VHC-72

Semi-custom Commercial Energy Recovery Ventilator

Installation, Operation and Maintenance Instructions Manual

VENMAR CES

Capacity: 5,000 to 8,000 cfm
Model: VHC-72

⚠ WARNING

Improper installation, adjustment, alteration, service or maintenance can cause injury or death. Read the installation, operation and maintenance instructions thoroughly before installing or servicing this equipment.

IMPORTANT

The use of this appendix is specifically intended for a qualified installation and service agency. A qualified installation and service agency must perform all installation and service of these appliances.

FOR YOUR SAFETY

What to do if you smell gas:

1. Open windows if appliance is indoors.
2. Do not touch electrical switches or use any phone in the building.
3. Extinguish any open flame.
4. Leave the building immediately.
5. Immediately call Gas Supplier.

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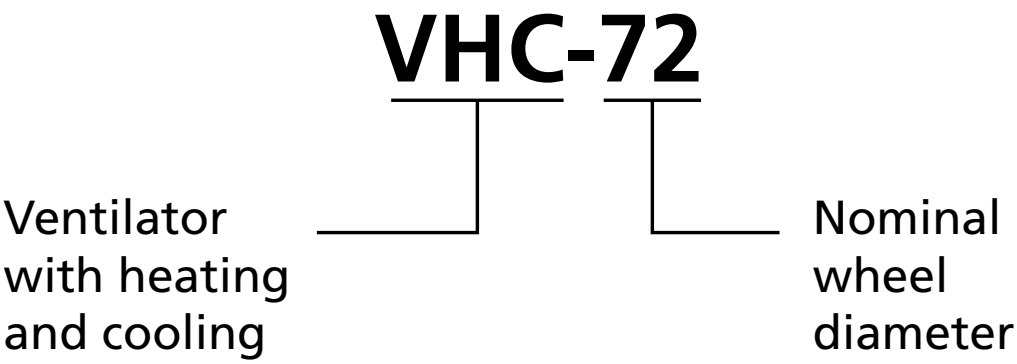
Manufacturer reserves the right to discontinue or change specifications or designs without notice or obligation.

Nomenclature



The VHC-72 offers a wide range of features and options and can be used as a stand alone air-to-air energy recovery device or as an integrated packaged system. For a detailed list of options please consult the Order Guide on the following page.

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CES Group, LLC d/b/a Venmar CES furnishes equipment pursuant to its then-current Terms and Conditions of Sale and Limited Warranty, copies of which can be found under the Terms & Conditions of Sale and Warranty link at www.ces-group.com. Extended warranties, if any, shall be as offered and acknowledged in writing by Venmar CES.

Safety Considerations

Warning, Caution and Important notes appear throughout this manual in specific and appropriate locations to alert Installing Contractors, maintenance or service personnel of potential safety hazards, possible equipment damage or to alert personnel of special procedures or instructions that must be followed as outlined below.

⚠ WARNING

Identifies an instruction which if not followed, might cause serious personal injuries including possibility of death.

CAUTION

Identifies an instruction which if not followed, might severely damage the unit, its components, the assembly or final installation.

IMPORTANT

Indicates supplementary information needed to fully complete an instruction or installation.

Hazards may exist within this equipment because it contains electrical and numerous moving components. Only qualified service personnel should install or service this equipment. Untrained personnel may perform basic maintenance such as maintaining filters. Observe precautions marked in literature and on labels attached to the unit. Follow all safety codes.

⚠ WARNING

Disconnect the main power switch to the unit before performing service or maintenance. Electric shock can cause personal injury or death.

General Information

This manual is designed to provide general information on the common operation of all standard and optional components that may have been installed in the unit. Note that some sections of this manual may not apply to your unit. This manual has been designed for general purpose and describes all options offered by Venmar CES Inc. that could be included in the unit. Consult the manual from the component manufacturer if more detailed technical information about a specific component is required.

All documentation that was specifically designed for your unit has been included in the pocket of the control panel, including (if applicable):

- Electrical schematics
- Venmar CES Control System VHC-72 Sequence
- Keypad Operational Guide
- Hardware Specifications Manual
- BACnet/Modbus Interface Manual

Recommended Spare Parts

Spare parts should be ordered at the time the installation is accepted by the owner. Spare parts will reduce the down time in the event of a failure.

The list of spare parts outlined below is considered minimal. Installation in remote locations or when the operation of heating equipment is essential may require more spare parts than listed. Please contact the service department at Venmar CES for recommendations.

Minimum spare parts include:

- Two sets of fuses
- One matching set of fan belts
- One set of filters
- One burner control relay module, flame signal amplifier and purge card (optional)
- One flame sensor (optional)
- One spark igniter (optional)

Unit Inspection on Arrival

Inspect the equipment exterior and interior for any damage on arrival that may have occurred during unit shipment and for shipped loose parts. Ensure that there is no damage to any protruding exterior components such as door handles, disconnect switch handle, etc. or to internal components such as fans, motors, dampers, enthalpy wheel and structures. File a claim with the shipping company if the unit is damaged. Check the packing slip against all items received. If any items are missing, sign the carrier's bill of lading with the notation "Shipment Received Less Item #___." Contact the factory immediately if damage is found. No return shipment will be accepted without authorization.

IMPORTANT

The hoods for these units are not installed from the factory for shipping purposes and must be installed on site. They can be installed before or after the unit is installed providing the hoods are secured and are not damaged by the spreader bars or cables. Foam gasket is factory attached to the hood flanges for sealing to the unit and self drilling screws supplied for fastening to the unit. See Appendix A for hood installation.

Unit Application Limitations

CAUTION

Venmar CES equipment is not designed to be used for temporary heating, cooling and/or ventilation during construction.

Using Venmar CES units for temporary ventilation during construction is subject to the unit warranty terms and should be reviewed carefully before proceeding, as this may void the standard warranty conditions.

Fine dust, larger particulate matter, solvents, varnishes and other chemicals may cause filter clogging and elevated cabinet pressures, higher power consumption and possible irreparable damage to the desiccant material of the enthalpy wheel, which could reduce energy recovery performance of the wheel and also reduce the heat transfer effectiveness of other components. Potential damages include, but are not limited to, these examples.

Installation

Unit Location Requirements

Consult local building codes and electrical codes for special installation requirements and note additional requirements listed in this manual. In choosing the installation location of the unit, consider the following factors:

- The unit should be installed to allow easy access for maintenance and for systems operation. The main components, overall dimensions and recommended clearances are shown in the mechanical drawings.
- When possible, mount the unit over an unused area such as a hallway. Although fans and motors are mounted on vibration isolators or are dynamically balanced, the unit will be even less perceptible if positioned away from busy offices.
- Locate the unit in an area requiring the least amount of ductwork and direction changes to allow optimum performance, to reduce pressure loss and to use less electricity to achieve proper ventilation. Ductwork must be in accordance with ducting mechanical rules to prevent sound issues and system effects.
- The fresh air intake hood must be positioned away from sources of contamination such as hot chimneys or kitchen exhaust vents.
- Fresh air intake must also be positioned in a direction opposite to that of prevailing winds to reduce entry of snow or rain.
- The unit should be mounted on a level foundation to allow condensation to flow into internal drains. The foundation must provide adequate continuous support to minimize deflection of the unit base frame to not more than 1/16" [1.6 mm] over entire length. In addition to these recommendations, a Structural Engineer must be involved to properly size supporting structural elements.
- When mounting the unit indoors, if drain connections are required mount the unit on a housekeeping pad of sufficient height to allow for drain trap height and condensate lines to slope toward the building drain.
- When mounting the unit on a roofcurb check the height from the finished roof to the bottom of the intake hood. Consult with local authorities or your building code for minimal intake hood height for the water-tight height from and above the finished roof and in snow prone areas the buildup of snow to determine the height of the roofcurb. Venmar CES optional roofcurbs measure 14" [356 mm] in height. If additional height is required from the finished roof to the top of the roofcurb, to the bottom of the intake hood or if other than level, custom height roofcurbs must be ordered.

Roofcurbs Supplied by Venmar CES (External Applications Only)

Roofcurbs supplied by Venmar CES should be mounted as follows:

- The roofcurb is shipped knocked-down with assembly hardware and instructions provided. The roofcurb must be field erected, assembled and set in place by the Installing Contractor.
- Roofcurb dimensions are submitted with the unit mechanical drawings which can also be found in the unit control panel pocket or by calling Technical Support personnel from the Venmar CES factory.
- After the roofcurb has been assembled, ensure that the roofcurb dimensions suit the unit for which it is designated.
- The cross members must be positioned as per the roofcurb drawing to properly support the ductwork plenums for bottom vertical return and supply connections and for stability.
- Ensure that the assembled roofcurb is square, plumb and level to within 1/16" [1.6 mm] over the entire length. The building structure must provide continuous structural support to the full perimeter of the roofcurb and all cross members requiring support. The roofcurb may be shimmed as required to provide continuous support.
- The roofcurb must be fastened to the building structure.
- The Installing Contractor is responsible for making the roofcurb water-tight by caulking all roofcurb joints.

IMPORTANT

The following items must be completed prior to setting the unit on the roofcurb:

- The roofcurb roofing must be completed including insulation, cant strip, flashing and counter-flashing.
- Vertical ductwork must be attached to the roofcurb cross members and building structure, not to the unit. See the mechanical drawings for information on roofcurb installation, recommended ductwork attachment and dimensions.
- If there is no building roof access underneath the unit, and drain or piping connections must be made (in the roofing), it is recommended to do so before unit installation using the appropriate materials provided by the Installing Contractor.
- Remove the length of 3/8" x 1½" [9.5 x 38 mm] polyvinyl gasket strip with adhesive backing supplied with the unit and apply a continuous strip to the top perimeter of the roofcurb and duct opening connections for an air and water-tight seal.

IMPORTANT

The gasket between the unit and the roofcurb is critical for an air and water-tight seal. An improperly applied gasket can result in air and water leakage and poor unit performance. Position the unit with equal spacing all around between the roofcurb and inside unit base rail using ½" [13 mm] wood shims as it is being lowered.

Roofcurbs Supplied by Others

Roofcurbs supplied by others must be designed with the same dimensions and cross member arrangement as per Venmar CES roofcurb drawings and must be designed to evenly withstand perimeter and cross section static loads.

IMPORTANT

Venmar CES is not liable for any damages, costs or other issues arising from roofcurbs supplied by others.

Rigging and Lifting the Unit

Unit shall be lifted by cables attached to all the lifting lugs provided on the unit base. Consult the mechanical drawings for unit weight. These cables shall be lifted by a crane or a lift of the appropriate capacity.

CAUTION

Rigging and lifting units without using all lifting lugs will compromise the structural integrity of the unit. The lifting lugs are factory bolted on the unit base. All lifting lugs provided must be used.

When lifting the unit, use spreader bars, cables and pulleys to apply an even vertical lifting force only at all the lifting points to prevent damage to the unit. See Appendix B for example of rigging and lifting. Provide additional blocking and coverings (as required) to prevent damage to the unit finish and/or components. The spreader bars will help to maintain a certain distance between the cables and the unit. Venmar CES will not be responsible for any damage caused to the unit casing during the lifting process. Main areas where damage may occur are: electrical panels, filter gauges, rain gutters, hoods, roofing corners, door handles and paint finish. The lifting point must be at the center of gravity to ensure that the unit is level during hoisting and prior to setting. When commencing to hoist, take up the slack in the hoisting cables slowly and gradually increase the cable tension until the full unit weight is suspended. Avoid sudden, jerking movements. Do not permit the unit to be suspended by the lifting lugs for an extended period of time.

Field Fabricated Ductwork

On bottom vertical duct connections, secure all ducts to the roofcurb and building structure. Do not secure ductwork to the unit. See roofcurb mechanical drawings for illustrations and more information on recommended bottom ductwork attachment.

On horizontal duct connections, make connections to the casing by applying caulking around the connection and screwing flanged ducts directly to the casing and/or flange with self-drilling sheet metal screws. It is important to seal all duct connections to prevent air leakage and system performance problems. Ductwork must be supported by the building structure.

For duct connection sizes, see the mechanical drawings. Insulate and weatherproof all external ductwork, joints and roof openings with counter-flashing and mastic in accordance with applicable codes. Ductwork running through roof decks must comply with local fire codes.

Ducts passing through unconditioned spaces must be insulated and covered with a vapor barrier. Flexible connectors should be installed close to the unit in the duct leading to occupied spaces to minimize noise transmission.

The design of the ductwork immediately downstream of the indirect gas-fired furnace is critical for successful applications. Poorly designed ductwork can contribute to excessive temperature fluctuations. Avoid splitting or branching of the ductwork immediately downstream or within five duct diameters from the discharge where temperature stratifications may exist.

Hood Installation

Intake and exhaust hoods for the unit are shipped separately. See Appendix A for information on installation of hoods. Make sure that all screws are secured to maintain proper support and keep seals water-tight.

Internal Packaging

Open access doors or panels and remove all packaging from the unit. Removal of all packaging is critical.

Electrical Connections

The unit is factory wired (unless otherwise specified) except for power connections, shipped loose sensors/items or remote control options as indicated in the electrical schematics. The unit may or may not have an optional preheat or post heat electrical heating coil with a total unit MCA exceeding 200 Amps, a separate field supplied disconnect and power feed cable must also be run to the electric heater control panel. If the unit control panel disconnect is not supplied or the electric heater requires a separate disconnect and power supply, the Electrical Contractor must provide and install disconnect outside the unit as per local electrical codes and run the wiring to the control panel and/or electric heater control panel.

⚠ WARNING

When installed, the unit must be electrically grounded in accordance with local codes or, in the absence of local codes, with the National Electrical Code, ANSI/NFPA70, and/or the Canadian Electrical Code CSA C22.1. Unit cabinet must have an uninterrupted, unbroken electrical ground to minimize the possibility of personal injury if an electrical fault should occur. Failure to follow this warning could result in the Installer being liable for personal injury of others.

- Check nameplate for correct power supply requirements.
- See electrical schematics and Venmar CES VHC-72 Sequence located in the control panel pocket for field wiring of power connections, shipped loose sensors/items and remote control interlocks. The Electrical Contractor must locate, install and wire sensors/items as per electrical schematics and Venmar CES VHC-72 Sequence.
- Numbered terminal strips are included in the control panel for ease of connection and service.
- Install copper wiring of proper size to handle current load.

All field wiring must comply with NEC and local requirements. In Canada, electrical connections must be in accordance with CSA C22.1 Canadian Electrical Code Part One.

Field Connection

High voltage power line, shipped loose sensors/items or remote control option field wiring entry points to the main control panel are provided in the top right hand corner of the main control panel. Two 4" x 6" [102 x 152 mm] cutouts in the inner wall on the back and side of the control panel and 6" [152 mm] clearance along the top are provided for field wiring. Depending on panel location and field wiring entry points the Electrical Contractor must determine location, size and drill holes through the outer wall of the control panel and unit casing.

Should the Electrical Contractor decide to run the power feed cable through the roofcurb, he/she must determine location, routing, drill necessary holes (avoid drilling holes through drain pan) and seal after completion. Remote control wiring can be located next to the power feed cable provided it is inserted in a shielded cable that will protect it from electromechanical interference. Ensure the power feed cable ground is securely connected to the terminals located in the control panel.

Electrical Contractor must provide wiring for controls that are supplied optionally and shipped loose or field supplied. All field supplied low voltage wiring must be Class II. Mark the electrical schematic with the connections completed and leave with the unit for start-up and service.

Coil or WSHP Piping Connections

CAUTION

Internal coil or WSHP connections may only be field extended through the cabinet within designated areas. Refer to the interior coil connections label on the floor of the coil access compartment. A pipe chase or access openings to extend piping must be field cut by the Installing Contractor then sealed air and water-tight as the access compartment is under a negative pressure. If a pipe chase or access opening has to be cut outside of the designated areas, the Installing Contractor must call the factory to get a detailed floor layout.

Connections to the unit coil or WSHP system is by others. External supply and return piping design and all other safety, freeze protection or control piping requirements for system operation are the sole responsibility of the Installing Contractor and/or Design Engineer. Refer to ASHRAE handbooks and local building codes for correct piping procedures and proper installations. Refer to the mechanical drawings for coil performance design information.

Internal factory installed piping components and control interlocks are offered as an option for WSHP units; see Appendix C for recommended and optional piping components and the unit order guide and piping schematic in the pocket of the control panel for options included with the unit.

CAUTION

Glycol is used for factory tests and to prevent any possibility of freezing during transit and/or storage. In units that include factory made water piping, some glycol may remain in the system due to factory tests done using a water-glycol mixture. Flush the system in the field, prior to completing the piping installation, if no glycol traces are desired. In low temperature applications, the water supply line and return line should be insulated to prevent condensate and antifreeze solution should be used to protect water-to-refrigerant heat exchanger from freezing damage.

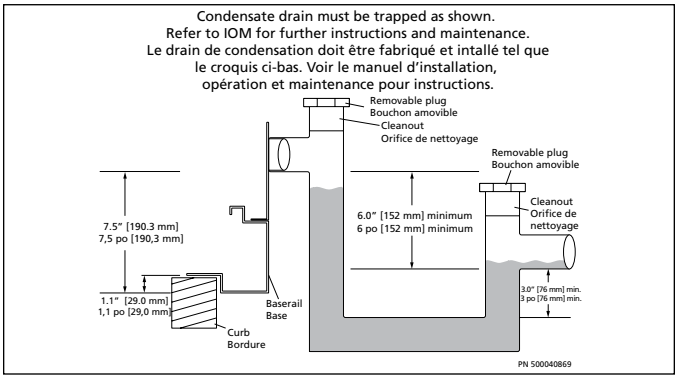
A hydrostatic test must be performed in field by the Installing Contractor at 1.2 times the operating pressure on all equipment involving water piping to hydronic coils or WSHP to verify that the installed unit and its connections to the network are free of leaks prior to the unit being set in operation. This test shall be performed after the unit is completely piped to the water network and shall cover the connections between the unit and the network, as well as all internal components of the unit.

Condensate Drain Trap

Cooling coil drain pan is provided with a 1¼" MPT drain connection. A drain trap and condensate line of equal size must be field provided on the drain connection to prevent air or sewer gases from being pulled into the unit caused by the negative (suction) pressure and forcing water out of the pan into the unit.

A label with recommended trap height is provided on the unit as per Figure 1.

Figure 1: Condensate drain trap



The trap height allows for the maximum suction pressure after the cooling coil with intake damper, dirty pre and secondary high efficiency filters, high efficiency enthalpy wheel plus 1" w.c. per ASHRAE Guidelines for outdoor units with intake hood or indoor unit with up to 0.5" w.c. external static intake duct.

Slope the drain lines downward in direction of flow 1/8" per foot [10.4 mm/meter] referring to local codes for proper drainage requirements. Installing a plug for cleaning of the trap and a vent in the high side of the drain line is recommended. Prime the trap by filling with water before start-up. Winterize the drain line before freezing on outdoor units.

Check and clear drains annually at start of cooling season. Drainage problems can occur should drains be inactive and dry out, or due to reduced water flow caused by buildup of algae. Regular maintenance will prevent these from occurring.

Gas Connections

Refer to Appendix D for gas-fired furnace module installation and maintenance information.

Start-up

Pre Start-up Checklist

Before requesting start-up, check that the installation is complete and unit is ready. Complete the pre start-up checklist below and in Appendix E for each unit as items are checked. For torque values on set screws, belt tension, etc., check under Maintenance.

