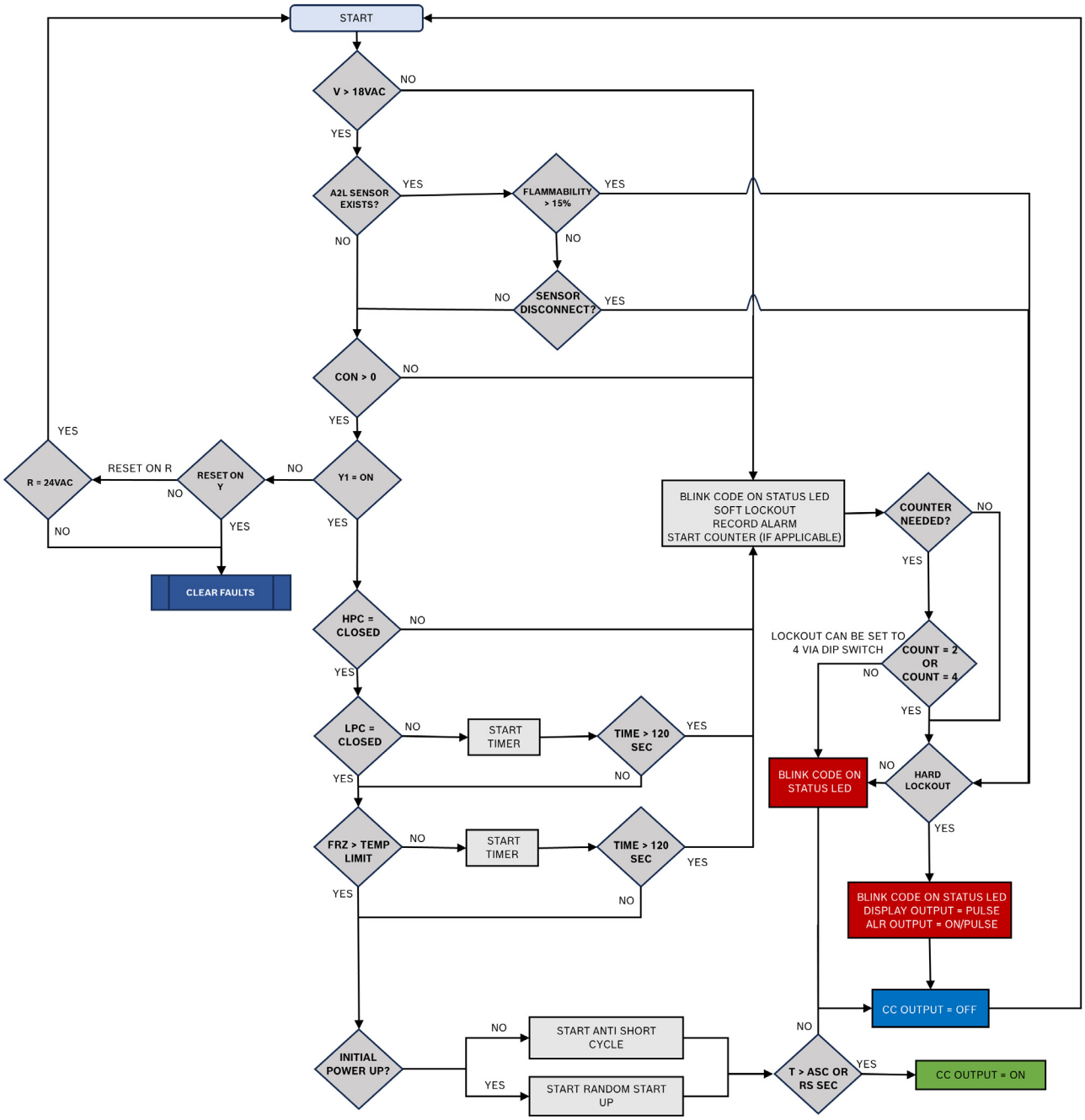


Fig. 54 — UPM Sequence of Operations

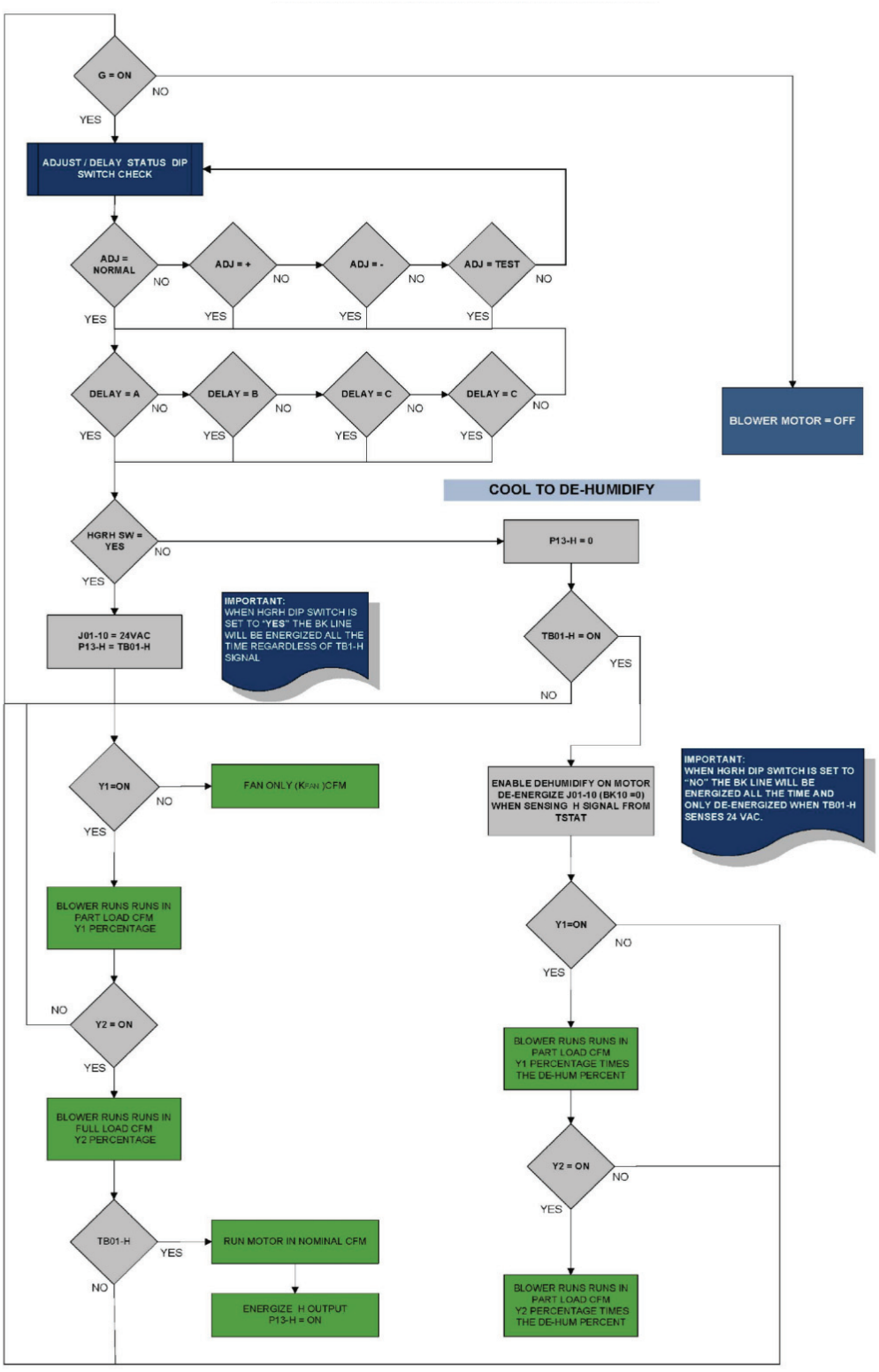


Fig. 55 — ECM Control Board Dehumidification Options Sequence of Operation

Sequence of Operation for Units with TruVu DDC Controller

Units with TruVu™ DDC controller still feature a UPM board for unit operation, so the operation will be similar to the sequence for units without DDC controller. TruVu™ controller does feature advanced functionality, such as automatic fan speed control and intelligent alarming, which will differ from the units with UPM board only. Below is an overview of the different features for the TruVu™ controls. See Fig. 56 for TruVu™ Control Board overview.

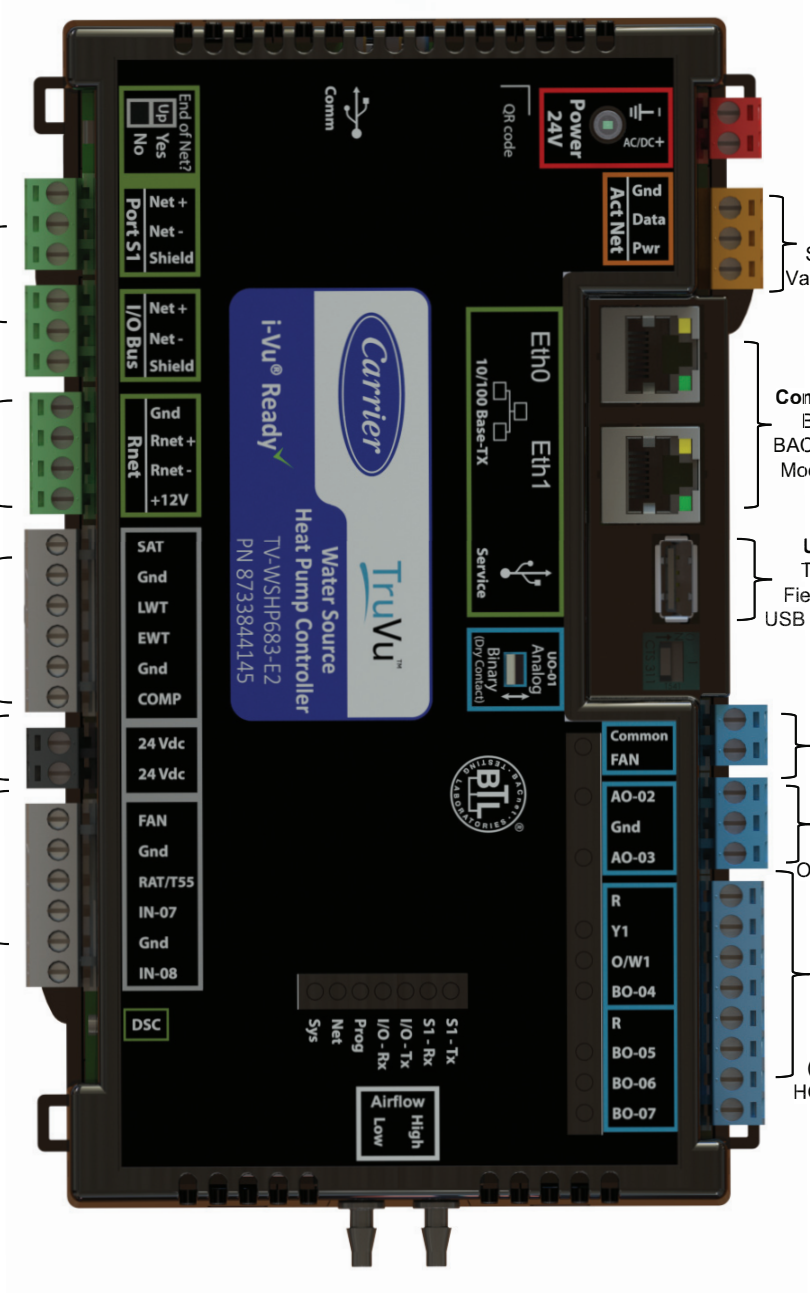


Fig. 56 — TruVu™ Control Board

SCHEDULING

Time periods can be configured to schedule the transitions from occupied to unoccupied operation. The time periods control the space temperature to occupied heating and cooling setpoints. The unit operates continuously in the Occupied mode until a time schedule is configured by using either the TruVu™ Equipment Touch, Field Assistant, the i-Vu® application, or a third-party control system enables/disables the BAS On/Off point. The local time and date for these functions must be set to operate properly.

