	110,000	120,000	135,000
80 / 80 / 63 *	100,000	110,000	128,000	100,000	110,000	125,000
50 / 80 / 63 *	75,000	75,000	82,000	75,000	75,000	82,000
BTU COOLING CAPACITY						
95 / 90 / 80 *	-	-	-	72,000	72,000	82,000
COEFFICIENT OF PERFORMANCE, HEATING						
80 / 80 / 80 *	5.7	5.7	5.7	5.7	5.7	5.7
80 / 80 / 63 *	5.5	5.5	5.5	5.5	5.5	5.5
50 / 80 / 63 *	4.0	4.0	4.0	4.0	4.0	4.0
Low Ambient Operation	√	√	√	√	√	√
Air Operating Temperature	45-110°F	45-110°F	45-110°F	40-110°F	40-110°F	40-110°F
Active Defrost	-	-	-	√	√	√
Rated Voltage	230V~ 60Hz 1Ph	230V~ 60Hz 1Ph	230V~ 60Hz 1Ph	230V~ 60Hz 1Ph	230V~ 60Hz 1Ph	230V~ 60Hz 1Ph
Recommended Breaker Size	40A	40A	50A	40A	40A	50A
Water Flow Rate (Min/Max)	30 / 75 GPM	30 / 75 GPM	30 / 75 GPM	30 / 75 GPM	30 / 75 GPM	30 / 75 GPM
Water Connection Diamter	2 x 2-1/2 in	2 x 2-1/2 in	2 x 2-1/2 in	2 x 2-1/2 in	2 x 2-1/2 in	2 x 2-1/2 in
Water Inlet to Outlet Distance	10.25 in	10.25 in	10.25 in	10.25 in	10.25 in	10.25 in
Refrigerant	4 lb 10 oz	4 lb 14 oz	4 lb 14 oz	5 lb 0 oz	5 lb 4 oz	5 lb 4 oz
Refrigerant Type	R-410A	R-410A	R-410A	R-410A	R-410A	R-410A
Unit Dimensions (LxWxH)	33.6 x 30.5 x 44 in	33.6 x 30.5 x 44 in	33.6 x 30.5 x 44 in	33.6 x 30.5 x 44 in	33.6 x 30.5 x 44 in	33.6 x 30.5 x 44 in
Unit Weight	230 lbs	233 lbs	233 lbs	237 lbs	240 lbs	240 lbs
Unit Shipping Dimensions (LxWxH)	36.5 x 31 x 49 in	36.5 x 31 x 49 in	36.5 x 31 x 49 in	36.5 x 31 x 49 in	36.5 x 31 x 49 in	36.5 x 31 x 49 in
Unit Shipping Weight	278 lbs	281 lbs	281 lbs	285 lbs	288 lbs	288 lbs
Rear & Side Clearance (Min)	12"	12"	12"	12"	12"	12"

WARNING: REMOVE BEFORE INSTALLATION

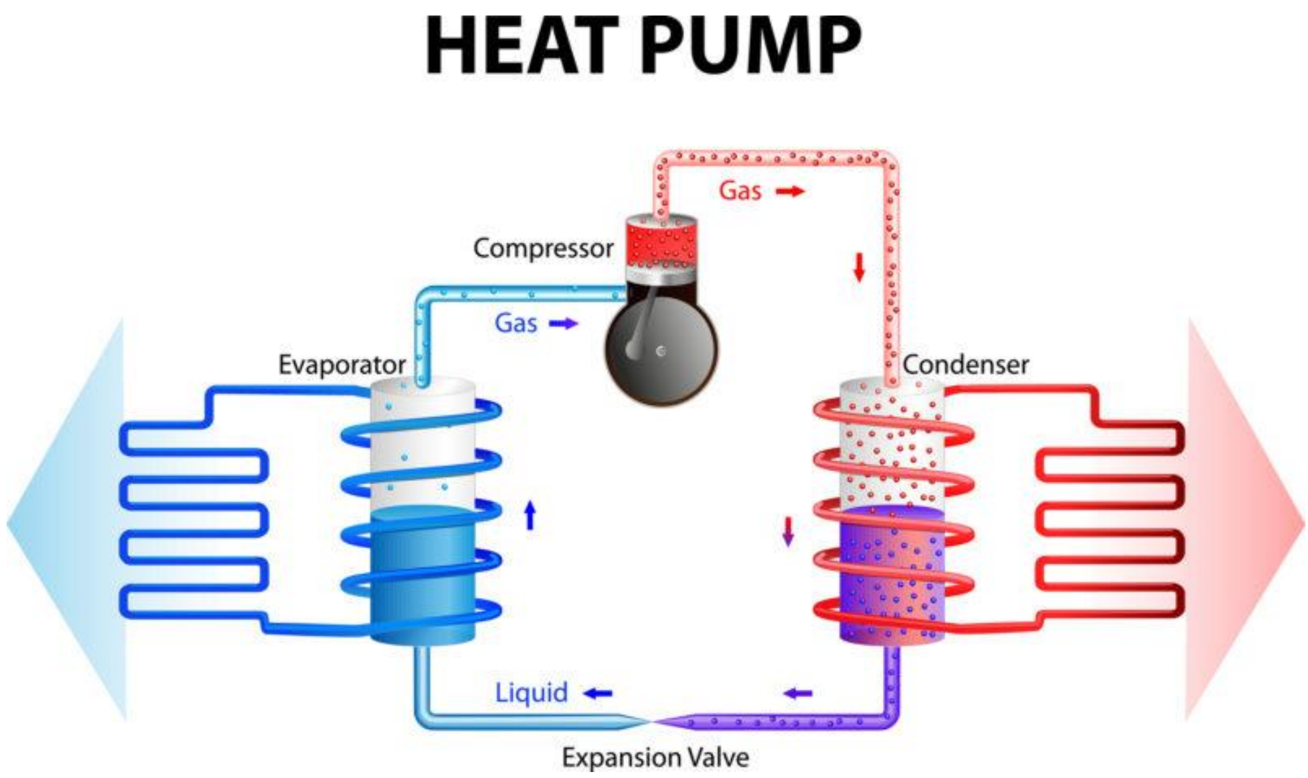
ALWAYS MAKE SURE TO REMOVE RED CAP PLUGS PRIOR TO MAKING WATER CONNECTIONS.



PIPING DIAGRAM



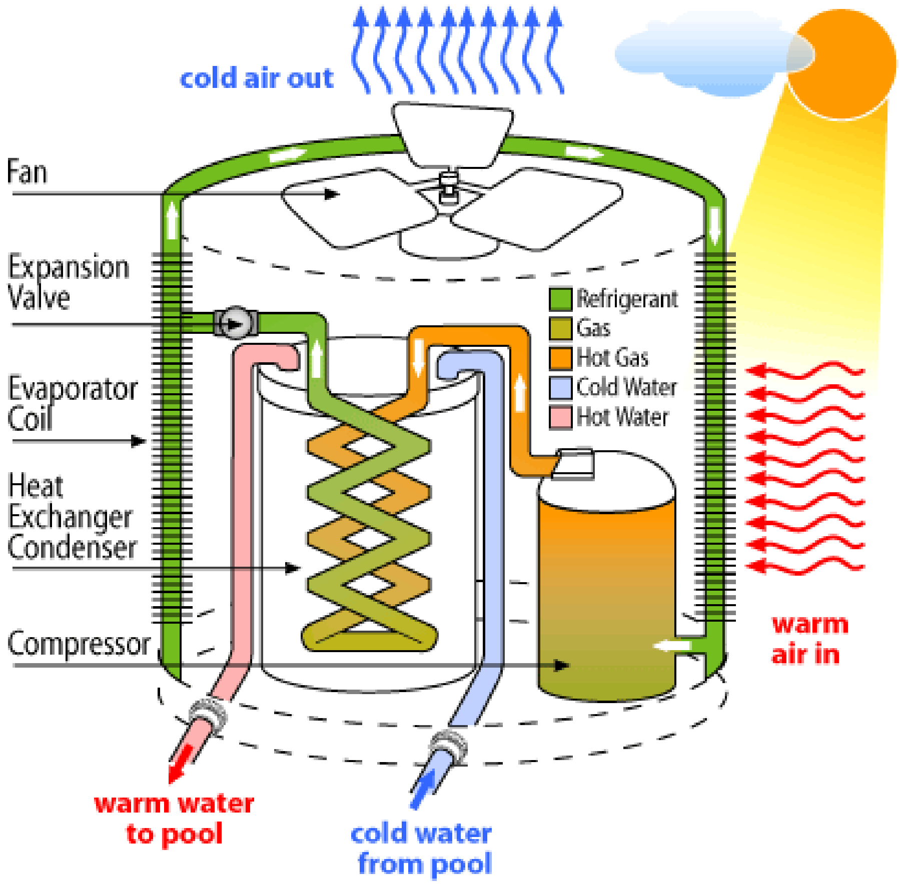
REFRIGERATION CYCLE AND COMPONENTS – PART 1



REFRIGERATION CYCLE AND COMPONENTS – PART 2

1. Water enters the condenser.
2. Heat is transferred to the water (from the refrigerant – R-410A).
3. Water exits to the pool.

For technicians coming from the HVAC world:
Think of it like a package unit heat pump.
In HVAC, the supply air and return air is the media being heated.
In Pool Heating, the supply water and return water is the media being heated.



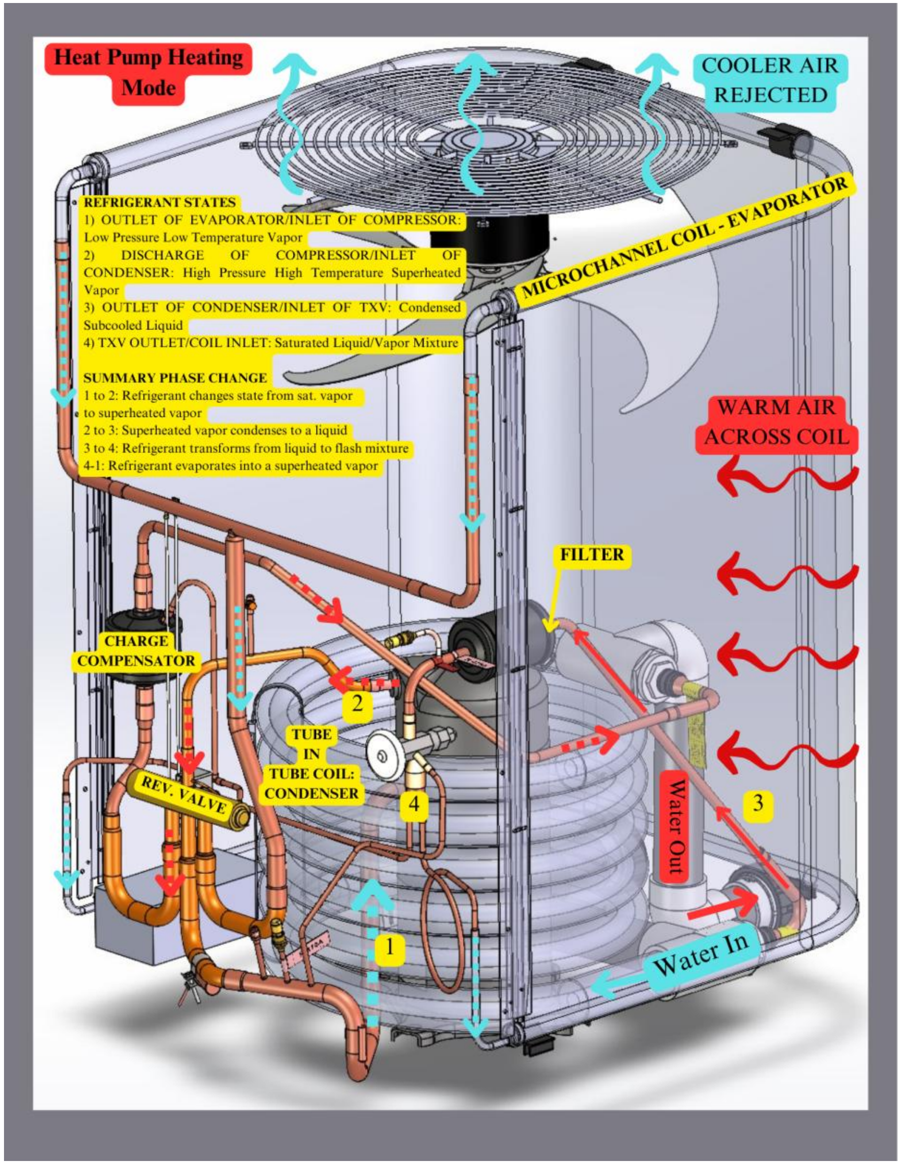
All pool heat pumps consist of the following components:

- A hermetically sealed scroll compressor
- An evaporator
- A condenser
- A metering device i.e. TXV / EEV / Orifice
- A fan motor and fan blade

Minor - Components: A charge compensator, a filter drier, service stubs, controls enclosure, control board.

Typical Sensors Used in Pool Heat Pumps

- A suction line thermistor (used in Hayward model heat pumps for defrost control)
- A coil temperature thermistor (not for Hayward models)
- Pressure safety switches for refrigerant on the low and high side (suction and liquid side)
- Water inlet thermistor
- Flow switch



Compressor

The compressor is the heart of the refrigeration system.

Its job is to:

•Compress low-pressure refrigerant vapor into a high-pressure, high-temperature vapor.

•Circulate refrigerant throughout the system.

•Provide the energy needed for heat transfer.

If the compressor stops, the refrigeration cycle stops.

Condenser

The condenser rejects heat from the refrigerant.

As hot, high-pressure vapor enters the condenser:

•Heat is transferred to the water.

•The refrigerant cools and condenses into a high-pressure liquid.

In a pool heat pump heating mode, coaxial heat exchanger acts as the condenser.

Filter Drier

The filter drier protects the refrigeration system.

Its functions are to:

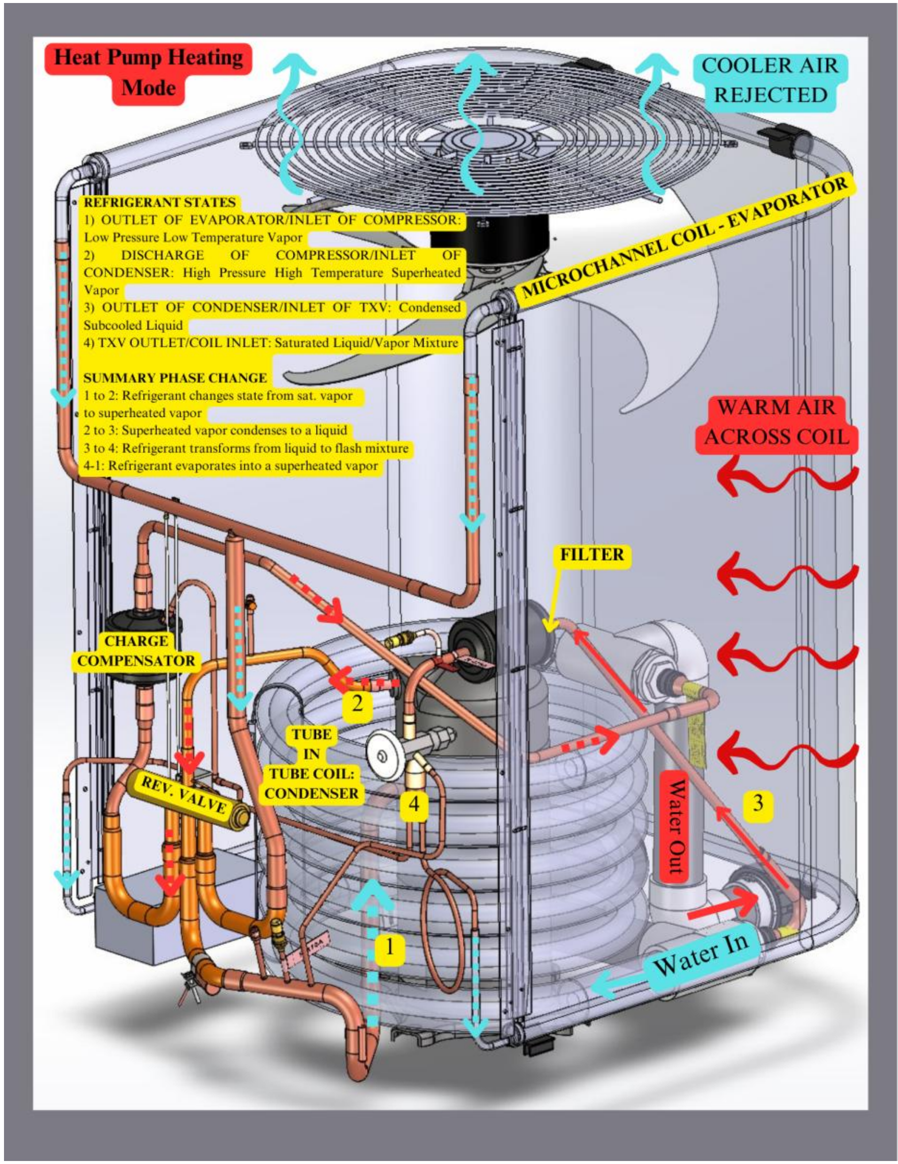
•Remove moisture from the refrigerant.

•Capture dirt and debris.

•Prevent acid formation.

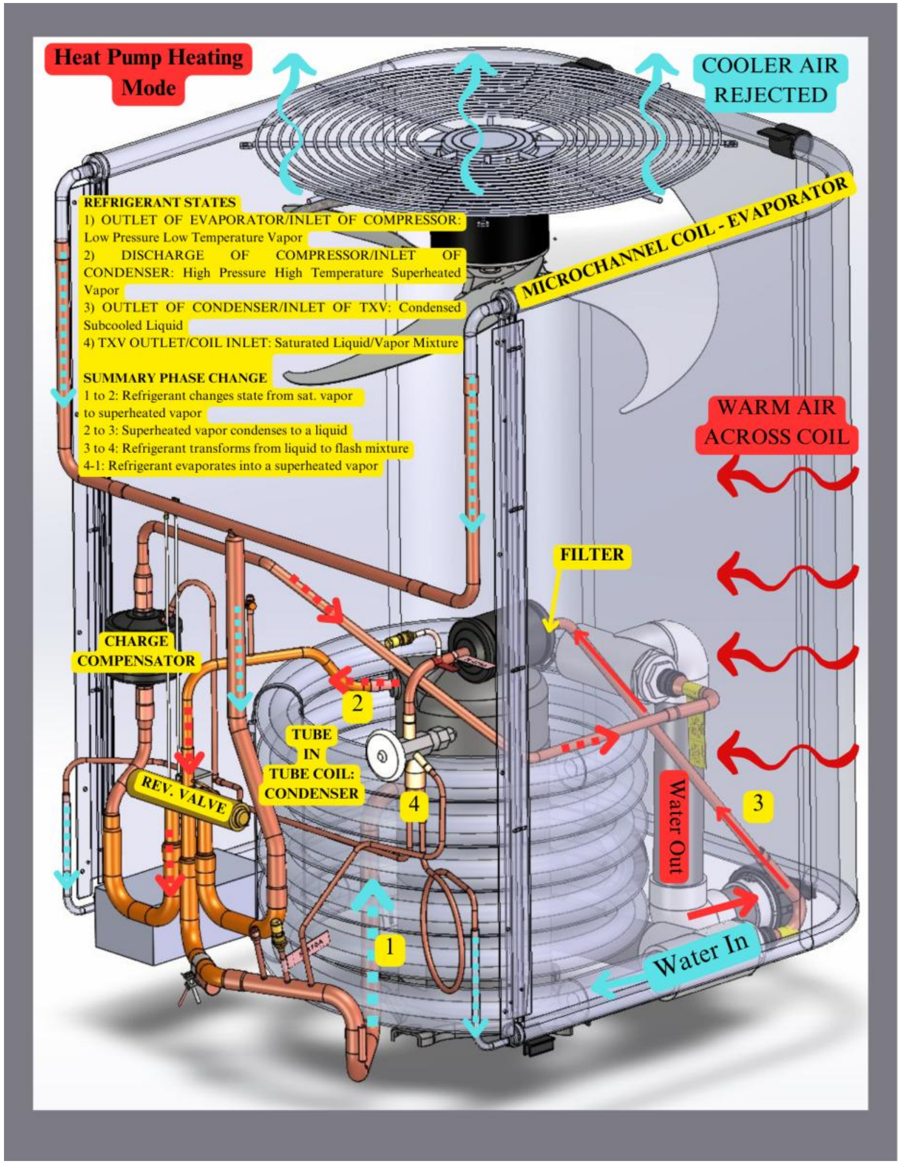
•Protect the TXV and compressor.

A restricted filter drier can cause low suction pressure, high superheat, and reduced performance.



Thermostatic Expansion Valve (TXV)
The TXV regulates refrigerant flow into the evaporator.
The TXV:
•Meters the amount of refrigerant entering the evaporator.
•Maintains proper superheat.
•Prevents liquid refrigerant from returning to the compressor.
Too little refrigerant flow causes high superheat; too much flow can cause flood back and low superheat.

Evaporator Coil
The evaporator is where the refrigerant absorbs heat.
As refrigerant enters the evaporator:
•It expands and boils into a vapor.
•Heat is absorbed from the surrounding medium.
•The refrigerant leaves as a low-pressure vapor and returns to the compressor.
In Hayward pool heat pumps, the evaporator is the microchannel coil that absorbs heat from ambient air.



Charge Compensator

The charge compensator is a refrigerant storage device used to manage excess refrigerant during cooling mode.

Its functions include:

•Providing a place to store excess refrigerant when the system operating conditions change.

•Preventing overcharging of active heat exchanger circuits.

•Improving refrigerant distribution between heating and cooling modes.