1. Set the electrical disconnect to the 'Off' position.
2. Check the unit for obstructive packaging, objects near or in fans, dampers, enthalpy wheel, etc. Remove all red tie down bolts on fan assemblies if so equipped.
3. Check that the fans and enthalpy wheel are rotating freely.
4. Check blower wheels and drive set screws. Tighten if required.
5. Check belt alignment and tension.
6. Check that the air filters are installed and clean. Replace if necessary. See Appendix F for optional downstream high efficiency HEPA filter installation. If filters are equipped with optional differential pressure switch, check desired setpoint. Filter differential pressure switches are factory set at 50% of dirty filter allowance from clean.
7. Check coils (if equipped) if fins have been damaged in transit or construction and are clean. Straighten fins with fin comb and clean coil if required (not applicable to brazed aluminum heat exchangers).
8. Check the refrigerant components and piping that they are in good condition and have no damage or leaks from shipping or installation.
9. Check that the clearance around the air cooled condenser is within minimum clearance and the discharge is not blocked.
10. Check that ductwork is connected and complete.
11. Check that condensate drain connections have been trapped, installed correctly and filled.
12. Check that all shipped loose or field supplied components have been correctly installed and wired.
13. Check that the wiring diagram has been marked up accordingly and left with the unit.
14. Check that all power supplies and control wiring have been inspected and approved by the Local Authorities having jurisdiction.
15. Check all factory and field wiring connections for tightness. Tighten if necessary.
16. Check that all fuses are properly installed in holders.
17. Check the voltage at the disconnect switch against the nameplate and against phase-to-phase readings on three-phase. If the voltage is not within 10% of rated or 2% of phase-to-phase, have the condition corrected before continuing start-up.
18. Check that all field piping and venting installation and connections for the heating and cooling options have been completed and tested.
19. Set the heating and cooling enable switches to the 'Off' position.

Start-up Procedure

To ensure proper operation of each unit qualified personnel should perform the start-up and complete the checklist below and the start-up form in Appendix E for permanent record. A completed checklist will provide valuable information for personnel performing future maintenance.

IMPORTANT

A completed copy must be sent back to the factory for warranty validation and for factory assistance.

All units are factory run tested. Fans, enthalpy wheel and compressors (if equipped) are set up to run correct when power is connected. If any one fan is running backwards or compressor is making loud noises, disconnect power and switch two leads (on three-phase power) to ensure proper rotation and avoid damage.

If units are equipped with compressors power must be turned on for 24 hours prior to a call for cooling, for the compressor crank case heaters to be energizing to prevent possible damage.

Units supplied with the factory installed, programmed and run tested control enables stand alone operation of the unit and includes all necessary sensors and interfaces to provide control of optional post conditioning functions. An intelligent programmable interface device (Bacview) with built-in time clock is included for setup, communication, display, mode selection, setpoint adjustment and to allow for servicing and is mounted inside the control panel on the back of the panel door.

1. Before proceeding complete the Pre Start-up Checklist.
2. Check that all access panels or doors are closed.
3. Open the access door to the main control panel to access the Bacview interface device. The Keypad Operational Guide and the Sequence of Operation are located in the document pocket inside the main control panel. The Bacview keypad will allow for the following modes of operation:
   a. Off mode: In off mode, the unit is shut down.
   b. Time clock mode: In time clock mode, the unit will switch between occupied and unoccupied operation via the unit's internal time schedule.
   c. Remote start/stop mode: In remote start/stop mode, the unit switches between occupied and unoccupied operation via a field supplied signal.
   d. Occupied mode: In occupied mode, the unit is fully operational per the Sequence of Operation.
   e. Unoccupied mode: In unoccupied mode, the unit is fully operational per the Sequence of Operation.
4. Turn the main disconnect to the 'On' position. Set the Bacview keypad to each mode of operation and check the operation according to sequence.
5. Check that dampers are operating properly.
6. Check that blowers and enthalpy wheel are rotating in the correct direction.
7. For recirculation scheduling mode the outside air and exhaust air dampers must be adjusted during start-up to achieve the required outside and exhaust air volumes. See Airflow Balancing for further information.
8. Recheck the voltage at the disconnect switch against the nameplate and against phase-to-phase readings on three-phase with all blowers operating. If the voltage is not within 10% of rated or 2% of phase-to-phase have the condition corrected before continuing start-up.
9. Check amperage draw to each motor on each phase against motor nameplate FLA. If significantly different, check ductwork static and/or take corrective action.
10. Before activating the compressor(s) on a WSHP unit, ensure the water shut-off valve(s) is open and water is circulating through the water-to-refrigerant heat exchanger.
11. Enable cooling and check if the sound of the compressor is normal or if there is excessive vibration.
12. Check all field and factory refrigerant and water piping connections for leaks and correct.
13. On units with gas-fired furnace module check supply air proving interlock switch setting to ensure minimum supply airflow prior to burner operation. Set the switch to open below the minimum supply airflow on the furnace rating plate.
14. Enable heating options, see start-up and instructions in Appendix D for gas-fired furnace and Appendix G for electric coil and complete.
15. Check the operation of the control options provided on the unit.
16. Check the reference setpoints on the Keypad Operational Guide, adjust and record changes as required.
17. When unit has achieved steady state take measurements and complete the readings section of the start-up form in Appendix E for each operating cycle to verify all components are functioning properly and send a copy of the start-up form to Venmar CES to validate warranty. Maintain a copy of the report at the unit for future reference.

⚠ WARNING

The Bacview keypad must be used to set the internal time clock, to check operation according to sequence and to adjust setpoints while power is on for start-up and while performing service. Electric shock can cause personal injury or death. Only qualified service personnel should install and service this equipment.

Airflow Balancing

IMPORTANT

On initial power up, the unit will perform a system check and operate at high speed for five seconds.

For proper performance the unit must operate at the specified supply and exhaust flow rates. Unit fan speed(s) and damper positions are theoretically set at the factory based on the ductwork static pressures and flow rates specified with the order and in the performance data. If conditions change or verification is required, airflow measurements should be taken using AMCA suggested methods. This would normally be a velocity traverse measurement or flow measuring station (FMS) installed in the ducts. Where space is limited in the outdoor air and exhaust air pressure drop readings can be taken across the enthalpy wheel (with economizer heat recovery wheel bypass dampers closed, if equipped) and read or calculated from the Enthalpy Wheel Pressure Drop vs. Flow Formula and Curves located in Appendix I for the wheel diameter and thickness. Heat recovery performance is tested in accordance to AHRI Standard 1060 and is accurate to within +/– 5% if there is no dirt buildup in the heat recovery wheel.

Should flow rates need to be reset, adjust the VFD fan speed and/or the outside air, exhaust air and mixed air damper setpoint positions.

Flow Measuring Stations (FMS) and magnehelic gauges can be used to measure supply and exhaust flow.

It is important to locate the FMS in the "warm side" ductwork to minimize the effect of differences in air density, especially when balancing during extremely cold outside conditions or to take temperature readings and make the necessary corrections if installed in the "cold side" ductwork. Air density variations can effect the FMS by more than 15%.

The FMS should be located downstream in straight sections of duct and not immediately after fans or obstructions that will cause turbulent flow.

Refer to Appendix D for gas-fired furnace module air balancing information. The installation is to be adjusted to achieve the air throughput within the range specified on the gas-fired furnace module rating plate.

Imbalanced airflows may cause supply air temperatures to be below freezing. Adequate freeze protection, such as glycol or low limit temperature protection for downstream coils or reheat to protect building systems, must be field provided.

Maintenance

⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

Please see the mechanical drawings for service clearance dimensions. See Appendix H for troubleshooting and additional service and maintenance information on: optional WSHP water line piping options (Appendix C), gas-fired furnace module (Appendix D) and electric heating coil and controls (Appendix G).

Please refer to Appendix M for a recommended list of routine maintenance items and time intervals. A more detailed description of maintenance items follows.

Air Filters

The standard medium efficiency filters and optional high efficiency filters are disposable and should be replaced every three months. More frequent replacement may be required under extremely dirty operating conditions. Optional filter differential switches, pressure transducers and gauges are available to provide visual or remote indication when to replace filters.

To replace the filters on outdoor, exhaust or mixed air, open the filter access door, grasp the filters and pull straight out. The filters will slide completely out of the unit. Slide the new filters into the frame and close the filter access door.

The optional supply downstream high efficiency MERV 15 (HEF – 90–95%) and MERV 17 (HEPA – 99.99%) filters are front access. See Appendix F for instructions and tools required for installing the MERV 17 HEPA filters into HEPA frames.

Interior Liners and Partitions of Unit

Remove the filters from the unit. Wipe the interior galvanized liner surfaces and partitions with a soft cloth and mild cleaning solution.

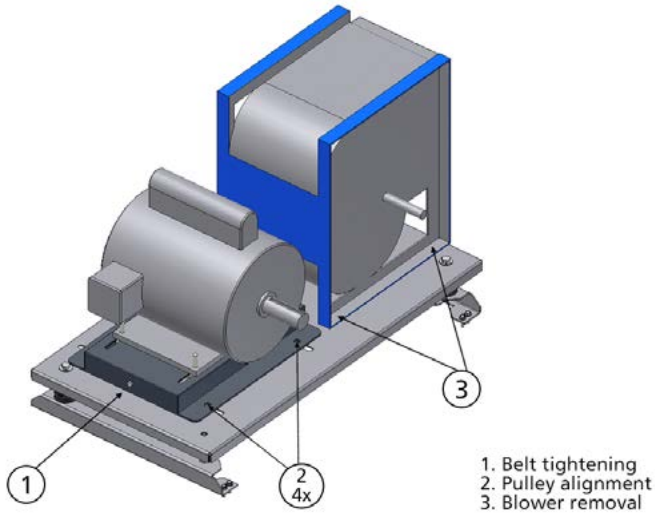
⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

Fan wheels and housings should be checked for dirt buildup. If the forward curved exhaust fan is dirty, it will be necessary to remove the blower assembly to clean the dust out through the fan discharge.

The forward curved exhaust fan (if equipped) is fitted with regreasable bearings. The grease type, quantity and regreasing interval depends on bearing (fan size) and rpm and are indicated in the tables in Appendix L. Clean the grease nipple first, then rotate the fan shaft slowly by hand while regreasing. The regreasing intervals are theoretical and will depend on site conditions, hours of operation and temperature. It is recommended to make periodic inspections of the bearings before these theoretical intervals.

Figure 2: Forward curved exhaust fan and motor for side discharge



Forward Curved Exhaust Fan and Motor

The forward curved exhaust fan and motor can be removed separately. First remove the drive belts.

To remove the motor, disconnect the four-wire electrical cable from the motor junction box, then remove the four nuts (#2, Figure 2) that fasten the motor to the slide base. The motor may have to be lifted over the slide base bolts.

To remove the fan, remove all screws that fasten the blower to the flex collar then remove the four nuts (#3, Figure 2) that fasten it to the fan and motor base frame. The fan may have to be lifted over the fan and motor base frame bolts.

The belt tension is adjusted by turning the sliding base bolt(s) (#1, Figure 2) clockwise or counter-clockwise to achieve the maximum deflection as described below. Verify that the sheave and pulley faces are still parallel. The fan rpm can be adjusted to achieve the design airflow by setting the adjustable sheaves on the motor shaft or by adjusting the VFD setpoint.

1. Measure the belt span with a span scale (see Figure 3).
2. Divide the belt span by 64 to determine the belt deflection needed to check tension.
3. Set the O-ring on the span scale to the required deflection value.
4. Set the small O-ring at zero on the force scale.
5. Place the scale end of the tension checker squarely on one belt at the center of the belt span. Apply force on the plunger until the bottom of the large O-ring is even with the top of the next belt or until it is even with a straight edge laid across the sheaves.
6. Read the force scale under the small O-ring to determine the force required to give the needed deflection.
7. Compare the force scale reading in Step 6 with the correct value for the belt style and cross section. The force scale reading should be between the minimum and maximum values shown in the table below.
8. If the deflection value is below the minimum, tighten the belts. If the deflection value is above the maximum, loosen the belts. The tension on new belts should be checked during the first day of operation, at the end of the first week and monthly thereafter.

Figure 3: Belt tension adjustment

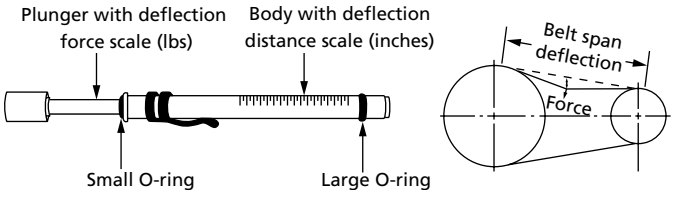


Table 1: Force Scale Reading

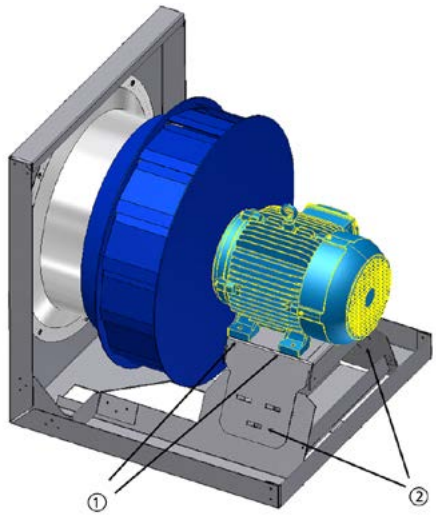
V-belt Cross Section	Small Sheave Diameter Range (inches)	Recommended Deflection Force (lbs)		
		Initial Installation	Re-tensioned	
			Maximum	Minimum
A	3.0–3.4	3.3	2.9	2.2
	3.6–4.2	3.5	3.1	2.4
	4.6–6.0	3.7	3.3	2.5
B	4.6–5.4	6.0	5.1	4.0
	5.6–7.4	6.3	5.5	4.2
	8.6–9.4	6.6	5.7	4.4

⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

Plenum Supply or Exhaust Fan and Motor

Figure 4: Plenum fan and motor



To remove plenum fan and motor disconnect the four-wire electrical cable from the motor junction box. Remove the four bolts (#1, Figure 4) and slide the motor and plenum fan past the inlet cone, then lift out of the unit. A 1¾" socket is required to remove the fan from the motor shaft.

IMPORTANT

No lubrication is necessary during servicing.

Both motor shaft and fan bore must be completely free of paint, grease, oil and dirt. If necessary, clean the surfaces with non petroleum based solvent, such as isopropyl alcohol. Insert the bushing into the fan, making sure the mating hub is flush against the shoulder at the flats. Position the assembly at the desired location on the motor shaft and hand tighten nut (clockwise) until the assembly becomes snug on the shaft.

CAUTION

Do not hammer or use any type of impact to force the bushing along the shaft.

CAUTION

The shaft must fully engage the shaft gripping area of the bushing.

Using a torque wrench and a 1¾" socket, tighten the nut to the proper installation torque. See table below for torque value.

Table 2: Installation Torque Value

Shaft Size	Ft-lb
5/8" to ¾"	100
13/16" to 1"	125
1-1/16" to 1¼"	167

Fan should overlap inlet cone by 3/8" [9 mm] and have a clearance of 1/16" [1.6 mm]. Motor/fan assembly position is adjustable by loosening the four bolts (#2, Figure 4) and sliding shelf forwards and back.

Supply FANWALL® Array

Figure 5: FANWALL and motor

FANWALL array of multiple direct driven plenum fan and motor "cubes" are equipped with permanently sealed bearings and do not require lubrication.

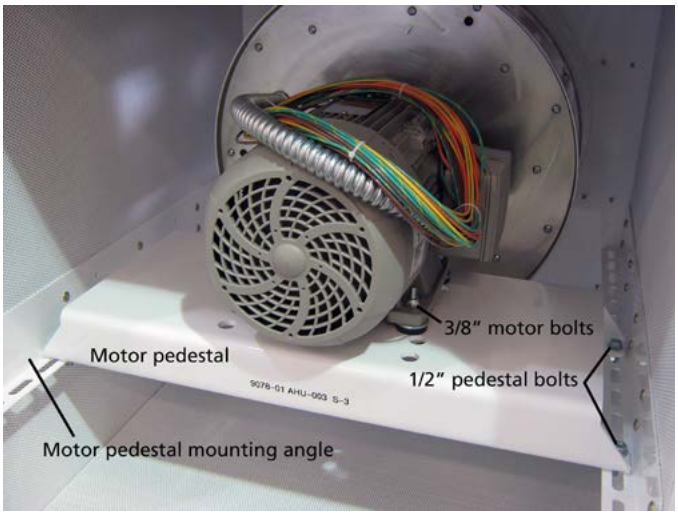
To remove the supply FANWALL and motor, follow the steps outlined below:

1. Disconnect power to the fan/control panel before maintenance. Follow all lockout and tag out procedures.
2. Disconnect the four-wire electrical cable from the motor junction box. Make note of wire locations for reinstallation later.
3. Mark motor pedestal location on the motor pedestal mounting angles (both sides), then loosen and remove (four) ½" pedestal bolts that retain the motor pedestal to the mounting angles (see Figure 6).

⚠ WARNING

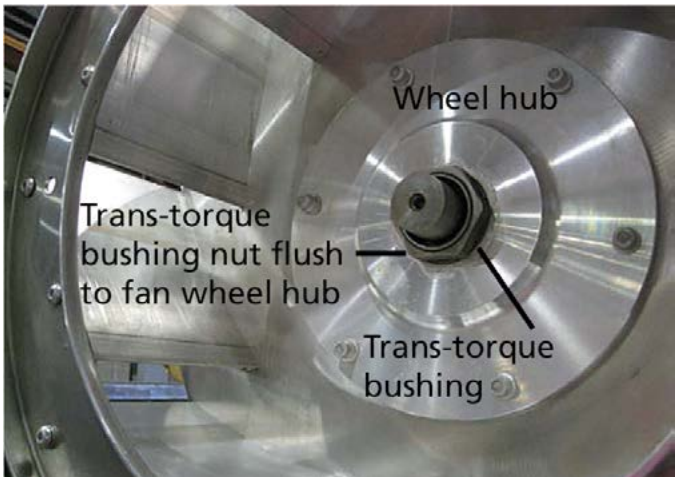
Disconnect the main power switch to the unit before performing service and maintenance procedures.

Figure 6: Fan/motor and pedestal mounting



4. After removing the mounting bolts, slide the motor pedestal to the point where the motor lifting ring is exposed enough to use. If a mechanical device is available for use, attach it to the lifting ring for use. Lift the motor/fan/pedestal assembly and turn 180°.
5. Push the pedestal back into the fan cube so that the fan wheel is in the cube. Bolt down the pedestal for support and block the fan from rotating by using a wood block or a pipe.
6. Mark the location of the trans-torque bushing on the shaft and the fan. To remove the fan wheel from the motor shaft, remove the trans-torque bushing retaining hex nut using a 1¾" socket with a 12" extension by turning counter-clockwise. Loosen progressively until the bushing is free from wheel hub and motor shaft. Remove fan/hub assembly (see Figure 7).