The occupancy source can be changed to one of the following:

Occupancy Schedules

The controller is occupied 24/7 until you configure a time schedule using either the TruVu Equipment Touch, Field Assistant, the i-Vu® application, or a third party Enables/Disables the BAS On/Off point. You can disable this by going to Configuration > Unit Configuration > Occupancy Schedules, changing the point from Enable to Disable and clicking OK.

NOTE: You must Enable this point in order for the TruVu ET Touch, Field Assistant, or the i-Vu® application to assign a time schedule to the controller.

Schedule_Schedule

The unit operates according to the schedule configured and stored in the unit. The schedule is accessible via the TruVu ET, the i-Vu® application, or Field Assistant. The daily schedule consists of a start and stop time (standard or 24-hour mode) and 7 days of the week, starting with Monday and ending on Sunday.

IMPORTANT: Scheduling can only be controlled from one source.

Occupancy Input Contact (Option)

If configured for remote occupancy control (default), the TruVu™ controller can use an external dry contact closure to determine the occupancy status of the unit. You must disable the Occupancy Schedules in order to use the occupancy contact input. The unit enters an occupied mode when it senses the abnormal input. After the input returns to its normal state, the unit stays in the occupied mode for the configured Occ Override Delay period (15 minutes default).

BAS (Building Automation System) On/Off

For use with a Building Automation System that supports network scheduling, you must disable the Occupancy Schedules so the BAS system can control the unit through a network communication and the BAS scheduling function.

Global Occupancy Scheduling

The TruVu™ controller can read the occupancy status from another unit so that a group of WSHPs can be controlled from a single occupancy schedule. The local Occupancy Schedules must be disabled in order to use the global occupancy input.

BACnet® Network Occupancy Input

The TruVu™ controller can accept an external BACnet®[1] Binary Network Input for occupancy control. This function is only compatible with units used in BACnet® systems. You need to configure the System Occupancy BACnet® network input point to locate the device and point name where the external occupancy point information resides. You must also disable Occupancy Schedules in order to use this input.

INDOOR FAN

Fan Modes

You can configure the indoor fan to operate in any one of 3 fan modes:

- Auto - intermittent operation during both occupied and unoccupied periods
- Continuous (default) - intermittent operation during unoccupied periods and continuous during occupied periods
- Always On - operates the fan continuously during both occupied and unoccupied periods

In the continuous default mode, the fan is turned on when any one of the following is true:

- It is in occupied mode, which is determined by the occupancy status.
- There is a demand for cooling or heating in unoccupied mode.
- There is a call for dehumidification (optional).

Auto Fan Speed Control

The TruVu™ controller can control up to 3 fan speeds using ECM (Electronically Commutated Motor). The motor operates at the lowest speed possible to provide quiet and efficient fan operation with the best latent capability. The motor increases speed if additional cooling or heating is required to reach the desired space temperature setpoint. The control increases the motor's speed as the space temperature rises above the cooling or below the heating setpoint. The amount of space temperature increase above or below the setpoint required to increase the fan speed is configurable in the setpoint. Also, the control increases the fan speed as the Supply Air Temperature approaches the configured minimum or maximum limits.

- Heating Max SAT Control - When heat is required and active, the control continuously monitors the supply air temperature to verify it does not rise above the configured Maximum Heating SAT Limit (110°F default). As the SAT approaches this value, the control increases the fan speed as required to ensure the SAT remains within the limit. This provides the most quiet and efficient operation by running the fan at the lowest speed possible.
- Cooling Min SAT Control - When mechanical cooling is required and active, the control continuously monitors the supply air temperature to verify it does not fall below the configured Minimum Cooling SAT Limit (50°F default). As the SAT approaches this value, the control increases the fan speed as required to ensure the SAT will remain within the limit. Fan operates at the lowest speed during dehumidification to maximize latent capacity during cooling.

Fan Delay

When power is reapplied after a power outage, there is a configurable delay of 5 - 600 seconds (default 60) before starting the fan. You must configure the fan delay:

- The Fan On Delay defines the delay time (0 - 30 seconds, default 10) before the fan begins to operate after heating or cooling is started.
- The Fan Off Delay defines the delay time (0 - 180 seconds, default 45) the fan continues to operate after heating or cooling is stopped.

NOTE: The fan continues to run as long as the compressors, heating stages, or the dehumidification relays are on. If the SPT failure alarm, ZS Sensor failure alarm, or condensate overflow alarm is active, the fan is shutdown immediately, regardless of occupancy state or demand.

Fan Status

You can configure an optional input as either an occupancy input contact or a fan status input. If configured as fan status, the controller compares the status of the fan to the desired commanded state. When the fan is commanded to run (ON), the fan status is checked and verified to match the commanded state. If the fan status is not on, then a fan status alarm is generated after 1 minute and the equipment's compressor(s) and auxiliary heat is disabled and the optional OA damper closes.

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COOLING OPERATION

Space Temperature Control

The TruVu™ controller operates 1 or 2 stages of compression to maintain the desired cooling setpoint. The compressor outputs are controlled by the PI (Proportional-integral) cooling loop and cooling stages capacity algorithm. The algorithm calculates the desired number of stages needed to satisfy the space by comparing the control temperature (return air or space) to the appropriate cooling setpoint.

NOTE: The waterside economizer, if applicable, is used for first stage cooling, in addition to the compressor(s). The following conditions must be true for the cooling algorithm to run:

- Cooling is set to Enable.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Heat mode is not active and the compressor time guard(s) have expired.
- Condensate overflow alarm status is Normal
- Fan Status is True (if option is enabled).
- If occupied, the control temperature is greater than the occupied cooling setpoint.
- Control temperature reading is valid.
- If unoccupied, the control temperature is greater than the unoccupied cooling setpoint.
- If economizer cooling is available and active, and the economizer alone is insufficient to provide enough cooling.
- OAT > Cooling Lockout Temperature if OAT is available.
- Source water pump is on (if source water linkage is active)
- Water Flow Switch Status is True (if option is enabled).

If all of the above conditions are met, the compressors' relays are energized as required. Otherwise, they will be de-energized. If cooling is active and if the SAT approaches the minimum SAT limit, the fan will be indexed to the next higher speed. If this is insufficient, and if the SAT falls further (equal to the minimum SAT limit), the fan will be indexed to the maximum speed. If the SAT still continues to falls 5°F below the minimum SAT limit, all cooling stages will be disabled.

During Cooling, the reversing valve output is held in the cooling position (either B or O type, as configured), even after the compressor is stopped. The valve does not switch position until the heating mode is required.

The configuration screens contain the Min SAT parameter as well as Cooling Lockout based on outdoor air temperature (OAT). Both can be adjusted to meet various specifications.

Passive Dehumidification

When the unit is configured for auto fan speed control the TruVu™ controller will use the lowest fan speed setting possible to meet the setpoint and stay within the maximum SAT limits. Using the lowest fan speed possible in cooling operation will provide a method of passive dehumidification allowing for enhanced latent capacity.

Hot Gas Reheat Dehumidification

The TruVu™ controller provides occupied and unoccupied dehumidification only on units that are equipped with the reheat option. This function requires an accessory hardwired space relative humidity sensor. When using a relative humidity sensor to control dehumidification during occupied or unoccupied times, the dehumidification setpoints are used accordingly. Also, you may use a ZS Humidity Sensor or a network input point System Space RH in place of the hardwired RH sensor.

When the indoor relative humidity becomes greater than the dehumidification setpoint, a dehumidification demand is acknowledged. Once acknowledged, the dehumidification output is energized, bringing on the supply fan (medium speed), mechanical cooling, and the integral reheat coil. The controls engage cooling mode and the waste heat from the compressor cooling cycle is returned to the reheat coil simultaneously, meaning that the reversing valve causes the compressor to operate in the cooling mode.

NOTE: During cooling mode, the unit cools and dehumidifies, and disables the reheat coil. However, once the call for cooling has been satisfied and there is still a call for dehumidification, the unit continues to operate in the reheat mode.

HEATING OPERATION

Space Temperature Control (Reverse Cycle Heating)

The TruVu™ controller operates 1 or 2 stages of compression to maintain the desired heating setpoint. The compressor outputs are controlled by the heating PI (Proportional-integral) loop and heating stages capacity algorithm. The algorithm calculates the desired number of stages needed to satisfy the space by comparing the control temperature (return air or space) to the appropriate heating setpoint.

The following conditions must be true for the heating algorithm to run:

- Heating is set to Enable.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Cool mode is not active and the compressor time guard has expired.
- Condensate overflow alarm status is Normal.
- Fan Status is True (if option is enabled).
- If occupied, the control temperature is less than the occupied heating setpoint.
- Control temperature reading is valid.
- If unoccupied, the control temperature is less than the unoccupied heating setpoint.
- OAT > < Heating Lockout Temperature if OAT is available.
- Source Water Pump is on (if Source Water Linkage active).
- Water Flow Switch Status is True (if option is enabled).

If all the above conditions are met, the heating outputs are energized as required, otherwise they are de-energized. If heating is active and the SAT approaches the maximum SAT limit, the fan is indexed to the next higher speed. If this is insufficient, and if the SAT rises further and reaches the Maximum Heating SAT limit, the fan is indexed to the maximum speed. If the SAT still continues to rise 5°F above the maximum limit, all heating stages are disabled.

Space Temperature Control (Reverse Cycle Heating and Auxiliary Heat)

The TruVu™ controller can control a 2-position or modulating water or steam valve, connected to a coil on the discharge side of the unit and supplied by a boiler, or a single stage ducted electric heater, in order to maintain the desired heating setpoint. If the compressor capacity is insufficient, or a compressor failure occurs, the auxiliary heat is used. Unless the compressor fails, the auxiliary heat only operates to supplement the heat provided by the compressor, if the space temperature falls more than 1°F below the desired heating setpoint. (This amount is configurable.) The heat is controlled so the SAT does not exceed the Maximum Heating SAT limit.

The same conditions required for Reverse Cycle Heating must be true in order for the Auxiliary Heat algorithm to run.

<u>Auxiliary Modulating Hot Water / Steam Heating</u>

The control can modulate a hot water or steam valve connected to a coil on the discharge side of the unit, and supplied by a boiler in order to maintain the desired heating setpoint, if the compressor capacity is insufficient, or a compressor failure occurs. Unless a compressor fault condition exists, the valve only operates to supplement the heat provided by the compressor if the space temperature falls more than 1°F below the desired heating setpoint. The valve is controlled so the SAT does not exceed the Maximum Heating SAT limit.