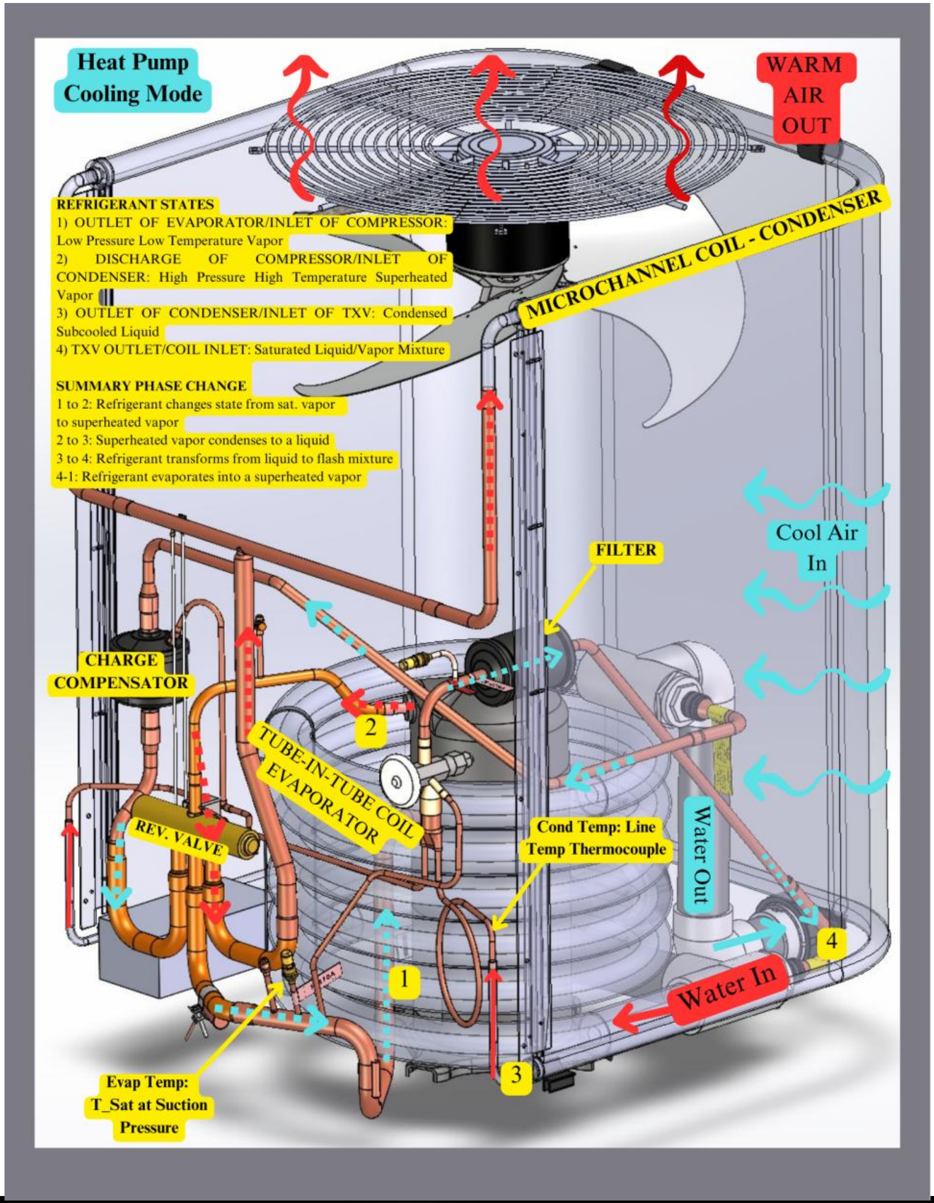
•Helping maintain stable system pressures.

In pool heaters with cooling capability:

•The active refrigerant circuit changes between operating modes.

•The charge compensator stores refrigerant that is temporarily not needed by the system.

•This helps ensure proper refrigerant charge and system efficiency in both heating and cooling modes.



Fan Motor and Fan Blade

The 825rpm single speed 1/3 hp fan motor is paired with either a 22in 3 blade or 22 in 4 blade fan. It's job is to move air across the air-side coil (microchannel coil).

Its functions include:

•Starting up first during operation set to RUN.

•The fan powers ON first, followed by a timed delay before the compressor turns ON.

•The fan blade is mounted on the 1/2in fan motor shaft.

•The fan blade is 22in 3 blade for the 110kBTU models.

•The fan blade is 22in 4 blade for the 120kBTU and 140kBTU models.

Controls

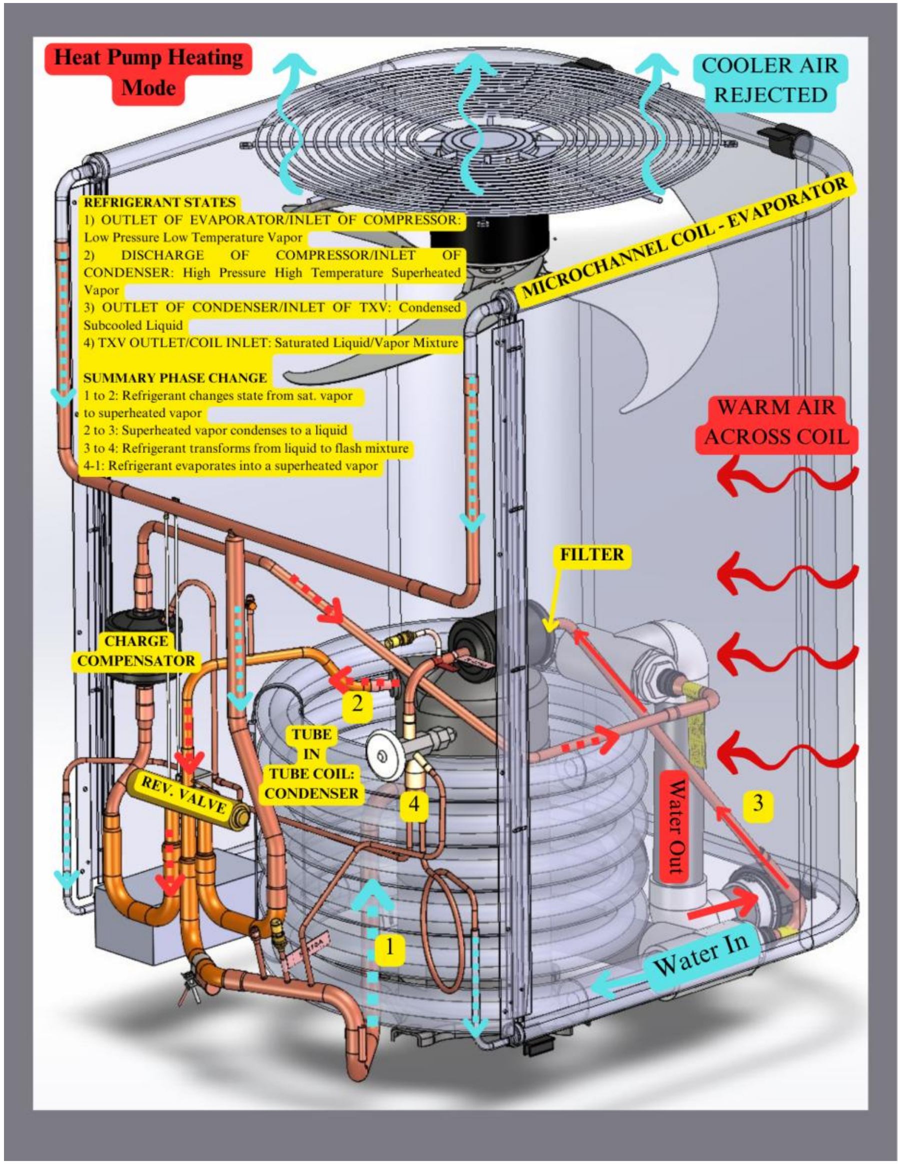
The control board has inputs and outputs.

Inputs include:

•Water inlet thermistor, defrost thermisor (mounts to suction line), low pressure switch, high pressure switch, flow switch, bypass operation terminals (for remote control)

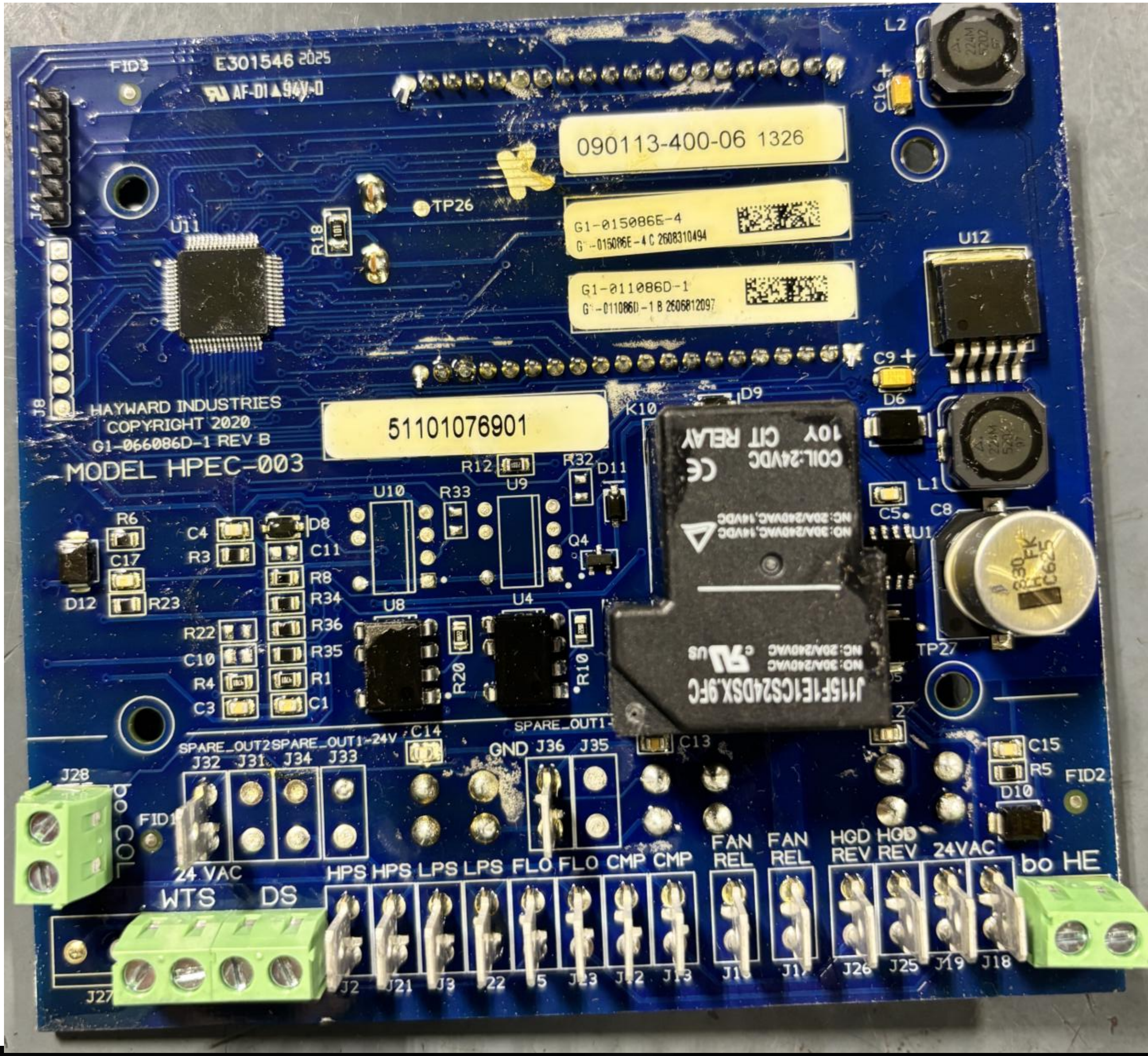
•Outputs include:

•Contactor energization signal, fan relay energization signal, reversing valve signal (heat/cool models only)



HEAT PUMP COMPONENTS & FUNCTIONS – PART 6 - BOARD

- **Controls**
- **The control board has inputs and outputs.**
- Inputs include:
- Water inlet thermistor, defrost thermisor (mounts to suction line), low pressure switch, high pressure switch, flow switch, bypass operation terminals (for remote control)
- Outputs include:
- Contactor energization signal, fan relay energization signal, reversing valve signal (heat/cool models only)



MCHX SEGMENT: INTRO - MICROCHANNEL HEAT EXCHANGERS

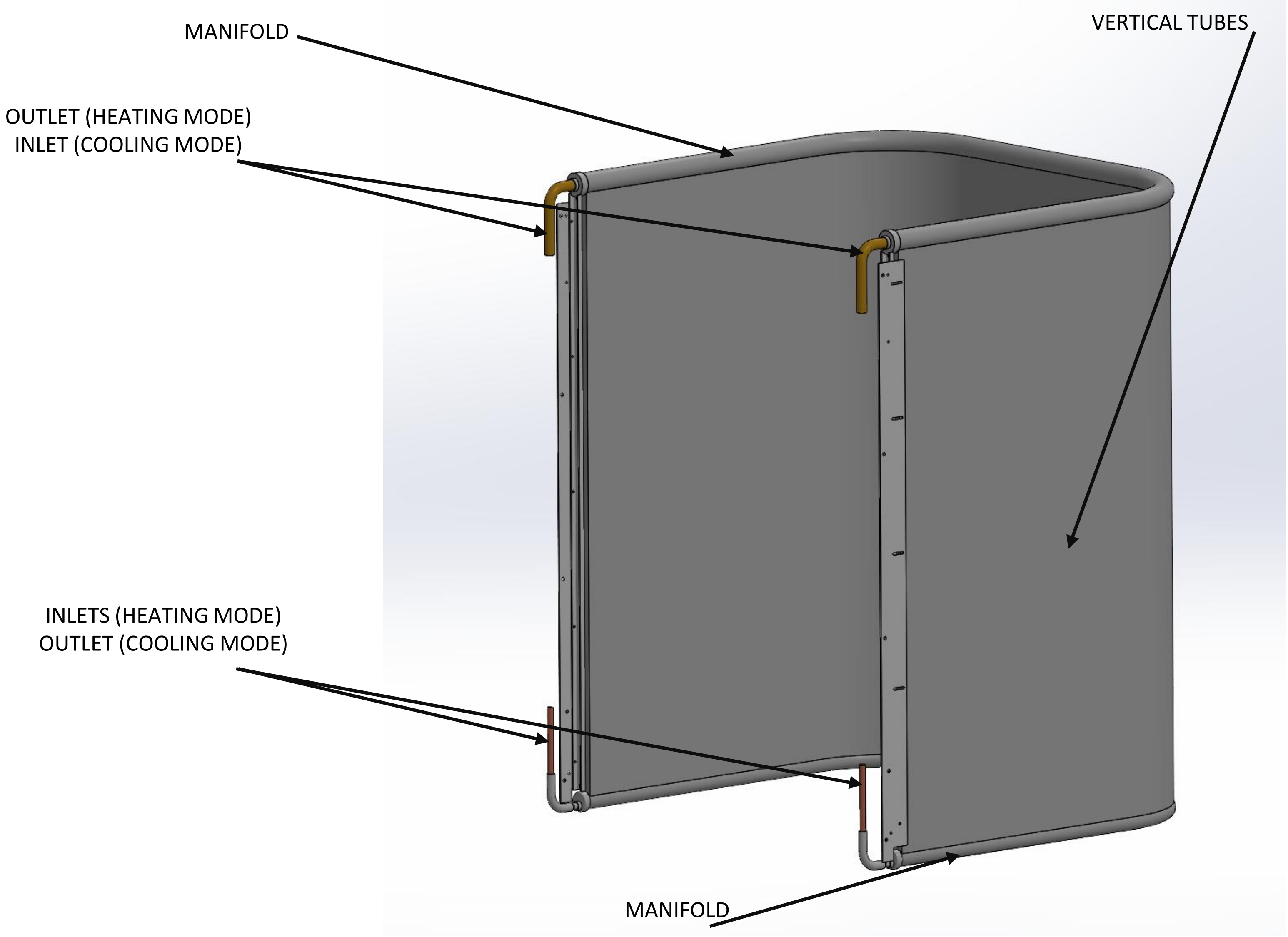
A **microchannel heat exchanger (MCHE)** is an all-aluminum coil that transfers heat between the refrigerant and the surrounding air. It replaces the traditional **copper tube and aluminum fin** coil found in many heat pumps.

The refrigerant flows through multiple small channels (microchannels) inside flat aluminum tubes, creating a large heat transfer surface area and improving efficiency.

How It Works
In a heat pump, the microchannel coil can function as either:
•**Condenser** (rejecting heat)
•**Evaporator** (absorbing heat)

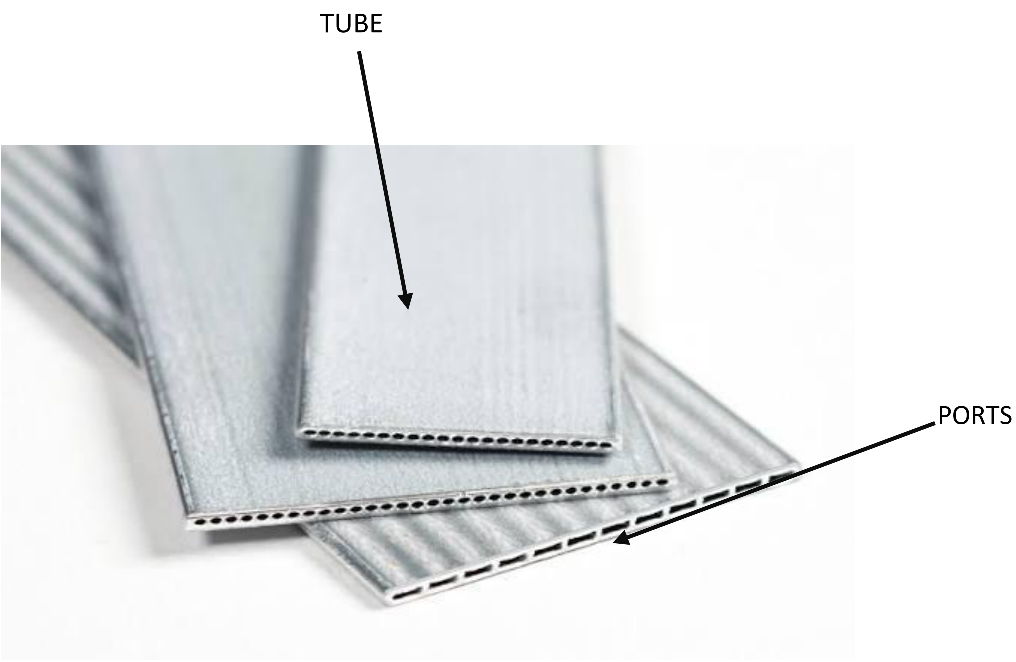
Depending on whether the unit is in heating or cooling mode.

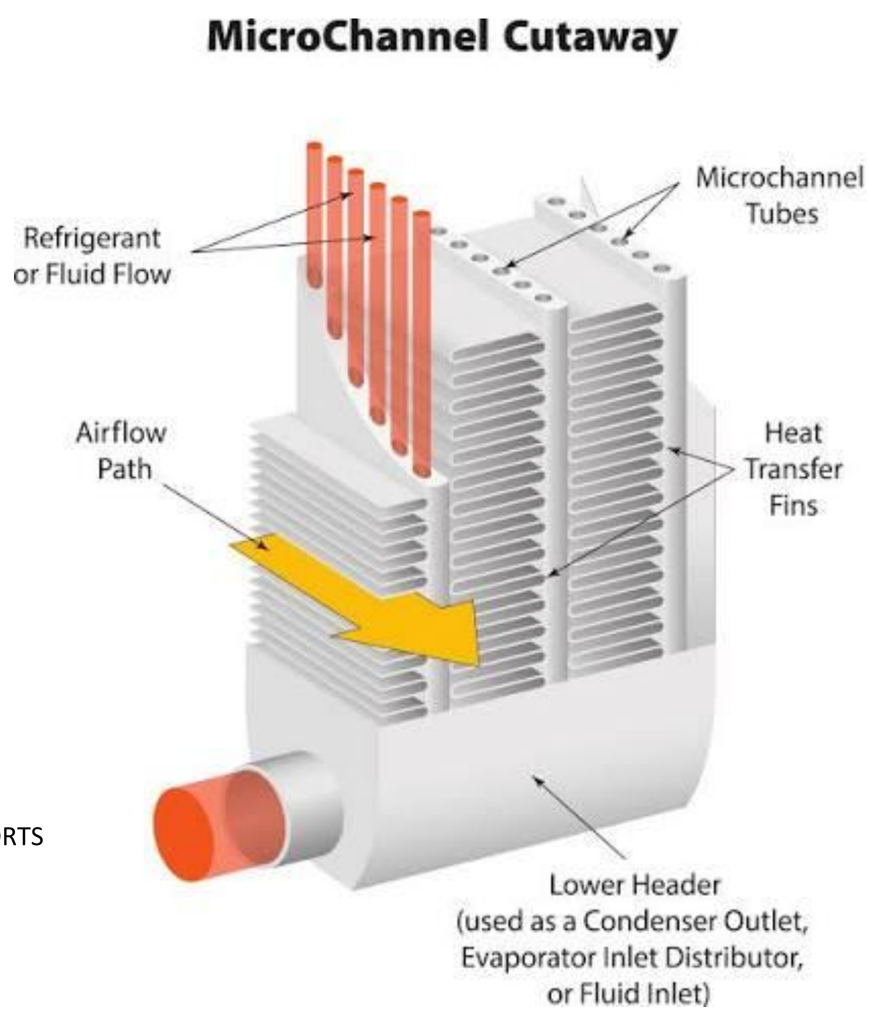
The small refrigerant passages increase the contact area between the refrigerant and the aluminum surface, allowing heat to transfer more efficiently.