Figure 7: Fan wheel hub on motor shaft

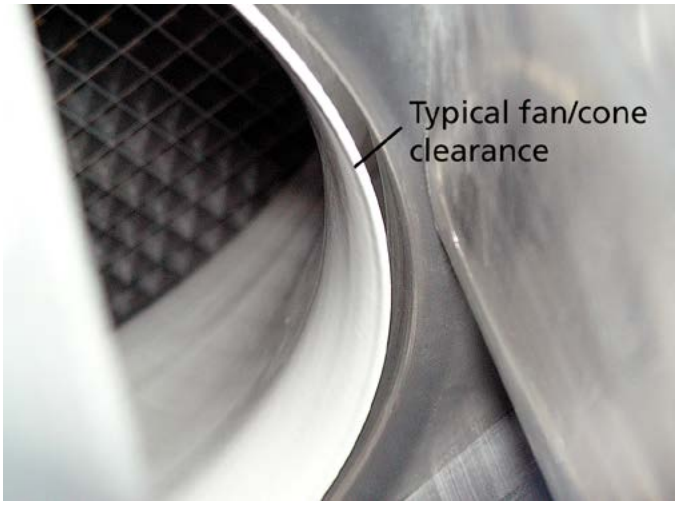


7. If needed the motor may now be removed for service by removing the 3/8" motor bolts. Be sure to mark the motor base pattern and bolt holes used on the motor pedestal. If the motor is to be replaced, make sure to remove the shaft grounding ring off the front of the motor that is being replaced. Install the shaft grounding ring onto the new motor by drilling and taping mounting holes. Use a 7/64" or a #35 drill bit and #6-32 tap. Clean away any chips and shavings before installing the shaft grounding ring.
8. With the motor pedestal secured on the motor pedestal mounting angles that run front to back along the cube, set the motor on the pedestal using the same motor base pattern and bolt holes that you marked previously. Use proper lifting techniques, crane or motor/rail system if possible for lifting the motor into position. Once the motor is placed on the pedestal align the base and bolt holes on the motor to those marked on the pedestal making sure that the motor shaft is pointing towards you.
    a. Next, insert 3/8" bolts into the holes from the underside; make sure to use a standard washer on the bolt side, only a locknut is required on the motor side.
    b. Square the motor and tighten the bolts to 40 ft-lbs.
9. Reinstall the fan on the motor shaft with the hub facing towards you. Line up the markings on the hub/trans-torque bushing/shaft. Make sure that the trans-torque bushing nut is flush to the hub; tighten the bushing nut to 80 ft-lbs.
10. Once the fan/motor/pedestal assembly is done, turn it 180° so the fan is facing the inlet of the fan cube. Slide the pedestal forward to the line that you previously marked on the motor pedestal mounting angles. Line the four pedestal bolt holes up with the bolt holes on the mounting angles.
    a. Insert ½" bolts into the holes, make sure to use a standard washer on the bolt side and a standard washer and lock washer on the nut side. Hand tighten the bolts for now (see Figure 6).
11. Check the inlet cone alignment to the fan wheel. Fan wheel should not be rubbing against the fan inlet cone when rotated by hand. The fan wheel to inlet cone clearance should be approximately 1/16" [1.6 mm] gap and the overlap should be as indicated in Appendix K for the fan wheel size. Adjust the overlap of the wheel and cone by moving the motor pedestal forward or backward. Fan wheel should not be rubbing on the inlet cone. If cone alignment is required see instructions for Fan Wheel/Cone Alignment. Once alignment and overlap are correct tighten the ½" pedestal mounting bolts to 90 ft-lbs.

⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

Figure 8: Typical fan/cone clearance

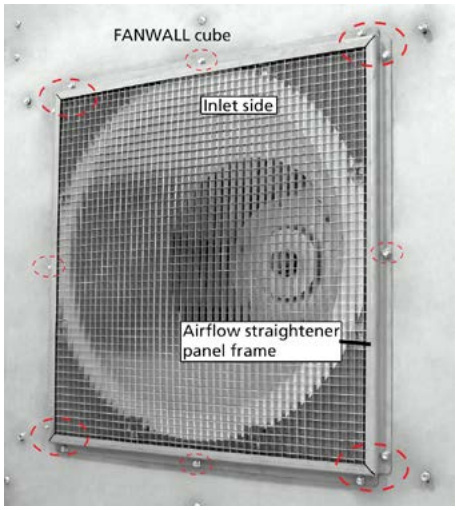


12. Reconnect the four-wire electrical cable from the motor junction box. Before operation, start the motor slowly to ensure the fan rotation is correct. If the fan wheel is not rotating correctly, check the motor leads for proper installation.
    a. Drive Side – Clockwise rotation when looking at motor end.
    b. Inlet side – Counter-clockwise rotation looking at fan inlet.
13. Re-balance the fan wheel once the motor rotation and alignment have been corrected before placing the unit in operation.

Fan Wheel/Cone Alignment

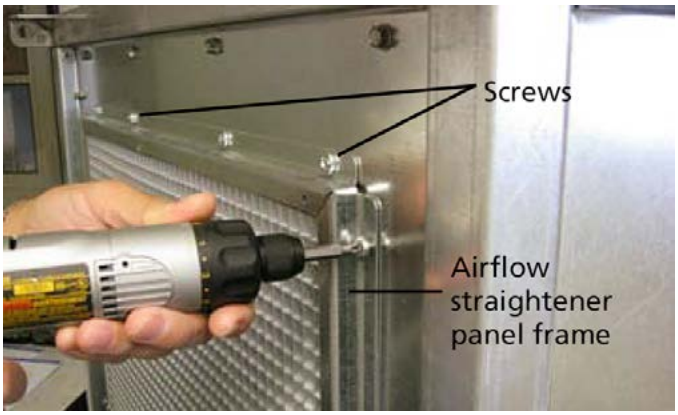
1. To align fan wheel/cone, first disconnect power to the FANWALL® array control panel. Follow all lockout and tag out procedures.
2. Airflow straighteners are furnished on the inlet side of each fan cube in the FANWALL array and must be removed on the ones requiring fan wheel/cone alignment.

Figure 9: Airflow straightener on inlet side of fan cube



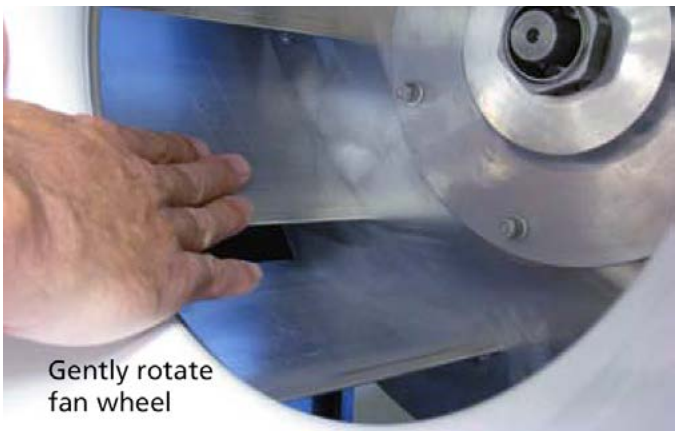
3. Remove all tek screws on the airflow straightener panel frame and remove it from the cube.

Figure 10: Remove airflow straightener



4. Gently rotate the fan wheel to verify location of adjustment required.

Figure 11: Rotate wheel to verify location of adjustment

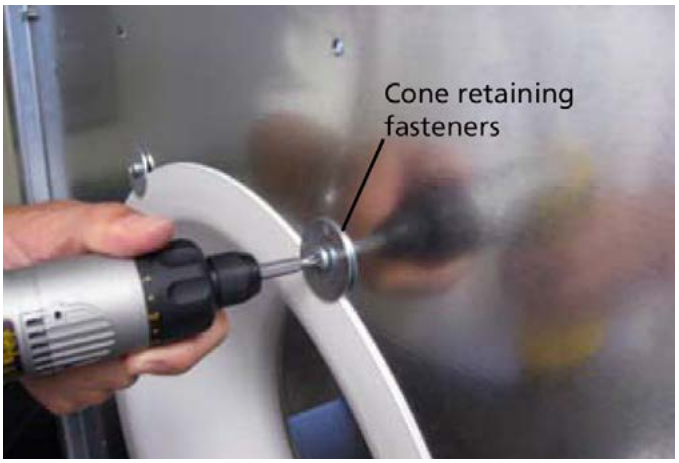


⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

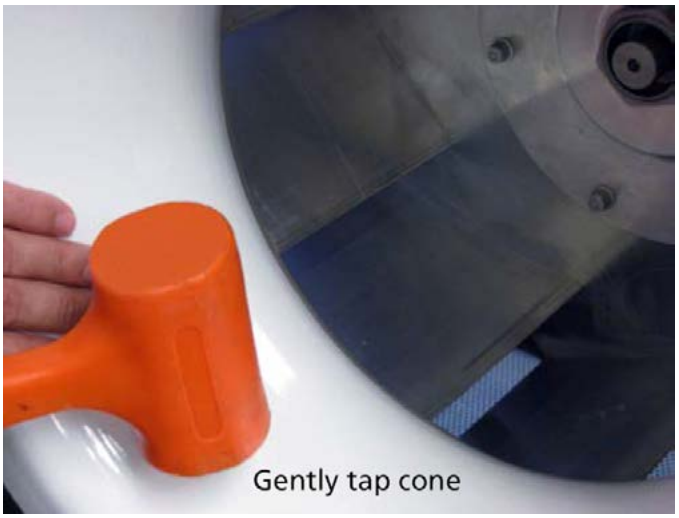
5. To make adjustment, loosen (do not remove) all the cone retaining fasteners.

Figure 12: Loosen cone retaining fasteners



6. Using a rubber mallet, gently tap around the cone until desired clearance is acquired between fan wheel and inlet cone.

Figure 13: Tap around cone until desired clearance acquired



7. Gently rotate the fan wheel to verify cone adjustment for proper clearance from wheel.

Figure 14: Rotate wheel to verify cone adjustment and proper clearance from wheel

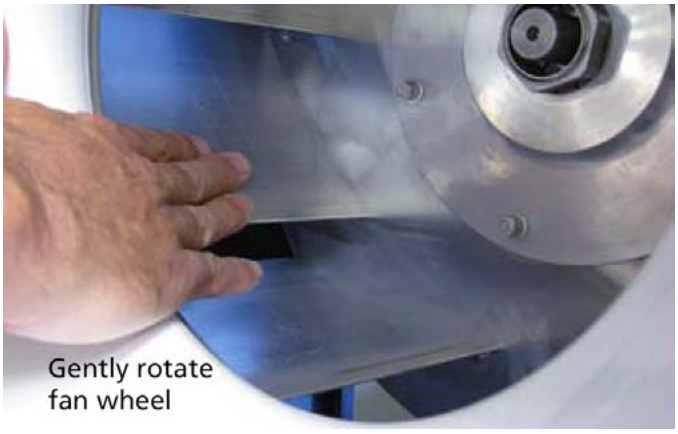
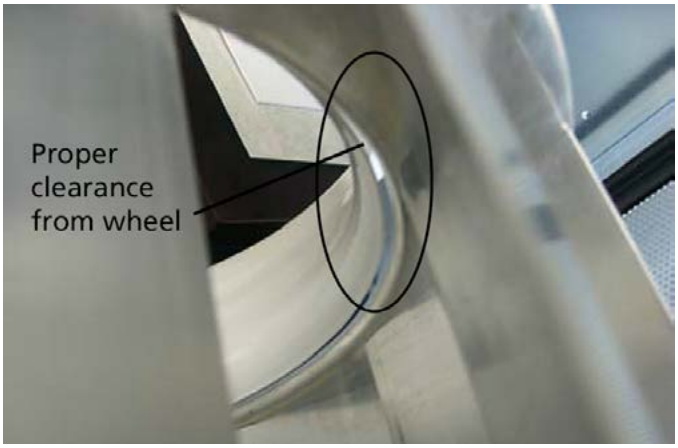


Figure 15: Proper clearance from wheel



8. Tighten all the cone retaining fasteners.

Figure 16: Tighten cone retaining fasteners

9. Once again gently rotate the fan wheel to verify cone alignment.
10. To install the airflow straightener, reverse the steps above.

Enthalpy Wheel

⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

The opposing airflow pattern through the enthalpy wheel allows for self-cleaning and if the air filters on both airstreams are properly maintained there should be minimal dirt buildup.

If the enthalpy wheel has become restricted with dirt and needs cleaning, use low pressure (20 psi maximum) compressed air or vacuum. If this is insufficient, please contact the factory for further instructions. When cleaning the wheel, protect the motor and other components from contamination.

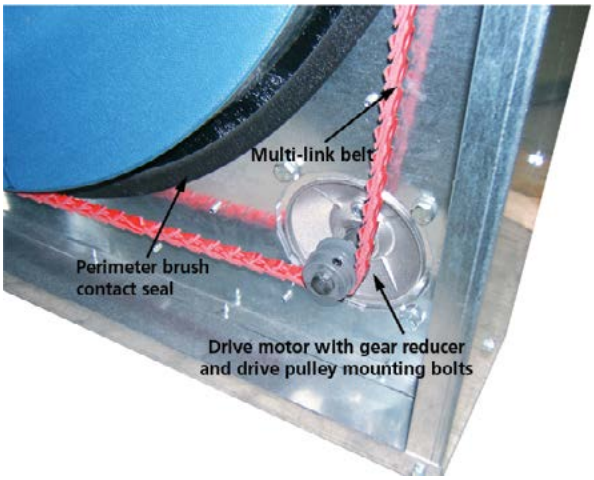
CAUTION

Enthalpy wheel cleaning is an important part of routine maintenance. The listed methods of cleaning have been found effective, if done properly. However, any method of cleaning has the potential to cause damage to the enthalpy wheel media or desiccant if done improperly. **Venmar CES is not liable for any damage caused as a result of enthalpy wheel cleaning.**

The enthalpy wheel drive belt is a strong and flexible multi-link which provides quick and easy servicing or replacement. See Appendix J for belt repair and replacement instructions. The multi-link belt is factory set for proper tension but should it need a tension adjustment, simply remove one of the link sections and re-install the belt (see Figure 17).

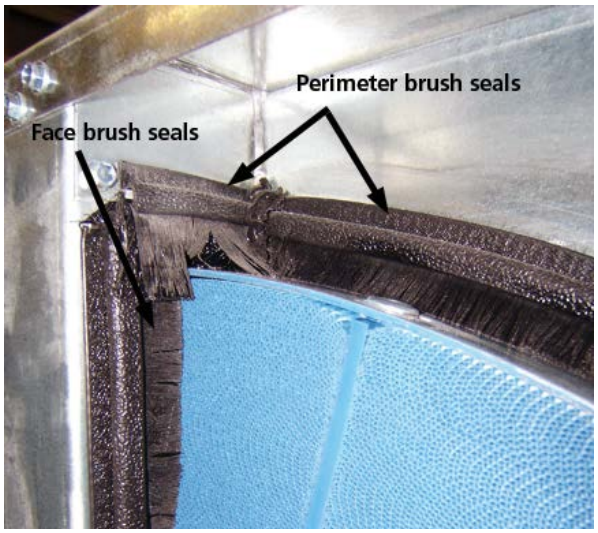
The drive motor and gear reducer are permanently lubricated and require no maintenance. Mounting bolts and drive pulley set screws should be checked for tightness at time of start-up, after 24 hours of operation and at regular intervals (see Figure 17).

Figure 17: Multi-link belt and drive



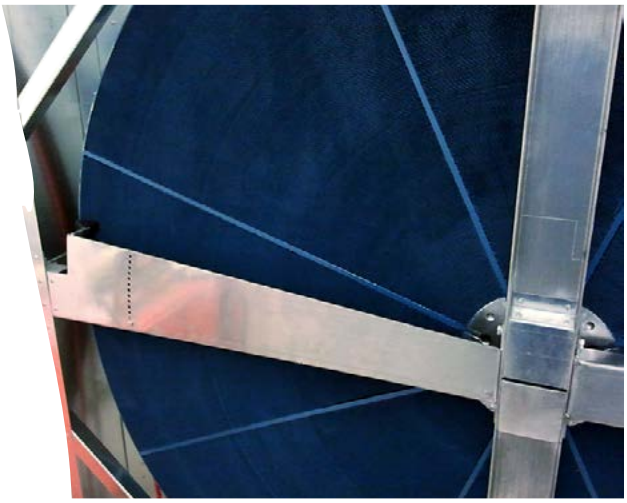
The enthalpy wheel face and perimeter contact brush seals are designed to be durable and require no maintenance or adjustment. Seals should be inspected for unusual wear or damage and can be easily replaced. See Figure 17 and Figure 18 for seal locations.

Figure 18: Face and perimeter brush seals



The wheel includes an optional tamper proof, non-adjustable purge which returns a small amount of supply air captured in the wheel as it rotates to the exhaust to minimize cross contamination. The purge angle is factory set based on the performance requested in the heat wheel performance data (see Figure 19).

Figure 19: Tamper proof (non-adjustable) purge



The enthalpy wheel is provided with no maintenance permanently lubricated inboard bearings. The enthalpy wheel is designed to last the lifetime of the equipment. If removal or replacement does become necessary contact the factory for instructions.

Testing and Replacement of the Damper Actuator

⚠ WARNING

Disconnect the main power switch to the unit before performing service and maintenance procedures.

After disconnecting the power from the unit, determine if the actuator is defective. Disconnect the 24 volt power source. Connect the actuator directly to a 24 volt power source with an appropriate cable. If the damper operates correctly, the problem is either in the wiring connections or main circuit board.

If the actuator does not work, it must be replaced. Loosen the nuts on the jack shaft clamp and remove the actuator. Tighten the clamp on the damper jack shaft. Test for proper operation.

Coils

Dirt on the surface of the coil reduces its ability to transfer heat which lowers the efficiency of the unit, resulting in poor air quality and expensive operating costs. Because of the condensate on the coil, the dirt often becomes wet and contributes to the growth of microbial organisms. Negligence in maintenance may result in serious health related indoor air quality problems.

The coil should be kept clean for maximum performance. To achieve maximum efficiency, clean the coil often during periods of high demand or when dirty conditions prevail. Venmar CES recommends cleaning the coil a minimum of once per year to prevent dirt buildup in the coil fins where it may not be visible.

CAUTION

Do not use acidic chemical coil cleaners. Do not use alkaline chemical coil cleaners with a pH value greater than 8.5 or lower than 6 (after mixing) without using an aluminum corrosion inhibitor in the cleaning solution. Using these types of cleaners may result in unit damage.

Coil fins can be cleaned by using steam with detergent, hot water spray or a commercial chemical coil cleaner. After cleaning the coil, be sure to rinse thoroughly.