2-Position Hot Water / Steam Heating

The control can operate a 2-position, NO or NC, hot water or steam valve, connected to a coil on the discharge side of the unit and supplied by a boiler, in order to maintain the desired heating setpoint, if the compressor capacity is insufficient or a compressor failure occurs. Unless a compressor fault condition exists, the valve only opens to supplement the heat provided by the compressor, if the space temperature falls more than 1°F below the desired heating setpoint. The valve is controlled so the SAT does not exceed the Maximum Heating SAT limit and is subject to a 2-minute minimum OFF-time to prevent excessive valve cycling.

Electric Auxiliary Heat

The control can operate factory or field-installed single or two stage of electric heat that is installed on the discharge side of the unit, in order to maintain the desired heating setpoint, if the compressor capacity is insufficient or a compressor failure occurs. Unless a compressor fault condition exists, the heat stage only operates to supplement the heat provided by the compressor if the space temperature falls more than 1°F below the desired heating setpoint. The heat stage is controlled so the SAT does not exceed the Maximum Heating SAT limit and is subject to a 2-minute minimum OFF-time to prevent excessive cycling.

"Boilerless" Control (Auxiliary Heat)

The TruVu™ controller can be configured to control the auxiliary heat source for "boilerless" types of systems or system with no means for heat injection into the source water loop. Compressor will be disabled, and the auxiliary heat source will be enabled when the entering water temperature drops below the configurable boilers electric heat setpoint.

WATERSIDE ECONOMIZER

The TruVu™ controller can provide modulating, or 2-position waterside economizer operation (for a factory or field-installed economizer coil mounted to the return air side of the unit and connected to the source water loop), in order to provide free cooling or preheating, when water conditions are optimal. Waterside economizer settings can be accessed on Properties > Equipment > Status.

The following conditions must be true for economizer operation:

- SAT reading is available.
- EWT reading is available.
- If occupied, the control temperature is greater than the occupied cooling setpoint or less than the occupied heating setpoint and the source water is suitable.
- Space temperature reading is valid.
- If unoccupied, the SPT or ZS is greater than the unoccupied cooling setpoint, or less than the unoccupied heating setpoint, and the source water is suitable.

Modulating Waterside Economizer Control

Modulates a water valve to control source water flowing through a coil on the entering air side of the unit.

Cooling

Provides an economizer cooling function by using the source water loop when the entering water loop temperature is at least 5°F below space temperature. If the water loop conditions are suitable, the valve modulates open to maintain a Supply Air Temperature that meets the load conditions. If the economizer coil capacity alone is insufficient for a period greater than 5 minutes, or if a high humidity condition occurs, then the compressor starts, in order to satisfy the load. If the SAT approaches the Minimum Cooling SAT limit (HOME > CONFIG > UNIT), the economizer valve modulates closed during compressor operation.

Heating

In addition, the control modulates the water valve if the entering source water loop temperature is suitable for heating (at least 5°F above space temperature) and heat is required. The valve is controlled in a similar manner, except to satisfy the heating requirement. If the coil capacity alone is insufficient to satisfy the space load conditions for more than 5 minutes, then the compressor starts in order to satisfy the load. If the SAT approaches the Maximum Heating SAT limit, the economizer valve modulates closed during compressor operation.

2-position Waterside Economizer Control

2-Position Waterside Economizer Control has the capability to control a NO or NC, 2-position water valve to control source water flow through a coil on the entering air side of the unit.

Cooling

The purpose is to provide a cooling economizer function directly from the source water loop when the entering water loop temperature is at least 5°F below space temperature. If the optional coil is provided and the water loop conditions are suitable, then the valve opens to provide cooling to the space, when required. If the capacity is insufficient for a period greater than 5 minutes, or if a high humidity condition occurs, the compressor is started in order to satisfy the load. If the SAT reaches the Minimum Cooling SAT limit, the economizer valve closes during compressor operation.

Heating

In addition, the economizer control opens the water valve, if the entering water loop temperature is suitable for heating (at least 5°F above space temperature) and heat is required. The valve is controlled in a similar manner, except to satisfy the heating requirement. If the coil capacity is insufficient to satisfy the space load for more than 5 minutes, then the compressor is started to satisfy the load. If the SAT reaches the Maximum Heating SAT limit, the economizer valve closes during compressor operation.

Indoor Air Quality and Demand Control Ventilation

If the optional hardwired indoor air quality sensor is installed, ZS CO_2 (IAQ), or the System Space AQ network input point is used, the TruVu™ controller maintains indoor air quality with a modulating OA damper, which provides demand- controlled ventilation. The control operates the modulating OA damper during occupied periods, monitors the CO_2 level, compares it to the configured setpoints, and adjusts the ventilation rate, as required. The control provides proportional ventilation to meet the requirements of ASHRAE specifications by providing a base ventilation rate and then increasing the rate as the CO_2 level increases. The control proportionally increases ventilation when the CO_2 level rises above the start ventilation setpoint and reaches the full ventilation rate when the CO_2 level is at or above the maximum setpoint.

Configure the minimum damper position to ensure that proper base ventilation is delivered when occupants are not present. Access the IAQ configurations through the configuration screen.

The following conditions must be true in order for this algorithm to run:

- Damper Control is configured for DCV.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Fan status is True (if option is enabled).
- The unit is in an occupied mode.
- IAQ sensor reading is greater than the DCV start CTRL setpoint.

The control has the following 4 adjustable setpoints:

- DCV Start Ctrl Setpoint
- DCV Max Ctrl Setpoint
- Minimum Damper Pos
- DCV Max Vent Damper Pos

NOTE: For the damper to maintain proper base ventilation, you must configure the fan as Continuous or Always On.

2-Position OA Damper

Alternatively, the controller can be configured to operate as a ventilation damper in a 2-position ventilation mode to provide the minimum ventilation requirements during occupied periods.

Differential Pressure Switch / Water Flow Switch

The flow switch monitors the pressure difference between two points on the waterside. An optional input can be configured as condenser water flow status input. If configured, the flow status must be ON for 3 seconds to enable the compressors.

COMPRESSOR STATUS

The TruVu™ controller provides a status input to monitor the compressor operation. The status is monitored to determine if the compressor status matches the commanded state. This input is used to determine if a refrigerant safety switch or other safety device has tripped and caused the compressor to stop operating normally. If this occurs, an alarm is generated to indicate the faulted compressor condition.

DEMAND LIMITING

The TruVu™ controller can accept 3 levels of demand limit from the BACnet®[1] network. In response to a demand limit, the unit decreases its heating setpoint and increases its cooling setpoint to widen the range, in order to immediately lower the electrical demand. You can configure the temperature adjustment for both heating and cooling and for each demand level. You can also set the response to a particular demand level to 0.

REMOTE DISABLE

Fire/Smoke Detector Input

The TruVu™ controller can read the status of a normally closed FSD contact input to determine if a fire or smoke detector alarm is present. If the controller determines an alarm condition is present, all heating, cooling, and the fan are disabled. The switch is factory set to Normally Closed and cannot be changed.

Shutdown Input

The TruVu™ controller has a shutdown input (software point) which, when set to its Active mode causes the WSHP to safely shutdown in a controlled fashion. Heating and cooling is disabled after any minimum runtime conditions expire and the fan is disabled after the fan-off timer expires. All alarms are reset but any active alarm remains active. After the shutdown input transitions from Active mode to Inactive, the TruVu™ controller restarts after the configured power fail restart delay expires.

ALARMS

High Discharge Pressure (UPM Alarm)

The TruVu WSHP monitors the status of a high discharge pressure fault condition via the serial port (S1). The fault condition is determined by the Unit Protection Module (UPM) included on all WSHPs. The UPM monitors a high-pressure switch input and establishes a high-pressure fault when the discharge pressure exceeds 600 PSIG. Upon fault a 5-minute break is initiated (soft lockout) and the compressor is disabled. The unit will automatically restart after this time period. If the fault occurs 2 times (configurable on UPM) within 60 minutes the UPM will put the unit into hard lockout requiring manual reset. Manual reset can be accomplished remotely when the UPM is configured for the reset method "Y" by remotely disabling the unit via the TruVu WSHP.

Low Suction Pressure (UPM Alarm)

The TruVu WSHP monitors the status of a low suction pressure fault condition via the serial port (S1). The fault condition is determined by the Unit Protection Module (UPM) included on all WSHPs. The UPM monitors a low-pressure switch input and establishes a high-pressure fault when the discharge pressure drops below 40 PSIG. Upon fault a 5-minute break is initiated (soft lockout) and the compressor is disabled. The unit will automatically restart after this time period. If the fault occurs 2 times (configurable on UPM) within 60 minutes the UPM will put the unit into hard lockout requiring manual reset. Manual reset can be accomplished remotely when the UPM is configured for the reset method "Y" by remotely disabling the unit via the TruVu WSHP.

Air Coil Freeze Alarm (UPM Alarm)

The TruVu WSHP monitors the status of an air coil freeze fault condition via the serial port (S1). The fault condition is determined by the Unit Protection Module (UPM) included on all WSHPs. The UPM monitors the heating liquid line refrigerant temperature and establishes a high-pressure fault if the temperature drops below 26°F (configurable on UPM) for 30 seconds. Upon fault a 5-minute break is initiated (soft lockout) and the compressor is disabled. The unit will automatically restart after this time period. If the fault occurs 2 times (configurable on UPM) within 60 minutes the UPM will put the unit into hard lockout requiring manual reset. Manual reset can be accomplished remotely when the UPM is configured for the reset method "Y" by remotely disabling the unit via the TruVu™ WSHP.

Water Coil Freeze Alarm (UPM Alarm)

The TruVu WSHP monitors the status of a water coil freeze fault condition via the serial port (S1). The fault condition is determined by the Unit Protection Module (UPM) included on all WSHPs. The UPM monitors the cooling liquid line refrigerant temperature and establishes a high-pressure fault if the temperature drops below 26°F (configurable on UPM) for 30 seconds. Upon fault a 5-minute break is initiated (soft lockout) and the compressor is disabled. The unit will automatically restart after this time period. If the fault occurs 2 times (configurable on UPM) within 60 minutes the UPM will put the unit into hard lockout requiring manual reset. Manual reset can be accomplished remotely when the UPM is configured for the reset method "Y" by remotely disabling the unit via the TruVu WSHP.

Condensate Overflow Alarm (UPM Alarm)

The TruVu WSHP monitors the status of a condensate overflow fault condition via the serial port (S1). The fault condition is determined by the Unit Protection Module (UPM) included on all WSHPs. The UPM monitors a condensate overflow switch and upon fault puts the unit in a hard lockout condition, disabling the compressor. The hard lockout condition requires manual reset. Manual reset can be accomplished remotely when the UPM is configured for the reset method "Y" by remotely disabling the unit via the TruVu WSHP.

Brownout Alarm (UPM Alarm)

The TruVu WSHP monitors the status of a brownout fault condition via the serial port (S1).

Fire/Smoke Detector Alarm

The control monitors the voltage input to J1-9 to detect if a smoke detector or fire detector NC contact has opened, indicating an alarm condition. The control verifies the presence of 24 vac on this input. If the input opens at any time, an alarm is generated after 3 seconds and the equipment (fan, compressor, aux heat, and damper) immediately shuts down.

Space Temperature Alarms

The control provides the ability to generate an alarm when the space temperature exceeds the alarm setpoint. A separate occupied hysteresis and fixed unoccupied high and low alarm setpoints are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the control uses the occupied temperature setpoint and applies the hysteresis value to determine the alarm setpoints. When occupancy transitions from unoccupied to occupied or the occupied temperature setpoints are changed, causing an alarm condition to occur, the control automatically calculates an alarm delay (equivalent to the configured delay time in minutes/ °F, multiplied by the temperature error, + 15 minutes). This prevents nuisance alarms when an occupancy change occurs and allows time for the unit to correct an alarming temperature condition.