MANIFOLD
VERTICAL TUBES
OUTLET (HEATING MODE)
INLET (COOLING MODE)
INLETS (HEATING MODE)
OUTLET (COOLING MODE)
MANIFOLD

MCHX SEGMENT: ANATOMY OF MICROCHANNEL HEAT EXCHANGER-PART 2

The refrigerant travels inside the tubes, absorbing heat of air as the fan pulls ambient air across fins, and phase change happens. The refrigerant enters as a saturated mixture, and leaves as a low pressure superheated vapor.





Inspect for Refrigerant Leaks

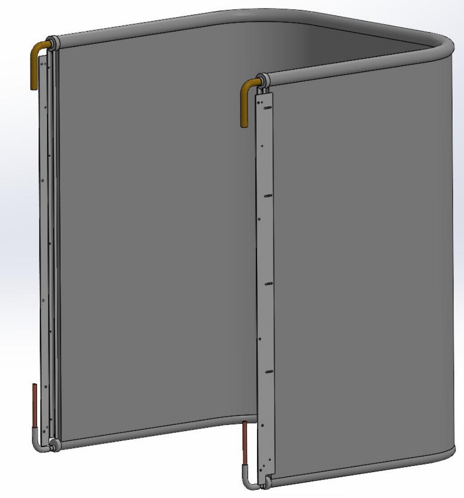
Look for signs of refrigerant leakage around the microchannel coil:

- Oil stains on the coil surface or around headers
- Physical damage from hail, rocks, or impact
- Corrosion or damaged tube joints
- Reduced system performance or loss of capacity

Leak Detection Methods

- Electronic leak detector
- Soap bubble solution applied to suspected leak areas
- Nitrogen pressure test
- UV dye (if approved by manufacturer)

Note: Leaks often occur near header connections, braze joints, or areas of physical damage.



Common Symptoms of a Faulty Microchannel Heat Exchanger

Symptom	Possible Cause
Low cooling/heating capacity	Refrigerant leak or restriction
Low suction pressure	Leak or internal blockage
High head pressure	Airflow restriction
Frost formation	Refrigerant restriction
Oil residue on coil	Refrigerant leak
Uneven coil temperatures	Internal blockage or low charge

Tube-in-Tube Refrigerant-to-Water Heat Exchangers

A **tube-in-tube heat exchanger** (also called a **coaxial heat exchanger**) is a device used in water-source and pool heat pumps to transfer heat between the **refrigerant** and **water** without allowing the two fluids to mix.

How It Works

The heat exchanger consists of:

- An **inner tube** carrying refrigerant
- An **outer tube** carrying water

The two fluids flow past each other through separate passages, allowing heat to transfer through the tube wall.

Cooling Mode

- Refrigerant rejects heat to the water.
- Water temperature increases.
- Refrigerant condenses into a liquid.

Heating Mode

- Refrigerant absorbs heat from the water.
- Water temperature decreases.
- Refrigerant evaporates into a vapor.

Advantages of Tube-in-Tube Heat Exchangers

Excellent Freeze Resistance

- Can tolerate lower water temperatures than many plate heat exchangers.
- Commonly used in pool and geothermal heat pumps.

Durable Construction

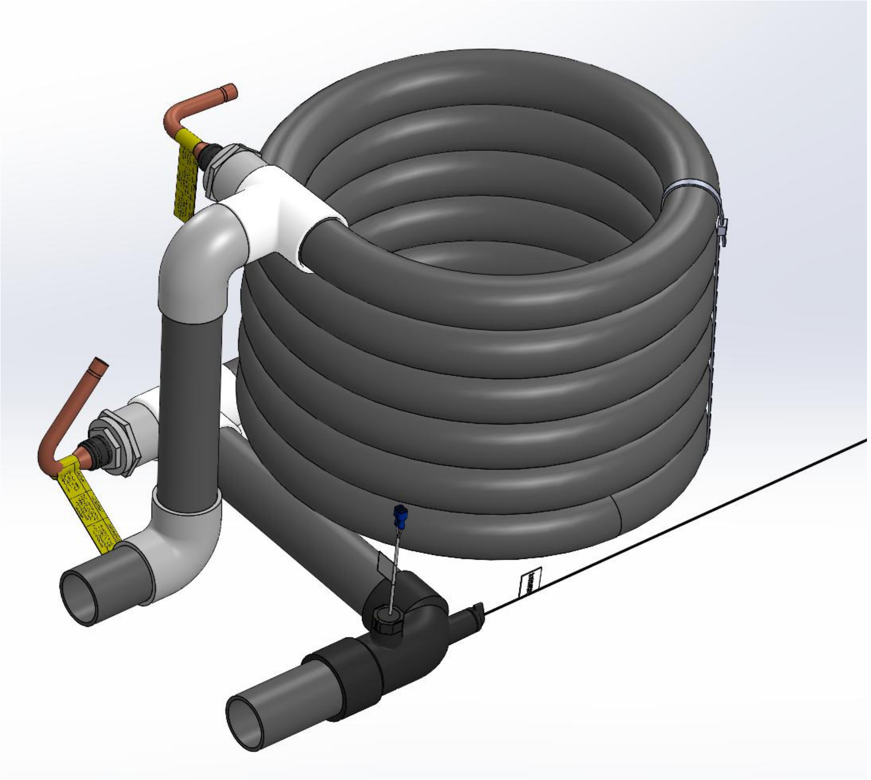
- Resistant to vibration and thermal stress.
- Long service life when water quality is maintained.

Less Susceptible to Plugging

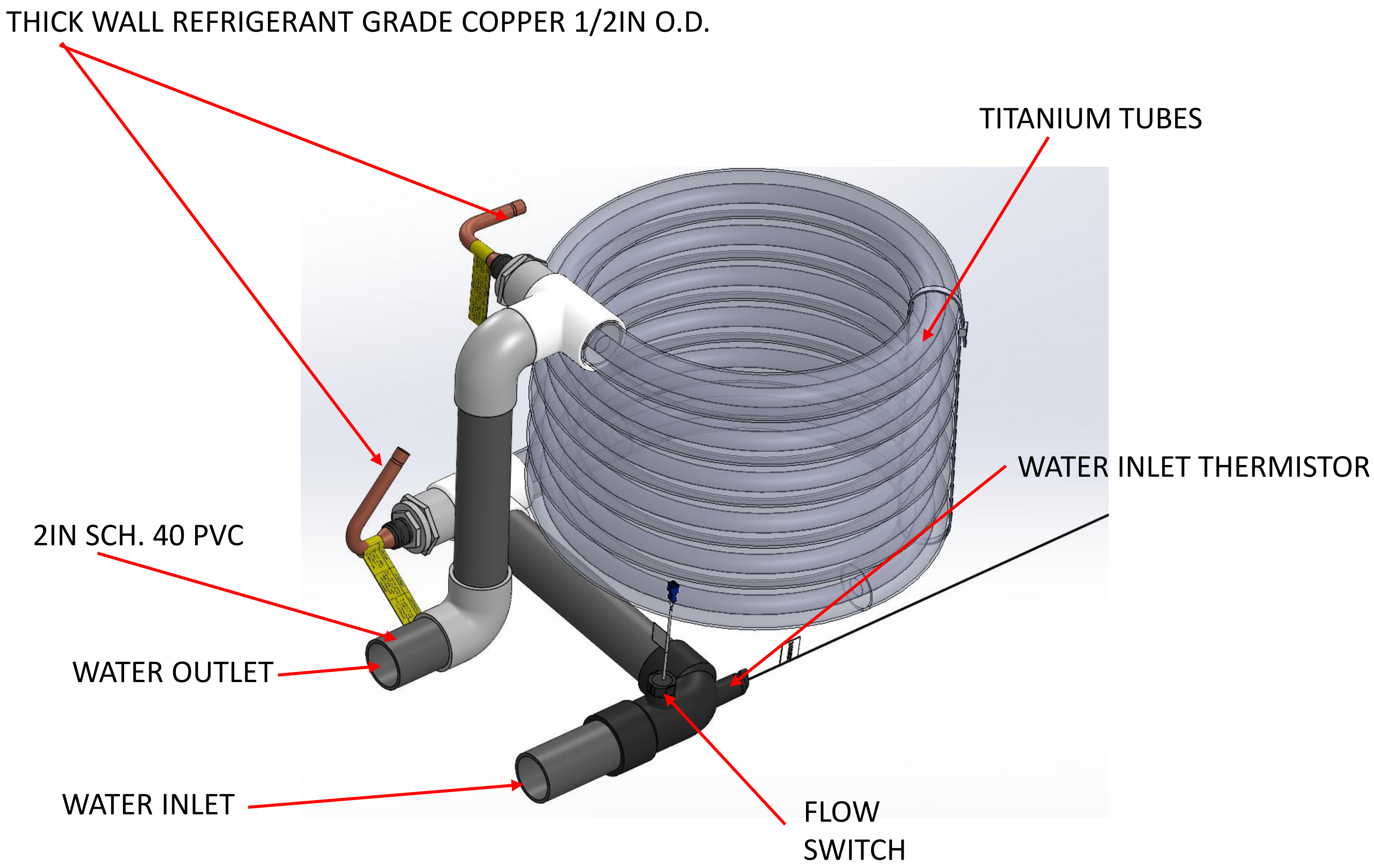
- Larger water passages compared to brazed plate heat exchangers.
- Better suited for systems with less-than-perfect water quality.

Easy to Service

- Can often be flushed to remove scale buildup.



COAXIAL HEX SEGMENT: ANATOMY OF A TUBE-IN-TUBE HEAT EXCHANGER

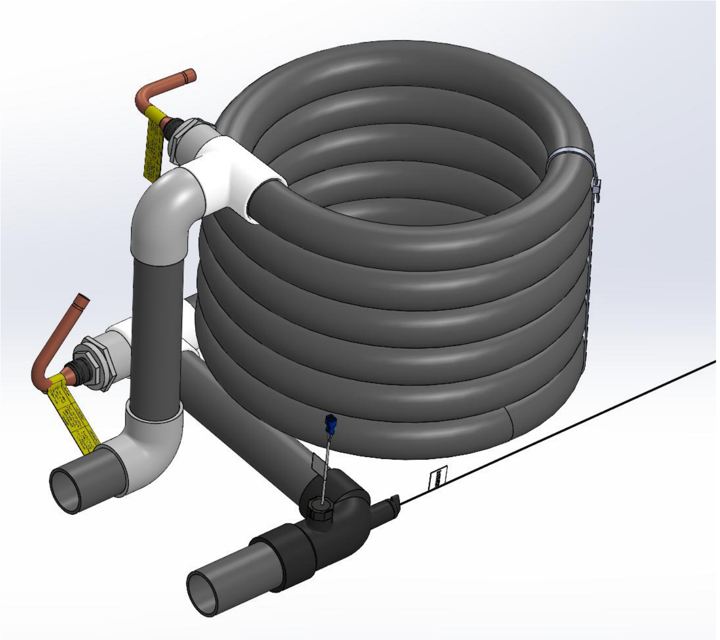


COAXIAL HEX SEGMENT: TROUBLESHOOTING TIPS –PART 1

1. Verify Water Flow
Insufficient water flow is the most common cause of heat exchanger performance issues.
Check:
•Water pump operation
•Dirty filters or strainers
•Closed valves
•Air trapped in the water loop
•Flow switch operation
Symptoms of Low Water Flow
•High head pressure
•High water temperature rise
•Reduced heating capacity
•High compressor amperage
2. Measure Entering and Leaving Water Temperatures
Take water temperature readings at the inlet and outlet of the heat exchanger.
Possible Findings
•Excessive temperature difference → Low water flow
•Little or no temperature difference → Poor heat transfer or refrigeration issue
Compare readings to manufacturer specifications whenever possible.

3. Check Refrigerant Pressures
Monitor suction and discharge pressures during operation.
High Head Pressure May Indicate:
- Low water flow
- Scaled heat exchanger
- Fouled water passages

Low Suction Pressure May Indicate:
- Low refrigerant charge
- Refrigerant restriction
- TXV problem



4. Check for Scale Buildup

Mineral deposits inside the water passages reduce heat transfer.

Symptoms

- High discharge pressure
- Reduced capacity
- Higher energy consumption
- Increased compressor run time

If scaling is suspected:

- Measure pressure drop across the heat exchanger
- Perform a cleaning or descaling procedure per manufacturer recommendations

5. Inspect for Refrigerant Leaks

Check for:

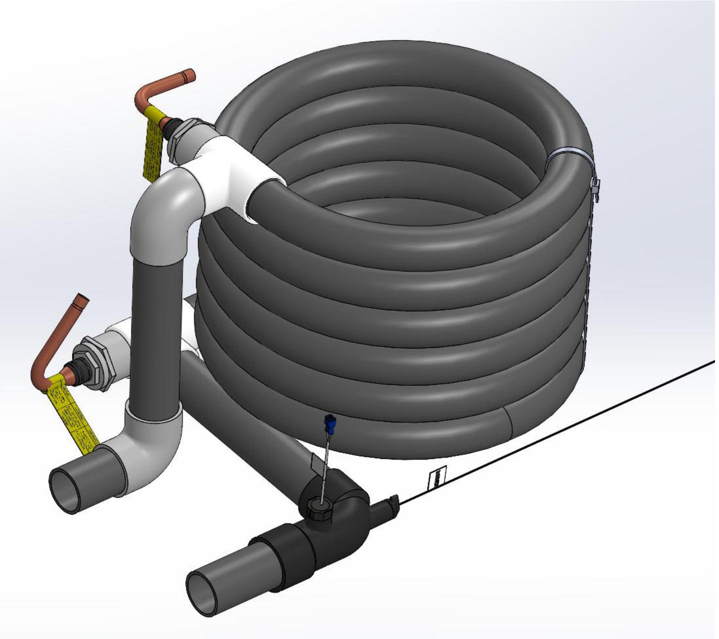
- Oil stains around brazed connections
- Damaged tubing
- Evidence of refrigerant loss

Use:

- Electronic leak detector
- Soap bubbles
- Nitrogen pressure test

Symptoms

- Low suction pressure
- Reduced capacity
- High superheat



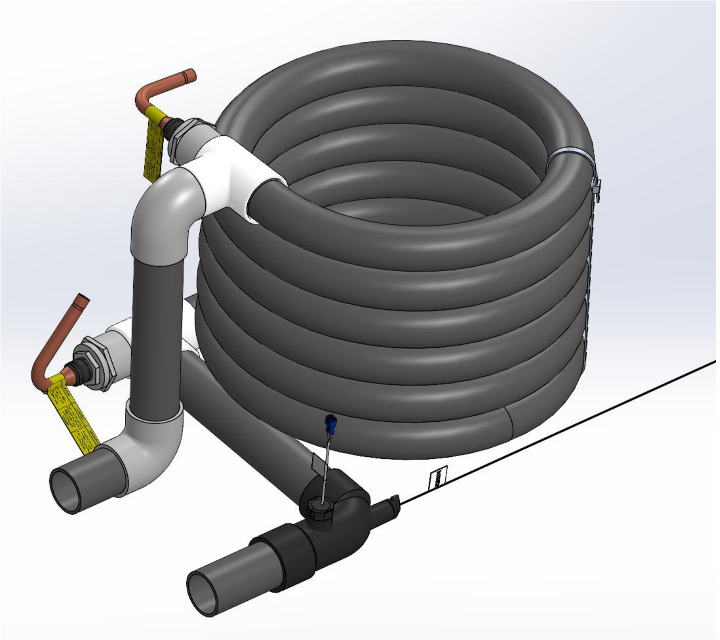
COAXIAL HEX SEGMENT: TROUBLESHOOTING TIPS-PART 3

6. Check for Internal Restrictions
A restriction in the refrigerant circuit can limit flow through the heat exchanger.
Possible Causes
- Debris from compressor failure
- Moisture contamination
- Restricted filter drier

Symptoms
- High superheat
- Low suction pressure
- Reduced heating performance

7. Check for an Internal Tube Failure
A damaged inner tube can allow refrigerant and water to mix.
Possible Indicators
- Unexplained refrigerant loss
- Water contamination
- Pressure abnormalities
- Water appearing in refrigeration components

This condition usually requires heat exchanger replacement.



FILTER DRIER SEGMENT: INFORMAT

What Is a Filter Drier in a Heat Pump?

A **filter drier** is a refrigeration system component designed to **remove moisture, acids, contaminants, and debris** from the refrigerant circulating through a heat pump.

Think of it as the system's **filter and moisture absorber combined into one device**.

Removes Moisture
•Contains a desiccant material that absorbs water from the refrigerant.
•Prevents ice formation at expansion devices and other restrictions.

Filters Contaminants
•Traps dirt, metal particles, solder residue, and other debris.
•Protects valves, metering devices, and the compressor.

Prevents Acid Damage
•Helps reduce acid formation caused by moisture and compressor burnout.
•Extends system component life.

Location in the System
In most heat pumps, the filter drier is installed in the **liquid line** between the:
•Condenser
•Expansion device (TXV or capillary tube)
It typically looks like a small cylindrical copper or steel canister brazed into the refrigerant line.

FILTER DRIER SEGMENT: TROUBLESHOOTING

Troubleshooting a Restricted Filter Drier

<u>Symptoms of a Restricted Filter Drier</u>

•Reduced heating and cooling capacity
•Low suction pressure
•High superheat
•Frost or ice forming at the filter drier inlet
•Significant temperature difference across the filter drier
•Longer run times

<u>Diagnostic Procedure</u>

1. Check Temperature Across the Filter Drier

•Measure the line temperature at both the inlet and outlet of the filter drier.
•A temperature drop of more than **3°F (2°C)** may indicate a restriction.
•Severe restrictions often create noticeable frost at the inlet.

2. Verify System Pressures

•Compare suction and discharge pressures to normal operating conditions.

- A restricted filter drier may cause:
- Low suction pressure
- Reduced refrigerant flow
- Elevated superheat

3. Inspect for Frosting

•Look for frost or condensation concentrated at the filter drier.
•Frost forming immediately before the drier is often a sign of refrigerant restriction.

4. Confirm Refrigerant Charge

•Verify the system charge is correct before diagnosing a restriction.
•An undercharged system can exhibit symptoms similar to a restricted filter drier.

Corrective Action

Replace the filter drier if:

•Excessive temperature drop exists across the drier.
•Frosting indicates a restriction.
•Pressure and temperature readings confirm restricted refrigerant flow.

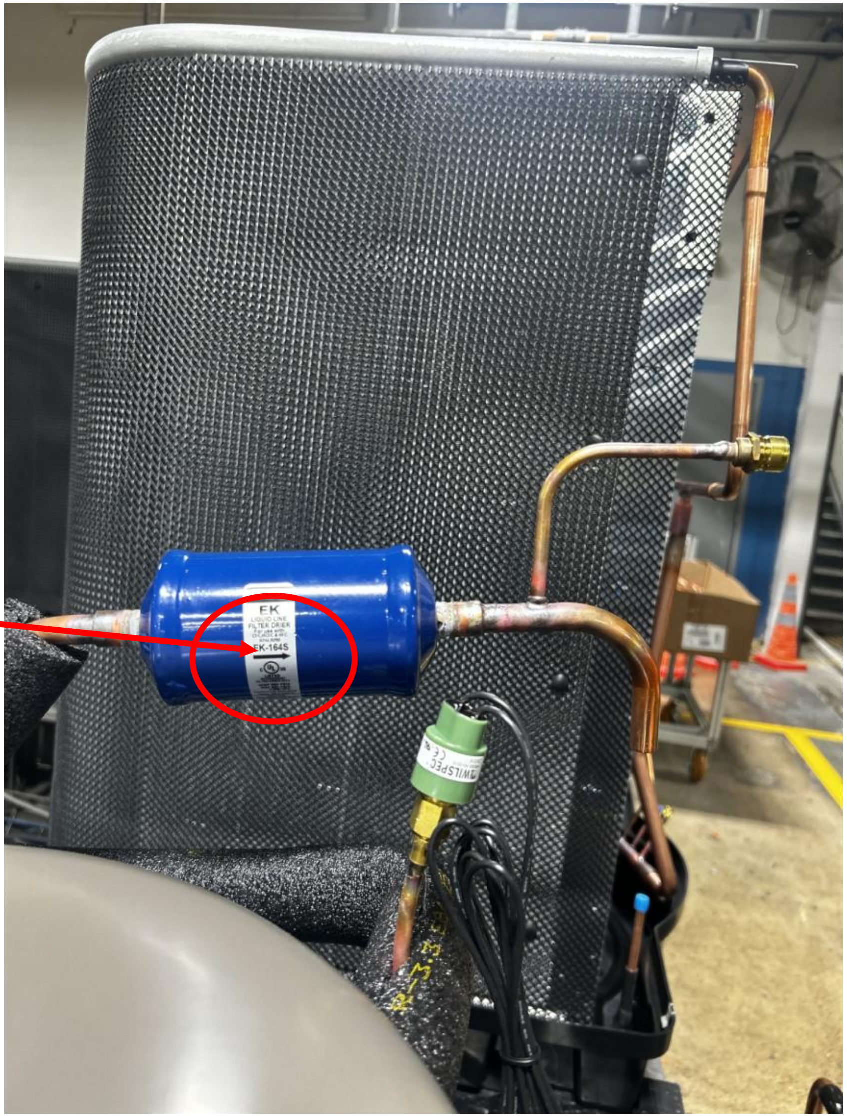
FILTER DRIER SEGMENT: INSTALL ORIENTATION

NOTICE: BIFLOW = ALLOWS FLOW BOTH DIRECTIONS
UNIFLOW = ONE WAY FLOW ONLY – USED ON HEAT-ONLY

PAY SPECIAL ATTENTION TO ORIENTATION OF FILTER DURING INSTALLATION

YOU CAN USE BIFLOW FILTERS ON HEAT ONLY AS WELL.