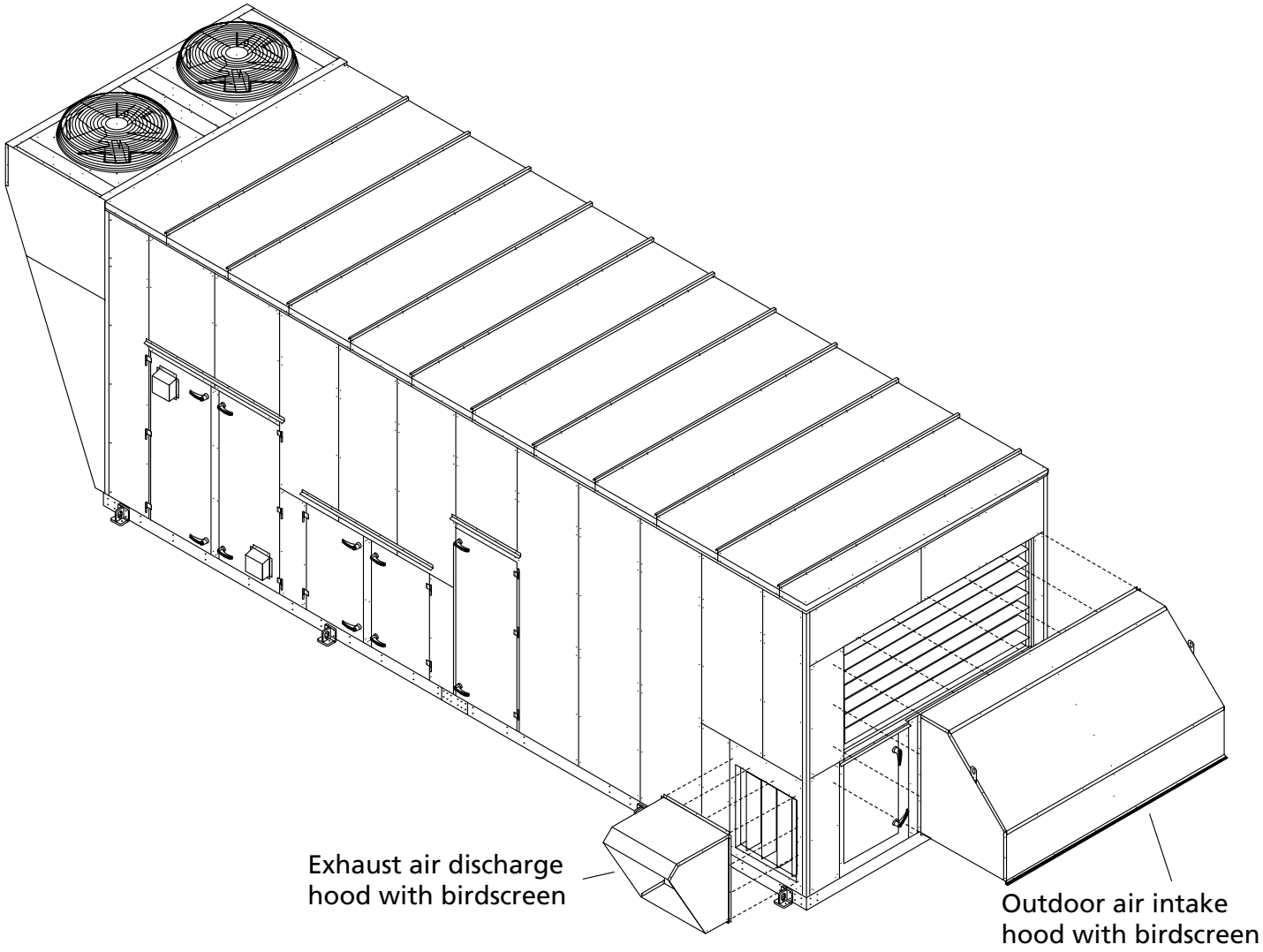
Cleaning Procedure

1. Shut down the unit by closing the main disconnect at the power inlet.
2. Open panels or doors to gain access to both sides of the coil section.
3. Remove soft debris from both sides of the coil with a soft brush.
4. Using a steam cleaning machine, clean the leaving airside of the coil first (going downward) then clean the entering airside. Use a block-off to prevent the steam from penetrating a dry section of the unit.
5. Allow the unit to dry thoroughly before restoring power.
6. Damaged coil fins (excluding brazed aluminum) should be straightened by using a fin comb.
7. Close all panels and doors once the coil is dry.
8. Restore electrical power to the unit.

System Operation Check

Verification of all control modes should be checked to ensure proper operation. Refer to Start-up section.

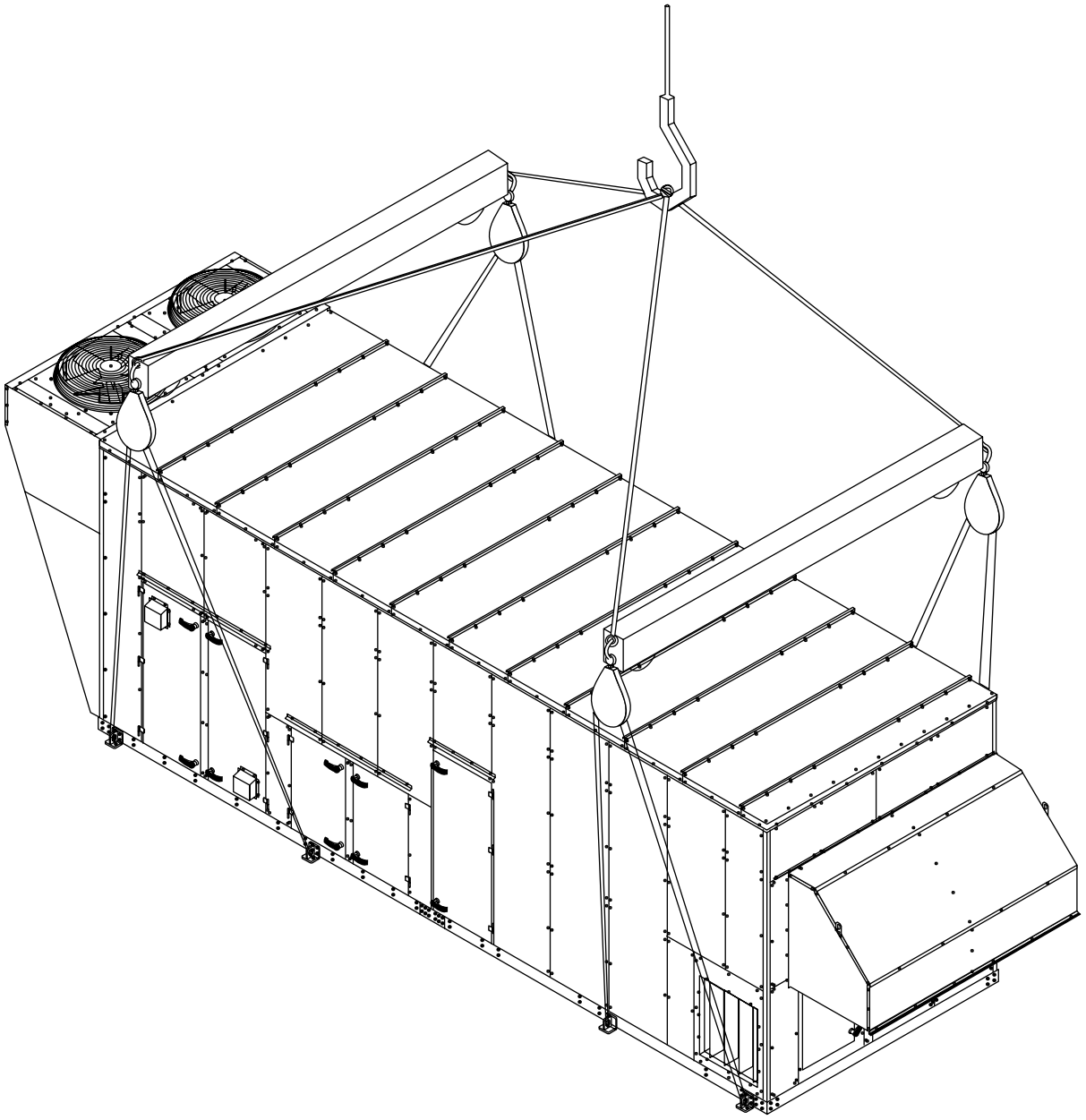
Appendix A: Hood Installation



IMPORTANT

1. Outdoor air intake and exhaust air discharge hoods with birdscreen are shipped separately with factory installed foam gasket attached to the hood flanges for field installation with the self-drilling screws factory supplied.
2. Position the exhaust air discharge hood squarely over the exhaust discharge opening so as not to interfere with damper opening and secure at all pre-punched holes with self-drilling screws provided into the casing.
3. Using the lifting lugs provided, hoist the outdoor air intake hood over the outdoor air intake opening onto the bottom positioning ledge provided. Secure at all pre-punched holes with self-drilling screws provided into the casing so as not to interfere with damper opening.

Appendix B: Rigging and Lifting Details



CAUTION

1. Rigging and lifting units without using all lifting lugs will compromise the structural integrity of the unit. All lifting lugs provided must be used.
2. Use spreader bars, cables and pulleys to apply an even vertical lifting force only at all the lifting points to prevent damage to the unit.
3. Provide additional blocking and coverings (as required) to prevent damage to the unit finish and/or components.
4. Lifting lugs may be removed after installation if desired. Return bolts with washer and seal with silicone to prevent any water penetration or leakage.

Appendix C: Water Source Heat Pump (WSHP) Water Line Piping Requirements and Options

Water Supply and Return Piping Requirements

IMPORTANT

WSHP external water supply and return piping shall be in accordance with National and Local Codes. Line sizing, pressure limiting devices, backflow preventers, strainers, valves, flow temperature and pressure measuring, freeze protection, all other safety or control piping requirements for system operation are the sole responsibility of the Installing Contractor and/or Design Engineer. The water supply must be sized for the minimum flow as indicated on the mechanical drawings.

Recommended and required WSHP water line piping components with a detailed functional description are outlined below:

- Manual shut-off valves in supply and return water lines are recommended for isolation and service.
- Pressure and temperature gauge connections in the supply and return water lines are recommended for testing and service.
- A water strainer (16–20 mesh minimum) in the supply water line is recommended on open loop systems to eliminate contaminants.
- Air vents are required on the high side of the water supply or inlet line to discharge the non-condensable air in order to avoid unexpected high head pressure and poor cooling/heating performance. Manual air vents are factory installed on the water condenser and economizer coil (if equipped).
- A balancing valve with pressure and temperature gauge connections in the return water lines is recommended for balancing and service.
- A two-way motorized on/off water shut-off valve is recommended to isolate water flowing through both the economizer coil (if equipped) and water-to-refrigerant condenser for conservation when the unit is off. The motorized water valve must open 90 seconds prior to compressor start-up and remain open five seconds after the compressor is shut off.
- A waterside economizer coil, a three-way modulating water economizer valve and a temperature sensor on the water inlet or supply line and downstream of the economizer coil is required for energy conservation. The water temperature sensor is input to the DDC Control System which determines when to divert water to the economizer coil for energy conservation in cooling mode. The three-way motorized economizer valve and the inlet water temperature sensor are included with the WSHP WiSE coil option and factory provided and installed in the compressor compartment.
- A three-way modulating head pressure control valve is required to maintain stable operation of the refrigeration systems when operated on ground loop water systems when the design inlet water temperature is below 65°F [18°C] in the cooling mode. A refrigerant pressure transducer on the compressor discharge is used to modulate the water flow to the condenser using a 2 to 10 VDC signal to prevent the compressor discharge pressure from falling below the compressor operating limit. The three-way motorized valve and the pressure sensor option is factory provided and installed in the compressor compartment if the design inlet water temperature is below 65°F [18°C] in the cooling mode.
- A flow switch is required on the water return or leaving side of the condenser to monitor the presence or absence of flow which will shut down the compressor and unit if no flow is present. The water flow switch option is factory provided and installed in the compressor compartment.
- A water temperature sensor is required on the water return or leaving side of the condenser to monitor the water temperature which will shut down the compressor and unit for freeze protection if the leaving water temperature drops below 35°F [2°C]. The water temperature sensor option is factory provided and installed in the compressor compartment on 100% water systems.
- A relief valve must be installed in the water supply or inlet line if the maximum pressure of components is less than the water supply pressure to prevent damage, injury or death due to instantaneous release of high pressure water.

⚠ WARNING

Prior to connection of water supply or inlet line, verify water pressure is less than the maximum pressure for components in the water line. To prevent injury or death due to instantaneous release of high pressure water, relief valves must be installed in system water supply or inlet piping.

Factory Installed Piping Options and Physical Description

Some of the recommended and required components in the water supply and return line are available or included as factory installed and pre-wired options. When the factory installed options are selected the piping schematic, component size and C_v rating will be included based on compressor selected with the submittals. These components are mounted inside the compressor compartment, piped in copper lines with sweat or threaded connections as indicated in the submittals. Physical description, opera-

tion, temperature and pressure limits of the optional components are provided below.

Strainer with Blowdown Valve

The strainer with blowdown valve is a combination Y-strainer and ball valve of forged brass (cast brass on 2 and 2½") construction with a 304 stainless steel removable 20 mesh screen and includes a blowdown/drain ball valve, PT (pressure temperature) ¼" test port, union end and tailpiece. If pressure drop becomes excessive, accumulated dirt should be blown down through the blowdown/drain valve to a drain. Maximum temperature rating of 325°F [163°C] and pressure rating of 600 psi.

On/off Control Valve

The on/off control valve is a two-way motorized water shut-off valve consisting of a 24 VAC NEMA one or two actuator with a temperature rating of –22°F to 122° F [–30°C to 50°C], nickel plated forged brass valve and replaceable valve cartridge assembly. These hydronic valves are intended for use in a normal indoor or outdoor protected environment for hot or cold water or glycol solutions to 60% concentration with a medium temperature rating of 0°F to 212°F [–18°C to 100°C]. The valve and actuator are pre-assembled for 0% flow to the coil when the unit does not require heating or cooling.

WSHP WiSE Coil

The WSHP WiSE coil includes a waterside water economizer cooling coil, three-way modulating water control valve and two temperature sensors on the inlet water line and downstream of the economizer coil. The DDC Control System logic determines when to switch to water or Dx cooling when conditions are favorable for energy conservation. The three-way modulating economizer valve consists of a 24 VAC NEMA one or two modulating actuator with a temperature rating of –22°F to 122°F [–30°C to 50°C], nickel plated forged brass valve with stainless steel ball, stem and replaceable valve cartridge assembly. These hydronic valves are intended for use in a normal indoor or outdoor protected environment for hot or cold water or glycol solutions to 60% concentration with a medium temperature rating of 0°F to 212°F [–18°C to 100°C]. The valve and actuator are pre-assembled for 0% flow to the economizer coil when the unit does not require cooling.

Head Pressure Control

The head pressure control consists of a 24 VAC NEMA one or two modulating actuator with a temperature rating of –22°F to 122°F [–30°C to 50°C] connected to a pressure sensor in the refrigerant line and a nickel plated forged brass three-way water control valve with stainless steel ball, stem and replaceable valve cartridge assembly. These hydronic valves are intended for use in a normal indoor or outdoor protected environment for hot or cold water or glycol solutions to 60% concentration with a medium temperature rating of 0°F to 212°F [–18°C to 100°C]. The valve and actuator are pre-assembled for 100% flow to the condenser coil with minimum of 2 VDC signal.

Water Flow Switch

The water flow switch for freeze protection has a stainless steel vane that is inserted (threaded) into the water return or outlet line. Maximum temperature rating of 200°F [93°C] and pressure rating of 1,000 psi.

Leaving Water Temperature Sensor

The water temperature sensor is mounted on the outside of the water return or outlet line for freeze protection.

Balancing Valves

Two types of balancing valves are offered as options:

1. Circuit setter
   The circuit setter is a dual purpose calibrated manual balancing valve with modified venture and ball valve with union end and tailpiece of forged brass construction which includes two PT (pressure temperature) high and low test plugs for differential pressure readings. Maximum temperature rating of 325°F [163°C] and pressure rating of 600 psi. The ball valve handle has an adjustable memory stop for locking the handle to a maximum open position once the correct gpm is achieved. Multiple passes are usually required to properly balance the system. The balancing valve must be manually set in the field by an experienced balance contractor. A differential pressure meter measuring in psi across the venturi is required to read the differential pressure then using the tagged modified venture number located on the valve body or handle, the calculated correction factor for glycol and flow equation (below), calculate the US gpm. Accuracy is +/– 3%.
2. Automatic flow control valve
   The automatic flow control valve is a combination ball valve and automatic flow control valve with union end, tailpiece of forged brass (cast brass on 2 and 2½") construction which includes two PT (pressure temperature) test plugs for temperature and pressure readings. Maximum temperature rating of 325°F [163°C] and pressure rating of 600 psi. The automatic flow control valve has an internal cartridge that is preset to a specific flow rate (US gpm). The gpm cannot be adjusted in the field; however, the cartridge may be exchanged for a different pre-set cartridge.

Flow Equation

US gpm = C_v x $\sqrt{\Delta P/SG}$

Where:

C_v is the flow coefficient for the valve
ΔP is the fluid pressure drop across the valve in psi
SG is the specific gravity for the hydronic fluid

C_v for Nexus UltraXB valves are as follows:

Table 3: C_v for Nexus Ultra XB Valves

Size	C_v
1A	0.86
1B	1.32
1C	3.53
1D	0.30
2A	2.46
2B	1.32
3A	3.53
3B	7.42
3C	16.6
4A	16.6
5A	29.7
6A	51.6
6B	29.7

Specific gravity for ethylene glycol and propylene glycol are as follows:

Table 4: Specifc Gravity for Water and Ethylene Glycol

Temperature		Ethylene Glycol Solution (% by volume)						
°F	°C	25	30	40	50	60	65	100
–40.0	–40.0	1)	1)	1)	1)	1.120	1.130	1)
0.0	–17.8	1)	1)	1.080	1.100	1.110	1.120	1.160
40.0	4.4	1.048	1.057	1.070	1.088	1.100	1.110	1.145
80.0	26.7	1.040	1.048	1.060	1.077	1.090	1.095	1.130
120.0	48.9	1.060	1.038	1.050	1.064	1.077	1.082	1.115
160.0	71.1	1.018	1.025	1.038	1.050	1.062	1.068	1.100

1) Below freezing point.

Table 5: Specifc Gravity for Water and Propylene Glycol

Temperature		Ethylene Glycol Solution (% by volume)						
°F	°C	10	20	30	40	50	60	70
–22.0	–30.0	1)	1)	1)	1)	1.07	1.08	1.09
–4.0	–20.0	1)	1)	1)	1.06	1.07	1.07	1.08
14.0	–10.0	1)	1)	1.04	1.05	1.06	1.06	1.07
32.0	0.0	1.01	1.02	1.03	1.04	1.05	1.06	1.06
50.0	10.0	1.01	1.02	1.03	1.04	1.05	1.05	1.05
68.0	20.0	1.01	1.02	1.03	1.03	1.04	1.05	1.05

1) Below freezing point.

Appendix D: Gas-fired Furnace Module Installation and Maintenance

⚠ WARNING

Fire or Explosion Hazard

1. Failure to follow safety warnings exactly could cause serious injury, death or property damage.
2. Be sure to read and understand the installation, operating and maintenance instructions in this appendix thoroughly before installing or servicing this equipment.
3. Improper installation, adjustment, alteration, service or maintenance can cause serious injury, death or property damage.
4. Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

For Your Safety – What to do if You Smell Gas

1. Open windows if appliance is indoors.
2. Do not try to light any appliance.
3. Do not touch electrical switches or use any phone in the building.
4. Extinguish any open flame.
5. Leave the building immediately.
6. Immediately call your gas supplier from a phone remote from the building. Follow the Gas Supplier's instructions.
7. If you cannot reach your Gas Supplier, call the fire department.

Installation and Service

1. Installation and service must be performed by a qualified installer, service agency or the Gas Supplier.

The furnace covered by this appendix is a component of a "Listed" product, subject to the guidelines of application as designated by the Certifying Agency and outlined in the appliance manufacturer's installation and operation instructions. The information provided in this appendix applies to the furnace module, installed in the appliance and to its operation, maintenance and service. Refer to the appliance manufacturer's instructions for information related to all other components.

IMPORTANT

Combustion air intake and vent locations may differ; see mechanical drawings for actual locations.

Installation Requirements

1. Be sure that the appliance is located with respect to building construction and other equipment to provide ready access and clearance to access panels or doors that must be opened to permit adjustment and servicing of the heating section. See the required clearances provided on the mechanical drawing.
2. Do not install the appliance where it may be exposed to potentially explosive or hazardous atmospheres containing flammable vapors or combustible dust.
3. Do not locate the appliance in areas or near building ventilators or exhausts where corrosive vapors (such as chlorinated, halogenated or acidic or airborne substances containing silicone) are present in the atmosphere or can be mixed with combustion air entering the furnace module.
4. Do not install the appliance in locations where flue products can be drawn in the adjacent building openings such as windows, fresh air intakes, etc.
5. The appliance is not certified or suitable for use in drying or process applications. Units used in such applications voids any warranty and manufacturer disclaims any responsibility for this appliance or application.
6. If any original wire supplied with the furnace must be replaced, it must be replaced with wiring material having a temperature rating of at least 104°F [90°C].
7. Provide necessary support for wiring in furnace vestibule. Wiring should not contact metal surfaces that may be hot during furnace module operation.