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Source Water Temperature Alarm

The control has 4 configurable alarm limits for source water temperature. The control verifies that the water temperature is within operating range (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor. Once the compressor is started, the source water temperature is further monitored to verify that it is within limits to ensure sufficient water is flowing through the coil. If the leaving water temperature rises above or falls below the appropriate limits, and lasts for more than 15 seconds, an alarm is generated and the compressor shuts down.

Supply Air Temperature Alarm

The control has 2 configurable alarm limits for supply air temperature. The control verifies that the supply air temperature is within operating range (between high and low limits) when the compressor or auxiliary heat is operating. If the air temperature rises above or falls below the appropriate limits, and this lasts for more than 5 minutes, an alarm is generated.

Fan Status Alarm

The control generates a fan status alarm if the fan status input detects the fan is OFF after any fan speed output has been enabled. A 30-second alarm delay is used to allow the fan to start operation before an alarm condition is detected. The control monitors the fan output and if the fan is operating at any speed, the fan status must detect the fan is operating.

Compressor Status Alarm

The control generates a compressor failure alarm if the compressor status input detects the compressor is OFF after the compressor output has been energized. A 6-minute alarm delay is used to allow the compressor to start (prevents alarms due to timeguard operation) before an alarm condition is detected. The control monitors the compressor output and if the compressor output is energized, the compressor status input must detect the compressor operation.

Filter Status Alarm

The control provides the ability to generate a dirty filter alarm after the number of fan run hours exceeds a configurable filter alarm timer limit. The control monitors the fan output and if the fan is operating at any speed, it accumulates run time. If the fan run time hours exceed the configurable limit, an alarm is generated. To reset the alarm timer after the alarm has been generated, a Reset Filter Alarm input is provided. You can disable the filter alarm by setting the Filter Alarm Timer Delay to 0 (factory default).

Indoor Air Quality Alarm

The control provides the ability to generate a high CO_2 level alarm during occupied periods when the CO_2 sensor value exceeds the adjustable limit. When a transition from unoccupied to occupied occurs, or the occupied alarm limit is changed to a value that causes an alarm condition to occur, the control will automatically calculate an alarm delay (equivalent to the configured delay time in minutes/ppm, times the error that occurred, + 15 minutes). This prevents nuisance alarms from occurring when occupancy changes or the setpoint is changed. You can disable the IAQ alarm by setting Occupied High IAQ Alarm Limit to 0.

Relative Humidity Alarm

The control provides the ability to generate an alarm when the space relative humidity exceeds the alarm setpoint. Separate occupied and unoccupied high humidity alarm setpoints are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the controller uses the occupied high RH alarm limit. When an occupancy transition from unoccupied to occupied occurs, or the occupied high alarm limit is lowered, causing an alarm condition to occur, the control automatically calculates an alarm delay (equivalent to the configured delay time in minutes/% RH, times the humidity error condition that occurred, + 15 minutes). This prevents nuisance alarms when an occupancy change occurs and allows time for the unit to correct an alarming humidity condition.

Source Water Linkage Failure Alarm (if Source Water Linkage was active)

The control generates a Source Water Linkage failure alarm if Linkage fails after once being active. The Linkage status is monitored and if it fails to be updated from the Loop controller, then a Source Water Linkage alarm is generated. There is a 6-minute alarm delay to prevent false alarms.

NOTE: You can reset this alarm only by re-establishing Linkage and correcting the condition that caused the Linkage failure, or by momentarily setting the Shutdown point to Active.

Airside Linkage Failure Alarm (if Airside Linkage was active)

The control generates an Airside Linkage failure alarm if Linkage fails after once being active. The Linkage status is monitored and if it fails to be updated from the master zone controller, then an Airside Linkage alarm is generated. There is a 6-minute alarm delay to prevent false alarms.

NOTE: You can reset this alarm only by re-establishing Linkage and correcting the condition that caused the Linkage failure, or by momentarily setting the Shutdown point to Active.

OAT Sensor Alarm (if Network OA Temperature was active)

The control generates an OAT Sensor failure alarm if the value of OAT fails to be updated through the network after once being active. The update status is monitored and if it fails to be updated, then an OAT sensor alarm is generated. There is an alarm delay (approximately 1 hour) to prevent false alarms, while minimizing the required update rate for OAT.

NOTE: You can reset this alarm by momentarily setting the Shutdown point to Active.

SPT Sensor Alarm (if SPT sensor was active)

The control generates an SPT sensor failure alarm if the SPT sensor fails to communicate with the control for 5 minutes or greater. The update status is monitored and if it fails to be updated, then an SPT sensor alarm is generated.

ZS Sensor Alarm (if ZS sensor was active)

The control generates a ZS sensor failure alarm if the ZS sensor fails to communicate with the control for 5 minutes or greater. The update status is monitored and if it fails to be updated, then a ZS sensor alarm is generated.

UPM Alarm - Hard lockout status

The control generates Alarm when Hard lockout Alarm is active on UPM board. Configurable 2 or 4 soft lockout alarms on UPM board before unit enters to hard lock out. Soft lockout alarm history is available via controller.

Low Water Flow Alarm

The control monitors differential pressure switch (water flow switch), and generates alarm if water flow is not met. This alarm is presented only if unit is provided with differential (flow) pressure switch option.

Air Side Delta T Alarm

The control has 4 configurable alarm limits for Air Side Delta T.

The control verifies that the calculates delta T based on Return and Supply Air temperatures reading and verifies if it operates within configured ranged (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor.

Source Water Valve Alarm

The control generates alarm if communication with Act Net device is lost.

Water Side Delta T Alarm

The control has 4 configurable alarm limits for Source water Delta T.

The control verifies that the calculates delta T based on Entering and Leaving water temperatures reading and verifies if it operates

within configured ranged (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor.

Entering Water Temperature Alarm

The control has 4 configurable alarm limits for Entering Water temperature.

The control verifies that the entering water temperature is within operating range (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor. Once the compressor is started, the entering water temperature is further monitored to verify that it is within limits to ensure sufficient water is flowing through the coil. If the entering water temperature rises above or falls below the appropriate limits, and lasts for more than 15 seconds, an alarm is generated and the compressor shuts down.

Return Air Temperature Alarm (if RAT provided)

The control has 2 configurable alarm limits for return air temperature. The control verifies that the return air temperature is within operating range (between high and low limits) when unit is operating. If the air temperature rises above or falls below the appropriate limits, and this lasts for more than 5 minutes, an alarm is generated.

SERVICE

Perform the procedures outlined below periodically, as indicated. An annual "checkup" is recommended by a licensed refrigeration mechanic. Recording the performance measurements of volts, amps, and water temperature differences (both heating and cooling) is recommended. This data should be compared to the information on the unit's data plate and the data taken at the original start-up of the equipment.

Periodic lockouts almost always are caused by air or water flow problems. The lockout (shutdown) of the unit is a normal protective measure in the design of the equipment. If continual lockouts occur call a qualified technician immediately and have them check for water flow problems, water temperature problems, airflow problems or air temperature problems. Use of the pressure and temperature charts for the unit may be required to properly determine the cause.

Jobsite Check

CHECKS TO THE AREA

Prior to beginning work on systems containing flammable refrigerants, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the refrigerating system the following precautions shall be completed prior to conducting work on the system.

WORK PROCEDURE

Work shall be undertaken under a controlled procedure to minimize the risk of a flammable gas or vapor being present while the work is being performed.

GENERAL WORK AREA

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

CHECKING FOR PRESENCE OF REFRIGERANT

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with R-454B refrigerant, i.e. non-sparking, adequately sealed or intrinsically safe.

PRESENCE OF FIRE EXTINGUISHER

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO_2 fire extinguisher adjacent to the charging area.

NO IGNITION SOURCES

No person carrying out work in relation to a refrigerating system which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the possible ignition sources. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

VENTILATED AREA

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

⚠ WARNING

To avoid injury and the discharge of refrigerant into the environment, all refrigerant discharged from this unit must be recovered without exception. Technicians must follow industry accepted guidelines and all local, state and federal statutes for the recovery and disposal of refrigerants.

⚠ WARNING

To avoid injury and the release of refrigerant into the atmosphere, the refrigerant circuit of this unit must only be serviced by technicians who meet local, state and federal proficiency requirements.

⚠ WARNING

To prevent injury or death due to electrical shock or contact with moving parts, open unit disconnect switch before servicing unit.

Electrical Devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily repaired. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner so all parties are advised.

Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking;
- that no live electrical components and wiring are exposed while charging, recovering or purging the system;
- that there is continuity of earth bonding

Repairs to Sealed Components

Sealed electrical components shall be replaced.

Repair to Intrinsically Safe Components

Intrinsically safe components must be replaced.

Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or other adverse

environmental effects. During the check take into account the effects of aging or continual vibration from sources such as compressors or fans.

Filters

Filter changes or cleanings are required at regular intervals. The time period between filter changes will depend upon type of environment the equipment is used in. In a single family home, that is not under construction, changing or cleaning the filter every 60 days may be sufficient. In other applications such as motels, where daily vacuuming produces a large amount of lint, filter changes may be need to be as frequent as biweekly. See Fig. 2 and 3 for replacement filter sizes. Note that horizontal units containing two filters are taped together at the factory to facilitate removal. This should be done by end user as new filters are installed.

IMPORTANT: Units should never be operated without a filter.

⚠ CAUTION

Equipment should never be used during construction or renovation due to possibility of contaminants entering the air coil of the equipment which permanently affects the performance and may shorten the life of the equipment.

Condensate Drain Pans

The condensate drain should be checked quarterly by cleaning and flushing to ensure proper drainage.

Refrigerant System

Verify air and water flow rates are at proper levels before servicing. To maintain sealed circuitry integrity, do not install service gauges unless unit operation appears abnormal. Check to see that unit is within the superheat and subcooling temperature ranges shown in Tables 24-35. If the unit is not within these ranges, recover and reweigh in refrigerant charge.

REFRIGERATING EQUIPMENT.

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed.

The following checks shall be applied to installations using flammable refrigerants:

- the actual refrigerant charge is in accordance with the room size within which the refrigerant containing parts are installed;
- the ventilation machinery and outlets are operating adequately and are not obstructed;
- if an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant;
- signs on the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected;
- refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

DETECTION OF FLAMMABLE REFRIGERANTS

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems:

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.). Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL gas (25% maximum) and it is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

NOTE: Examples of leak detection fluids are the bubble method and fluorescent dye method. If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

Compressor

IMPORTANT: When a compressor is removed from this unit, system refrigerant circuit oil will remain in the compressor. To avoid leakage of compressor oil, the refrigerant lines of the compressor must be sealed after it is removed.

Conduct annual amperage checks to ensure that amp draw is no more than 10% greater than indicated on the serial plate data.

Fan Motors

All units have lubricated fan motors. Fan motors should never be lubricated unless obvious, dry operation is suspected. Periodic maintenance oiling is NOT recommended as it will result in dirt accumulating in the excess oil and cause eventual motor failure. Conduct annual dry operation check and amperage check to ensure amp draw is no more than 10% greater than indicated on serial plate data and remove any build up on the blower assembly.