ARROW MUST POINTS TOWARD TXV FOR UNIFLOW FILTERS ON HEAT/ONLY APPLICATIONS



FILTER DRIER SEGMENT: TABLE OF PARTS

All Hayward HeatPro microchannel heat pumps come equipped with Emerson® filter driers. You are welcome to source a different brand. The table below shows equivalent brands. They are dimensionally the same.

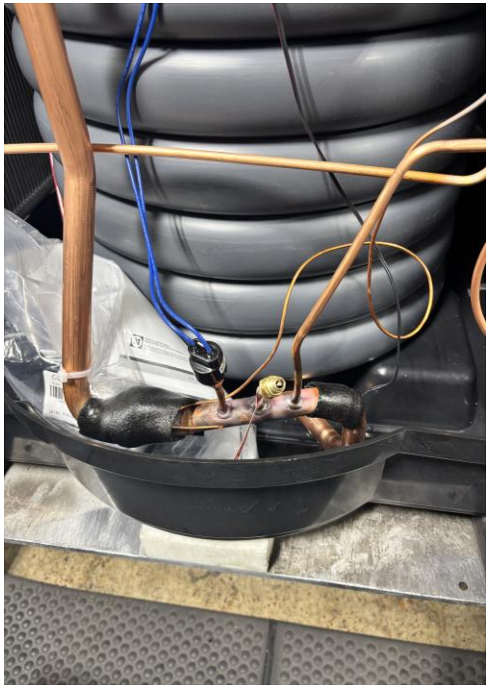
SUPPLIER	SUPPLIER PART NUMBER
EMERSON (FACTORY EQUIPPED ON THE HEAT/COOL MODELS)	BFK-164S (BIFLOW)
EMERSON (FACTORY EQUIPPED ON HEAT/ONLY MODELS)	EK 164S (UNIFLOW)
PARKER	BF-164S (BIFLOW)
PARKER	164S (UNIFLOW)
SANHUA	STGB-164S (BIFLOW)
SANHUA	DTGA-084S (UNIFLOW)
SPORLAN	C-164S (UNIFLOW)
SPORLAN	HPC-164-S (BIFLOW)

TXV SEGMENT: INFORMATION

All Hayward HeatPro microchannel heat pumps use a Sporlan thermal expansion valve rated for 5-tons, and 30% bleed, for R-410A. Thermal Expansion Valves are metering devices used to flash the refrigerant from a liquid, into a saturated vapor/liquid mixture. This ensures when it enters the evaporator coil (microchannel coil) it can evaporate and completely change back into vapor by the time it re-enters the suction port.

When replacing a TXV, keep the bulb far away from braze work area to prevent damage / over heating bulb

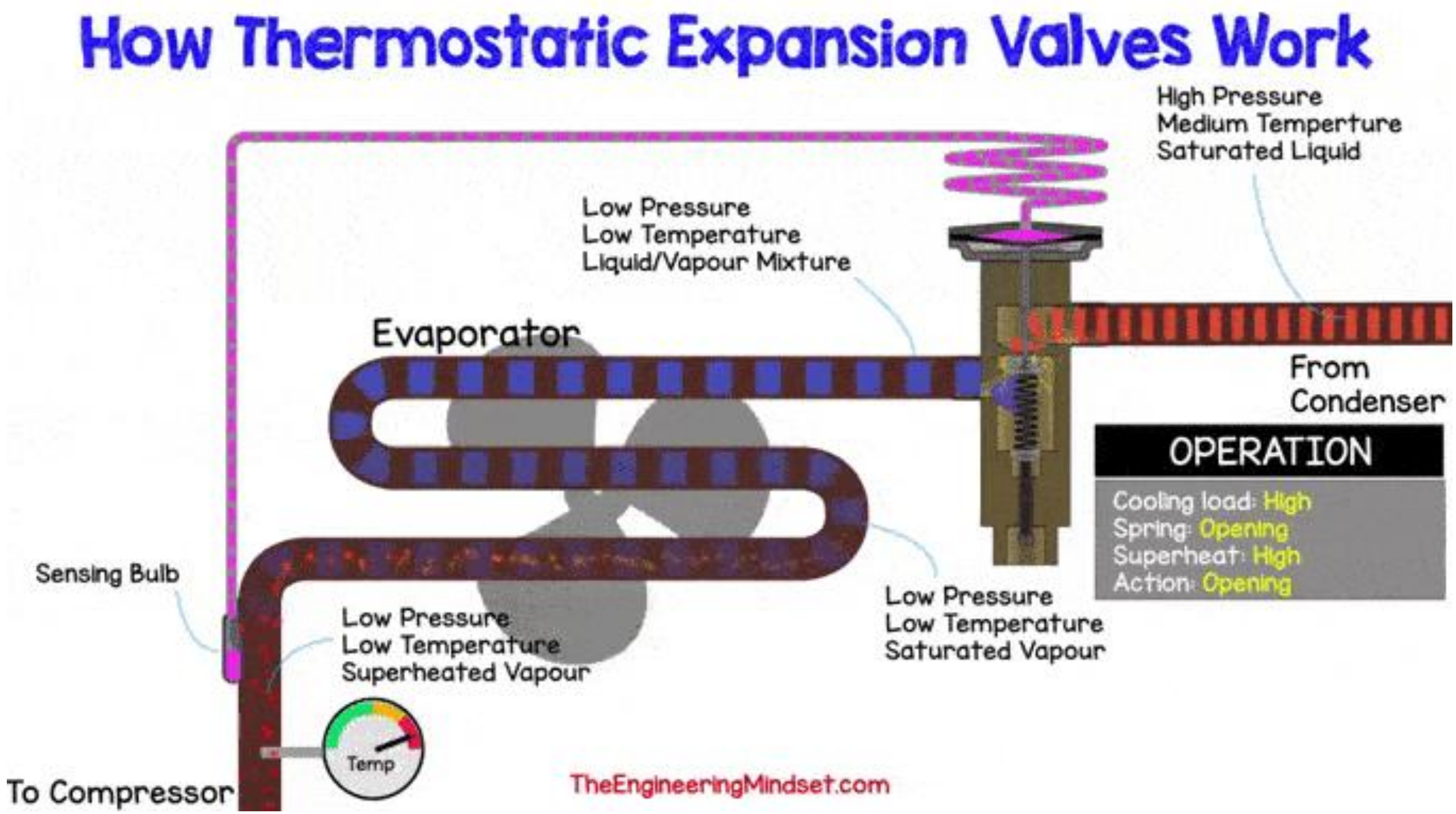
Mount bulb with insulated black Tacky Tape (also known as Cork Tape.)



A failed TXV could be **failed closed or failed open. Contaminants / debris can cause restrictions. A broken spring or internal defect can cause it to be stuck open.**

TXV PART NUMBER
ALL MODELS: HPX51701081801

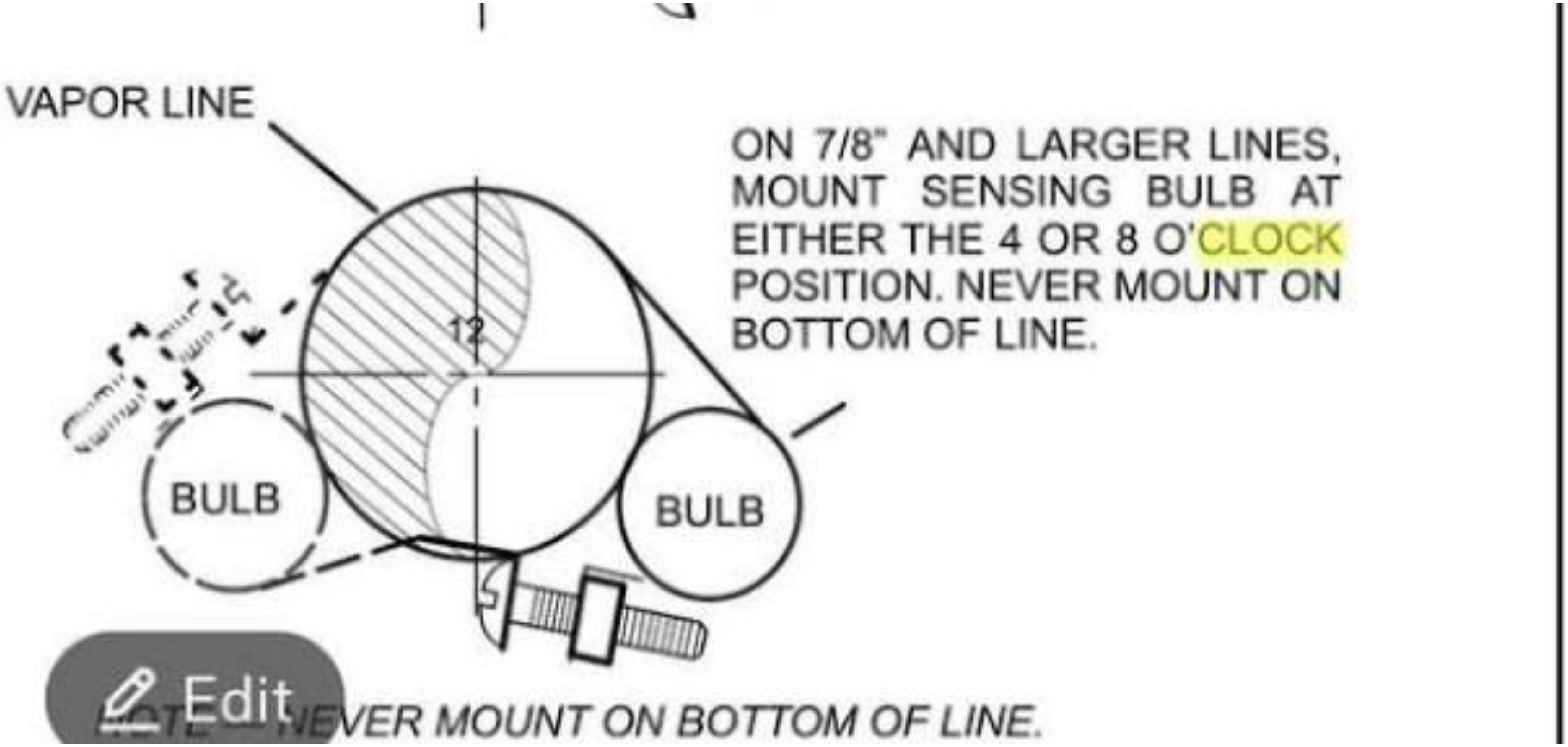
TXV SEGMENT: HOW A TXV WORKS



TXV PART NUMBER
ALL MODELS: HPX51701081801

TXV SEGMENT: MOUNTING GUIDELINES FOR TXV

Install on a horizonal SEGMENT of suction tube. You are viewin ga cut-SEGMENT of a tube.
4 or 8 O'Clock mounting position



TXV PART NUMBER
ALL MODELS: HPX51701081801

TXV SEGMENT:TROUBLESHOOTING TIPS FOR A SUSPECTED FAILED TXV

Check for Blockages and Pressure Drops

- **Stuck Closed:** You will see a vacuum or near 0 PSI on the suction side, while the head pressure rises significantly.
- **High Superheat:** The valve is likely restricted or stuck closed (starving the coil). The evaporator will run extremely cold, potentially freezing over.

•**Low Superheat:** The valve is likely stuck open (flooding the coil).

Perform the "Hand-on-Bulb" Test

- To test if the valve mechanism is internally jammed or still able to move:
- Locate the TXV's brass sensing bulb clamped to the suction line.
- Remove the insulation and hold the bulb firmly in your hand to warm it up.
- A working valve will open to allow more refrigerant, causing the suction pressure to rise and superheat to drop.
- If the suction pressure and superheat remain entirely unchanged, the valve is internally jammed and must be replaced

Verify System Charge and Subcooling

Before blaming the TXV, ensure the system has a full charge.

•Connect your gauges to check high-side and low-side pressures.

•Measure subcooling at the condenser liquid line. If you do not have factory-specified subcooling (typically around 15-20°F on a warm day between 75°F-85°F, the system is low on charge. A bad TXV cannot be accurately diagnosed unless the liquid line is full

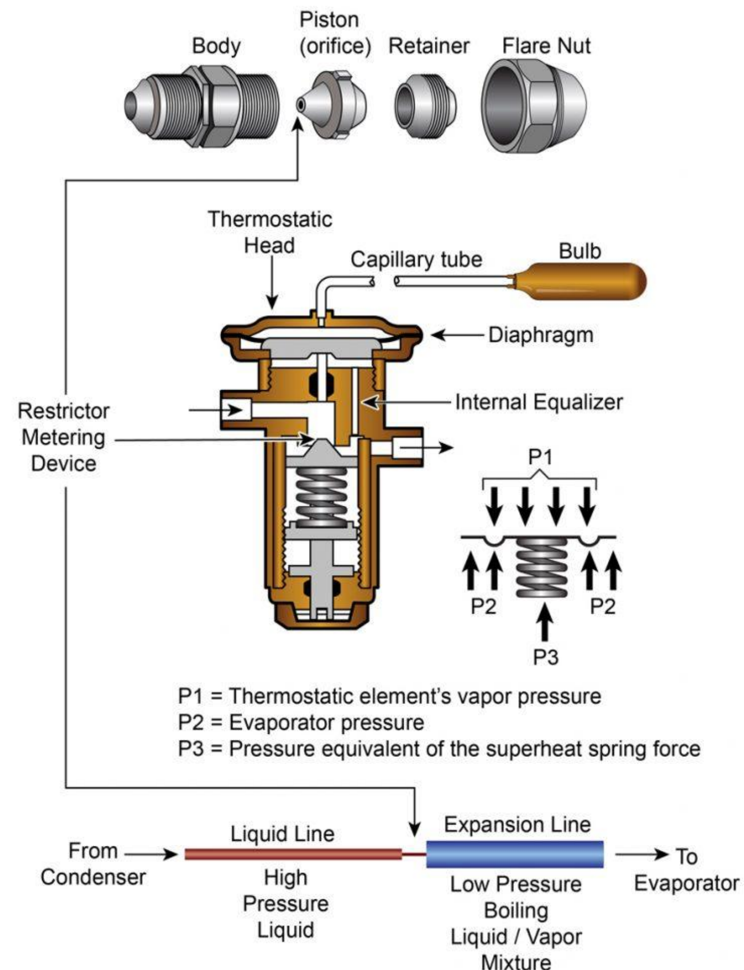


Image courtesy of HVACR School ; reference: [Link to Reference]

TXV PART NUMBER
ALL MODELS: HPX51701081801

TXV SEGMENT: WHY WOULD A TXV FAIL OPEN?

Causes of a TXV Failing Open
A TXV that is stuck or failed **open** allows too much refrigerant into the evaporator, resulting in **low superheat** and potentially liquid refrigerant returning to the compressor.

Common Causes

1. Failed Power Element (Lost Charge)
•The bulb and power head contain a refrigerant charge that controls valve movement.
•If the power element fails internally, the valve may lose proper control and remain excessively open.

2. Debris Preventing Valve Closure
•Dirt, metal shavings, moisture, or contamination can lodge between the valve seat and needle.
•This prevents the valve from closing completely, causing overfeeding.

3. Oversized TXV
•A TXV selected for a larger system may consistently overfeed the evaporator.
•Symptoms can resemble a TXV stuck open.

4. Loose or Improperly Mounted Sensing Bulb
•If the bulb loses thermal contact with the suction line, the TXV may receive incorrect temperature information.
•Depending on conditions, the valve can overfeed the evaporator.

5. Moisture or Wax Buildup
•Contamination inside the valve can interfere with normal movement of internal components.
•This may cause erratic operation or a valve that remains partially open.

6. Weak or Broken Internal Spring
•The spring helps regulate valve position.
•A damaged spring can reduce closing force and allow excessive refrigerant flow.

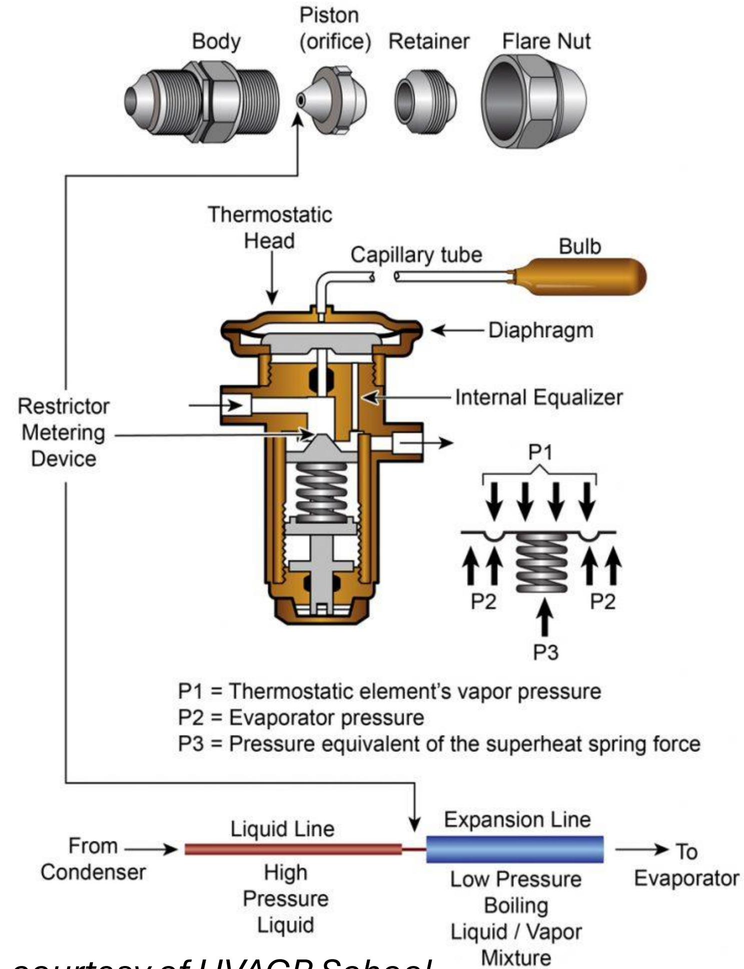


Image courtesy of HVACR School ; reference: [Link to Reference]

TXV PART NUMBER

ALL MODELS: HPX51701081801

TXV SEGMENT: WHY WOULD A TXV FAIL CLOSED?

Causes of a TXV Failing Open
A TXV that is stuck or failed **open** allows too much refrigerant into the evaporator, resulting in **low superheat** and potentially liquid refrigerant returning to the compressor.

Common Causes

1. Failed Power Element (Lost Charge)

•The bulb and power head contain a refrigerant charge that controls valve movement.

•If the power element fails internally, the valve may lose proper control and remain excessively open.

2. Debris Preventing Valve Closure

•Dirt, metal shavings, moisture, or contamination can lodge between the valve seat and needle.

•This prevents the valve from closing completely, causing overfeeding.

3. Oversized TXV

•A TXV selected for a larger system may consistently overfeed the evaporator.

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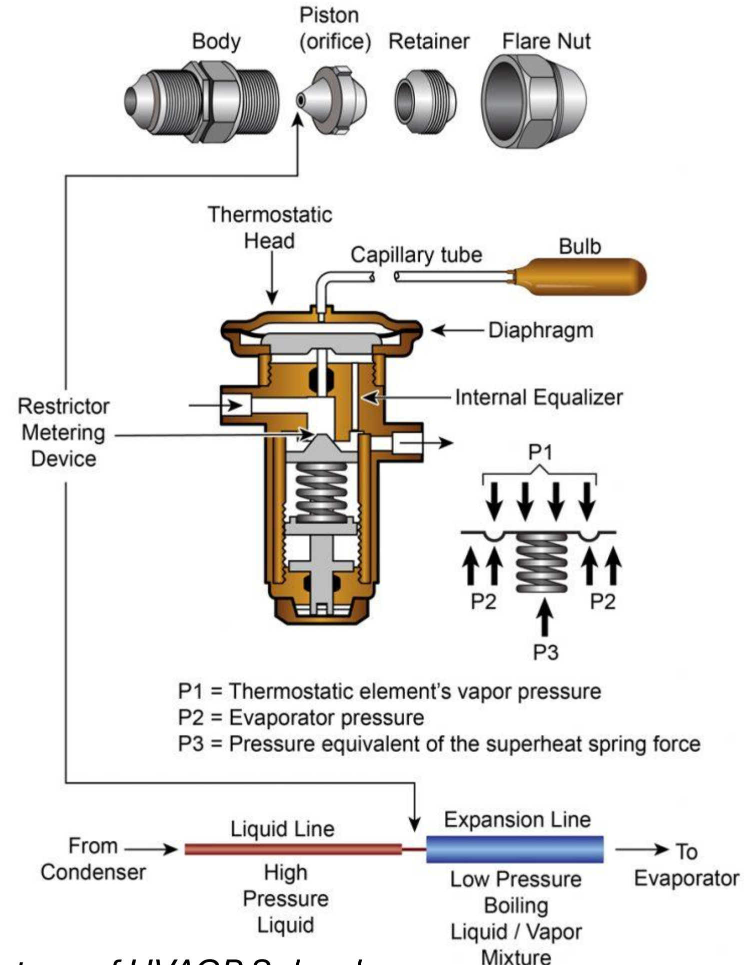


Image courtesy of HVACR School ; reference: [Link to Reference]

TXV PART NUMBER
ALL MODELS: HPX51701081801

TXV SEGMENT: MORE TROUBLESHOOTING INFO

Q: What is the correct way to diagnose a TXV?
A: First, take all of your refrigerant readings and your liquid line and suction temperature. This means superheat, subcooling, suction saturation (evaporator coil temp), and liquid saturation (condensing temp). For a TXV to do what it is supposed to, you need a full line of liquid before the TXV. That means you need at least 1°F of subcooling in theory, but in reality, you will want to make sure that you have the factory-specified subcooling, which is usually around 15-20°F.