Installation

IMPORTANT

All gas furnace installations must be in accordance with the National Fuel Gas Code ANSA Z223.1 (NFPA 54) in the United States, to the Gas Installation Code Can/CGA B149 in Canada and all other applicable local codes and ordinances. These requirements include but are not limited to:

1. Combustion air supply to the gas furnace.
2. Venting of the products of combustion.
3. Gas supply piping and connections.
4. Unit location and clearances.

Verify the following before placing the gas furnace into service:

1. Gas supply provided matches the gas type marked on the furnace module rating plate, the gas supply line has been completed according to the Gas Supply, Piping and Connections section and has been cleaned, drained and purged to the external manual shut-off valve.
2. There is an adequate supply of air for the combustion process for the furnace module according to the type of installation.
3. There is a properly designed vent system connected to the furnace module to convey the products of combustion (flue gases) outdoors and are directed away from any combustion air intakes according to the installation.

Outdoor Installation

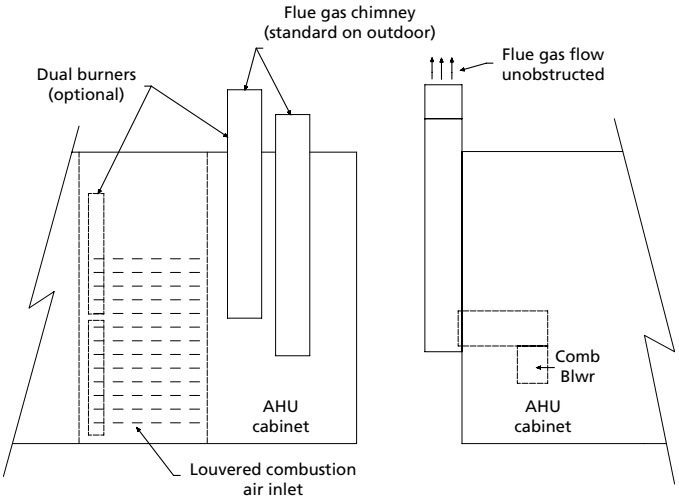
Air for Combustion

The furnace is power vented with a combustion air draft inducer/blower and needs an ample supply of air for proper and safe combustion of the fuel gas. Combustion air inlet louvers are pre-punched into a panel on the furnace vestibule. Do not block or obstruct air openings to the area where the appliance is installed. Provide at least 6 feet [1,829 mm] clearance to side of the appliance, where the combustion air inlet or vent (flue) gas discharge is located, from walls, parapets or adjacent buildings or equipment. Do not locate appliance near building ventilators or exhausts, or areas where corrosive chemical vapors can be drawn into combustion air supply. Refer to appropriate installation codes for required clearances to combustion air openings and flue gas (vent) outlets.

Venting

The venting system for outdoor appliances is a Category III, with the vent products at positive pressure and up to 550°F [288°C]. Each furnace must be individually vented. The venting system is designed for horizontal direct discharge to the exterior of the cabinet and provided with factory built individual vertical exterior double wall vent stacks that extend above the top of the appliance by a minimum of 1 to 2 feet [302 to 604 mm], providing a minimum 4 foot [1,016 mm] separation between flue gas discharge and combustion air inlet and extending below the discharge opening by 1 foot [302 mm] permitting condensate that may form to drain through the bottom. The vent stacks are open at top and bottom but protected by ½" x ½" [12 x 12 mm] mesh screens. The vent discharge opening should be located to provide an unobstructed discharge to the outside (see Figure D1).

Figure D1: Outdoor vertical venting



Where sufficient height for proper vertical venting must be greater or in jurisdictions requiring a greater separation between flue gas discharge and combustion air inlet the vent stacks provided with the unit must be replaced by separate self-supported factory built closed chimneys or vents complying with a recognized standard to Category III with a 90° elbow and a field supplied rectangular to round transition. The closed venting system must employ a drain line in the vent chimney and an approved rainproof vent cap must be applied to the termination.

The proper vent pipe diameter must be used for each furnace to ensure proper venting of combustion products. See Table D1 for number of furnaces/vents, size of connections, vent pipe diameter required and submittal for location.

Indoor Installation

Air for Combustion

Locate appliance to ensure an adequate supply of fresh air to replace air used in the combustion and ventilation process of the furnace module. The appliance must be installed in a location with adequate clearances to provide for combustion air, service and inspection, and proper distances from combustible construction. The appliance must be located in such a manner that it does not interfere with the circulation of air in the heated space.

All fuel burning equipment must be supplied with air that enters into the combustion process and is then vented outdoors. Sufficient air must enter the appliance location to replace the air exhausted through the vent system. Do not install appliance in a confined space without providing wall openings to and from this space. If building construction is such that the normal infiltration does not provide sufficient air for combustion and venting, outside air must be introduced. Install air openings that provide a total free area in accordance with the following and to the National Fuel Gas Code Z223.1 (NFPA 54) in the U.S. or in Canada, to the Can/CGA B149 Installation Code:

1. Air from inside the building – Opening of 1 sq. inch [645 mm^2] per 1,000 Btuh [293 W] of input, but never less than 100 sq. inch [0.06 m^2].
2. Air from outside (ducted) – Opening of 1 sq. inch [645 mm^2] per 2,000 Btuh [586 W].
3. Air from outside (direct opening) – Opening of 1 sq. inch [645 mm^2] per 4,000 Btuh [1,172 W].

Venting

Each furnace must be connected to a venting system to convey flue gases outside of the heated space. Refer to installation codes noted above for specific requirements for the product type being installed.

The induced draft fan rectangular vent connection for each furnace is factory run to the side of the furnace vestibule. A field supplied rectangular to round transition is required. See submittal drawings for location of vents.

Each furnace must be connected to a separate factory built chimney or vent complying with a recognized standard, or a masonry or concrete chimney lined with a material acceptable to the authority having jurisdiction.

The proper vent pipe diameter must be used for each furnace to ensure proper venting of combustion products. See Table D1 for number of furnaces/vents and vent pipe diameter required.

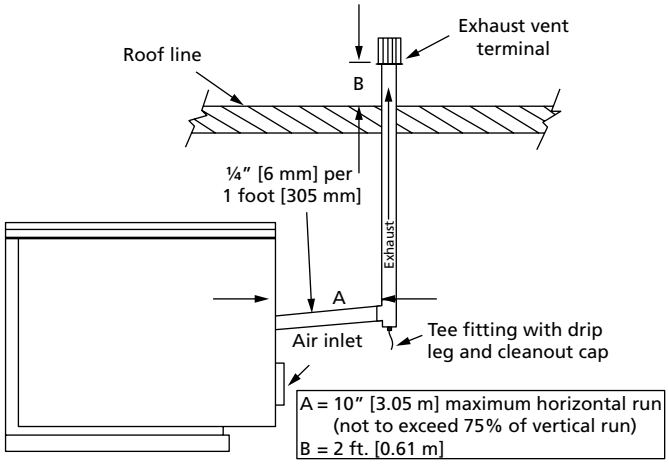
Table D1: VHC-72 Number of Separate Furnaces/ Vents, Vent Connection Size and Vent Pipe Diameter

Input Rating BTUH [Watts]	Number of Furnaces/ Vents	Vent Connection Size Each	Vent Pipe Diameter
250,000–400,000 [73,268–117,228]	1	1 @ 4.5" x 3.75" [114.3 x 95.25 mm]	6" [152 mm]
500,000–800,000 [146,536–234,456]	2	2 @ 4.5" x 3.75" [114.3 x 95.25 mm]	6" [152 mm]

Vertically Vented Furnaces – Category I (per NFGC and ANSI Z21.13 is a non-condensing appliance with negative vent pressure) (see Figure D2)

1. Use single wall or double wall (Type B) vent pipe diameters for the appropriate models. Use insulated vent outdoors.
2. Maximize the height of the vertical run of vent pipe. A minimum of 5 feet [1.5 m] of vertical pipe is required. The top of the vent pipe must extend at least 2 feet [0.61 m] above the highest point on the roof. Use Listed Type B vent for external runs. An approved weatherproof vent cap must be installed to the vent termination.
3. An approved weatherproof vent cap must be installed to the vent termination.
4. Horizontal runs must not exceed 75% of the vertical height of the vent pipe, up to a maximum of 10 feet [3 m]. Horizontal runs should be pitched upward ¼" per foot [21 mm per meter] and should be supported at 3 foot [1 m] maximum intervals.
5. Design vent pipe runs to minimize the use of elbows. Each 90° elbow is equivalent to 5 feet [1.5 m] of straight vent pipe run.
6. Vent pipe should not be run through unheated spaces. If such runs cannot be avoided, insulate vent pipe to prevent condensation inside vent pipe. Insulation should be a minimum of ½" [12.7 mm] thick, of 1½" density and foil faced material suitable for temperatures up to 550°F [288°C].
7. Dampers must not be used in vent piping runs. Spillage of flue gases into the occupied space could result.
8. Vent connectors serving Category I furnace must not be connected into any portion of a mechanical draft system operating under positive pressure.

Figure D2: Indoor vertical venting



Horizontally Vented Furnaces – Category III (per NFGC and ANSI Z21.13 is non-condensing with positive vent pressure) (see Figure D3)

Pressures in Category III venting systems are positive and therefore, care must be taken to avoid flue products from entering the heated space. Use only vent materials and components that are UL listed and approved for Category III venting systems.

⚠ WARNING

Do not use Type B vent within a building on horizontally vented indoor furnaces.

1. All vent pipe joints must be sealed to prevent leakage into the heated space. Follow instruction provided with approved venting materials used.
2. The total equivalent length of vent pipe must not exceed 50 feet [15.35 m]. Equivalent length is the total length of straight sections, plus 5 feet [1.52 m] for each 90° elbow and 2.5 feet [0.76 m] for each 45° elbow.

3. The vent system must also be installed to prevent collection of condensate. Pitch horizontal pipe runs downward ¼" per foot [21 mm per meter] toward the outlet to permit condensate drainage. Insulate vent pipe exposed to cold air or routed through unheated areas. Insulate vent pipe runs longer than 10 feet [3 m]. Insulation should be a minimum of ½" [12.7 mm] thick foil faced material of 1½" density and suitable for temperatures up to 550°F [288°C]. Maintain 6" [152 mm] clearance between vent pipe and combustible materials.
4. A vent cap approved for horizontal venting must be provided. Vent cap inlet diameter must be the same as the required vent pipe diameter. The vent terminal must be at least 1 foot [305 mm] from the exterior wall that it passes through to prevent degradation of building material by flue gases. The vent terminal must be located at least 1 foot [305 mm] above grade, or in snow areas, at least 3 feet [1 m] above snowline to prevent blockage. Additionally, the vent terminal must be installed with a minimum horizontal clearance of 4 feet [1.2 m] from electric meters, gas meters, regulators or relief equipment. Periodically clean the screens in the vent terminal (where applicable).

IMPORTANT

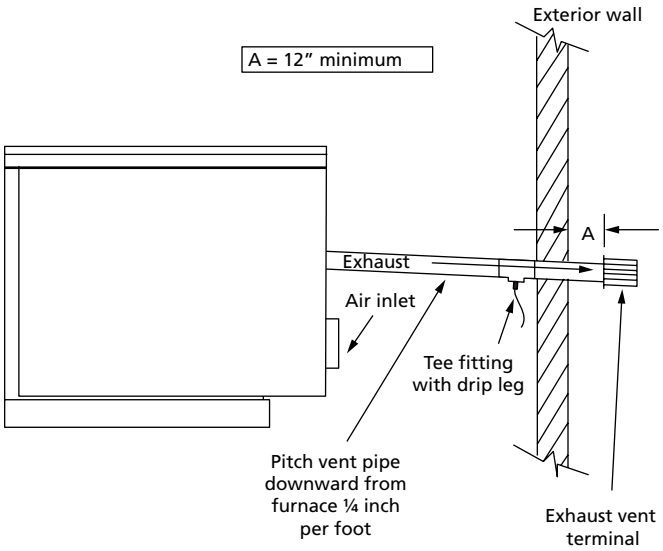
Each furnace must have its own individual vent pipe and terminal. Do not connect vent system from horizontally vented units to other vent systems or a chimney.

5. Through the wall vents shall not terminate over public walkways, or over an area where condensate or vapor could create a nuisance or hazard. Provide vent termination clearances to building or structure features as per Table D2:

Table D2: Vent Termination Clearances

Structure	Minimum Clearance
Door, window or gravity inlet	4 ft. [1.2 m] below
	4 ft. [1.2 m] horizontally
	1 ft. [305 mm] above
Forced air inlet within 10 ft. [3 m]	3 ft. [0.91 m] above
Adjoining building or parapet	6 ft. [1.8 m]
Adjacent public walkways	7 ft. [2.1 m] above grade

Figure D3: Indoor horizontal venting



Separated Combustion Air Intake Systems

On indoor appliances for operation with separated combustion air intake systems, the furnace burner section is in a reasonably air-tight vestibule compartment, as these systems provide combustion air from outside the heated space and vent the products of combustion outdoors. No air openings are to be made in the furnace vestibule and sealing grommets or gaskets must be provided for gas and electrical entry points into the vestibule to provide a reasonably air-tight seal. Additionally, the unit must include the following:

1. A suitable air-tight gasket on the vestibule door or access panel.
2. An observation window in the door to permit observation of ignition and main burner flame during operation and servicing.
3. A door or panel interlock switch to ensure that door or panel is closed or in place during operation.
4. The induced draft fan rectangular vent connection for each furnace is factory run to the side of the furnace vestibule. A field supplied rectangular to round transition is required. See Table D1 for number of furnaces/vents, size of connections, vent pipe diameter required and submittal for location.
5. A pilot hole for a single combustion air inlet supply pipe is provided which must be field sized and cut into the furnace vestibule. See submittal drawings for location.
   The combustion air inlet supply pipe must be at least the same diameter as the vent pipe for a single furnace unit or of a diameter to have twice the internal area for a dual furnace unit.

IMPORTANT

Approved combustion supply air intake and exhaust flue gas vent piping and terminals must be used between the unit and outdoors for combustion supply air and exhaust flue gas. The inlet and outlet terminals must be located in the same outdoor pressure zone to provide for safe appliance operation.

Proper installation of combustion air intake and flue gas exhaust piping are essential to proper operation of the in-shot gas burner module. See Figure D4 and Figure D5 for recommended installation.

Figure D4: Separated combustion – vertical venting

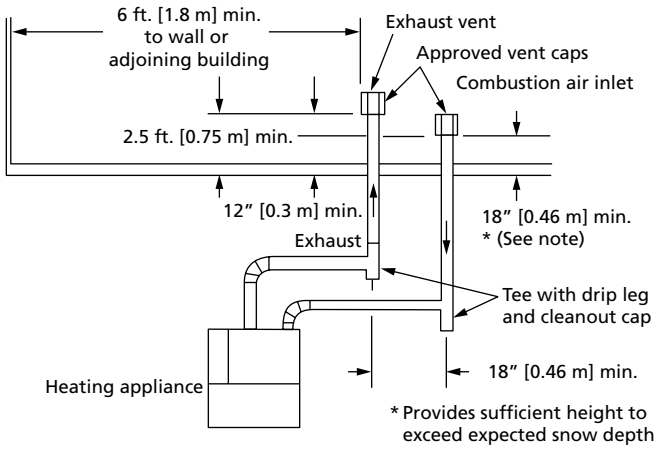
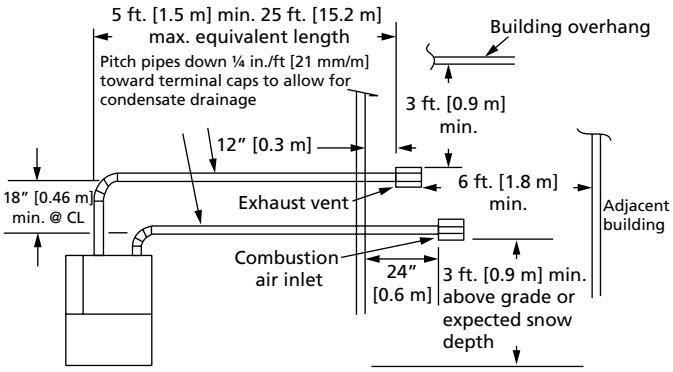


Figure D5: Separated combustion – horizontal venting

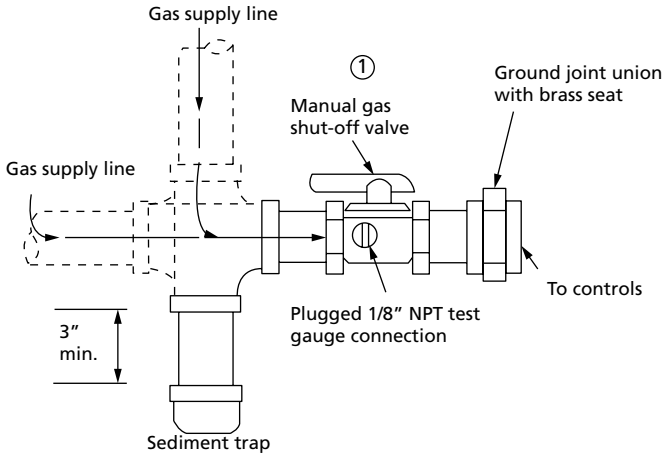


Note: Be sure that the vent cap used for horizontal venting applications is approved for horizontal application. Certain Manufacturer's vent terminals are approved for vertical installation only.

Gas Supply, Piping and Connections

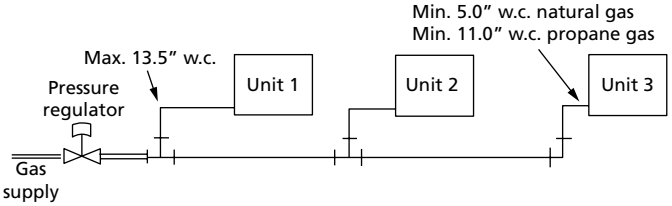
1. All gas piping must conform with local building codes and ordinances or, in the absence of local codes, with ANSI Z223.1 the National Fuel Gas Code and NFPA 54 in the US. In Canada, installation must be in accordance with Can/CGA B149.1 for natural gas and B149.2 for propane units.
2. Gas piping must be sized for the total Btuh input of the appliance serviced by a single supply line. Refer to the number of furnace(s) and the total input of their rating plate(s). Each furnace has a ¾" NPT piping connection located inside the furnace control enclosure which must be field joined in a single supply line then extended to the exterior of the cabinet. The gas supply line feeding more than one furnace must be checked for size relative to the connection at each furnace to maintain minimum required pressure to each furnace.
3. A drip leg (sediment trap) and a manual gas shut-off valve must be field supplied and installed immediately adjacent to the point where the gas supply line enters the cabinet. To facilitate servicing, installation of a union is recommended (see Figure D6). The appliance must be isolated from the gas supply system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures greater than 13.5" w.c. [½ psi]. Always use clean, scale-free pipe and malleable iron fittings, and remove all cutting and threading debris prior to connecting pipes. Firmly support the gas piping so that it cannot be dislodged from its installed position.

Figure D6: Union installation



4. For the furnace(s) to operate properly, the minimum inlet gas supply pressure to each furnace for natural gas operation is 5.0" w.c. and for propane (LP) gas is 11.0" w.c. with the furnace(s) operating. Maximum inlet pressure for either gas is 13.5" w.c. [½ psi]. For higher gas pressures, a separate field supplied and installed high pressure regulator sized for the total Btuh input is required to reduce pressure to within minimum and maximum range. The high pressure regulator used must include full internal relief or a separate relief valve is required to prevent gas pressure exceeding the maximum 13.5" w.c. [½ psi] limit to prevent damage to the furnace gas valve(s).
5. A 1/8" NPT tap is provided on the inlet of the gas valve to each furnace. A fitting suitable for connection to a pressure gauge capable of measuring gas pressure should be connected to each furnace. Check gas inlet pressure at each furnace with all of the furnaces operating at the same time. See Figure D7.