Condensate Drain Cleaning

Clean the drain line and unit drain pan at the start of each cooling season. Check flow by pouring water into drain. Be sure trap is filled to maintain an air seal.

Air Coil Cleaning

Remove dirt and debris from evaporator coil as required by condition of the coil. A 10% solution of dishwasher detergent and water is recommended for moving parts, lockout/tagout disconnect switch sides of the coil, followed by a thorough water rinse. Clean coil with a stiff brush, vacuum cleaner, or compressed air. Use a fin comb of the correct tooth spacing when straightening mashed or bent coil fins.

Condenser Cleaning

Water-cooled condensers may require cleaning of scale (water deposits) due to improperly maintained closed-loop water systems. Sludge build-up may need to be cleaned in an open water tower system due to induced contaminants.

Local water conditions may cause excessive fouling or pitting of tubes. Condenser tubes should therefore be cleaned at least once a year, or more often if the water is contaminated.

Proper water treatment can minimize tube fouling and pitting. If such conditions are anticipated, water treatment analysis is recommended. Refer to the Carrier System Design Manual, Part 5, for general water conditioning information.

⚠ CAUTION

Follow all safety codes. Wear safety glasses and rubber gloves when using inhibited hydrochloric acid solution. Observe and follow acid manufacturer's instructions.

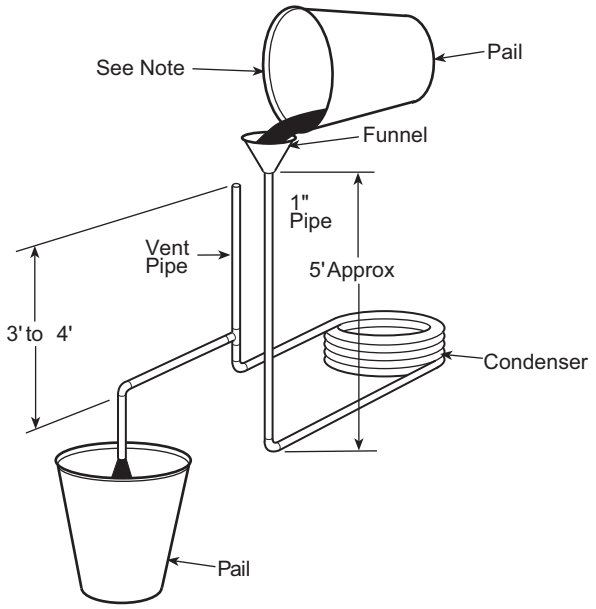
Clean condensers with an inhibited hydrochloric acid solution. The acid can stain hands and clothing, damage concrete, and, without inhibitor, damage steel. Cover surroundings to guard against splashing. Vapors from vent pipe are not harmful, but take care to prevent liquid from being carried over by the gases.

Warm solution acts faster, but cold solution is just as effective if applied for a longer period.

GRAVITY FLOW METHOD

Do not add solution faster than vent can exhaust the generated gases.

When condenser is full, allow solution to remain overnight, then drain condenser and flush with clean water. Follow acid manufacturer's instructions. See Fig. 57.



NOTE: Fill condenser with cleaning solution. Do not add solution more rapidly than vent can exhaust gases caused by chemical action.

Fig. 57 — Gravity Flow Method

FORCED CIRCULATION METHOD

Fully open vent pipe when filling condenser. The vent may be closed when condenser is full and pump is operating. See Fig. 58.

Regulate flow to condenser with a supply line valve. If pump is a non-overloading type, the valve may be fully closed while pump is running.

For average scale deposit, allow solution to remain in condenser overnight. For heavy scale deposit, allow 24 hours. Drain condenser and flush with clean water. Follow acid manufacturer's instructions.

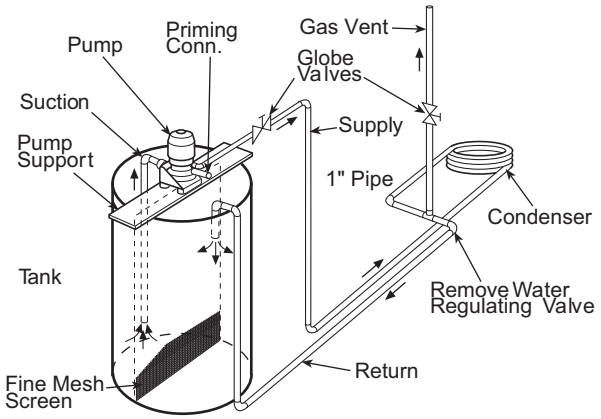


Fig. 58 — Forced Circulation Method

Removal and Evacuation

When breaking into the refrigerant circuit to make repairs, or for any other purpose, conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

- safely remove refrigerant following local and national regulations
- evacuate
- purge the circuit with inert gas (optional for A2L)
- evacuate (optional for A2L)
- continuously flush or purge with inert gas when using flame to open circuit; and
- open the circuit.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerant purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

Refrigerant Charging

⚠ WARNING

To prevent personal injury, wear safety glasses and gloves when handling refrigerant. Do not overcharge system — this can cause compressor flooding.

NOTE: Do not vent or depressurize unit refrigerant to atmosphere. Remove and recover refrigerant following accepted practices.

CHARGING PROCEDURES

In addition to conventional charging procedures, the following requirements shall be followed:

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines

shall be as short as possible to minimize the amount of refrigerant contained in them.

- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the refrigerating system.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

RECOVERY

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labeled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant. If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Evaporator Coil Removal

VERTICAL CONFIGURATION UNITS

For vertical configuration units, the evaporator coil can be removed from the front side of the unit (refer to Fig. 59). Follow these steps:

1. Shut off the main power supply to the unit and apply lock-out/tag-out procedures.
2. Remove the upper front panel.
3. Open the front lower access panel with the control box.
4. Disconnect electrical power and lift off the access panel to remove it.
5. Remove the remaining front brace located between the upper and lower panels.
6. Slide out and remove the blower assembly.
7. Disconnect the refrigerant pipes connected to the evaporator coil (requires cutting the pipes).
8. Remove the screws from the full side panel.
9. Pivot out and remove the evaporator coil.

NOTE: Evaporator removal/replacement requires cutting/brazing pipes. Follow the Refrigerant Removal, Evacuation, and Charging procedures in the Service section on page 82.

Ensure all steps are followed for safe and efficient removal of the evaporator coil.

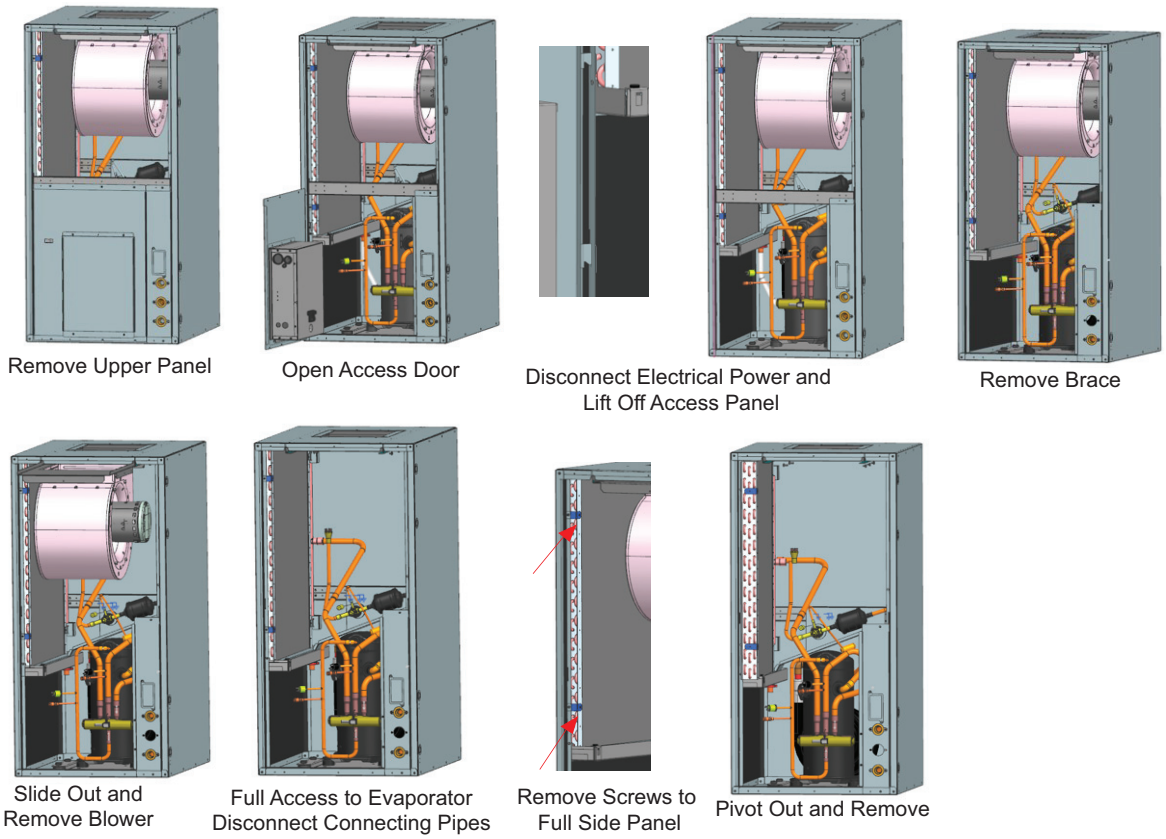


Fig. 59 — Evaporator Coil Service on Vertical Units

Blower Assembly Service and Removal

⚠ CAUTION

Before attempting to remove fan motors or motor mounts, place a piece of plywood over evaporator coils to prevent coil damage.

Vertical Configuration Units

For the vertical configuration, the blower assembly is designed to slide out to facilitate access and servicing of the blower/motor assembly. If removal of the blower assembly is required, such as when installation constraints prevent the use of the slide-out feature, follow these steps:

1. Disconnect the motor power wires from the motor terminals before removing the motor from the unit.
2. Shut off the main power supply to the unit and apply lock-out/tag-out procedures.
3. Remove the three screws positioned above the motor. See Fig. 60.
4. Drop down and slide off the welded pins situated on the opposite side from the motor. See Fig. 60.

Ensure all steps are followed for safe and efficient removal of the blower assembly.