The next thing that a TXV needs is enough liquid pressure to have the required pressure differential. This amount of required pressure differential will vary a bit based on the valve. Usually, we want to see a 100 PSI minimum difference between the liquid line pressure and the desired evaporator pressure. If the head pressure drops too low due to low ambient conditions, this can come into play and impact the ability of the valve to do its job.

Once this is all confirmed, then it is simply a matter of checking the superheat at the end of the evaporator. Most A/C systems will maintain 6-14°F of superheat at the evaporator outlet. If it is in that range, then the valve isn't bad; it's doing its job.

Q: How do they fail?
A: A TXV **may fail either too far open or too far closed.** Too far open is also called "overfeeding," meaning that boiling refrigerant is being fed too far through the evaporator coil; this would show up in low superheat.

If the TXV fails closed, it can be said to be "underfeeding," which means that not enough boiling refrigerant is fed through the evaporator coil; superheat will be too high at the evaporator outlet.

These failures can and do occur, but they are usually caused by contaminants or moisture in the system that have worked their way to the valve and caused it to stick or become restricted.

Other causes of valve failure include rub-outs on the bulb tube or an external equalizer without a core depressor installed on a port that has a Schrader core in place.

When a valve is overfeeding, the first thing to check is bulb insulation, placement, and strapping. If the bulb isn't properly sensing the suction line, it can lead to the valve remaining too far open.

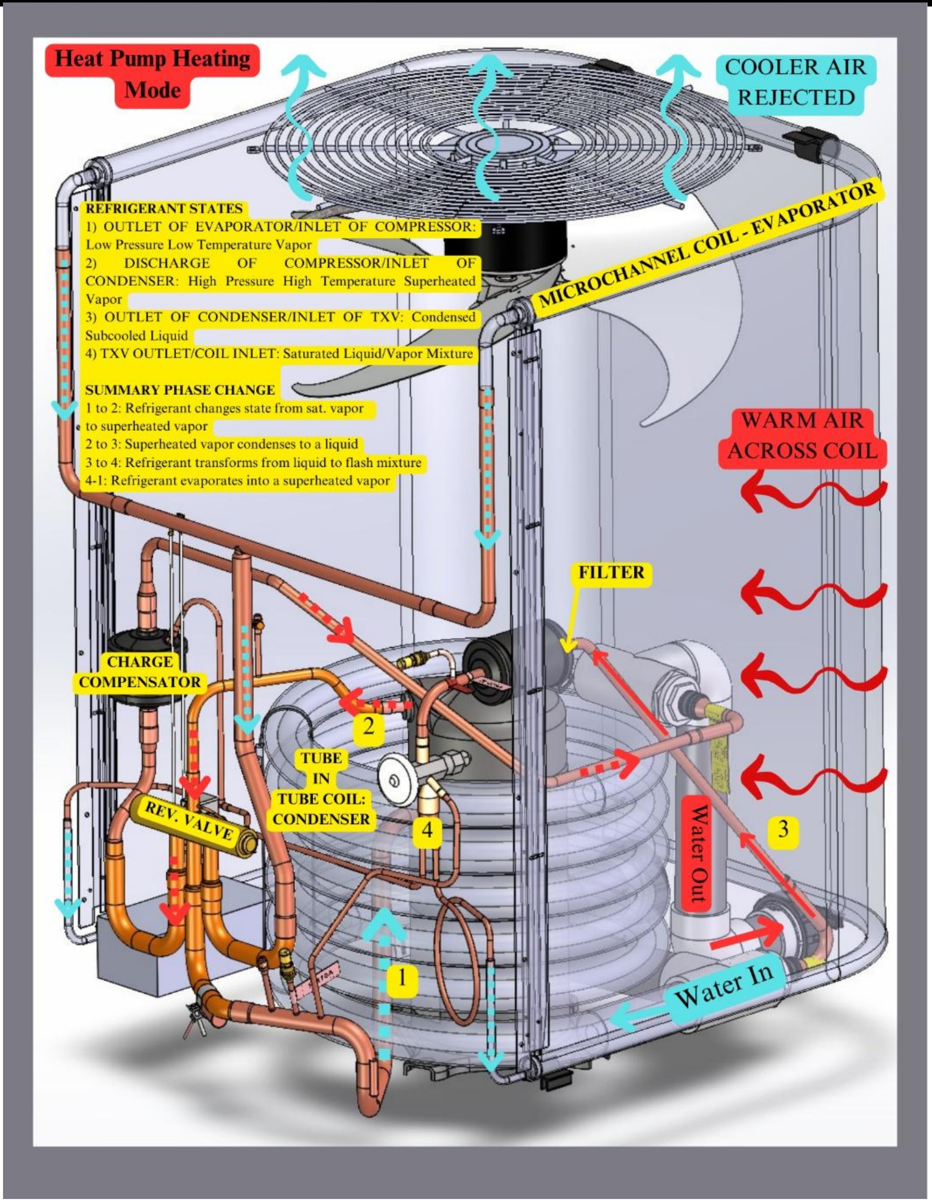
Info courtesy of HVACR School ; reference: [Link to Reference]

TXV PART NUMBER
ALL MODELS: HPX51701081801

BASIC SEQUENCE OF OPERATION – HEATING MODE

1. WATER ENTERS THE INLET OF THE CONDENSER.
2. WATER IS HEATED BY HOT REFRIGERANT.
3. WATER EXITS CONDENSER.

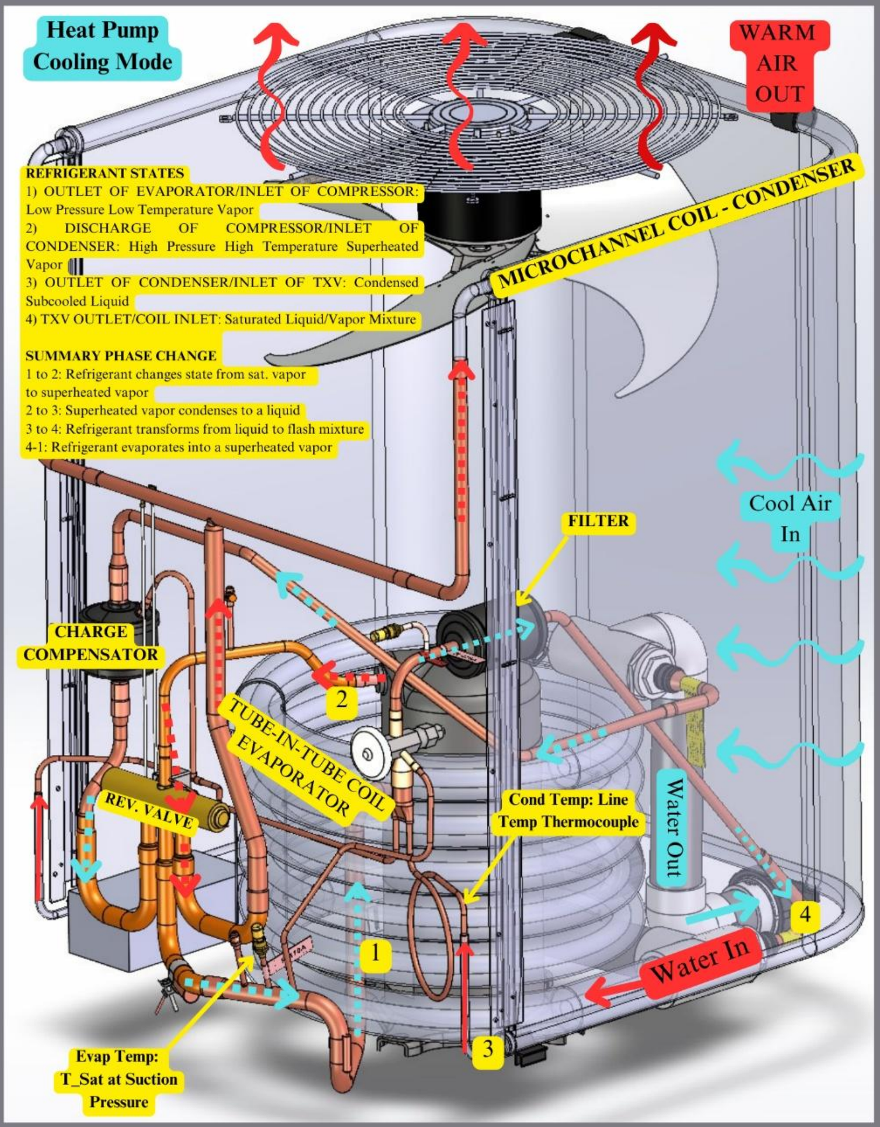
IN HEATING MODE, THE EVAPORATOR COIL IS THE MICROCHANNEL COIL, AND THE SPIRAL TUBE-IN-TUBE COIL IS THE CONDENSER COIL.



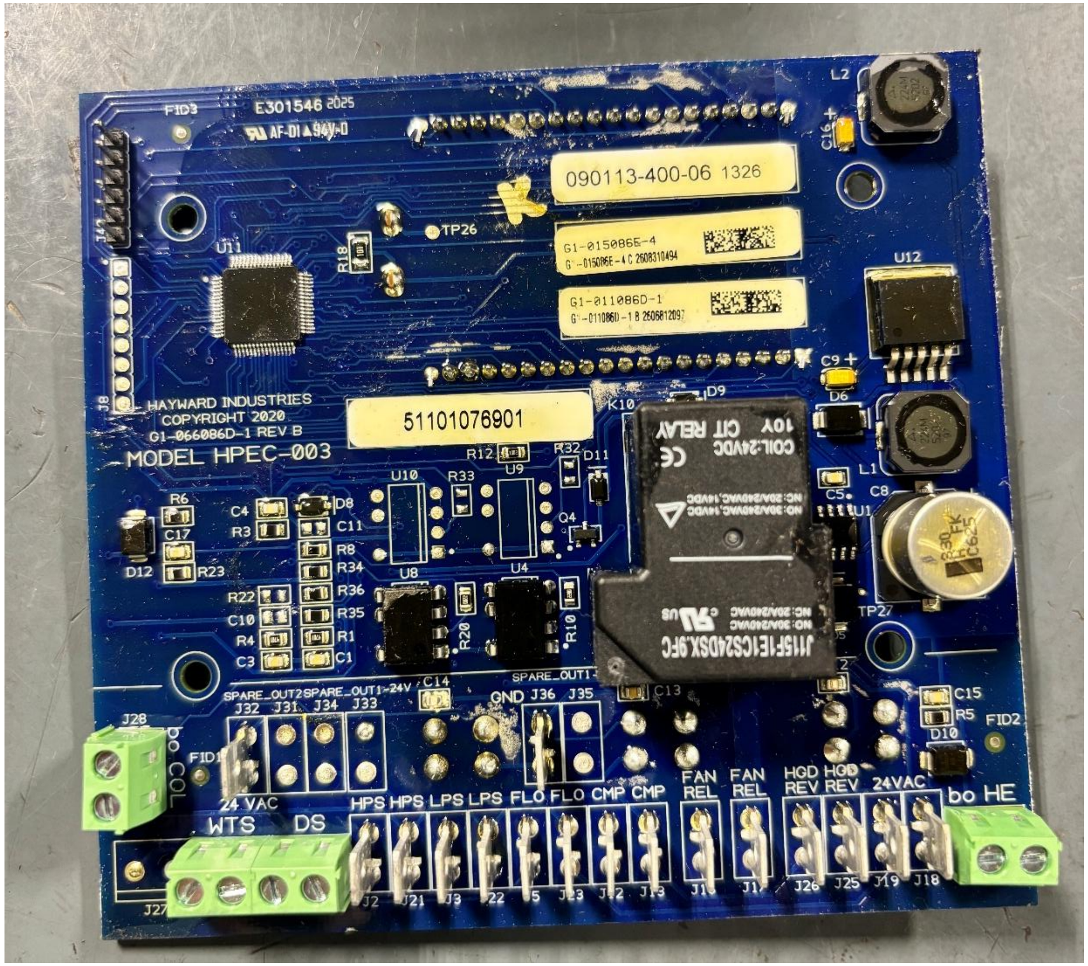
BASIC SEQUENCE OF OPERATION – COOLING MODE

1. WATER ENTERS THE INLET OF THE CONDENSER.
2. WATER IS COOLED BY HOT REFRIGERANT.
3. WATER EXITS CONDENSER.

THE MICROCHANNEL COIL NOW FUNCTIONS AS THE CONDENSER COIL, AND THE TUBE-IN-TUBE COIL FUNCTIONS AS THE EVAPORATOR.



CONTROL BOARD OVERVIEW IMAGE

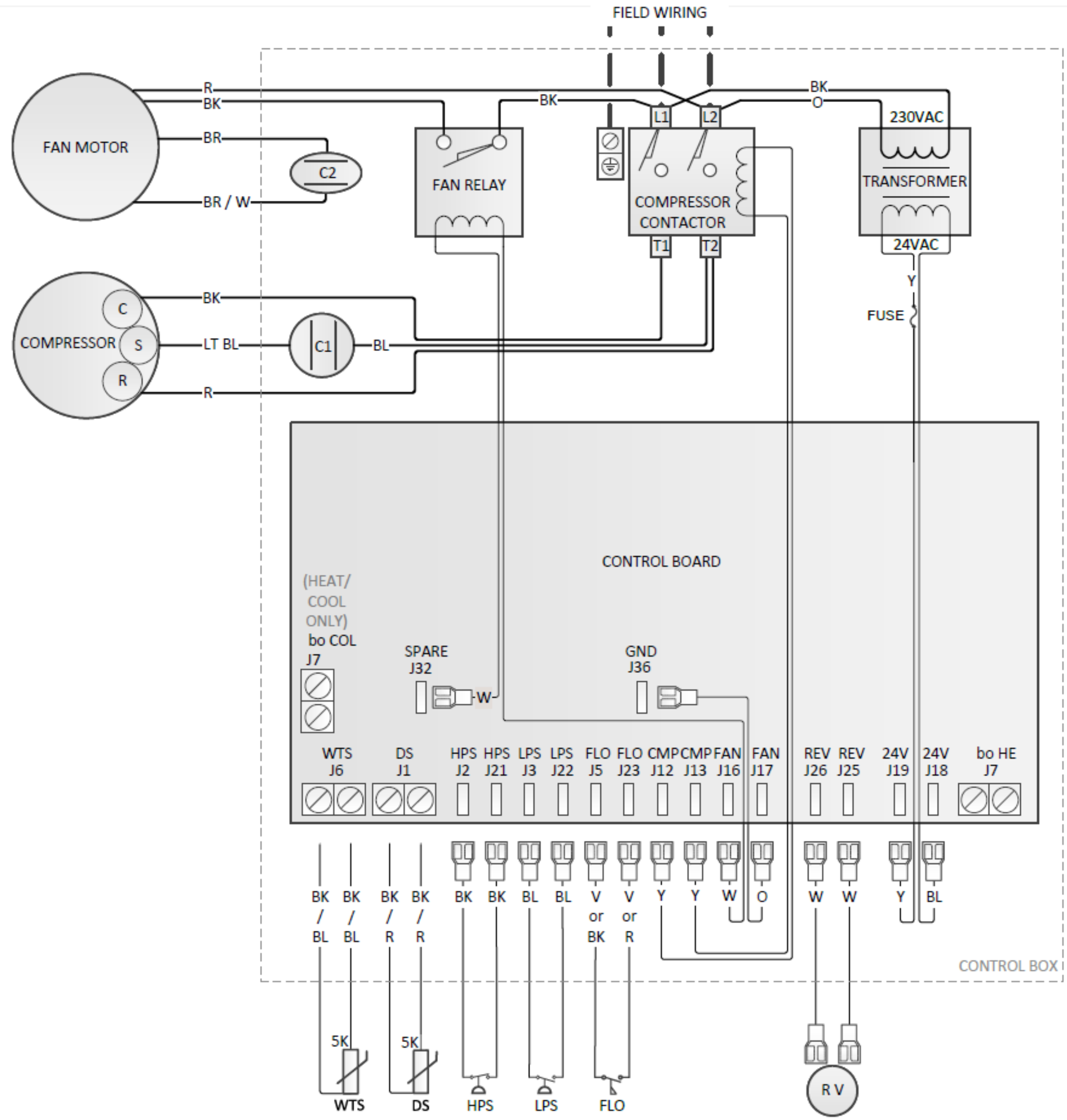


WIRING DIAGRAM GEN 5 HEAT PUMP MCHX

51300122901 REV B
230 VAC, 1 ~, 60 Hz

Field Wiring 230 VAC
230 VAC
24 VAC

WTS	Water Temperature Sensor	*Pressostat d'eau*	*Interruptor de presión de agua*
DS	Defrost Sensor	*Capteur de dégivrage*	*Sensor de descongelación*
HPS	High Pressure Switch	*Pressostat haute pression*	*Interruptor de alta presión*
LPS	Low Pressure Switch	*Pressostat basse pression*	*Interruptor de baja presión*
FLO	Flow Switch	*Interrupteur de débit*	*Interruptor de flujo*
RV	Reversing Valve	*Vanne d'inversion*	*Válvula de inversión*
C1	Capacitor, Compressor	*Condensateur, compresseur*	*Condensador, compresor*
C2	Capacitor, Fan	*Condensateur, ventilateur*	*Condensador, ventilador*
bo HE	Bypass Operation, Heating	*Fonctionnement en dérivation, chauffage*	*Operación de derivación, calefacción*
bo COL	Bypass Operation, Cooling	*Fonctionnement en dérivation, refroidissement*	*Operación de derivación, refrigeración*
BK	BLACK	*NOIR*	*NEGRO*
BL	BLUE	*BLEU*	*AZUL*
O	ORANGE	*ORANGE*	*NARANJA*
R	RED	*ROUGE*	*ROJO*
V	VIOLET	*VIOLET*	*VIOLETA*
W	WHITE	*BLANC*	*BLANCO*
Y	YELLOW	*JAUNE*	*AMARILLO*



CONDENSATION ON THE AIR-SIDE COIL - NOTICE

The heat pump evaporator coil develops condensation on the surface during heating mode operation. This is especially evident in climates with greater than 65% relative humidity. This condensation will travel into the base-pan, where channels divert it out of the base pan onto the pad.
The heat pump base pan design allows for a drain line to be attached using readily available components to drain this water away if it is a problem. In most installation situations however, this moisture simply runs off the pad and is absorbed into the ground.

TESTING FOR A POOL WATER LEAK

1. Shut the unit off. A true leak from the plumbing, or heat-exchanger will continue to leak regardless of the unit operating or not.

2. Test the water with a chlorine test strip. If the water shows no or very low levels of chlorine the water is condensation. If the test strip shows levels of chlorine as high as typical pool water, there is a water leak from the appliance.

MENUS & NAVIGATION – ACCESS SERVICER MENU

1. PRESS THE MENU KEY AND HOLD UNTIL THE WORD "LOC" IS SHOWN
2. CYCLE UP TO OPTION 50 WITH THE PLUS KEY
3. PRESS MENU KEY TO ENTER AND OPEN THE SERVICE MENU
4. CYCLE THROUGH SERVICE MENU USING MENU KEY
5. WHEN LANDED ON THE OPTION TO CHANGE, USE + OR – TO ADJUST SETTING
6. THEN PRESS MENU KEY TO SAVE

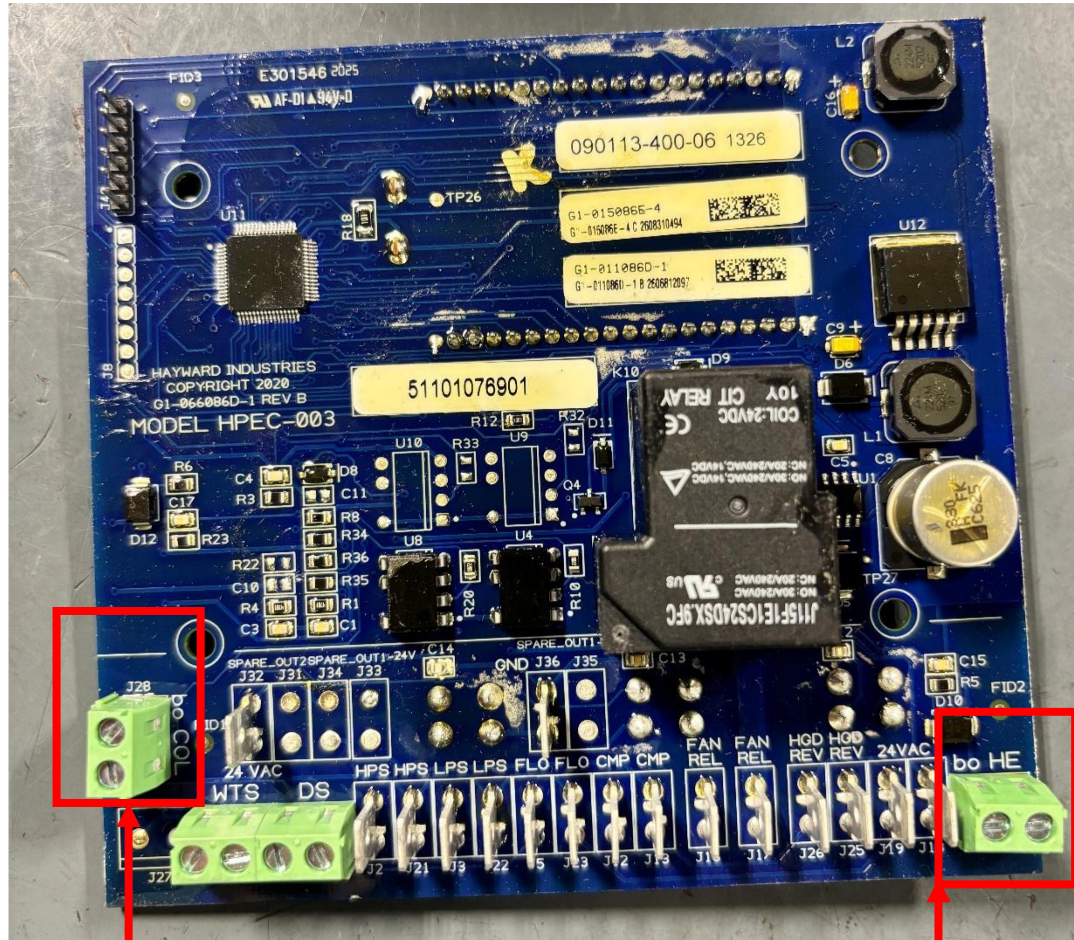
TO RETURN TO IDLE SCREEN, DON'T PRESS ANYTHING FOR 10 SECONDS

HOW TO ENABLE BYPASS MODE

1. PRESS MENU AND "+" AND HOLD
2. WHEN LCD DISPLAYS "BO" RELEASE BUTTONS IMMEDIATELY.
3. WAIT UNTIL IT FLASHES ONCE TO SAVE.