Figure D7: Gas piping line, regulator and overpressure relief valve must be sized to be within the minimum and maximum pressure ratings of all furnaces or appliances serviced



⚠ WARNING

1. All field gas piping must be pressure/leak tested prior to operation. Never use an open flame to check for leaks. Use a soap solution or other leak detecting solution for testing.
2. Gas pressure to furnace controls must never exceed 13.5" w.c. [½ psi].

⚠ WARNING

1. When pressure testing at ½ psi or less, close the manual shut-off valve on the furnace before testing.
2. When pressure testing gas supply line at ½ psi or higher, close manual gas valve and disconnect furnace from supply line to be tested. Cap or plug the supply line.

Airflow Considerations, Condensation and Full Modulation Firing Rate Control

1. Airflow through the furnace is horizontal. In this configuration, condensate due to operation of air conditioning system can form in the furnace tubes and would drain to the furnace flue box. A condensate drain fitting is provided in the flue box. A ¼" silicone drain line is attached to the flue box and extended through to the outside of the furnace vestibule just above the base frame (see Figure D9).
2. Furnaces equipped with modulating control are capable of minimum input rates as low as 20% on units with a single furnace and 10% on units with dual furnaces. Below the minimum modulation rate the furnace will cycle on and off to maintain the discharge air setpoint. Consideration must be given to the vent conditions and particularly the circulating airflow rates to ensure that the operating air temperature rise is above the dew point temperature of the flue gases in all applications and below the maximum allowable air temperature rise to limit the furnace tube temperature. The selection software limits the furnace input to be below the maximum temperature rise of 80°F [44.4°C] and the discharge sensor limits the maximum supply air leaving temperature. On units with a single furnace with 5:1 turndown the DDC controller compares the inlet and discharge temperature to and from the furnace and will override the turndown to limit the minimum temperature rise to 20°F [11.1°C] to reduce the possibility of condensation in the furnace tubes. On units with dual furnaces with 10:1 turndown the minimum temperature rise will be over ridden to limit the minimum temperature rise to 10°F [5.6°C] to reduce the possibility of condensation in the furnace tubes. In the event of a heat wheel failure where the furnace design temperature rise may be insufficient, the low limit function will shut down the unit to also reduce the possibility of condensation. Condensation of the flue gas is corrosive and will result in shortened heat exchanger life and is not permitted. The materials used for furnace tubes and vent connectors are designed for non-condensing operation during the heating cycle. The selection software will also limit the furnace selection to a maximum temperature rise of 80°F [44.4°C].

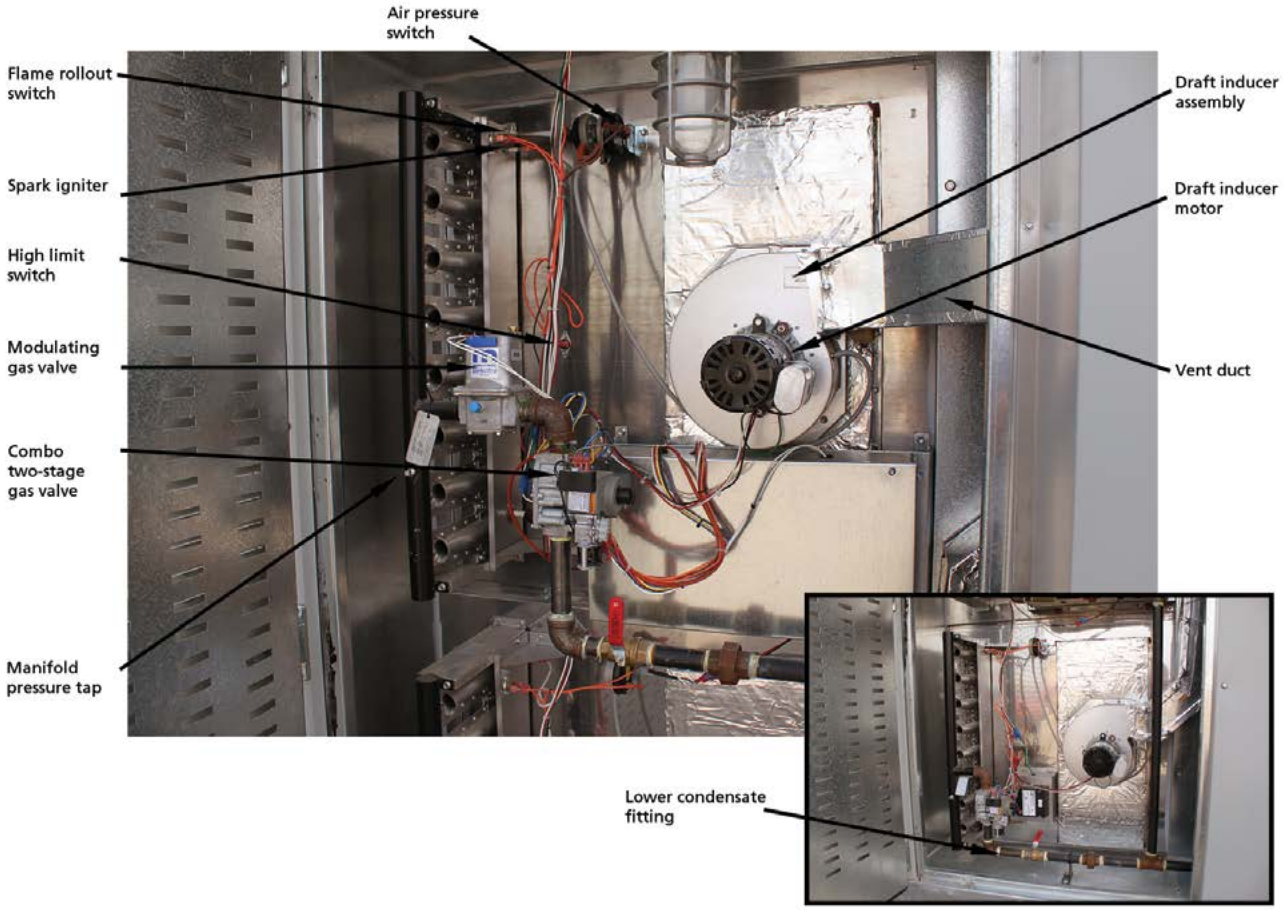
Figure D9: Drain line from flue box to exterior of casing

3. The heat capacity of the furnace is controlled by the burner orifices and the gas manifold pressure. The manifold pressure is factory set but should be checked at the time of start-up as described below. It is important not to change the design conditions or airflow, to measure the minimum and maximum temperature rise sufficiently far enough downstream (where the temperature is uniform) and make the proper adjustments.

⚠ WARNING

Operation of the furnace module at vent temperatures below that specified for a Category III could result in condensation during operating cycles causing premature failure of the vent connections or heat exchanger and hazardous operation. Operation of the furnace module above the maximum air temperature rise could result in excessive tube temperatures, premature failure and high limit switch shut down.

Figure D8: Horizontal airflow configuration



Operating and Safety Instructions

⚠ WARNING – FOR YOUR SAFETY

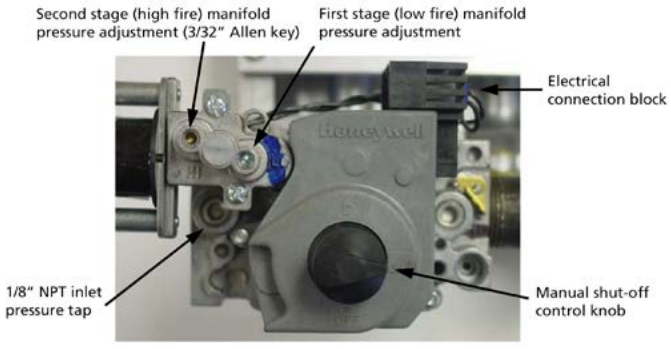
The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.

1. See Figure D8 for component locations.
2. This furnace module does not have a pilot. It is equipped with a direct spark ignition device that automatically lights the gas burner. Do not try to light burners by hand.
3. Before operating, leak test all gas piping up to furnace gas valve. Smell around the appliance area for gas. Do not attempt to place furnace in operation until source of gas leak is identified and corrected.
4. Use only hand force to push and turn the gas control knob to the 'On' position. Never use tools. If knob does not operate by hand, replace gas valve prior to starting the unit. Forcing or attempting to repair the gas valve may result in fire or explosion.
5. Do not attempt to operate unit if there is indication that any part or control has been under water. Any control or component that has been under water must be replaced prior to trying to start the unit.

Start-up

1. Turn thermostat or temperature controller to its lowest setting.
2. Turn off gas supply at the manual shut-off valve.
3. Turn off power to the appliance at the disconnect switch.
4. Remove access panel or open door to appliance vestibule housing the gas furnace.
5. Move gas control knob to 'Off' position. The furnace module is provided with a supply air proving interlock switch to ensure minimum supply airflow prior to burner operation. Set the switch after ductwork has been completed to open just below the minimum supply airflow on the furnace rating plate.
6. Install a tapped fitting for attachment to a manometer (or other gauge suitable for 14" w.c.) in the inlet pressure tap and for 10" w.c. in the manifold pressure tap.
7. Wait five minutes for any gas to clear out. If you smell gas, see Step 2 above and correct leak. If you do not smell gas or have corrected any leaks, go to the next step.
8. Turn gas control knob to 'On' position.
9. Open all manual gas valves.
10. Turn power on at disconnect switch.
11. For start-up, temporarily set the DDC Control System for heating and to its highest position to initiate call for heat and maintain operation of furnace. Continue start-up following the Sequence of Operation, LED Flash Code Key and Trouble Shooting Guide for Utec Ignition Board based on the burner firing rate control (on/off, two-stage or full modulation) and Utec ignition board provided on the furnace at the end of this appendix.
12. Check and adjust manifold pressure (see Figure D10).
    a. The correct heat capacity of the furnace is controlled by the burner orifices and the gas manifold pressure. The manifold pressure is factory set but should be checked at the time of start-up as described below. For modulation control the analog input signal could also be limited by the control system depending on the airflow rate. See Airflow Considerations, Condensation and Full Modulation Firing Rate Control above.
    b. For two-stage and full modulation control systems manifold pressure should be 1.2" w.c. for natural gas and 3.5" w.c. for propane during the 90 second warm-up period. Adjust low regulator on two-stage gas valve, if necessary. After 90 seconds, manifold pressure should increase to 3.5" w.c. for natural gas and 10.5" w.c. for propane within 30 to 45 seconds for two-stage units. For modulating units, after 90 seconds, the manifold pressure will vary depending on the analog input signal. At 10 VDC, pressure should be 3.5" w.c. for natural gas and 10.5" w.c. for propane; at 0 volts the manifold pressure should be 0.4" w.c. for natural gas and 1.1" w.c. for propane.
    c. For on/off units, the manifold pressure should be 3.5" w.c. for natural gas and 10.5" w.c. for propane.

Figure D10: Gas valve



13. Prior to completing the start-up, check the appearance of the main burner flame. See Figure D11 and Figure D12 for flame characteristics of properly adjusted natural gas systems.
    a. The burner flame should be predominantly blue in color, well defined and centered at the tube entry. Distorted flame, yellow tipping of natural gas flame or a long yellow flame on propane,

may be caused by lint and dirt accumulation inside burner or at burner ports, at air inlet between burner and manifold pipe, or debris in the main burner orifice. Soft brush or vacuum clean affected areas.

b. Poorly defined, substantially yellow flames or flames that appear lazy indicate poor air supply to burners or excessive burner input. Verify gas supply type and manifold pressure with rating plate.
c. Poor air supply can be caused by obstructions or blockage in heat exchanger tubes or vent discharge pipe. Inspect and clean as necessary to eliminate blockage. Vacuum any dirt or loose debris. Clean heat exchanger tubes with stiff brush. Poor flame characteristics can also be caused by undersized combustion air openings or flue gas recirculation into combustion air supply. Increase air opening size or re-direct flue products to prevent recirculation.
d. Reduced air delivery can also be the result of fan blade slippage, dirt accumulation in the fan blade or low voltage to draft inducer motor. Inspect draft fan assembly and be sure fan blade is secure to motor shaft. Check line voltage to heater.

Figure D11: Burner flame at start-up 1.2" w.c. manifold pressure draft inducer – high speed

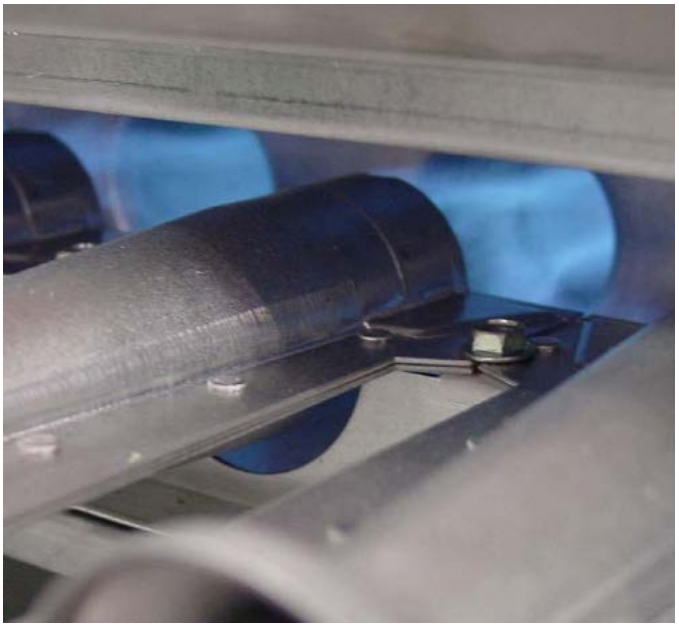
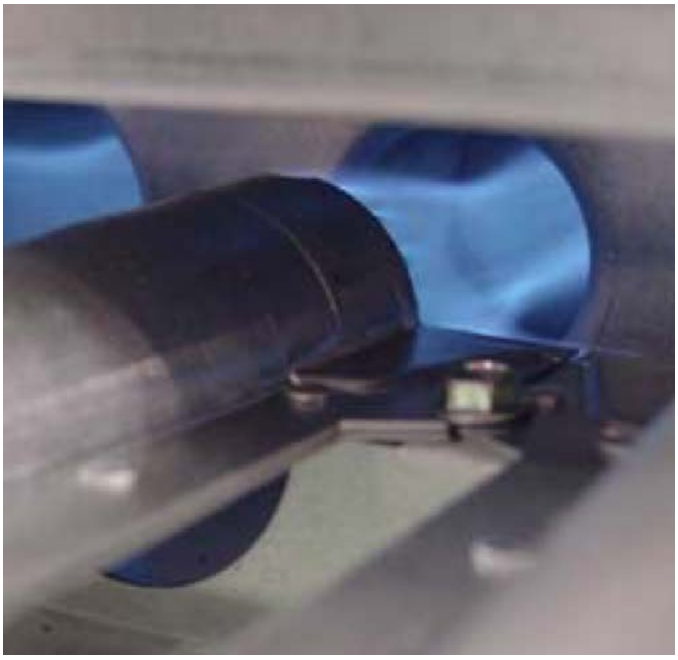


Figure D12: Burner flame at high fire 3.2" w.c. manifold pressure draft inducer – high speed



Shut Down

1. Set thermostat or controller to lowest setting.
2. Turn off electrical supply to unit at disconnect switch.
3. Turn off manual gas supply.
4. Disconnect manifold and inlet pressure taps and reinstall pipe plugs.
5. Replace vestibule access panel or close door.

Normal Operation

1. Turn on electrical supply to unit at disconnect switch.
2. Turn on manual gas supply.
3. Set thermostat or temperature controller to desired temperature.
4. Information outlining the normal Sequence of Operation and wiring diagram for the control system supplied with the furnace model is enclosed with the unit.

Security Device Operation

1. A combustion air pressure switch is provided as part of the control system to verify airflow through draft inducer by monitoring the difference in pressure between the draft inducer and the atmosphere. If sufficient negative pressure is not present, indicating lack of proper air movement through furnace heat exchanger, the switch opens shutting off gas supply through the ignition control module. On furnaces with two-speed draft inducer operation, a dual air pressure switch is used, monitoring high and low speed pressures. The air pressure switches have fixed settings and are not adjustable.

2. The furnace is equipped with manual reset rollout switch(es) in the event of burner flame rollout. The switch will open on temperature rise and shut off gas supply through the ignition control module. Flame rollout can be caused by insufficient airflow for the burner firing rate (high gas pressure), blockage of the vent system or in the furnace heat exchanger. The furnace should not be placed back in operation until the cause of rollout condition is identified. The rollout switch can be reset by pressing the button on top of the switch.
3. The furnace is equipped with a fixed temperature high limit switch mounted on the vestibule panel that shuts off gas to the heater through the ignition control module in the event of reduced circulating airflow over the heat exchanger. Reduced airflow can be caused by motor failure of the circulating air blower, dirt, blockage or restriction of the air inlet or outlet to the unit. The high limit switch will automatically reset when the temperature drops to 30°F [16.7°C] below the setpoint. Determine the cause of the reduced airflow and correct.

⚠ WARNING

A secure and effective functioning gas burner requires sufficient combustion gas exhaust discharge. Disabling a security device such as a pressure sensitive switch, rollout switch or high limit switch on a gas device is dangerous and can be fatal. This can also prevent proper functioning of the device and will result in the guarantee being void. Do not attempt to disable any of these switches to place the heater in operation. Contact a qualified service agency.

4. A circulating blower air proving pressure switch is installed that breaks power to the burner circuit to disable the furnace in the event of loss of circulating airflow over the heat exchanger. Loss of airflow can be caused by a motor failure, broken fan drive belt or restriction of the air inlet or outlet to the unit. A loss in circulating airflow, if not detected early, can cause the furnace to cycle on high limit which can cause overheating and damage to internal components.

⚠ WARNING

The circulating blower air proving switch is adjustable and must be set properly to avoid damage due to furnace cycling on high limit.

Maintenance

Furnace Module Inspection

Turn off all electrical power to the unit before inspection and servicing.

1. The furnace should be inspected annually by a qualified service agency. The condition of the burners, heat exchanger, draft inducer, vent system, operating controls and wiring should be determined. Check for obvious signs of deterioration, accumulation of dirt and debris and any heat or water related damage. Any damaged or deteriorated parts should be replaced before the unit is put back into service.

CAUTION

If any of the original wiring needs to be replaced, it must be replaced with wiring materials suitable for 221°F [105°C]. Label all wires prior to disconnection when servicing unit. Wiring errors can cause improper or dangerous operation. Verify proper operation after servicing.

2. Clean burners, heat exchanger, draft inducer and vent ducts. Periodically clean the screens in the vent terminal (where applicable).
3. Check heat exchanger for cracks. If any are present, replace heat exchanger before putting unit back into service.
4. Check the attachment point of the furnace module to the cabinet or ducts to verify that they are air-tight.
5. Check the automatic gas valve to ensure that the gas valve seat is not leaking.

Furnace Module Operation Check

1. Turn on power to the unit and set thermostat or heat controller to call for heat, allowing furnace module to operate.
2. Check for proper start-up and ignition as outlined in the Start-up section.
3. Check the appearance of the burner flame (see Figure D11 and Figure D12).
4. Return thermostat or heat controller to normal setting.
5. Refer to the appliance manufacturer's instructions for annual maintenance procedures on the complete unit.