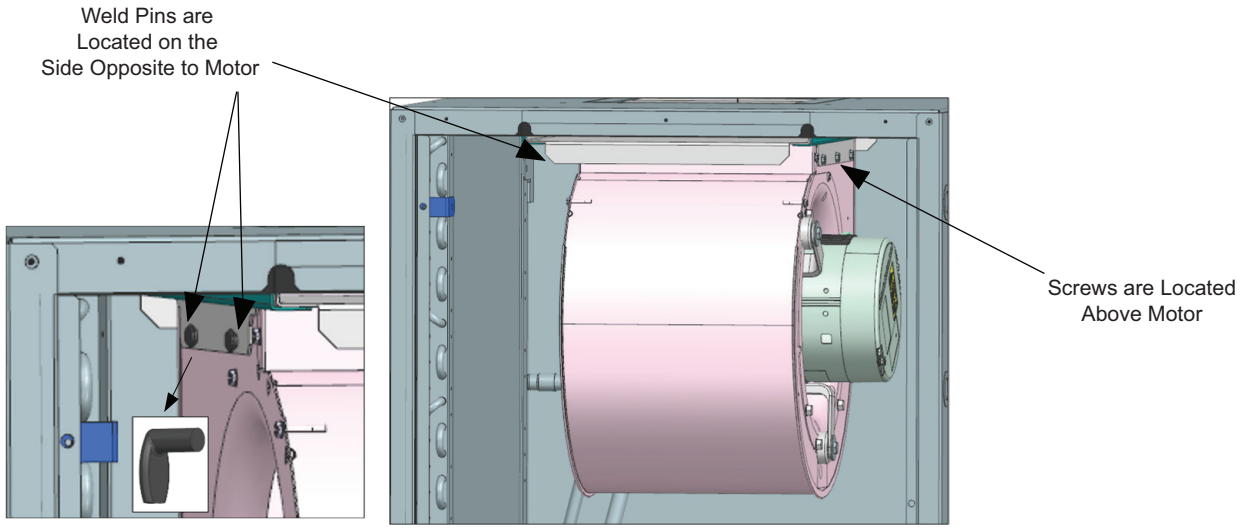


Fig. 60 — Vertical Units Blower Assembly

Horizontal Configuration Units

For horizontal configurations, if removal of the blower assembly becomes necessary, follow these steps:

1. Disconnect the motor power wires from the motor terminals before removing the motor from the unit.
2. Shut off the main power supply to the unit and apply lock-out/tag-out procedures.
3. Remove the three screws located on the motor side of the blower assembly. See Fig. 61.
4. Twist and pull blower back from welded pins located on opposite side to the motor, near the evaporator. See Fig. 61.

Ensure all steps are followed for safe and efficient removal of the blower assembly.

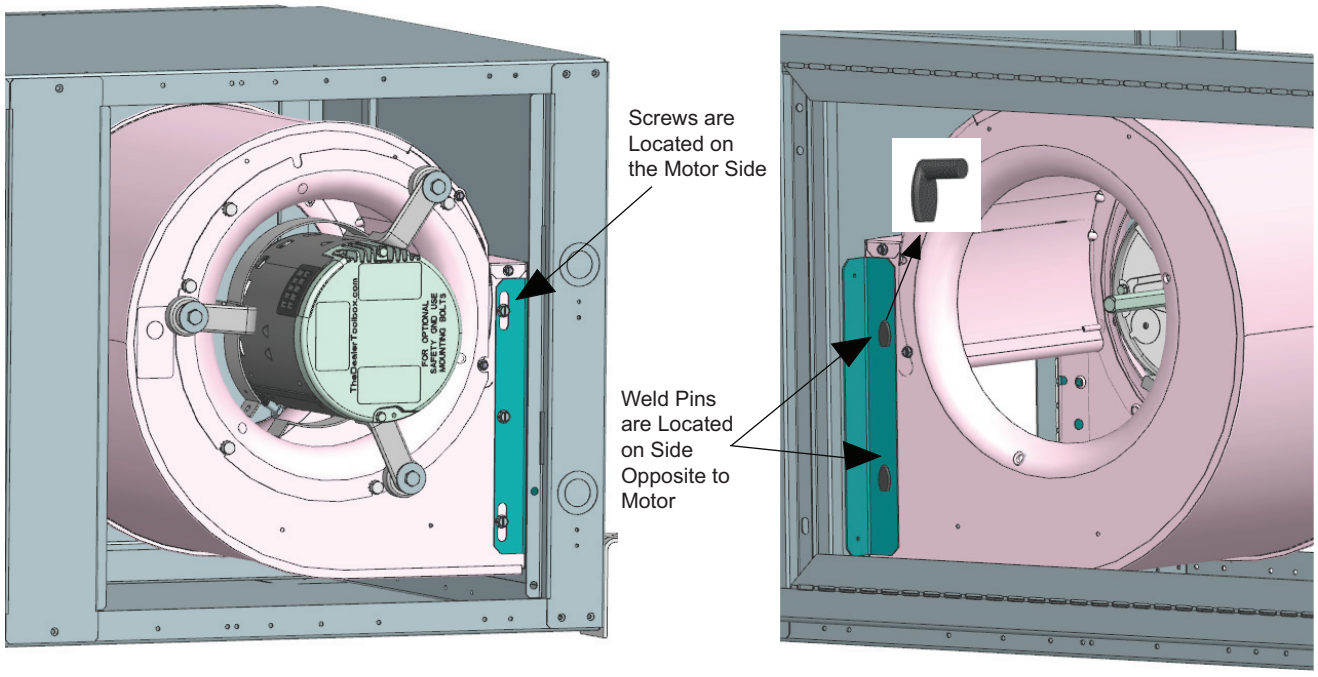


Fig. 61 — Horizontal Units Blower Assembly

Troubleshooting

When troubleshooting problems with a WSHP, consider the following.

UNIT PROTECTION MODULE (UPM)

All Carrier WSHPS are equipped with a 24-v low voltage control circuit. Units are selectable to be provided with no controls for control via a field installed thermostat or third party DDC or to be provided with a factory installed Carrier i-Vu DDC for advanced equipment control and monitoring. Regardless of the selection all units will be equipped with a unit protection module. The UPM board should be one of the first areas to start with troubleshooting an equipment issue. See Fig. 20. Refer "UPM Configuration and Alarms" under Step 9 — "Configure Unit Control Components" on page 24.

Thermostatic Expansion Valves

Thermostatic expansion valves (TXV) are used as a means of metering the refrigerant through the evaporator to achieve a preset superheat at the TXV sensing bulb. Correct superheat of the refrigerant is important for the most efficient operation of the unit and for the life of the compressor. Refer to Fig. 62 for refrigerant diagram.

Packaged heat pumps typically use one bi-flow TXV to meter refrigerant in both modes of operation. When diagnosing possible TXV problems it may be helpful to reverse the refrigerant flow to assist with the diagnosis.

Geothermal and water source heat pumps are designed to operate through a wide range of entering-water temperatures that will have a direct effect on the unit refrigerant operating pressures. Therefore, diagnosing TXV problems can be difficult.

TXV FAILURE

The most common failure mode of a TXV is when the valve fails while closed. Typically, a TXV uses spring pressure to close the valve and an opposing pressure, usually from a diaphragm, to open the valve. The amount of pressure exerted by the diaphragm will vary, depending on the pressure inside of the sensing bulb. As the temperature of and pressure within the bulb decreases, the valve will modulate closed and restrict the refrigerant flow through the valve. The result is less refrigerant in the evaporator and an increase in the superheat. As the temperature at the bulb increases the diaphragm pressure will increase, which opens the valve and allows more refrigerant flow and a reduction in the superheat.

If the sensing bulb, connecting capillary, or diaphragm assembly are damaged, pressure is lost and the spring will force the valve to a closed position. Often, the TXV will not close completely so some refrigerant flow will remain, even if there is inadequate flow for the heat pump to operate.

The TXV sensing bulb must be properly located, secured, and insulated as it will attempt to control the temperature of the line to which it is connected. The sensing bulb must be located on a dedicated suction line close to the compressor. On a packaged heat pump, the bulb may be located almost any place on the tube running from the compressor suction inlet to the reversing valve. If the bulb is located on a horizontal section, it should be placed in the 10:00 or 2:00 position for optimal performance.

⚠ CAUTION

Use caution when tightening the strap. The strap must be tight enough to hold the bulb securely but caution must be taken not to over-tighten the strap, which could dent, bend, collapse or otherwise damage the bulb.

The bulb must be secured to the pipe using a copper strap. The use of heat transfer paste between the bulb and the pipe will also help ensure optimum performance.

The bulb must also be properly insulated to eliminate any influence on valve operation by the surrounding conditions. Cork tape is the recommended insulation as it can be molded tight to the bulb to prevent air infiltration.

Causes of TXV Failure

The most common causes of TXV failure are:

1. A cracked, broken, or damaged sensing bulb or capillary can be caused by excessive vibration of the capillary during shipping or unit operation.

   If the sensing bulb is damaged or if the capillary is cracked or broken, the valve is considered failed and must be replaced. Replacement of the TXV "power head" or sensing bulb, capillary, diaphragm assembly is possible on some TXVs. The power head assembly screws onto most valves, but not all are intended to be replaceable. If the assembly is not replaceable, replace the entire valve.
2. Particulate debris within the system can be caused by several sources including contaminated components, tubing, and service tools, or improper techniques used during brazing operations and component replacement.

   Problems associated with particulate debris can be compounded by refrigerant systems that use POE (polyester oil). POE oil has solvent-like properties that will clean the interior surfaces of tubing and components. Particulates can be released from interior surfaces and may migrate to the TXV strainer, which can lead to plugging of the strainer.
3. Corrosive debris within the system may happen after a failure, such as a compressor burn out, if system was not properly cleaned.
4. Non-condensables may be present in the system. Non-condensables includes any substance other than the refrigerant or oil such as air, nitrogen, or water. Contamination can be the result of improper service techniques, use of contaminated components, and/or improper evacuation of the system.

Symptoms

The symptoms of a failed TXV can be varied and will include one or more of the following:

- Low refrigerant suction pressure
- High refrigerant superheat
- High refrigerant subcooling
- TXV and/or low pressure tubing frosting
- Equalizer line condensing and at a lower temperature than the suction line or the equalizer line frosting
- FP1 faults in the heating mode in combination with any of the symptoms listed above
- FP2 faults in the cooling mode in combination with any of the symptoms listed above. Some symptoms can mimic a failed TXV but may actually be caused by another problem.

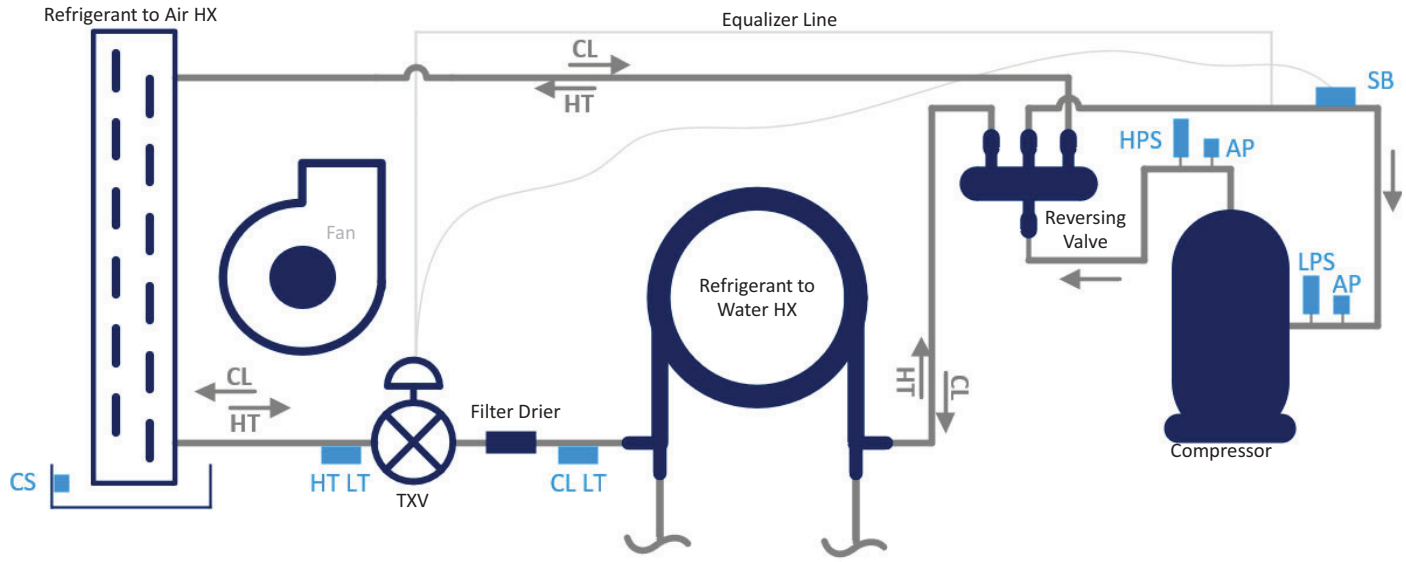
Before conducting an analysis for a failed TXV the following must be verified:

- Confirm that there is proper water flow and water temperature in the heating mode.
- Confirm that there is proper airflow and temperature in the cooling mode.
- Ensure coaxial water coil is clean on the inside; this applies to the heating mode and may require a scale check.
- Refrigerant may be undercharged. To verify, subcooling and superheat calculations may be required.