HOW TO EXIT/DISABLE BYPASS MODE

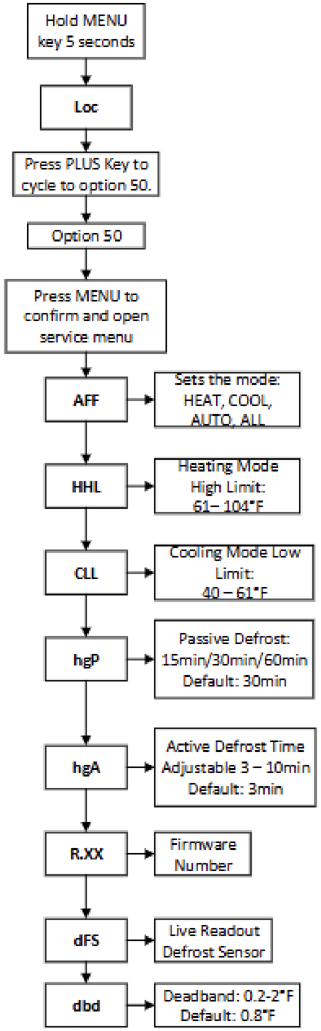
1. PRESS MENU AND "+" AND HOLD
2. WHEN LCD DISPLAYS "n" RELEASE BUTTONS IMMEDIATELY.
3. WAIT 8-10 SECONDS.



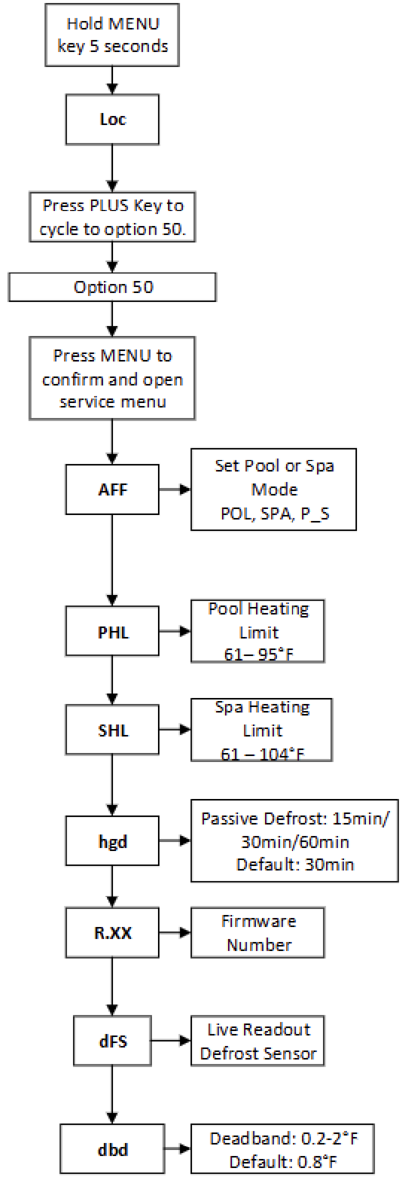
COOLING MODE BYPASS TERMINALS – (NOT POPULATED ON HEAT/ONLY BOARDS)

HEATING MODE BYPASS OPERATION TERMINAL

MENUS & NAVICATION – CHEAT SHEET – HEAT/COOL



MENUS & NAVIGATION – CHEAT SHEET – HEAT-ONLY



EXPLORING ERROR CODES: SUMMARY SHEET

FLO
- The pump is not running.
- The filter is dirty or clogged.
- Shortage of water to pump - air leak.
- Undersized pump.
- Valves not in correct position.
- Filter in backwash mode.
- Water flow switch defective, stuck open or closed

HP
- Low water flow to heat pump, ensure 30GPM-60GPM
- High load condition, unit exceeding design operation ambient outdoor temp +110 F
- Faulty high-pressure switch stuck closed

LP
- Evaporator (MICROCHANNEL) coil dirty.
- Fan motor not running.
- Low refrigerant pressure.
- Defective low-pressure switch.
- Low ambient air temperature.

SO
- Water temperature sensor “open circuit”

Check wire for knicks/landed properly

SS
- Water temperature sensor “shorted circuit”

Check wire for shorts, cuts, landed properly

DEF
- Unit in defrost – wait for cycle to finish.
- Please see defrost slides for information on logic of defrost.

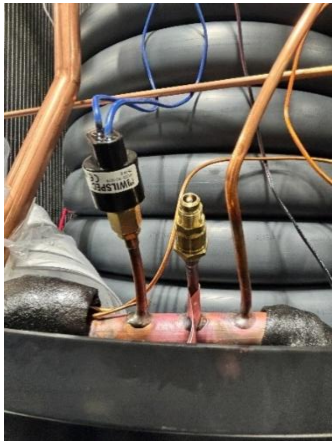
dSO
- Defrost sensor “open circuit”

Check sensor on suction line of compressor, wires on board landed properly

dSS
- Defrost sensor “short circuit”

Check sensor wires/are they landed to board correctly?

EXPLORING ERROR CODES: “LP” – LOW PRESSURE SWITCH

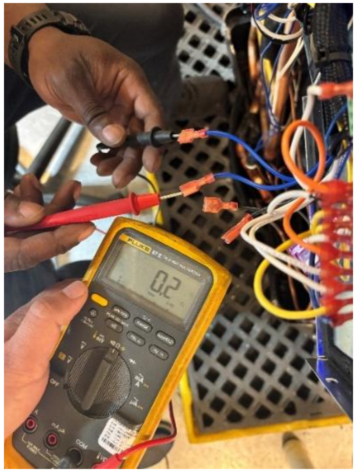


THE L.P. SWITCH HAS BLUE WIRE LEADS

NAME	INFORMATION
LOW PRESSURE SWITCH	REPLACEMENT PART: HPX51100118601
OPEN PRESSURE	50 +/- 5 PSIG
CLOSE PRESSURE	100 +/- 7 PSIG

STEPS TO FOLLOW

1. Check pressure of heat pump during run state with gauge set.
2. If pressure is low, there is a leak.
3. If pressure is good, check the switch. Test for continuity. Meter should read “OL” with a LPS code displayed.
4. If switch good, pressure good, check evaporator coil for dirt/debris. Ensure fan motor works. And in temperatures that are cold i.e. < 50°F low pressure can occur. We recommend not running below 50°F.



Other Common Causes of a “LP” code

- Evaporator coil dirty
- Fan motor not running.
- Low ambient air temperature in heating mode. The lowest temperature we recommend is 50°F. In some climates low pressure error codes will display at 55°F if the humidity is high.

FLOW CHART: LOW PRESSURE SWITCH ERROR CODE- "LP"

Heat pump runs for a few seconds
Then shows LP

Does fan come on when heat pump runs?

NO → Check fan motor and fan capacitor
Replace as needed

YES → Attach gauges to heat pump
Does suction pressure fall below 50PSI when heat pump is running?

YES → Heat Pump low on refrigerant

Perform leak check on heat pump.
Leak found?

YES → Repair leak, evacuate system to 500 microns vacuum, and recharge with refrigerant

Heat pump will not operate, shows LP.
Ambient Temp above 32^{o} F?

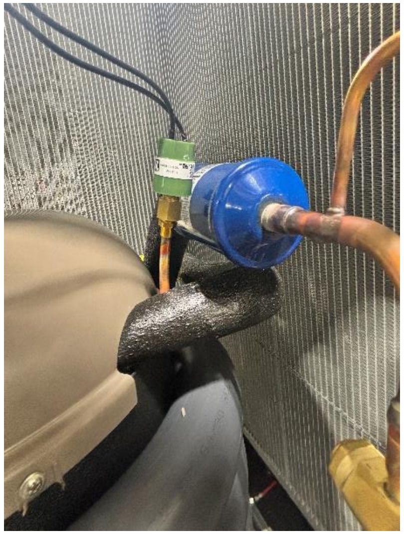
NO → Hayward design calls operation 50°F – 110°F

YES → Measure pressures
Greater than 120psig?

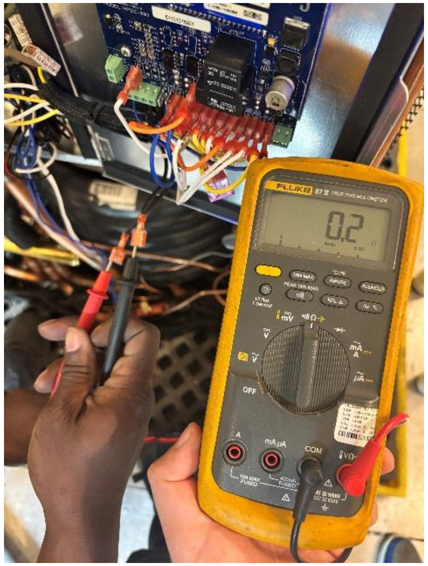
NO → Perform leak check on heat pump.
Leak found?

Check continuity on LP switch.
If you test no continuity AND the LCD reads "LP" that means the pressure switch is good. Check for leaks
If you read continuity, and there is no code that says "LP" that also means the switch is good.
If you read continuity, and there is a code "LP" displayed, then the board is bad.

EXPLORING ERROR CODES: “HP” – HIGH PRESSURE SWITCH



THE HIGH-PRESSURE SWITCH HAS BLACK WIRE LEADS.



NAME	INFORMATION
HIGH PRESSURE SWITCH	REPLACEMENT PART: HPX11024258
OPEN PRESSURE	440 +/- 15PSIG
CLOSE PRESSURE	590 +/- 25PSIG

STEPS TO FOLLOW

1. High refrigerant pressure – the most common cause is a low water flow; check pump flow rate ≥ 30 GPM.
2. Test for continuity. In “HP” error code state, the meter should read “OL.” In closed state of the switch with NO ERROR CODE, you will read a small resistance 0.1-0.3 Ω. If the switch is closed, yet you read a “HP” error code, then you may have a bad board, replace board.
3. We recommend a maximum of 110°F outdoor temperature for our heat pumps. Exceeding this limit or going below can cause the high-pressure switch to trip.

Other Causes of “HP” Error Code

Thermostatic Expansion Valve (TXV) failure:

- Loss of charge in the power head of the TXV closes the valve and will result in a HP error code.
- To determine if this is the problem, observe both high and low pressure readings when heat pump is running.
- If TXV is bad high pressure will quickly rise to 590PSI, while at the same time the low pressure will quickly drop.

Refrigerant Overcharge: Overcharge of the heat pump is unlikely, but not impossible. Heat pumps do not leave the factory overcharged, so the only way it can occur is if service has been previously performed on the system and the technician overcharged the refrigerant after or during a repair.

- To determine if this is the issue recover all refrigerant from the system, pull a 500-micron vacuum, and then recharge to factory charge (on data plate). Please use proper recovery/evacuation/vacuum/charging procedure **and weigh in the charge when re-charging**.

FLOW CHART: HIGH PRESSURE SWITCH ERROR CODE- "HP"

Does the heat pump operate intermittently then trip high pressure? I.e. runs 5min, trips, then runs again.

- YES → Please read notes.
- NO → Are the HP switch leads crimped securely? Are they seated securely onto the board terminals. Please check, re-seat if needed. Is your pump flow rate ≥ 30GPM? Filter clean?

YES →

Perform continuity test
If HP code shows on screen, continuity should show OPEN LINE.
If HP code does NOT shown on screen, you should read a small resistance: 0.1-0.4 Ω

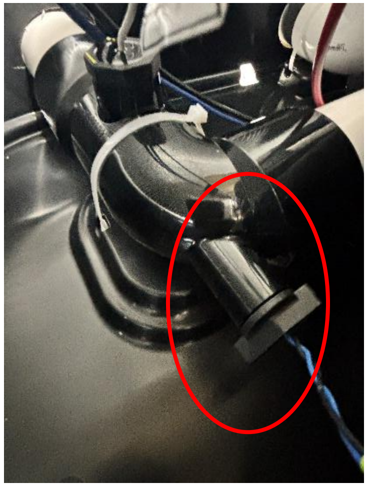
Continuity Test Passed?

- YES → Replace high pressure switch
- NO → Replace high pressure switch

Notes

Intermittent HP trips are usually due to low water flow rate. A common problem when running unit on spa exists when spa temperature of about 100° F is reached and the unit shuts off with the 'HP' fault.
At higher outdoor and water temperatures a higher flow rate may be required for proper operation. The unit requires a minimum of 30 GPM, but may require more under these conditions. HP after the heat pump has run for a few seconds could be an indication of a failed TXV. If the failure is caused by the TXV, the low side (suction) pressure will fall rapidly once the compressor is running, and the high side (head) pressure will rise rapidly above 590 PSI.

EXPLORING ERROR CODES: "SS" AND "SO"



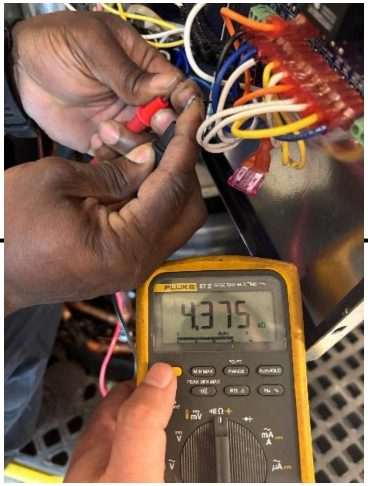
SS – WATER TEMP SENSOR SHORT

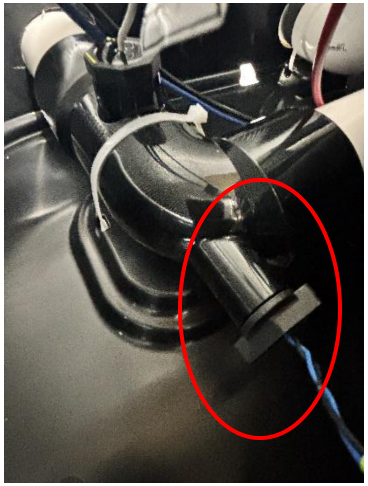
1.CHECK THE WIRE LEADS WHERE THEY LAND ON THE BOARD UNDER THE "WTS" SCREW TERMINAL BLOCK. ENSURE THEY AREN'T SHORTED i.e. TOUCHING OR IN SAME PORT.

2.IF THE WIRES ARE LANDED CORRECTLY, BUT THE "SS" CODE IS STILL THERE, CHECK THE WIRES TO SEE IF THEY ARE CUT/KNICKED.

3.MEASURE THE RESISTANCE OF THE SENSOR.

This is a 4.7k ohm sensor meaning at 77 degrees F (25C) the sensor should read 4.7k ohms resistance





SO – WATER TEMP SENSOR OPEN

1.CHECK THE WIRE LEADS AND ENSURE THEY ARE LANDED PROPERLY UNDER "WTS" TERMINAL ON BOARD. EACH LEAD HAS TO BE SEATED SECURELY INTO THE SCREW TERMINAL SEAT.

2. IF THE WIRES ARE LANDED CORRECTLY, BUT THE "SS" CODE IS STILL THERE, CHECK THE WIRES TO SEE IF THEY ARE CUT/KNICKED.

3.MEASURE THE RESISTANCE OF THE SENSOR.

This is a 4.7k ohm sensor meaning at 77 degrees F (25C) the sensor should read 4.7k ohms resistance

FLOW CHART: "SO" & "SS"

- Check control board wires.
- Make sure the crimped connectors are secure and not landed in same terminal.
- Ensure they are seated securely.

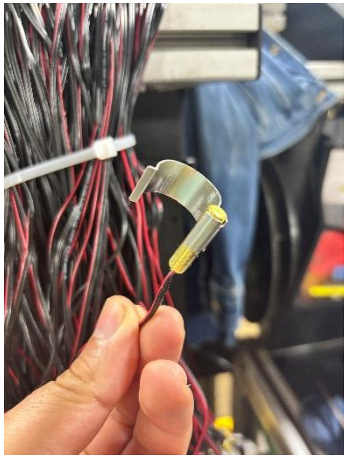
- Wiring integrity good, no shorts?

YES

- Check control board wires.
- Ensure both wires are securely connected to terminal and not loose.
- Check along wire for open circuit/cuts/knicks.

- Wiring integrity good, no visible open circuit?

YES



Replace Water Inlet Thermistor

EXPLORING ERROR CODES: "DSO" AND "DSS"

dSO Display Error (Open Defrost Sensor)

Error Description

A **dSO** code indicates that the **defrost temperature sensor circuit is open**.

Note: This error is frequently misread as **d50** on the display. Verify the code carefully before troubleshooting.

Troubleshooting Procedure

1. Inspect the Defrost Sensor and Wiring

•Check the defrost sensor wiring for:

- Broken wires
- Loose connections
- Damaged terminals

2. Evaluate Results

Replace the defrost sensor if:

•Resistance is **infinite (open circuit)**, or

Replace the control board if:

•Wiring is intact, but the **dSO** error remains active.

Common Cause

The most common cause of a **dSO** error is a **failed (open) defrost temperature sensor**.

Key Points

•**Display Code:** dSO

•**Indicates:** Open defrost temperature sensor circuit

•**Most Common Cause:** Failed defrost sensor

•**Secondary Cause:** Faulty control board

SS Display Error (Shorted Defrost Sensor)

Error Description

A **dSS** code indicates that the **defrost temperature sensor circuit is shorted**.

Note: This error is frequently misread as **d55** on the display. Verify the code carefully before troubleshooting.

Troubleshooting Procedure

1. Inspect the Defrost Sensor and Wiring

•Check the defrost sensor wiring for:

- Shorted wires
- Damaged insulation
- Pinched or grounded conductors
- Loose or damaged connections

2. Evaluate Results

Replace the defrost sensor if:

•Resistance is **0 Ω (short circuit)**, or

•Resistance is significantly lower than the value specified on the chart.

Replace the control board if:

•The sensor resistance matches the chart values, and

•Wiring is intact, but the **dSS** error remains active.

Common Cause

The most common cause of a **dSS** error is a **failed (shorted) defrost temperature sensor**.

Key Points

•**Display Code:** dSS

•**Indicates:** Shorted defrost temperature sensor circuit

•**Most Common Cause:** Failed defrost sensor

•**Secondary Cause:** Faulty control board

FLOW CHART: DSO & DSS

Do you have a short circuit? Check board terminals, wire terminals, wire length/integrity. Perform continuity testing.

YES

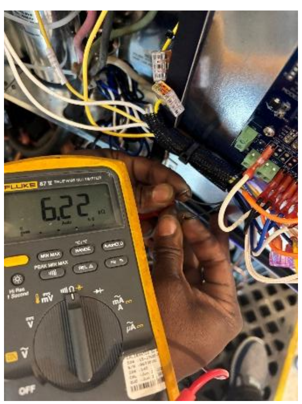
Fix the wires.

Do you have an open circuit? Perform continuity test.

YES

Fix the wires.

Replace defrost thermistor. It's the one located on the suction line.



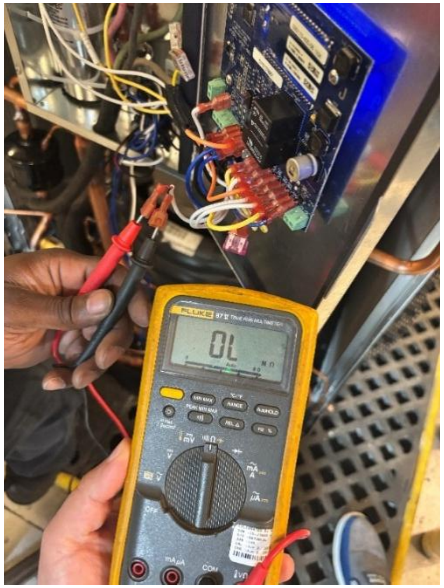
EXPLORING ERROR CODES: "FLO"

Troubleshooting Steps for “flo” error Code

1. Ensure pump is on, filter for pump is not clogged, and min. flow rate is 15GPM.
2. If filter is clean, pump on, and FLO appears, check wiring on board.
3. Ensure wires are crimped properly and seated to board terminals. Check integrity of wires for cuts/knicks. Check continuity of flow switch, with ZERO flow, meter will read OPEN LINE. With water flowing, continuity should be present.

To test continuity of flow switch:

Remove wires from control board to flow switch
With pump running check continuity through the switch
If switch is closed there should be no resistance (0 ohms)
If switch is open there will be infinite resistance.