Replacement Parts

Replacement parts for the gas-fired furnace module are available through our Parts and Service Department at:

Venmar CES
1502 D Quebec Avenue
Saskatoon, SK S7K 1V7
Email: venmarservice@venmarces.com
Phone: 1-866-4-VENMAR (1-866-483-6627)
Fax: 1-800-667-3716

On/Off Burner Firing Rate Control with Utec 1016-xxx Direct Spark Ignition

Sequence of Operation

1. Thermostat closes on call for heat providing 24 VAC to ignition control.
2. Draft inducer is energized (at line voltage).
3. Air switch closes initiating 30 second pre-purge.
4. At end of pre-purge period, spark and gas valve are energized for up to a five second ignition trial.
5. Burners ignite and carryover.
6. Flame is detected by flame sensor and control operates in steady state heating condition.
7. Unit continues in operation until the thermostat is satisfied.
8. Thermostat opens interrupting power to control and shutting unit off.
9. If ignition is not achieved within five seconds, the gas valve is shut off; the inducer continues to run for an inter-purge period. Additional ignition trials follow the specified sequence. If all trials (three) for ignition have occurred without proper ignition and flame detection, the control locks out.
10. Control may be brought out of lockout by cycling the thermostat or shutting off power for a minimum of five seconds.
11. If flame is lost once it has been established, the control will shut off the gas supply within 0.8 second and enter the inter-purge period. Control will initiate up to three additional trials per normal operation sequence (to restart, refer to Item 10).
12. If flame sensor indicates presence of flame during purge period, when no flame should be present, the inducer will remain energized, but the gas valve will remain off until the cause of the "false flame" is removed.
13. If the air pressure switch is closed when the inducer is energized, or does not close after the inducer is energized, the control will wait one minute for the sir switch to open or close and then lockout (to restart, refer to Item 10).
14. If the control detects power to the gas valve when it should be off, or not powered when it should be on, the control will go into lockout with all outputs off (to restart, refer to Item 10).

IMPORTANT

Refer to control Flash Code Key if control is provided with LED indicator light.

LED Flash Code Key

On Steady	Control operation normal.
1 Flash	Open pressure switch, limit switch or flame rollout switch.
2 Flashes	Pressure switch stuck closed.
3 Flashes	Ignition/flame sense failure.
4 Flashes	Repeated flame losses.
5 Flashes	Internal control fault.

Table D3: Troubleshooting Guide for Utec 1016-xxx Ignition Board

LED Code	System Mode	Description	Actions
Steady On	Normal	LED is lit.	24 VAC is applied to the control.
LED Off	Lockout	LED is off.	Check 120V is supplied to unit and transformer. Check to see if 24V is coming out of secondary side of transformer; if not, change transformer.
1 Flash	Lockout	Open pressure switch with induced draft blower energized.	Check pressure hose connection between the draft inducer and pressure switch. Check rollout switch manual reset to see if tripped. Check for open high limit. Replace pressure switch.
2 Flashes	Lockout	Pressure switch closed when induced draft blower is off.	Check wiring between PS1 and PS2 on the ignition controls for proper connection. Check pressure switch function. If pressure switch contacts remain closed, replace pressure switch.
3 Flashes	Lockout	Ignition lockout from too many trials.	Verify that gas supply available. Verify that the gas valve is working properly and manifold pressure is adequate. Check if spark igniter is cracked or dirty. Check flame sensor wiring. Check to see if the flame sensor is grounded.
4 Flashes	Lockout	Ignition lockout from too many flame losses within a single call for heat.	Check pressure switch hose for leaks or poor connection. Check pressure switch hose for condensate in line. Check pressure tap in the combustion blower for blockage. Check the induced draft blower.
5 Flashes	Lockout	Control hardware fault detected.	Change ignition control board.

Two-stage Burner Firing Rate Control with Utec 1171-63 Direct Spark Ignition

Sequence of Operation

When the control is in standby mode, the diagnostic red LED flashes a heartbeat pattern and continually monitors the thermostat input and safety circuit.

Call for Heat

1. On a call for first stage heat, 'W1' and 'R' closes allowing 24 VAC to flow to 'W1' circuit. The control board then checks to see if the pressure switches are open. If either pressure switch is closed, the control flashes '3' on the LED and waits indefinitely for it to open. When the pressure switch is sensed as open, the control begins the pressure switch proving period.
2. The induced draft blower is energized on high speed and the control waits for the pressure switch to close.
3. When the pressure switch closes, a 30 second pre-purge period begins.
4. At the end of the pre-purge period, the spark igniter is energized and then the second stage gas valve high fire is energized.
5. Once the flame is established and detected by the flame sensor, the spark igniter is de-energized and all the burners should be lit.
6. The unit will remain on second stage fire for a two minute warm-up period regardless of what the thermostat calls for.
7. After this warm-up period, the unit will react to what thermostat calls for. If the thermostat calls for low fire, the inducer will drop to low speed and the valve will go to low fire.
8. When the thermostat is satisfied, the gas valve is immediately de-energized and a 30 second post-purge period starts.

LED Faults and Operation Failures

Heartbeat	All conditions are normal.
2 Flashes	Pressure switch open with inducer on.
3 Flashes	Pressure switch closed with inducer off.
4 Flashes	Lockout from too many failed ignition tries.
5 Flashes	Lockout from too many flame losses.
6 Flashes	High temperature switch open.
7 Flashes	Rollout switch open.
8 Flashes	Flame present with gas off.
9 Flashes	Exceeded max limit trips in one call for heat (five).

1. If the flame is lost during a call for heat, the control de-energizes the gas valve and counts the flame loss. If the burner fails to light or prove flame a total of three times, the control will go into a one hour lockout period.
2. Any time the high temperature limit switch opens, the control will run the inducer on high speed, de-energize the gas valve and flash '6' on the LED. When the high limit switch closes, the control will restart the ignition sequence again.
3. If the flame is sensed for longer than two seconds when the gas valve should be closed, the control will enter lockout. The control will turn on the inducer blower while the flame signal is present.
4. If a rollout switch opens during operation, the control will run the inducer on high speed for the post-purge period, will immediately de-energize the gas valve and flash '7' on the LED.

Table D4: Troubleshooting Guide for Utec 1171-63 Two-stage Board

LED Code	System Mode	Description	Actions
Heartbeat		System is functioning properly.	None
2 Flashes	Inducer on, no gas	Low pressure switch is open.	Failed combustion blower. Check pressure switch hose for leaks. Check for blockage in pressure switch hose. Check for blockage in the inducer barb fitting. Check for condensate accumulation in the pressure switch and hose. Replace the pressure switch.
3 Flashes	No flame	Pressure switch in closed position at start.	Check wiring to the pressure switch. Check pressure switch for closed contact using an OHM meter. Replace the pressure switch.
4 Flashes	Lockout	Failed to light and/or carryover. Loss of flame or flame signal during ignition.	Verify gas supply available and manifold pressure is correct. Verify the gas valve is in the 'On' position. Verify that spark is present; if not, check igniter for debris between the electrodes, for cracked ceramic and check ignition wire for cracks. Check to see if the sensor ceramic is cracked or if the electrode wire is coated with dirt or oils. Check to see if the sensor wire is connected properly and not grounded due to wire abrasions. Check for air leaks. Check for recirculation of flue product. If all conditions are satisfactory, change the ignition control board.
5 Flashes	Lockout	Burners light then drop out resulting in too many flame losses.	Check to see if the sensor ceramic is cracked or if the electrode wire is coated with dirt or oils. Check to see if the sensor wire is connected properly and not grounded due to wire abrasions. Check for recirculation of flue product. Check to see if the flame is floating away from the sensor. Check to make sure the pressure switch is not dropping out, due to loss of pressure.
6 Flashes	No flame	Inducer is running on high speed, burners are off, high limit is open.	Check temperature rise and airflow over the heat exchanger. If high limit does not reset, change limit.
7 Flashes	No flame	Rollout switch has tripped open.	Check for any blockage in the flue vent. Check for air leakage inside the burner compartment. Reset the rollout switch and observe the flame for any sign of rolling out.
8 Flashes	Lockout	Flame is present without any call for heat.	Verify that there is no voltage to the gas valve. Check line pressure to make sure it is not higher than allowed by the gas valve manufacturer. If valve is not energized, check for gas flow. If gas is flowing, replace the gas valve, verify line and manifold pressures.

Full Modulation Burner Firing Rate Control with Utec 1016-427 Direct Ignition Control, TR1 Timer and SC30 Modulating Control

Sequence of Operation

1. Thermostat closes on call for heat.
2. 24 VAC is supplied to ignition control terminal 'W' through the thermostat.
3. The ignition control will verify that the pressure switch is open and that limits are in closed positions before energizing the combustion blower.
4. Draft inducer is then energized at high speed.
5. The pressure switch closes and a 30 second pre-purge period begins.
6. At the end of the pre-purge period, the spark igniter is energized and the gas valve is powered at high fire for a five second ignition trial.
7. At the end of the ignition trial period, the TR1 control is powered (SR LED lit) and begins a 90 second warm-up period while maintaining the combustion blower at high speed (FR LED lit). The SC30 will then power the modulating valve at high fire for the duration of the warm-up period.
8. Burners ignite and carryover. Once flame is detected by the flame sensor, the spark igniter is shut off and the gas valve and combustion blower stay energized.
9. When the warm-up period expires, TR1 defaults the gas valve to low fire and the combustion blower to low speed and returns control of the operating mode to the building temperature controller. The SR LED turns off and the MR LED is lit.
10. If the building controller is providing an analog signal between 1.0 and 5.3 VDC to the SC30 control, the system will continue to operate at low fire and low speed combustion blower. The modulating valve will be powered proportionally to the input voltage signal from the controller and will open or close, changing the gas manifold pressure. Manifold pressure will vary from 0.40" w.c. to 1.2" w.c.
11. If the signal increases above 5.3 VDC, the combustion blower switches to high speed (FR LED lit) and high fire second stage gas valve is energized (CR LED lit). The manifold pressure will vary from 1.4" w.c. to 3.5" w.c.
12. Operation will continue in high fire mode until the signal from the building management controller drops to below 4.7 VDC. At this point the SC30 de-energizes the second stage gas valve and the combustion blower switches to low speed.
13. When the building thermostat is satisfied and the demand for heat ends, the gas valve is de-energized, immediately the combustion blower is energized on high speed for a 30 second post-purge period.
14. The ignition control is capable of three retrials for ignitions if the above sequence is interrupted at any point.

LED Flash Code Key (Utec 1016-400 Series)

Steady On	Control operation normal.
1 Flash	Open pressure switch, limit switch or flame rollout switch.
2 Flashes	Pressure switch stuck closed.
3 Flashes	Ignition/flame sense failure.
4 Flashes	Repeated flame losses.
5 Flashes	Internal control fault.

1. Operational failures during a call for heat result in lockout of the ignition control. The control will reset itself one hour after a lockout occurs and initiate a new trial for ignition sequence. The control may also be reset manually by cycling the thermostat or powering off for a minimum of five seconds.
2. If the air pressure switch does not close after the inducer is energized, or if limit or rollout switch(es) are open, the control will wait one minute for the switch to close and then lockout (1 Flash).
3. If air pressure switch is closed when the inducer is energized, the control will wait one minute for the switch to open and then close or lockout will occur (2 Flashes).
4. If flame sensor indicates presence of flame during purge period, when no flame should be present, the inducer will remain energized but the gas valve will remain off until the cause of the "false flame" is removed (5 Flashes).
5. If ignition is not achieved within five seconds, the gas valve is shut off; the inducer keeps running for an inter-purge period of 60 seconds. Additional ignition trials follow the specified sequence. If all trials (three) for ignition have occurred without proper ignition and flame detection, the control will lockout (3 Flashes).
6. If flame is lost once it has been established, the control will shut off the gas supply within 0.8 second and enter the inter-purge period. Control will initiate up to three ignition trials per normal operation sequence (4 Flashes).
7. If the control detects power to the gas valve when it should be off, or not powered when it should be on, the control will go into lockout with all outputs off (5 Flashes).

Table D5: Troubleshooting Guide for Utec 1016-xxx Ignition Board

LED Code	System Mode	Description	Actions
Steady On	Normal	LED is lit.	24 VAC is applied to the control.
LED Off	Lockout	LED is off.	Check 120 volt is supplied to unit and transformer. Check to see if 24 volt is coming out of secondary side of transformer; if not, change transformer.
1 Flash	Lockout	Open pressure switch with induced draft blower energized.	Check pressure hose connection between the draft inducer and pressure switch. Check rollout switch manual reset to see if tripped. Check for open high limit. Replace pressure switch.
2 Flashes	Lockout	Pressure switch closed when induced draft blower is off.	Check wiring between PS1 and PS2 on the ignition controls for proper connection. Check pressure switch function. If pressure switch contacts remain closed, replace pressure switch.
3 Flashes	Lockout	Ignition lockout from too many trials.	Verify that gas supply available. Verify that the gas valve is working properly and manifold pressure is adequate. Check if spark igniter is cracked or dirty. Check flame sensor wiring. Check to see if the flame sensor is grounded.
4 Flashes	Lockout	Ignition lockout from too many flame losses within a single call for heat.	Check pressure switch hose for leaks or poor connection. Check pressure switch hose for condensate in line. Check pressure tap in the combustion blower for blockage. Check the induced draft blower.
5 Flashes	Lockout	Control hardware fault detected.	Change ignition control board.

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Appendix E: VHC-72 Start-up Form and Checklist

IMPORTANT

- Complete this form for each unit and email, fax or mail to Venmar CES immediately after start-up to validate warranty and to provide valuable information for personnel performing future maintenance or for factory assistance to the address below.
- Read the Installation, Operation and Maintenance Instructions Manual, the Venmar CES Control System Keypad Operation Guide and the Sequence of Operation before proceeding.
- Leave a copy of this report with the owner and at the unit for future reference and permanent record.
- To ensure proper operation of each unit, qualified personnel should perform the start-up, complete the checklist and report.
- All units are factory run tested. Blowers, enthalpy wheel and compressors (if equipped) are set up to run correctly when power is connected. If any blower is running backwards or compressor is making loud noises, disconnect power and switch two leads (on three-phase power) to ensure proper rotation and avoid damage.
- If units are equipped with compressors, power must be turned on for 24 hours prior to a call for cooling, for the compressor crank case heaters to be energizing to prevent possible damage.
- The Bacview keypad located at the control panel will allow for manual override for start-up, mode of operation selection and includes an internal time clock if remote interlocks are not provided.

Venmar CES

1502 D Quebec Avenue
Saskatoon, Saskatchewan
Canada S7K 1V7
Email to tech support: venmarservice@venmarces.com
Fax: 306-244-4221
Phone: 1-866-4-VENMAR

Unit Identification Information

Project: _____
Job Name: _____
Job Address: _____
Model Number: _____
Serial Number: _____
Tag: _____
Jobsite Contact: _____
Email: _____
Telephone: _____

Table D1: Pre Start-up Checklist

	Checklist Item	Yes	N/A
1	Is the electrical disconnect set to the 'Off' position?		
2	Have obstructive packaging, objects, tie downs on fans and enthalpy wheel been removed?		
3	Are fans and enthalpy wheel rotating freely?		
4	Are fan wheels and drive set screws tight?		
5	Are belt alignment and tension correct?		
6	Are air filters installed, clean or replaced? If filters are equipped with optional differential pressure switch, check desired setpoint. Filter differential pressure switches are factory set at 50% of dirty filter allowance from clean.		
7	Have coils been checked for fin damage and dirt, straightened and cleaned?		
8	Are refrigerant components and piping in good condition, no damage or leaks caused by shipment or installation?		
9	Is the minimum clearance around air cooled condenser met and is discharge clear?		
10	Is ductwork connected and complete?		
11	Are condensate drain connections trapped, installed correctly and filled?		
12	Are all shipped loose or field supplied components correctly installed and wired?		
13	Has power supply and control wiring been inspected and approved by the Local Authorities?		
14	Have factory and field wiring connections been checked and tightened?		
15	Are all fuses properly installed in holders?		
16	Is voltage at the disconnect switch within 10% of nameplate and phase-to-phase readings within 2% of nameplate?		
17	Are field piping and venting installation and connections for heating and cooling options completed and tested?		
18	Are heating and cooling enable switches set to the 'Off' position?		

Serial Number: _____

Table E2: Start-up Checklist

	Checklist Item	Yes	N/A
1	Before proceeding complete the Pre Start-up Checklist.		
2	Close all access panels or doors.		
3	Turn the main disconnect to the 'On' position.		
4	The unit can be started by using the Bacview keypad and selecting the mode of operation from the Venmar CES Control System Keypad Operation Guide and the Sequence of Operation. Run through the complete sequence of operation of the unit adjusting setpoints and documenting as required. Once completed, return the unit to the correct mode of operation and adjust the internal time clock if required.		
5	Are dampers operating properly?		
6	Are fans and enthalpy wheel rotating in the correct direction?		
7	Adjust the supply air fan motor VFD to the correct supply air volume.		
8	For occupied recirculation mode adjust outside air and exhaust air damper positioner to achieve the required air volumes.		
9	Recheck the voltage at the disconnect switch against the nameplate and against phase-to-phase readings on three-phase with all blowers operating. If the voltage is not within 10% of rated or 2% of phase-to-phase, have the condition corrected before continuing start-up.		
10	Check amperage draw to each motor on each phase against motor nameplate FLA. If significantly different, check ductwork static and/or take corrective action.		
11	Before activating the compressor on WSHP units, are water shut-off valves open and is water circulating through the water-to-refrigerant heat exchanger?		
12	Enable cooling and check if the sound of the compressor is normal or if there is excessive vibration.		
13	Check all field and factory refrigerant and water piping connections for leaks and correct.		
14	On units with gas-fired furnace module check supply air proving interlock switch setting to ensure minimum supply airflow prior to burner operation. Set the switch to open below the minimum supply airflow on the furnace rating plate.		
15	Enable heating options, see start-up and check out instructions in Appendix D for gas-fired furnace module and Appendix G for electric coil and complete.		
16	Check the operation of the control options provided on the unit.		
17	Check the setpoints on the DDC Points Reference, adjust and record changes as required.		
18	Has air balancing been completed for both occupied and unoccupied operation?		
19	When unit has achieved steady state, take measurements and complete readings section of start-up form for each operating cycle to verify all components are functioning properly!		