Diagnostics

Several tests may be required to determine if a TXV has failed. The following tools may be required for testing:

1. Refrigerant gauge manifold compatible with the refrigerant in the system.
2. Digital thermometer, preferably insulated, with wire leads that can be connected directly to the tubing.
3. Refrigerant pressure-temperature chart for the refrigerant used.



LEGEND

AP — Access Port
CL LT — Cooling Liquid Line Temperature / Water Side Freeze 1
CS — Condensate Overflow Switch
HT LT — Heating Liquid Line Temperature / Air Coil Freeze 2
HPS — High Pressure Switch
LPS — Low Pressure Switch
SB — TXV Sensing Bulb

NOTE(S):
1. Filter Drier only present on units equipped with scroll compressor 2 tons and up.
2. All Pilot and Equalizer Lines 1/4" OD.

Fig. 62 — Typical Refrigerant Diagram - 50WC Units

To determine that a TXV has failed, verify the following:

- The suction pressure is low and the valve is non-responsive.
- The TXV sensing bulb can be removed from the suction line and warmed by holding the bulb in your hand. This action should result in an increase in the suction pressure while the compressor is operating. The sensing bulb can also be chilled by immersion in ice water, which should result in a decrease in the suction pressure while the compressor is operating. No change in the suction pressure would indicate a nonresponsive valve.
- Simultaneous LOW suction pressure, HIGH refrigerant subcooling and HIGH superheat.
- LOW suction pressure, LOW subcooling and HIGH superheat may indicate an undercharge of refrigerant. HIGH subcooling and LOW superheat may indicate an overcharge of refrigerant. The suction pressure will usually be normal or high if there is an overcharge of refrigerant.
- LOW suction pressure and frosting of the valve and/or equalizer line may indicate a failed valve. However, these symptoms may also indicate an undercharge of refrigerant. Calculate the subcooling and superheat to verify a failed valve or refrigerant charge issue.

Repair

⚠ WARNING

Most TXVs are designed for a fixed superheat setting and are therefore considered non-adjustable. Removal of the bottom cap will not provide access for adjustment and can lead to damage to the valve or equipment, unintended venting of refrigerant, personal injury, or possibly death.

⚠ CAUTION

Always recover the refrigerant from the system with suitable approved tools, recovery equipment, and practices prior to attempting to remove or repair any TXV.

IMPORTANT: Repair of any sealed refrigerant system requires training in the use of refrigeration tools and procedures. Repair should only be attempted by a qualified service technician. A universal refrigerant handling certificate will be required. Local and/or state license or certificate may also be required.

Figure 62 illustrates the typical refrigerant diagram for 50WC units.

See Table 36 for compressor characteristics and Table 37 for additional troubleshooting information.

⚠ CAUTION

Disconnect power from unit before removing or replacing connectors, or servicing motor. Wait 5 minutes after disconnecting power before opening motor.

Table 36 — Compressor Characteristics

MODEL	VOLTAGE	COLD WINDING RESISTANCE VALUES (± 10%)					RUN CAPACITOR (µF/V)
		Single Phase		Three Phase			
		R-C	S-C	T1-T2	T2-T3	T3-T1	
50WC007	208-230/1/60	5.50	6.64	—	—	—	15µF/370-v
	265/1/60	7.84	5.59	—	—	—	15µF/440-v
50WC009	208-230/1/60	3.78	2.91	—	—	—	25µF/370-v
	265/1/60	4.30	4.27	—	—	—	20µF/440-v
50WC012	208-230/1/60	2.84	1.96	—	—	—	35µF/370-v
	265/1/60	3.67	2.96	—	—	—	30µF/440-v
50WC015	208-230/1/60	2.60	2.28	—	—	—	40µF/370-v
	265/1/60	3.04	3.18	—	—	—	30µF/440-v
50WC018	208-230/1/60	1.97	1.42	—	—	—	50µF/440-v
	265/1/60	2.54	1.87	—	—	—	30µF/440-v
50WC024	208-230/1/60	1.18	1.61	—	—	—	55µF/440-v
	265/1/60	2.44	2.23	—	—	—	40µF/440-v
	208-230/3/60	—	—	1.59			—
	460/3/60	—	—	6.079			—
50WC30	208-230/1/60	1.110	1.060	—	—	—	60µF/440-v
	265/1/60	1.176	1.661	—	—	—	35µF/440-v
	208-230/3/60	—	—	1.423			—
	460/3/60	—	—	4.565			—
50WC36	208-230/1/60	0.719	1.431	—	—	—	40µF/370-v
	265/1/60	0.888	1.342	—	—	—	45µF/370-v
	208-230/3/60	—	—	0.975			—
	460/3/60	—	—	4.266			—
50WC42	208-230/1/60	0.568	1.636	—	-	—	45µF/370-v
	265/1/60	0.665	1.539	—	-	—	40µF/370-v
	208-230/3/60	—	—	1.117			—
	460/3/60	—	—	4.404			—
50WC48	208-230/1/60	0.518	1.603	—	—	—	45µF/370-v
	208-230/3/60	—	—	—	—	—	—
	460/3/60	—	—	4.404			—
	575/3/60	—	—	5.613			—
50WC60	208-230/1/60	0.356	0.727	—	—	—	70µF/370-v
	208-230/3/60	—	—	0.629	0.772	0.629	—
	460/3/60	—	—	3.44			—
	575/3/60	—	—	4.91	3.75	4.91	—
50WC70	208-230/1/60	0.336	0.921	—	—	—	80µF/370-v
	208-230/3/60	—	—	0.542			—
	460/3/60	—	—	2.161			—
	575/3/60	—	—	4.91	3.75	4.91	—

Table 37 — Troubleshooting

FAULT	COOLING	HEATING	CHECK	POSSIBLE CAUSE	SOLUTION
No Compressor Operation but Fan Runs	X		Is fault LED Blinking 1 time?	High Pressure fault - no or low water flow	Check water valves and/or pumps for proper operation. Check for water coil blockage.
				High Pressure fault - high water temperature	Check water temperature - is it in range?
				High Pressure fault - fouled or scaled water coil	Check for proper flow rate and water temperature, but low waterside temp rise in cooling.
		X		High Pressure fault - no or low airflow	Check fan motor for proper operation.
					Check air filter.
					Inspect air coil for dirt/debris.
					Check ductwork - are dampers closed or blocked?
	X		Is fault LED Blinking 2 times?	Low Pressure fault - no or low airflow	Check fan motor for proper operation.
					Check air filter.
					Inspect air coil for dirt/debris.
					Check ductwork - are dampers closed or blocked?
				Low Pressure fault - low refrigerant	Check refrigerant pressure with gauge set.
		X		Low Pressure fault - no or low water flow	Check water valves and/or pumps for proper operation. Check for water coil blockage.
				Low Pressure fault - low refrigerant	Check for proper flow rate and water temperature, but low waterside temp drop in heating.
		X	Is fault LED Blinking 3 times?	Freeze fault, water coil - no or low water flow	Check water valves and/or pumps for proper operation. Check for water coil blockage.
				Freeze fault - low water temperature	Check water temperature - is it below 40°F entering? If heat pump is connected to a closed loop with antifreeze check that the "FREEZE 1" resistor on the UPM board has been cut to set the unit to antifreeze mode.
				Freeze fault - low refrigerant	Check refrigerant pressure with gauge set.
	X		Is fault LED Blinking 4 times?	Condensate fault - poor drainage	Check condensate pan for high water level. Check drain line for blockages, double trapping or inadequate trapping.
				Condensate fault - blocked return air	Check condensate pan for high water level. Check air filter and return air ductwork for blockage. Check that there is adequate space between the return air opening and walls or other obstructions on free return applications.
	X	X	Is fault LED Blinking 5 times?	Brown out fault - low supply voltage	Check primary voltage - ensure it is within the limits listed on the unit data plate.
				Brown out fault - overloaded control circuit	Check control voltage - if it is below 18-v check accessories connected to the unit and ensure that they do not exceed the VA draw shown on page 24.
				Brown out fault - bad thermostat connection	Check that thermostat wiring is proper gauge and length, that it is not damaged and that all connections at the thermostat and heat pump are secure.
	X		Is fault LED Blinking 6 times?	Freeze fault, air coil - no or low airflow	Check fan motor for proper operation.
					Check air filter.
					Inspect air coil for dirt/debris.
					Check ductwork - are dampers closed or blocked?
				Freeze fault, air coil - blocked return air	Check that there is adequate space between the return air opening and walls or other obstructions on free return applications.
				Freeze fault, air coil - low refrigerant	Check refrigerant pressure with gauge set.
	X	X	No fault LED - contactor not energized	Thermostat not calling for compressor operation	Ensure that the thermostat is on and calling for "Y".
				Bad thermostat connection	Check "Y" connection from thermostat. Ensure that there is 24 VAC between "Y" and "C".
				Loose wire to contactor coil	Check wiring - ensure that there is 24 VAC across the contactor coil.
				Burned out contactor coil	Test contactor with 24 vac (between "R" and "C"). Ohm contactor coil - an open circuit indicates a burned coil.
	X	X	No fault LED - contactor energized	Open compressor overload	Check for supply voltage at the load side of the contactor. For 3 phase models check phase rotation and voltage at all 3 phases.
				Poor wiring connections	Look for signs of heat on the wiring insulation. Check that all wiring connections are secure and properly torqued.
				Burned out compressor	Does compressor hum when power is applied? If not check the resistance of the compressor windings using the values shown in the compressor characteristics chart. Note that the compressor must be cool (70°F) when checking the windings.
No Compressor or Fan Operation	X	X	Power LED on	Bad thermostat connection / faulty thermostat	Check thermostat and wiring. Check unit terminal block for 24 VAC between "Y" and "C" and "G" and "C".
			Power LED off	Low or no supply power	Ensure that the supply voltage to the unit is with in the range shown on the unit data plate.
				Faulty control transformer	Check for 24 vac between "R" and "C" on the unit terminal block. For 75 and 100 VA transformers, check that the transformer circuit breaker has not tripped. Check low voltage circuit for overload conditions or short circuits before replacing the transformer.