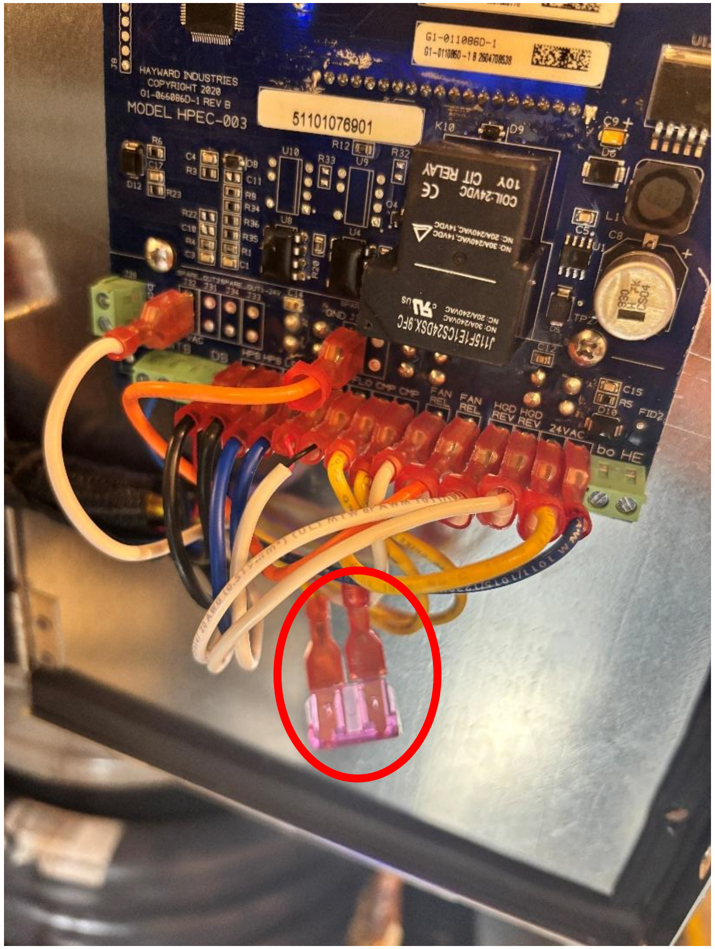
FLOW CHART DIAGNOSTIC: "FLO"

Check that the wiring is properly seated on board.

Test for continuity of the sensor. It should be open by default with no flow (OL). With flow, it should read continuity.

- Open the bypass valve if it is shut
- Check and make sure the time clock (if equipped) is not in OFF cycle
- Check if pump is operating
- Check for dirty pump filter

EXPLORING ERRORS: BLANK DISPLAY



Troubleshooting a Blank Display

Verify Power Supply

1.Check for **240 VAC** at the contactor **L1 and L2** terminals.

2.If 240 VAC is present, measure voltage between the transformer's **blue and yellow wires**.

3.Verify **24 VAC** is present at the transformer output.

4.Ensure the board fuse (3A) is not blown.

1. Shorted or Pinched Low-Voltage Wiring

•Inspect wiring connected to the **high-pressure and low-pressure switches**.

•Check for:

- Pinched wires
- Short circuits
- Ground faults

2. Defective Contactor Coil

•Measure coil resistance across the **yellow wires**.

•Expected resistance: **10–12 Ω** (approximately 11 Ω).

•Verify there is **no continuity to ground**.

Replace the contactor if:

•Resistance is outside the 10–12 Ω range, or

•Any continuity to ground is detected.

3. Defective Fan Relay

•Measure coil resistance across the **white wires**.

•Expected resistance: **100–130 Ω**.

•Verify there is **no continuity to ground**.

Replace the relay if:

•Resistance is outside the 100–130 Ω range, or

•Any continuity to ground is detected.

EXPLORING ERROR CODES: "DEF' OR "FS"

Heat Only Models Defrost Information
Defrost Operation
•When the **defrost sensor detects a suction line temperature of ≤ 24°F (-4°C)**, the control board shuts off the **compressor** while allowing the **fan to continue running**.
•The display will indicate **"FS"**.
Return to Normal Operation
•The heat pump remains in this mode until the defrost timer expires. Default value = 30min from factory. See "HGP" in service menu to adjust (hgp = defrost timer, passive, 15/30/60min)
•Once the timer expires, AND the board detects a suction line temperature of ≥ **42°F (6°C)** defrost ends.
•Once defrost ends, **compressor restarts** and the unit returns to **normal heating operation**.

Key Defrost Parameters
•**Defrost Initiation Temperature:** 24°F
•**Defrost Termination Temperature:** 42°F
•**Display Code During Defrost:** FS
•**Fan Operation:** Continues running
•**Compressor Operation:** Disabled during defrost cycle, resumes at 42°F

Defrost Sequence (Heat/Cool Mode)
Defrost Initiation
•When the **defrost sensor detects a suction line temperature of ≤ 24°F (-4°C)**, the control board shuts off the **compressor** while allowing the **fan to continue running**.
•The display will indicate **"def"**.
Defrost Monitoring
•The system remains in this mode until either:

- The defrost timer (set to 30min, hgd expires)
- **T_Suction Line ≥ 42°F**

Active Defrost Operation
•If the coil temperature does not reach **42°F** or greater after the passive defrost, active cycle initiates.

- The **fan is turned off**.
- The **reversing valve is energized**.
- The **compressor restarts**.

This allows **hot refrigerant gas** from the compressor to flow through the outdoor coil, melting any accumulated frost. This process is set by default to last 3min.
Return to Normal Operation
•After the active defrost timer expires, the unit will resume normal operation.
Key Defrost Parameters
•**Defrost Initiation Temperature:** 29°F
•**Defrost Termination Temperature:** 42°F
•**Maximum Passive Defrost Time:** 60min (user adjustable in service menu) "hgP"
•**Maximum Active Defrost Time:** 10min (user adjustable in service menu) "hgA"
•**Display Code During Defrost:** def
•**Fan Operation:** Runs initially; turns off during active defrost
•**Compressor Operation:** Off during passive defrost; restarts during active defrost
•**Reversing Valve:** Energized during active defrost cycle only

EXPLORING DEFROST: PASSIVE DEFROST

PASSIVE DEFROST

Is the suction line temperature ≤ 24°F

YES

PASSIVE defrost (timer for defrost timer is “hgd” in service menu) initiated, “def” shown on display

Passive defrost “hgd” is force to run for time = hgd setting. And if after t = 30min, suction line temperature ≥ 42°F?

YES

Passive Defrost Ends

Passive defrost works by moving ambient air across the frozen coil to melt ice.

Passive defrost initiates when the suction line temperature drops below 24°F. If after 3 attempts it fails, the unit goes into idle/non-running state.

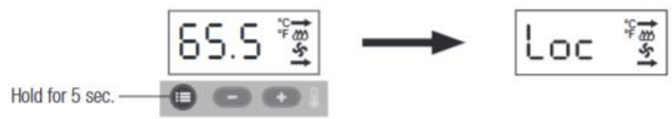
EXPLORING PASSIVE DEFROST: SETTINGS

Defrost Function for Heat Only models: For Heat Only models, "FS" will show on the display when in defrost mode. To initiate defrost mode, the defrost sensor must read less than or equal to 24°F. Passive defrost initiates once the defrost sensor reads 24°F. The compressor switches off and the fan continues to operate to pull ambient air over the evaporator coil.

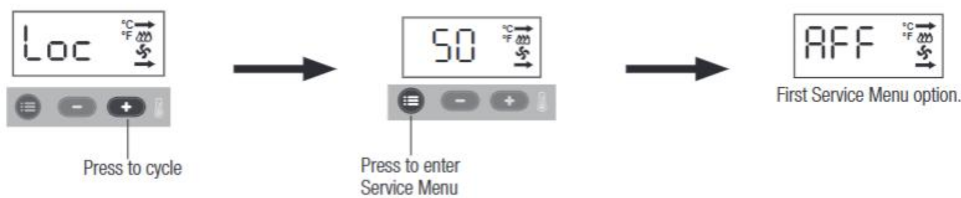
Passive defrost runs for a set mandatory time with the default being 30 minutes. The passive defrost time can be adjusted to 15, 30, or 60 minutes in the service menu under the "hgd" menu. Once the passive defrost timer expires, normal unit operation will resume.

Adjusting the Defrost Time (Heat Only)

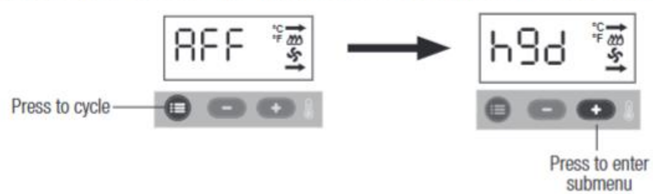
1. Starting from the main screen, press and hold the **MENU** button for about 5 seconds until the display reads "Loc".



2. From the Loc screen, press the **PLUS (+)** button and cycle to option "50". Press the **MENU** button to enter the service menu. The first service menu option ("AFF") will display.



3. Press the **MENU** button and cycle to access the "hgd" submenu. Press the **PLUS (+)** button to enter the submenu.



4. Press the **PLUS (+)** button to cycle through the defrost time options (15 min, 30 min, or 60 min). After selecting a defrost time, press the **MENU** button to save the setting and return to the "hgd" screen. After about 10 seconds, the display will automatically exit service mode and return to the main screen.

EXPLORING DEFROST: ACTIVE DEFROST

PASSIVE DEFROST INITIATES FIRST

Is the suction line temperature ≤ 24°F

YES

PASSIVE defrost “HGP” initiated, “def” shown on display

Passive defrost is forced to run for time set by “hgp”
(see service menu, default= 30min)
If after t = 30min, suction line temperature ≥ 42°F?

YES

Passive Defrost Ends

NO

INITIATE ACTIVE DEFROST “HGA” DISPLAYS

ACTIVE DEFROST: FAN OFF, COMPRESSOR ON, REVERSING VALVE ON: SENDING HOT REFRIGERANT INTO EVAPORATOR COIL TO MELT ICE– MINIMUM 3MIN

CYCLE ENDS

NORMAL OPERATION RESUMES

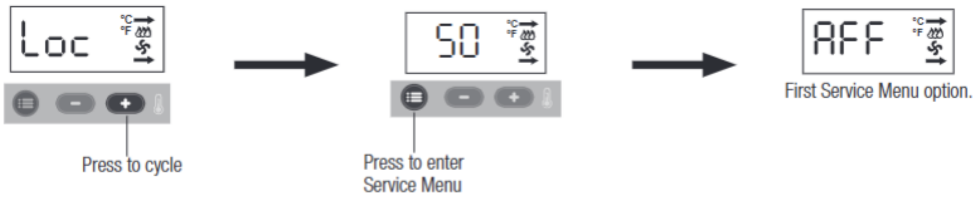
Active defrost is a back-up system if passive defrost fails for models equipped with a reversing valve. It’s coded as “HGD” and the minimum forced run time is 3min. You can adjust it up to 10min via the service menu.

EXPLORING ACTIVE DEFROST: SETTINGS

Adjusting the Defrost Time (Heat/Cool)

1. Starting from the main screen, press and hold the **MENU** button for about 5 seconds until the display reads "Loc".

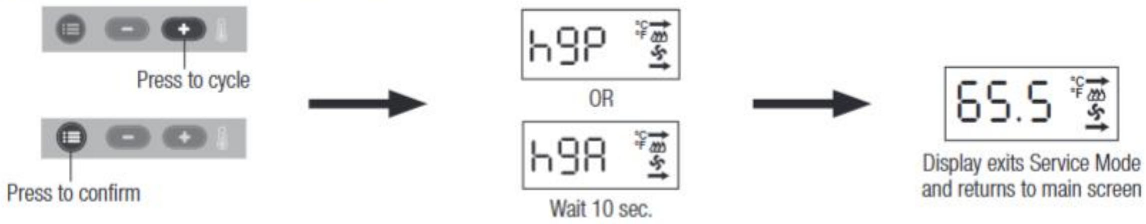
2. From the Loc screen, press the **PLUS (+)** button and cycle to option "50". Press the **MENU** button to enter the service menu. The first service menu option ("AFF") will display.



3. Press the **MENU** button and cycle to access the "hgP" submenu for Passive Defrost or "hgA" for Active Defrost. Press the **PLUS (+)** button to enter the submenu.

4. Press the **PLUS (+)** button to cycle through the defrost time options:
   a. Passive Defrost (hgP): 15 min, 30 min, or 60 min
   b. Active Defrost (hgA): 3-10 min

   After selecting a defrost time, press the **MENU** button to save the setting and return to the "hgP" or "hgA" screen. After about 10 seconds, the display will automatically exit service mode and return to the main screen.

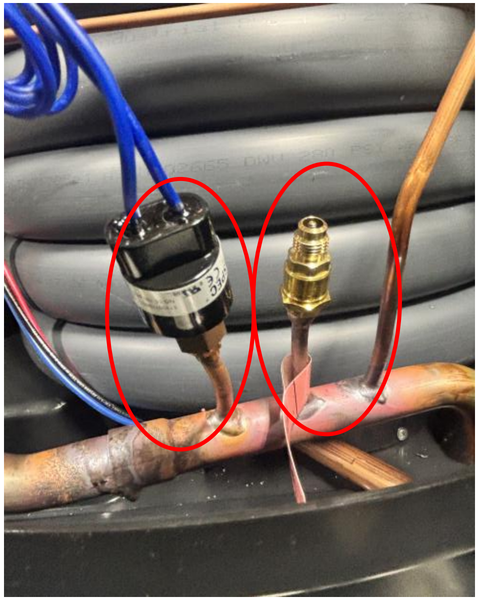


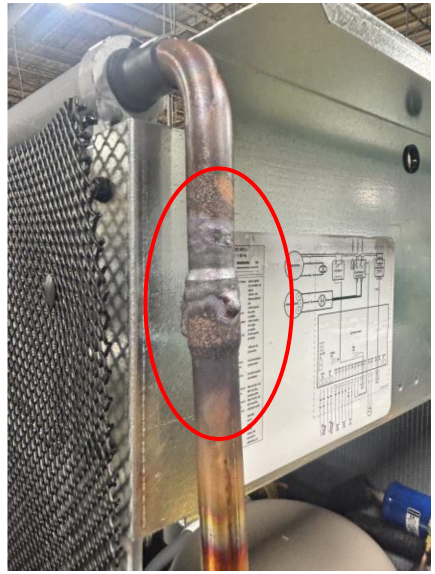
REFRIGERANT LEAKS SEGEMENT: INTRO

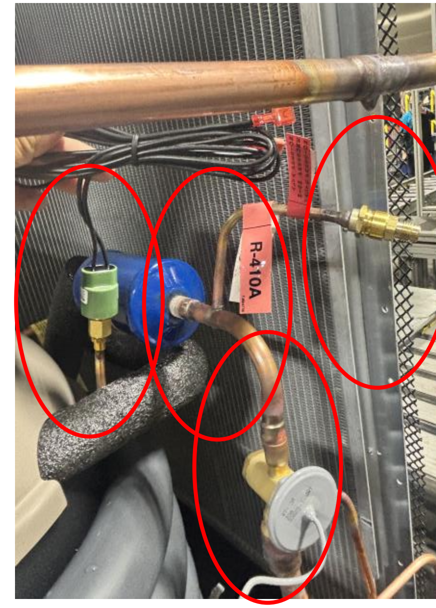
There's several known ways to find a refrigerant leak.

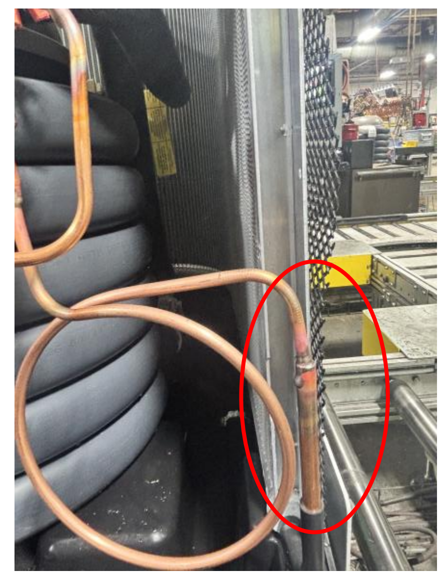
1. Hand-held leak detector
2. Nitrogen + Bubble Spray Detector
3. Flourescent Dye

REFRGIERANT LEAKS SEGMENT: AREAS TO SCAN









REFRIGERANT LEAKS SEGMENT: DETECTION TECHNIQUES – HAND-HELD LEAK DETECTOR

A handheld leak detector is a quick and easy way to scan suspected components/points of the system for leaks.

- CHECK SERVICE STUBS, AND FOR LEAKING SCHRAEDER VALVES
- CHECK BRAZE JOINTS
- CHECK AREAS ON THE COIL WHERE FINS ARE DAMAGED WHILE UNIT OPERATES
- THESE HAND-HELD DETECTORS ARE GREAT FOR QUICK SCANS, BUT THEY DON'T ALWAYS FIND SMALL LEAKS.

REFRIGERANT LEAKS SEGMENT: DETECTION TECHNIQUES – NITROGEN AND BUBBLE SPRAY

- **A second proven method** of finding leaks it to pressurize the system with nitrogen and use a liquid leak detector such as Big Blue to detect leaks.

Recommended pressurization: 300psig

REFRIGERANT LEAKS SEGMENT: DETECTION TECHNIQUES– UV LIGHT AND FLOURESCENT DYE

A third proven method is to inject a fluorescent dye into the system and use an ultraviolet light to detect the leak.

Given the sophistication of today's systems as well as the compact designs we believe that having a dye system leak detector is a requirement in your tool box.

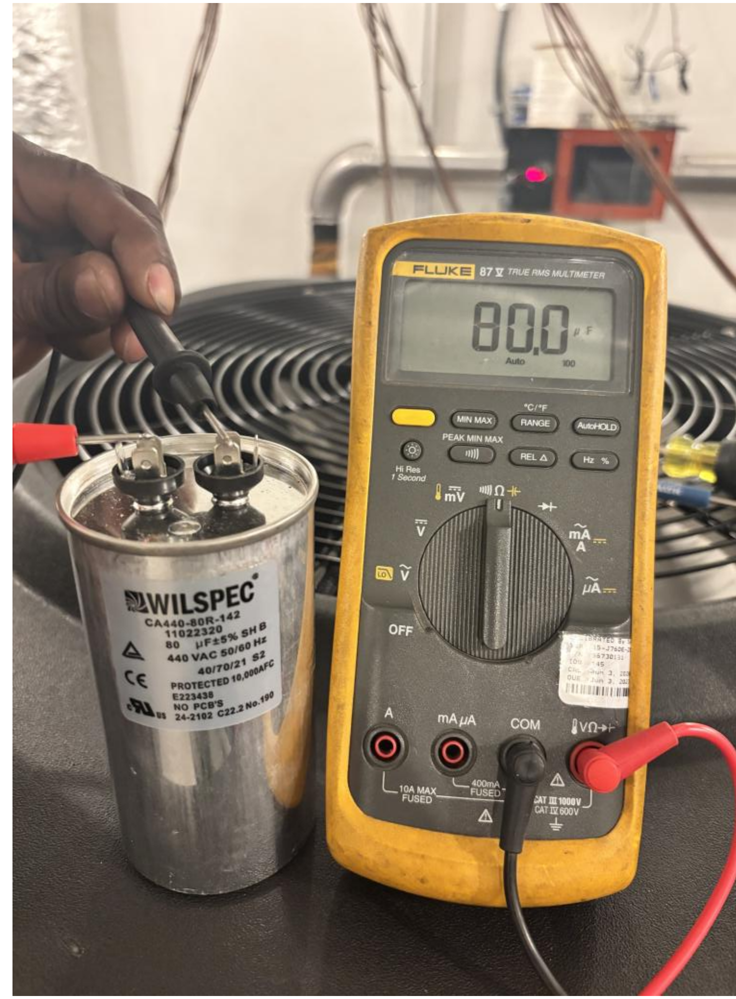
If you do not have a dye injector/ UV light detector kit you will need to purchase one. You should be able to purchase a Spectronics kit that contains the UV light, UV protective glasses, cleaner, and enough dye for at least 2 systems.

HOW TO SAFELY TEST A COMPRESSOR CAPACITOR

TROUBLESHOOTING STEPS

1. Set your meter to **capacitance**
2. Discharge the capacitor via an insulated handle screwdriver and make sure to bridge the terminals for 2-3 seconds to make it safe.
3. Test the capacitor. See table for specs.

*Swollen capacitors: Go ahead and replace, it's bad.



SPECS FOR COMPRESSOR CAPACITOR - SERVICE PART HPX51401591801
HIGHER LIMIT: 84 µF
NOMINAL RATING: 80 µF +/- 5%
LOWER LIMIT: 76 µF

HOW TO SAFELY TEST A FAN MOTOR CAPACITOR

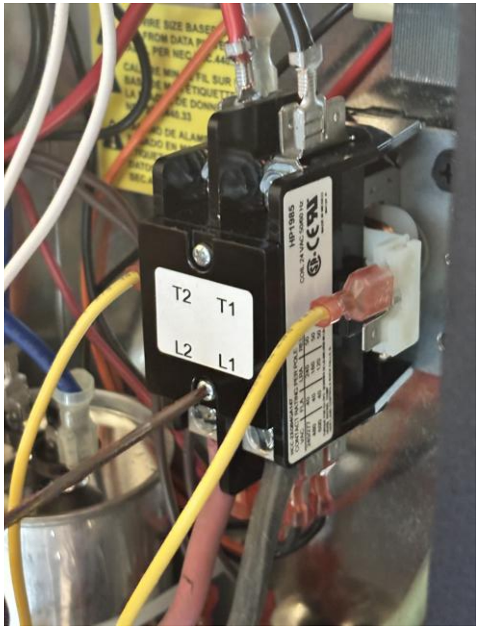
TROUBLESHOOTING STEPS

1. Set your meter to **capacitance**
2. Discharge the capacitor using an insulated screwdriver and holding it to bridge the terminals for 2-3 seconds.
3. Test the capacitor. See table for specs.

*Swollen capacitors: Go ahead and replace, it's bad.

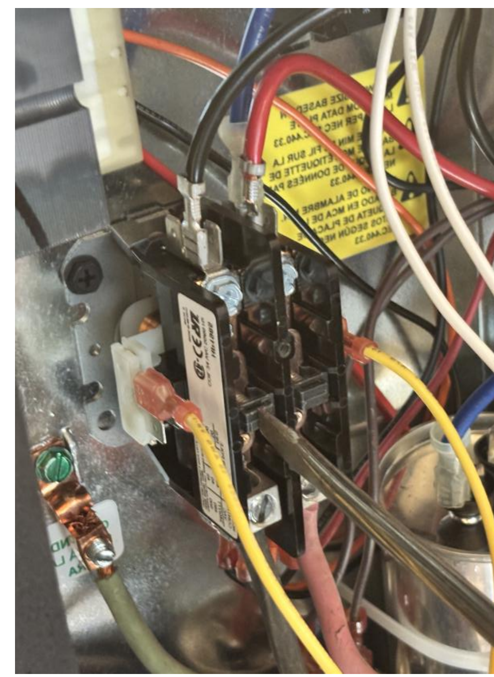
SPECS FOR FAN CAPACITOR - SERVICE PART HPX51401591801
HIGHER LIMIT: 7.875 µF
NOMINAL RATING: 7.5µF +/- 5%
LOWER LIMIT: 7.125 µF

TROUBLESHOOTING A CONTACTOR – TWO POLE



TROUBLESHOOTING STEPS

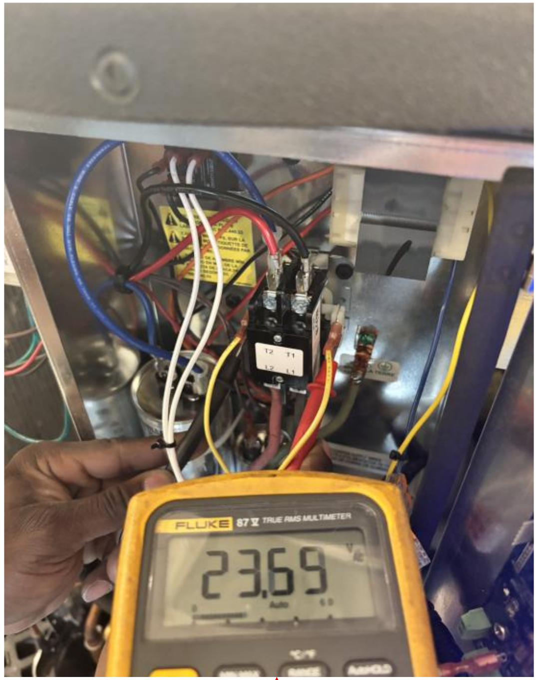
1. Disconnect breaker.
2. Remove cover plate and check visually the contact condition.
3. Visually inspect to see if contacts welded shut, replace contactor if so.
4. With breaker energized, unit idle/not running, you can push in the compressor button with a screw driver to check if it energizes the compressor. For a few seconds push in the contactor. If the compressor runs, then the contactor contacts are okay. You also need to verify if the coil is okay.
5. Test coil health, resistance: With unit off, breaker de-energized, test resistance between A1/A2 (contactor coil terminals) for resistance (good = 10-20Ω), bad = OL, near 0



Another way to check contactor function **while a call to heat or cool is set**, is to measure line and load side voltage. They should match. If the load size (T1-T2) phase to phase voltage measures is 0V, the contactor contacts have failed and no voltage is delivered to the compressor. Replace contactor

SPECS FOR CONTACTOR - SERVICE PART HPX1985
FLA: 40 AMP
COIL: 24VAC

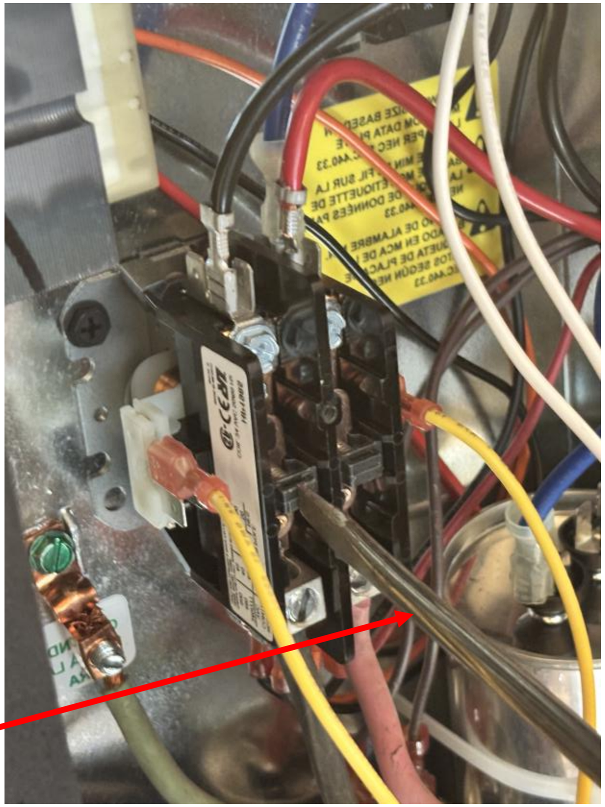
TROUBLESHOOTING A CONTACTOR – CONTINUED



TROUBLESHOOTING STEPS

1. Check low voltage power is supplied (22-26VAC) to the terminals.
2. Give a call for heat or cool, once the compressor signal is sent to the terminals of the contactor by the board, the contactor should PULL IN.
3. Once a compressor ON signal is sent, verify the compressor runs, or measure the load side voltage. You should now read a load side voltage of 230 to 240V with the contactor signal energized. If not, the contactor has failed.

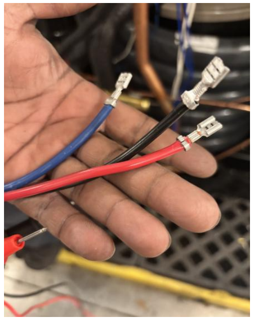
An alternate test is to remove the cover plate off the contactor front face, and with breaker energized, briefly press and hold the contactor test button in for 5-10 seconds to check if it operates normally.



This image shows a signal is sent to the contactor coil of ~24VAC. The contactor should pull in and compressor turn on. If not, check load side voltage or remove cover plate and visually inspect contacts.

SPECS FOR CONTACTOR - SERVICE PART HPX1985
FLA: 40 AMP
COIL: 24VAC

HOW TO CHECK COMPRESSOR RESISTANCE WINDINGS



TROUBLESHOOTING STEPS

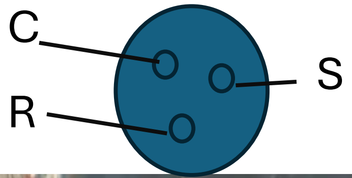
1. Set your meter to **OHMS, and unplug the three capacitor leads from contactor and capacitor.**
2. Test resistance between the run, start, and common compressor wire leads.
   Red = Run , Blue = Start, Black = Common
3. If any of the measurements show open line, the winding is failed. Replace compressor.

COM=BLK
RUN=RED
START = BLUE

VALUES OF RESISTANCE
Test A) COMMON TO RUN: 1.0Ω - 1.2Ω
Test B) COMMON TO START: 0.3Ω - 0.5Ω
Test C) RUN TO START: 1.3Ω - 1.7Ω

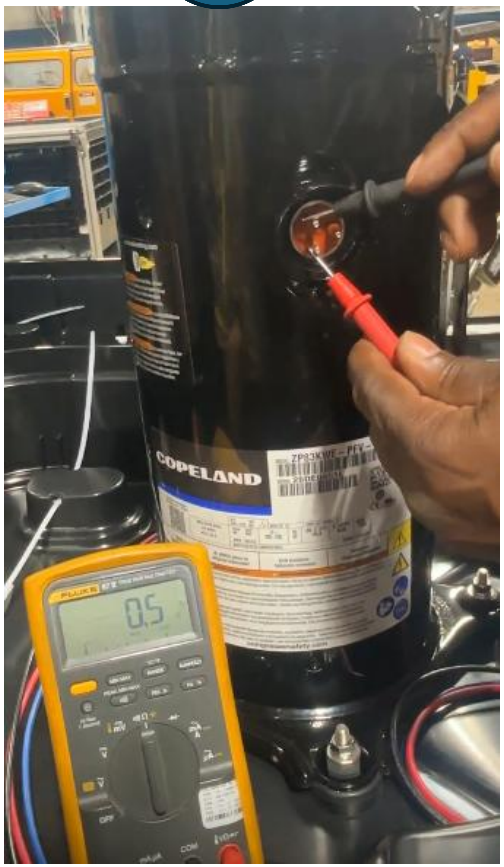
A good compressor will **not** read open lineon the meter on any of the tests A/B/C. If you read open line the winding is open, replace compressor. Also, your Start to Common, and Run to Common should add up to "Start to Run" value.

DIRECT COMPRESSOR WINDING RESISTANCE TEST – NO FUSITE PLUG



GENERAL RULE: (RUN TO COM RESISTANCE)+(START TO COM RESISTANCE) = START TO RUN RESISTANCE

COM=BLK
RUN=RED
START = BLUE

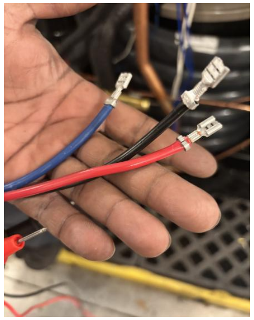


RUN TO COM: 0.3-0.5 Ω TYPICAL

START TO COM: 1.0-1.3Ω TYPICAL

START TO RUN: 1.5-1.6Ω TYPICAL

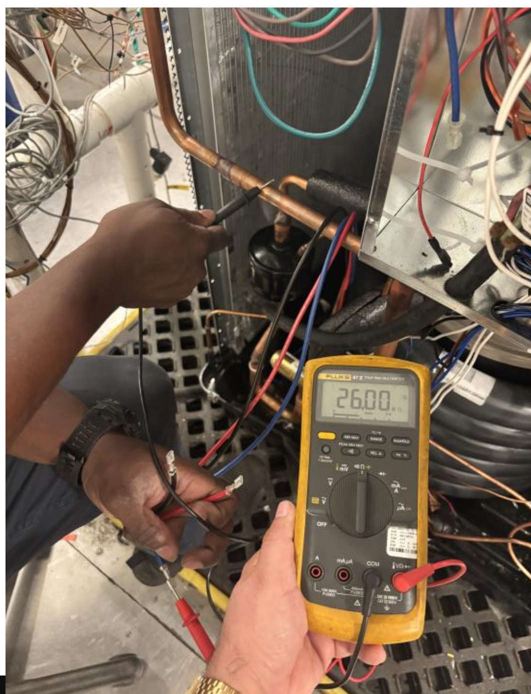
COMPRESSOR SHORT TO GROUND TESTING

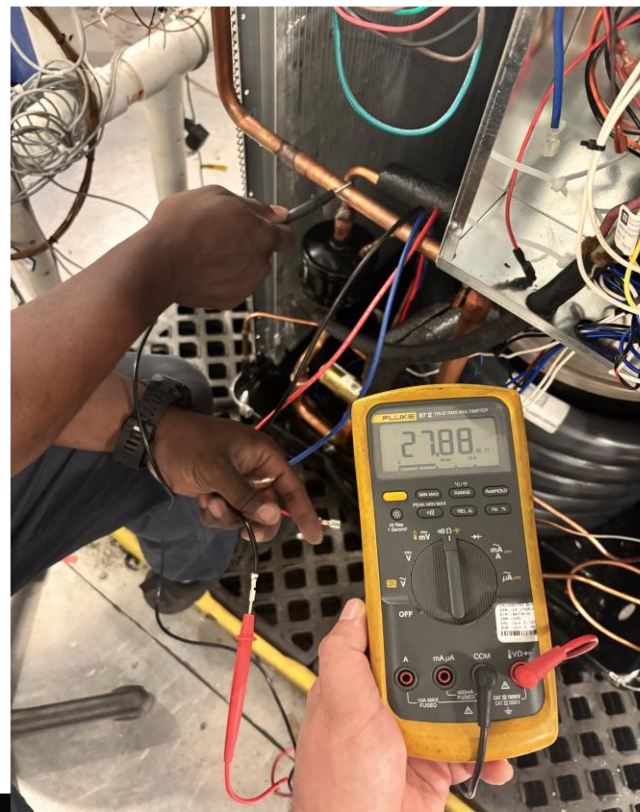


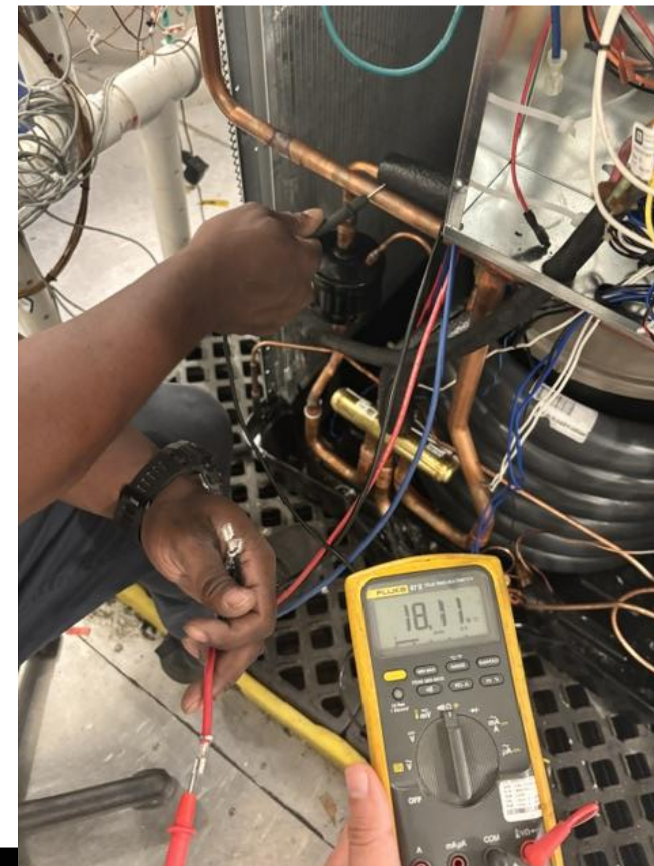
COM=BLK
RUN=RED
START = BLUE

TROUBLESHOOTING STEPS

1. Set your meter to **CONTINUITY.**
2. Unplug three compressor leads, START, COMMON, RUN.
3. Test by connecting one lead to the wire, and other lead to a ground point, i.e. copper tube, ground lug, or compressor body. If you **get continuity, that means the compressor winding failed**/is touching the inside of the compressor housing; the compressor has burned out and needs replacing. **If you read a resistance,** that is **good.**







COMPRESSOR SHORT TO GROUND ROOT CAUSES

A compressor shorts to ground when the protective varnish on its internal copper windings melts, allowing the electrical current to arc against the metal casing. This is usually caused by system contamination, electrical issues, or mechanical failures that cause the compressor motor to severely overheat.

Common triggers include:

•**Moisture and Acid:** Inadequate vacuum evacuation during installation leaves moisture in the system, turning oil into acid which eats away at winding insulation.

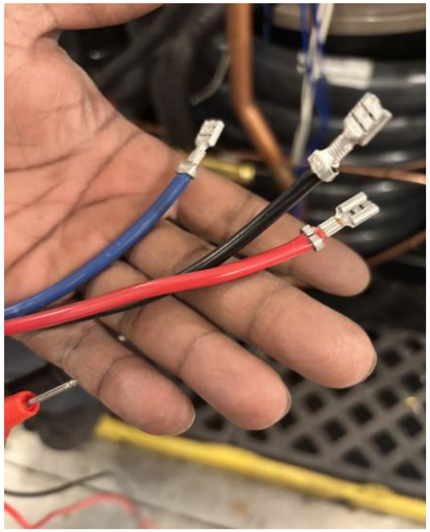
•**Electrical Surges:** High-voltage spikes from lightning or power grid drops can melt the wire coatings and fry the compressor terminals.

•**Bad Capacitors:** A weak run capacitor strains and overheats the windings by failing to provide necessary phase shifts during operation.

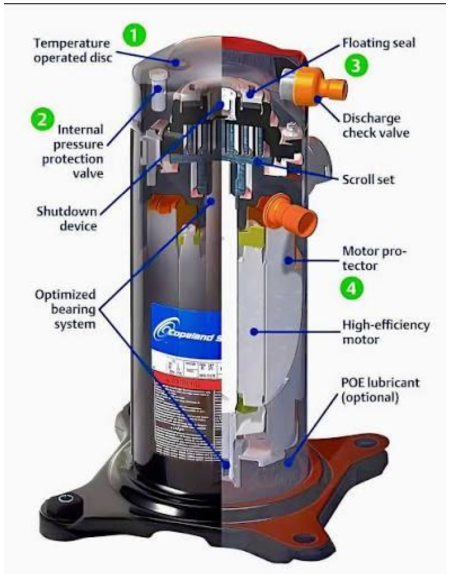
•**Lack of Lubrication:** Poor oil return from improperly sized refrigerant lines starves the compressor of lubrication, generating extreme friction and heat.

•**Liquid Slugging:** Liquid refrigerant returning to the compressor washes away oil and places immense physical stress on the motor.

•**Short Cycling:** Frequent turning on and off prevents proper cooling and causes the compressor to run unusually hot.



COM=BLK
RUN=RED
START = BLUE



HP21105T AND HP31105T – PRESSURES & TEMPERATURES

HP21105T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOL
HEATING	50°F	63%	80°F	87-90 PSIG	352-355PSIG	30-75 GPM	15-20° F ΔT	2-6 °F	15-30 °F
HEATING	80°F	63%	80°F	143-145 PSIG	365-368 PSIG	30-75 GPM	15-20° F ΔT	18-20 °F	20-25 °F
HEATING	80°F	80%	80°F	149-151 PSIG	368-372 PSIG	30-75 GPM	15-20° F ΔT	19-21 °F	20-25 °F

HP31105T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOLING
HEATING	50°F	63%	80°F	88-91 PSIG	307-310 PSIG	30-75 GPM	15-20° F ΔT	5-8 °F	4-10 °F
HEATING	80°F	63%	80°F	140-144 PSIG	325-330 PSIG	30-75 GPM	15-20° F ΔT	18-20°F	4-8 °F
HEATING	80°F	80%	80°F	148-151 PSIG	328-334 PSIG	30-75 GPM	15-20° F ΔT	20-22°F	6-10 °F
COOLING	95°F	N/A	90°F	155-159 PSIG	215-220PSIG	30-75 GPM	15-20° F ΔT	25-31°F	NOT AVAILABLE

HP21205T AND HP31205T PRESSURES & TEMPERATURES

HP21205T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOL
HEATING	50°F	63%	80°F	88-91 PSIG	315-320 PSIG	30-75 GPM	15-20° F ΔT	3-6 °F	10-12°F
HEATING	80°F	63%	80°F	142-146 PSIG	329-332 PSIG	30-75 GPM	15-20° F ΔT	8-10°F	10-12 °F
HEATING	80°F	80%	80°F	155-160 PSIG	335-340 PSIG	30-75 GPM	15-20° F ΔT	12-14 °F	11-13°F

HP31205T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOLING
HEATING	50°F	63%	80°F	88-90PSIG	325-330 PSIG	30-75 GPM	15-20° F ΔT	8-10 °F	15-19 °F
HEATING	80°F	63%	80°F	140-145 PSIG	328-334 PSIG	30-75 GPM	15-20° F ΔT	12-14°F	11-15°F
HEATING	80°F	80%	80°F	150-155 PSIG	329-333 PSIG	30-75 GPM	15-20° F ΔT	15-18 °F	11-14°F
COOLING	95°F	N/A	90°F	158-162 PSIG	219-224PSIG	30-75 GPM	15-20° F ΔT	30-32°F	NOT AVAILABLE

HP21405T AND HP31405T PRESSURES & TEMPERATURES

HP21405T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOL
HEATING	50°F	63%	80°F	79-82 PSIG	318-323 PSIG	30-75 GPM	15-20° F ΔT	4-6 °F	6-12 °F
HEATING	80°F	63%	80°F	138-142 PSIG	324-346 PSIG	30-75 GPM	15-20° F ΔT	7-12 °F	12-14 °F
HEATING	80°F	80%	80°F	148-152 PSIG	348-352 PSIG	30-75 GPM	15-20° F ΔT	14-16 °F	15-18 °F

HP31405T

OPERATING MODE	OUTDOOR TEMPERATURE UNITS: °F	RELATIVE HUMIDITY (%)	SETPOINT ON THE HEAT PUMP – 80°F	SUCTION PRESSURE (PSIG)	LIQUID PRESSURE (PSIG)	RECOMMENDED FLOW RATE FOR PUMP (GPM)	DELTA T – OUTDOOR VERSUS AIR FLOWING OUT FAN TOP	SUPERHEAT	SUBCOOLING
HEATING	50°F	63%	80°F	77-81 PSIG	342-346 PSIG	30-75 GPM	15-20° F ΔT	6-8 °F	23-27 °F
HEATING	80°F	63%	80°F	132-136 PSIG	341-345 PSIG	30-75 GPM	15-20° F ΔT	7-10 °F	17-20 °F
HEATING	80°F	80%	80°F	142-147 PSIG	342-348 PSIG	30-75 GPM	15-20° F ΔT	14-16°F	18-20 °F
COOLING	95°F	N/A	90°F	155-160 PSIG	224-230PSIG	30-75 GPM	15-20° F ΔT	25-30 °F	NOT AVAILABLE

END OF SLIDES

Hayward Tech Support: 908-355-7995