Table 37 — Troubleshooting (cont)

FAULT	COOLING	HEATING	CHECK	POSSIBLE CAUSE	SOLUTION
No Fan Operation (PSC motor)	X	X	Fan relay energized	Faulty motor	Check supply voltage from the fan relay to the motor. Check that all motor wires are secure. With power off spin the motor shaft - noise, resistance or uneven motion can be signs of motor failure.
			Fan relay not energized	No fan operation signal	Check for 24 VAC across the fan relay coil. Check all wiring connections.
				Bad fan relay	If the relay coil is energized but the relay does not pull in, check the resistance across the relay coil - an open circuit is an indicator of a faulty relay.
No Fan Operation (constant torque motor)	X	X		No fan operation signal	Check for 24 VAC between "G" and "C". Check all wiring connections.
				Loose wiring	Check all wiring connections at motor and control box.
				Faulty motor	Check supply voltage to the motor. Check that all motor wires are secure. With power off spin the motor shaft - noise, resistance or uneven motion can be signs of motor failure.
No Fan Operation (constant airflow motor)	X	X		No fan operation signal	Check for 24 VAC between "G" and "C". Check all wiring connections. Make sure that the thermostat connection plug is securely connected.
				Loose wiring	Check all wiring connections at motor and control box. Check that power and control harnesses are securely connected.
				Interface board problems	Make sure that the interface board is not damged and that all DIP switches are in the proper configuration (refer to the blower performance tables).
				Faulty motor	Check water temperature - is it below 40°F entering? If heat pump is connected to a closed loop with antifreeze, check the "FREEZE 1" DIP switch 5 is set to 15°F (On). With power off spin the motor shaft - noise, resistance or uneven motion can be signs of motor failure.
Unit Not Shifting into Cooling	X		Reversing valve solenoid energized	Faulty solenoid	Check that the reversing valve solenoid is receiving 24 VAC. If so, check the resistance of the solenoid - an open circuit may indicate a burned out solenoid.
			Reversing valve solenoid not energized	Miswired/faulty thermostat	Check that the reversing valve thermostat wire is connected to the "O" terminal of the thermostat. Check for a contact closure between "O" and "R".
				Loose wire on "O" terminal	Check that the wires from the thermostat to the unit are securely connected and that the wires from the electrical box to the reversing valve are connected.
Excessively Cold Supply Air Temperature in Cooling or Excessively Hot Supply Air Temperature in Heating	X	X	Reduced airflow	Dirty Filter	Replace filter.
				Fan speed too low	Consult blower performance table and increase fan speed if possible.
				Excessive duct pressure drop	Consult blower performance table and increase fan speed if possible.
Excessively Warm Supply Air Temperature in Cooling and/or Excessively Cool Air in Heating	X	X	Airflow too high	Fan speed setting too high	Consult blower performance table and reduce fan speed if possible.
			High or low water temperature	Inlet water temperature out of range	Check unit capacity vs. water temperature.
			Air leakage	Leaky ductwork	Inspect ductwork.
			Loss of refrigeration capacity	Low refrigerant	Check refrigerant pressures with gauge set.
High Humidity	X		Airflow too high	Fan speed setting too high	Consult blower performance table and reduce fan speed if possible.
			Loss of refrigeration capacity	Low refrigerant	Check refrigerant pressures with gauge set.
			Short cycling	Unit oversized	Check unit performance against building load calculations.
				Poor thermostat location	Make sure that thermostat is not located by a supply- air duct.
Objectionable Noise Levels	X	X	Air noise	Poor ductwork/grille design	Ensure ductwork and grilles are properly sized for unit airflow.
				Fan speed setting too high	Consult blower performance table and reduce fan speed if possible.
			Structure bourne noise	Unit not mounted on full vibration pad	Mount unit on a vibration pad.
				Unit not connected with flexible conduit, water lines and/or ductwork	Install unit in accordance with instructions.
				Unit cabinet touching wall or other building component	Adjust unit location to avoid unit touching structure.
	X		Compressor noise	High water temperature or low water flow rate elevating head pressure	Increase water flow rate and/or reduce water temperature if possible.
				Scaled or fouled water coil elevating heat pressure	Clean/descale water coil.
		X		Low airflow elevating head pressure	Check filter.
					Increase fan speed.
	X	X	Water hammer	Fast closing valves installed	Change valves to slow-close type.

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50WC START-UP CHECKLIST
(Remove and use for job file.)

NOTE: To avoid injury to personnel and damage to equipment or property when completing the procedures listed in this start-up checklist, use good judgment, follow safe practices, and adhere to the safety considerations/information as outlined in preceding sections of this Installation, Start-Up, and Service Instructions document.

CUSTOMER: _____ JOB NAME: _____

MODEL NO.: _____ SERIAL NO.: _____ DATE: _____

I. PRE-START-UP

Does the unit voltage correspond with the supply voltage available? (Y/N) _____

Have the power and control wiring connections been made and terminals tight? (Y/N) _____

Have water connections been made and is fluid available at heat exchanger? (Y/N) _____

Has pump been turned on and are isolation valves open? (Y/N) _____

Has condensate connection been made and is a trap installed? (Y/N) _____

Is an air filter installed? (Y/N) _____

II. START-UP

Is fan operating when compressor operates? (Y/N) _____

If 3-phase scroll compressor is present, verify proper rotation per instructions. (Y/N) _____

UNIT VOLTAGE — COOLING OPERATION

Phase AB Volts _____ Phase BC Volts _____ (if 3 phase) Phase CA Volts _____ (if 3 phase)

Phase AB Amps _____ Phase BC Amps _____ (if 3 phase) Phase CA Amps _____ (if 3 phase)

CONTROL VOLTAGE

Is control voltage above 21.6 volts? (Y/N) _____

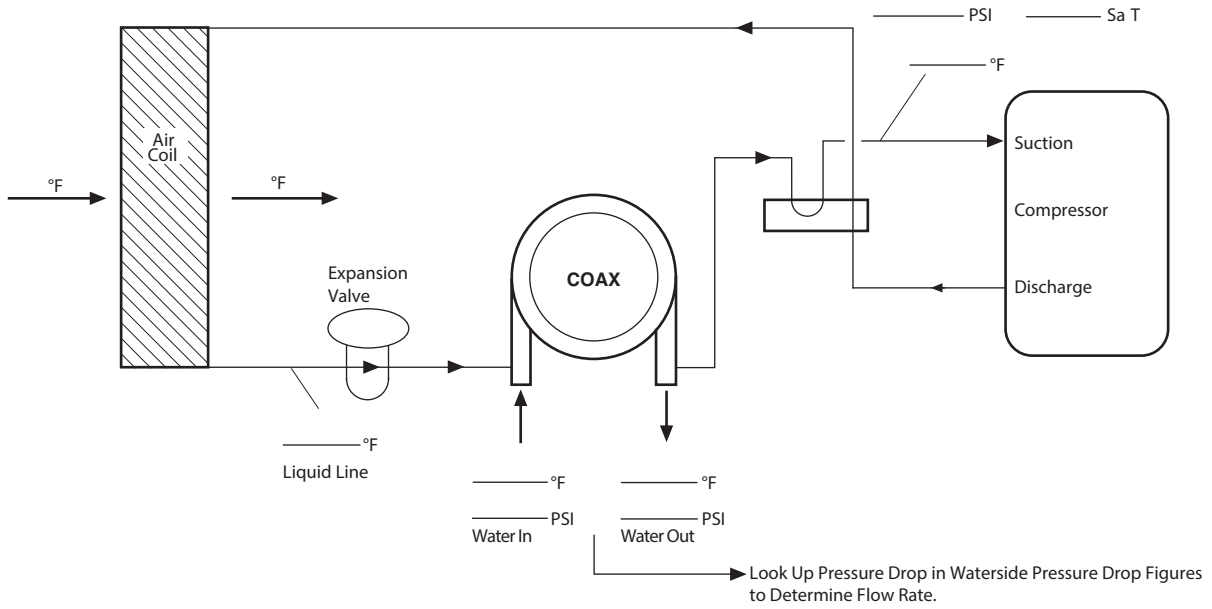
If not, check for proper transformer connection.

TEMPERATURES

Fill in the analysis chart attached.

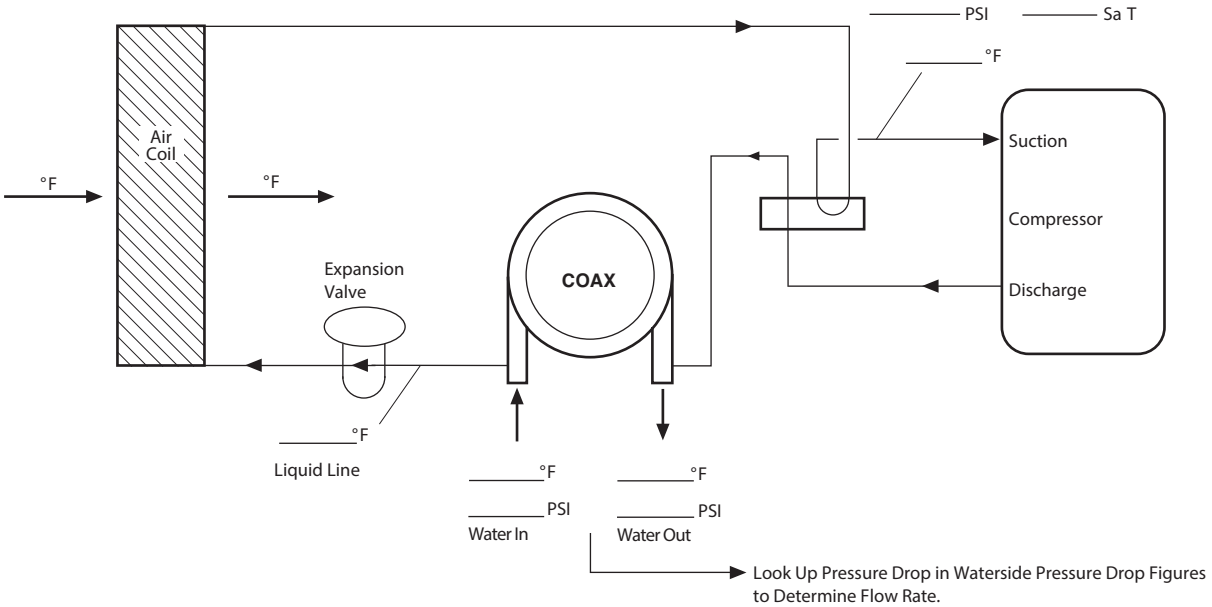
COAXIAL HEAT EXCHANGER	COOLING CYCLE: FLUID IN	_____ F	FLUID OUT	_____ F	_____ PSI	_____ FLOW		
	HEATING CYCLE: FLUID IN	_____ F	FLUID OUT	_____ F	_____ PSI	_____ FLOW		
AIR COIL	COOLING CYCLE: AIR IN	_____ F	AIR OUT	_____ F				
	HEATING CYCLE: AIR IN	_____ F	AIR OUT	_____ F				

HEATING CYCLE ANALYSIS



See Fig. 52 and 53 for waterside pressure drop.

COOLING CYCLE ANALYSIS



See Fig. 52 and 53 for waterside pressure drop.

HEAT OF EXTRACTION (ABSORPTION) OR HEAT OF REJECTION =

_____ FLOW RATE (GPM) x _____ TEMP. DIFF. (°F) x _____ FLUID FACTOR* = _____ (Btu/hr)

SUPERHEAT = SUCTION TEMPERATURE – SUCTION SATURATION TEMPERATURE
= ____ (°F)

SUBCOOLING = DISCHARGE SATURATION TEMPERATURE – LIQUID LINE TEMPERATURE
= ____ (°F)

*Use 500 for water, 485 for antifreeze.

CUT ALONG DOTTED LINE

CUT ALONG DOTTED LINE

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