Serial Number: _____

Table E3: Start-up Readings

Mode of Operation			Heating		Cooling	
Power supply	Nameplate voltage					
	Voltage at disconnect no motors	L1–L2				
		L2–L3				
		L1–L3				
Power supply with all loads connected	Voltage at full load L1/L2/L3					
	Supply fan (in occupied mode)		**Fan 1**	**Fan 2**	**Fan 3**	**Fan 4**
		Full load amps				
		Amp draw L1/L2/L3				
		Overload amp setting				
		Hertz				
	Exhaust fan (in occupied mode)	Full load amps				
		Amp draw L1/L2/L3				
		Overload amp setting				
		Hertz				
		RPM				
	Enthalpy wheel	Full load amps				
		Amp draw L1/L2/L3				
		Overload amp setting				
	Condenser fan #1 amp draw – L1/L2/L3					
	Condenser fan #2 amp draw – L1/L2/L3					
	Condenser fan #1 EAT – db/wb and LAT db (°F/°C)					
	Condenser fan #2 EAT – db/wb and LAT db (°F/°C)					
Airside	Airflow CFM	Supply				
		Exhaust				
		Occupied recirculation				
	Temperature °F/°C db/wb	Outdoor entering				
		Supply enthalpy wheel entering				
		Supply enthalpy wheel leaving				
		Cooling coil leaving				
		Heating coil leaving				
		Reheat coil leaving				
		Supply leaving				
		Return entering				
		Exhaust enthalpy wheel leaving				
	Static pressure inches w.c.	Outdoor duct				
		Supply enthalpy wheel entering				
		Supply enthalpy wheel leaving				
		Supply fan entering				
		Supply duct				
		Return duct				
		Exhaust enthalpy wheel entering				
		Exhaust enthalpy wheel leaving				
		Exhaust duct				

Serial Number: _____

Table E3: Start-up Readings

Mode of Operation			Heating	Cooling
WSHP waterside	US GPM			
	Entering temperature – °F/°C			
	Leaving temperature – °F/°C			
	Entering pressure – PSI			
	Leaving pressure – PSI			
Compressor refrigerant side	Circuit #1	Discharge pressure – PSI		
		Suction pressure – PSI		
		Discharge temperature – °F/°C		
		Suction temperature – °F/°C		
		Superheat – °F/°C		
		Subcooling – °F/°C		
		Site glass oil level	½ ¾ F	
		Site glass clear	Yes No	
		Amps – L1/L2/L3		
	Circuit #2	Discharge pressure – PSI		
		Suction pressure – PSI		
		Discharge temperature – °F/°C		
		Suction temperature – °F/°C		
		Superheat – °F/°C		
		Subcooling – °F/°C		
		Site glass oil level	½ ¾ F	
		Site glass clear	Yes No	
		Amps – L1/L2/L3		
Gas-fired furnace module	Natural gas Propane			
	Inlet pressure – inches w.c. furnace #1			
	Low fire manifold pressure – inches w.c. furnace #1			
	High fire manifold pressure – inches w.c. furnace #1			
	Inlet pressure – inches w.c. furnace #2			
	Low fire manifold pressure – inches w.c. furnace #2			
	High fire manifold pressure – inches w.c. furnace #2			
	Supply air inlet temperature – °F/°C			
	Supply air discharge temperature – °F/°C (measure downstream where temperature is even in duct)			

This unit has been checked out and started according with the above procedures and completed forms and is operating satisfactorily.

After 24 hours of satisfactory operation shut down the unit and check all foundation bolts, shaft bearings, drive set screws, valve train and terminals. Tighten where required.

Additional Comments:

_____

_____

_____

Start-up

By: _____

Company Name: _____

Date: _____

Email: _____

Telephone: _____

Email to tech support: venmarservice@venmarces.com or
Fax to: 306-244-4221

Appendix F: HEPA Filter Installation

These instructions are for installing AAF HEPA filters (11½" depth) into AAF HEPA holding frames. The holding frames are available in multiple sizes and materials, but include the P/N series of 30619XX-XXX, where the X's vary with frame size and material. All frames, latches, extension legs and filters are sold separately. Please read the entire installation instructions before beginning the installation process.

Install filters into the HEPA holding frames only after the frames have been securely installed into existing ductwork or housing. Frames should be bolted or pop riveted together into the permanent structure through the predrilled holes around the outside perimeter of the frames. Frames should be sufficiently caulked and sealed to prevent any air bypass or leakage.

Required Tools for Filter Installation

- T-handle Hexkey, size 5/32"

Framing Components Required

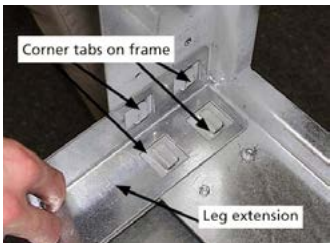
- AAF HEPA holding frames – P/N 30619XXXXX
- Leg extensions, four per frame – P/N 3061991-00X
- Latches, four per frame – P/N 3062007-00X

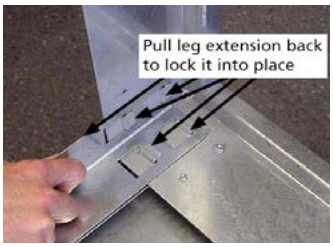
Figure F1: Leg extensions and latches

Step 1

At the inside corner of each frame are four tabs, two per side. Place a leg extension over the four tabs as shown in Figure F2 below, then pull back on the leg extension locking it into place.

Figure F2: Place leg extensions over the frame tabs, then pull back to lock the leg extension into place





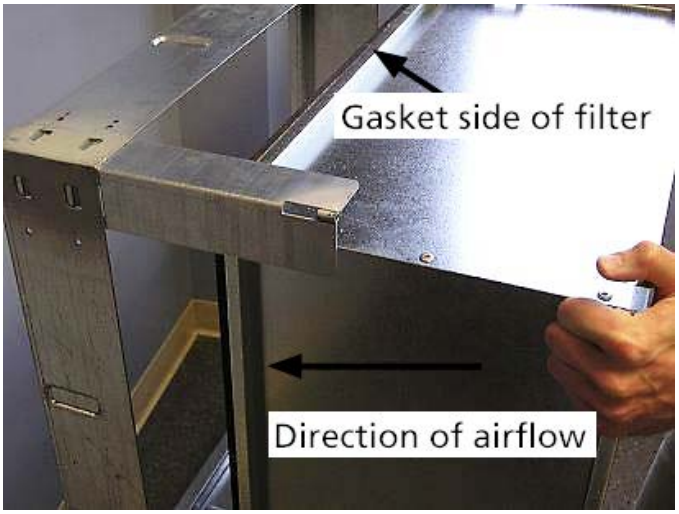
Repeat Step 1 with each of the four corners. The frame with leg extensions should look like Figure F3.

Figure F3: Frame with leg extensions installed

Step 2

Insert the HEPA filter into the HEPA holding frame. The HEPA should be installed with the gasket side of the filter facing the frame. Insert the filter as far into the frame as possible, so that the gasket material is contacting the frame. See Figure F4 below.

Figure F4: Insert HEPA filter into frame, until the gasket comes in contact with the holding frame



The filter should now be resting inside of the holding frame as shown in Figure F5. When installing the filters into a frame bank of multiple frames, install the lower filters first so that the upper filters can rest on the lower filters.

Figure F5: Filter placed inside of frame

Step 3

Place a latch so that it overlaps the leg extension, as shown below in Figure F6. Align the latch's cap screw with the threaded coupling on the end of the leg extension and tighten using the hexkey. Tighten the cap screw until there is an approximately ¼" gap between the latch and the leg extension coupling as shown in Figure F7. Repeat this step with all four corners.

Figure F6: Latch overlapping leg extension

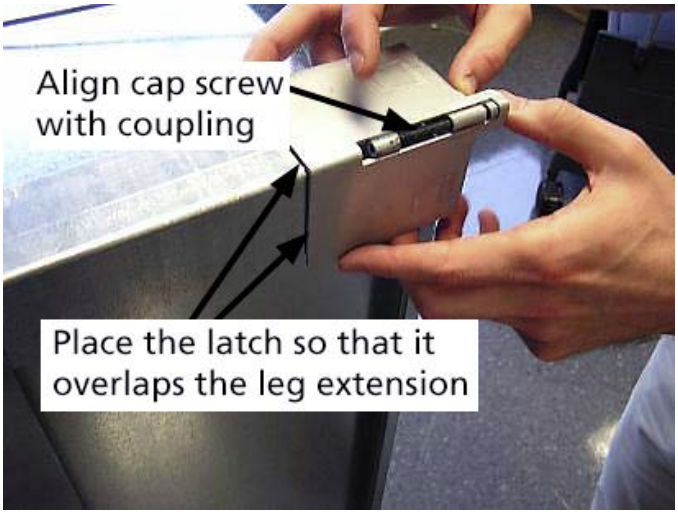
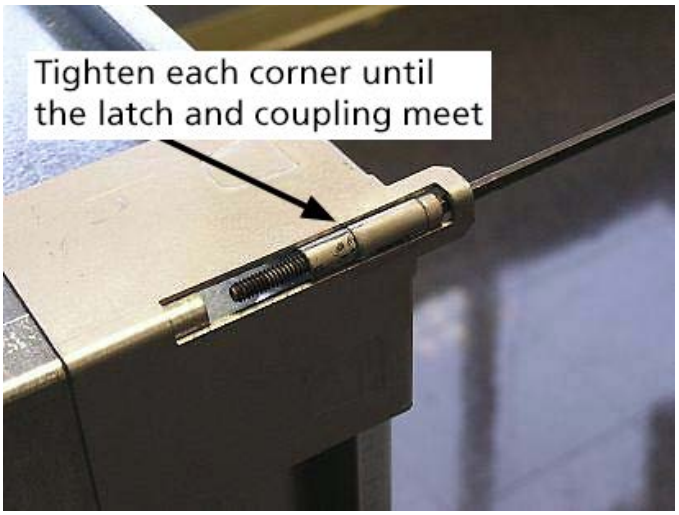


Figure F7: Tighten cap screw to ¼" of the coupling

Step 4

Once all four corner latches have been tightened within ¼" of the leg extension coupling, complete the installation by tightening each corner until the latch and leg extension coupling meet. This is illustrated in Figure F8.

Figure F8: Tighten until latch and coupling meet



Once all four corners have been tightened the filter should now be properly seated and sealed.

Repeat the process with all remaining filters working from the bottom to the top.

Figure F9: Properly installed filter

Appendix G: Electric Heating Coil and Controls Information

This electric heating coil module covered by this appendix is a component of a "Listed" product, subject to the guidelines of application as designated by the Certifying Agency and outlined in the appliance manufacturer's installation and operation instructions.

The information provided in this appendix applies to the electric heating coil module, installed in the appliance and to its operation, maintenance and service. Refer to the appliance manufacturer's instructions for information related to all other components.

1 – Mechanical Installation of Electric Coil Heaters

1.1 Handling

1.1.1 Remove the shipping covers just before installation.

1.1.2 Inspect the heater carefully and report any damage to the manufacturer.

Do not install a damaged heater.

1.2 Installation

Heater Position

1.2.1 The axis of the duct must always be perpendicular to the face of the heater.

1.2.2 The heating elements must always be installed horizontally.

Model SC or ST (Slip-in type)

1.2.3 Cut an opening in the side of the duct.

1.2.4 Slip the heater into the duct until the hole is completely covered by flanges around the heater.

1.2.5 Fasten the heater to the duct with sheet metal screws and seal openings with a suitable sealing compound.

1.2.6 If the heater is heavy, use additional hangers to support the heater.

Model FC or FT (Flanged type)

1.2.7 Flange both ends of the duct outwards on three sides to match the heater's flanges.

1.2.8 Fasten the heater to the duct with sheet metal screws (for heavy heaters, use nuts and bolts and additional hangers to support the heater).

1.2.9 Seal openings with a suitable sealing compound.

IMPORTANT

- Do not install spray humidifiers upstream of duct. Install it downstream instead.
- Do not cover the control box with thermal insulating materials.
- Use special air intake louvers of weatherproof construction for preheat duct heaters to avoid intake of water or snow particles.
- Make sure that motorized damper blades are not blocked with snow or dirt. Inspect the dampers regularly to ensure a suitable airflow.

2 – Electrical Installation of Electric Coil Heaters

2.1 Disconnect all power sources before opening the control box and working within.

2.2 Read the nameplate carefully and consult wiring diagram before starting to wire.

2.3 Supply Wires

Use only wires suitable for 167°F [75°C]. Wires shall be sized according to the Canadian Electrical Code requirements. All wires must be brought in through knock-outs.

2.4 Disconnecting Means

Install a disconnect switch close to the heater according to the code unless a disconnect switch is already built into the heater.

2.5 Control Circuit Wiring

Use Class II wiring for control circuit connections to the duct heater.

2.6 Magnetic Contactors

If magnetic contactors are mounted outside of the duct heater, use only contactors approved for:

- 250,000 operations when controlled by auto-reset thermal cut-out (A) and by other switching devices in series with this cut-out (thermostat, step controller, airflow switch, etc.).
- 100,000 operations when controlled by auto-reset thermal cut-out (A) alone.
- 100,000 operations when controlled by auto-reset thermal cut-out (A) plus manual reset cut-out in series (A & M).
- 6,000 operations when controlled by manual reset cutout (M) alone.

2.7 External Controls Ratings

Rating of external control devices shall be suitable for handling the VA ratings as marked on the nameplate; otherwise, a backup relay must be used.

2.8 Airflow Interlock

Heaters are generally supplied with one extra terminal marked for fan interlock or air sensing device connection. Remove jumper between terminals I and C before connecting the fan interlock. Select a suitable airflow sensing device of the differential pressure sensing type, with snap acting contacts. A slow make, slow brake device may cause undue cycling and in some instances chattering of the contactors. When fresh air dampers are used, make sure the heater is properly interlocked to prevent it from being energized before the damper is fully open.

3 – Operating Electric Coil Heaters

3.1 Minimum Airflow

Ensure that sufficient airflow as marked on the nameplate is passing through the heater. Airflow should be evenly distributed across the entire face of the heater. Use air turning vane at duct elbows and splitter damper at duct branch-offs to streamline the airflow in the heater. Use suitable airflow sensing device or interlock the heater with fan. An insufficient airflow will lead to the opening of the auto-reset thermal cut-out or damage to the heating elements.

3.2 Warning

The air flowing through the duct where the heater is installed shall not contain any combustible particles, nor any flammable vapor or gas.

3.3 Air Temperature

The air temperature should not exceed 120°F [49°C] at the heater outlet.

3.4 Minimum Static Pressure and Air Direction

The heater is protected by a differential pressure switch. To keep the contact of this switch closed, it is necessary to maintain a minimum total pressure of 0.07" of water for a constant flow.

3.5 Manual Reset Thermal Cut-out

This protection device is standard on all heaters of less than 300 volt and 30 kW and is optional on all other heaters. Please check the auto-reset thermal cut-out before resetting the manual thermal cut-out. If any defect has been detected in the auto-reset thermal cut-out, it will be necessary to replace it before resetting the manual reset thermal cut-out.

4 – Maintenance

All electric coil heaters have been designed to operate long term without problems. Those responsible for equipment and maintenance should be aware of the following suggestions.

4.1 Visual Inspection

It is strongly recommended to complete a periodic inspection. This precautionary step will help to keep your installations operating well. Note these eventual first signs of problems:

- Accumulation of dust on the heating elements.
- Signs of overheating on the heater frame.
- Traces of water or rust on the control box.

4.2 Electrical Inspection

Two weeks after start-up, all electric connections to contactors should be checked and tightened up. Before each heating season, check the resistance between the heating elements and ground. It is also recommended to check the electrical connections to heating elements, magnetic contactors and main power lugs. This inspection is recommended monthly during the first four months of operation. After that, two inspections per heating season are sufficient.

4.3 Checkpoints

- Check all fuses.
- Check the resistance to ground for each circuit.
- Check the resistance phase-to-phase for each circuit.
- Check the tightening of connections at all contactors and heating elements.
- Check all contactors.

4.4 Off-season Maintenance

Where tubular heating elements are used, it is strongly recommended that you start the heating system from time to time. This precaution will prevent moisture from percolating through the terminal gaskets into the heating element and accumulating in the insulating powder. Should a heater be shut off for a long period, we recommend that you check carefully the resistance to ground for each circuit. It is important not to power a heater when too low a resistance to ground has been measured. It is also recommended to pay attention to any other heater operating in normal conditions. Control components such as step controllers or modulating valves (SCR) should be maintained and checked according to respective manufacturer's instructions. Any defective components should be replaced only with identical original parts.

Appendix H: Troubleshooting

Table H1: VHC-72 Troubleshooting

Problem	Cause	Solution
Unit will not turn on.	Occupancy contact open.	Check internal time clock settings. Check remote interface signal.
	Unoccupied recirc contact open.	Check the wiring in the control panel.
Unit will not turn off.	Occupancy contact closed.	Check internal time clock settings. Check remote interface signal.
	Unoccupied recirc contact closed.	Check the wiring in the control panel.
Air from supply diffusers too cold.	Imbalance of supply and exhaust air.	Check filters and heat exchanger for blockage. Check balance of airflows. Install postheat module.
Unit makes an annoying noise.	Blower wheel out of alignment.	Remove the motor/blower assembly. Adjust blower wheel.
	Enthalpy wheel wiper seal not functioning properly.	Check for proper seal operation.
Enthalpy wheel freezing.	Imbalance of supply and exhaust air.	Check filters and heat exchanger for blockage. Check balance of airflows.
	Defrost damper not functioning.	Check for operation of damper actuator.
	Preheater not functioning.	Check the heat module circuit breaker.
Enthalpy wheel not running.	Unit is in free cooling.	Check jumper wire for proper operation.
	Unit is in recirc defrost.	Check unit circuit breaker.
	Drive motor capacitor failure.	Check motor electrical connections.
	Drive motor failure.	Check capacitor connections. Check motor operation with new capacitor.
	Drive motor relay in control box.	Check relay wiring.
	Drive belt.	Check for drive belt derailment off drive pulley or failure.
	Drive pulley.	Check for securely fastened pulley on motor shaft.
Motor and blower not functioning.	Electrical supply interrupted.	Check unit circuit breaker.
	Fan motor.	Check motor electrical connections.
	Fan motor failure.	Check VFD drive connections.
	Fan motor contactor failure.	Check contactor wiring. Check contactor operation.
	Fan drive belt.	Check for a tripped overload relay.
	Fan drive pulleys.	Check for securely fastened pulley(s) on motor or fan shaft(s). Set screw setting at 110 in-lbs to 130 in-lbs.
Only supply fan will turn on.	Unit is in recirc defrost (recirc units).	Wait until unit is out of defrost.
	Unit is in unoccupied recirc (recirc units).	Check external wiring.
	Damper end switch not made.	Check outdoor air damper for proper wiring. Check that the end switch is making.
Only exhaust fan will turn on.	Motor wiring incorrect.	Check connection to motor.
	Damper end switch not made.	Check exhaust air damper for proper wiring.
Damper will not open.	Electrical supply interrupted.	Check wiring on damper actuator.
	Defrost relay in control box.	Check relay wiring. Check relay operation.
Damper opens when it should be closed.	Wires are reversed.	Reverse wires #2 and #3 on damper actuator.
Compressor will not run.	No power.	Ensure main disconnect is on and measure main terminal block for voltage.
	Wiring is incorrect.	Verify if compressor is wired correctly.
	Controlled temperature lower (cooling) or higher (heating) than thermostat setting.	Adjust thermostat setting.
	Compressor failed.	Replace compressor.

Table H1: VHC-72 Troubleshooting

Problem	Cause	Solution
Compressor runs but stops quickly.	Overload, fuse burnout.	Check if voltage is too low, wiring is correct, wire gauge is sized correctly, replace blown fuse.
	Low or high pressure switch activated.	See solution for high pressure switch open and low pressure switch open.
Compressor makes an abnormal sound.	Reverse scroll operation.	Reverse any two phases on the three-phase compressor.
	Compressor quality issue.	Replace compressor.
Excessive compressor vibration.	Compressor screw is loose.	Tighten the screw.
Compressor is running but there is no pressure buildup.	Scroll reverse operation.	Reverse any two phases on the three-phase compressor.
Compressor system is normal, amps are too high.	Incorrect compressor voltage.	Replace with correct voltage compressor.
High pressure switch is open in cooling operation.	Condenser fan failed (AC system).	Check if wiring is correct, replace any failed components.
	Lack of water flow (WSHP).	Check if the motorized water valve is opening completely and confirm loop water pumps are running.
	Water flow rate is too small (WSHP).	Check if pump is sized correctly. If water strainer is installed inline, check if strainer is too dirty.
	Condenser is too dirty (AC system).	Clean condenser coil.
	Ambient temperature exceeds application upper limit (AC system).	Consult factory for operation out of application range.
	Water entering temperature exceeds application upper limit (WSHP).	Consult factory for operation out of application range.
	Refrigerant overcharge.	Charge correct amount of refrigerant.
	Non-condensable air accumulates in the coaxial coil.	Vacuum system, recharge refrigerant.
	Coaxial coil scaled.	Clean coaxial coil.
High pressure switch is open in heating position.	Supply fan failure.	Check if wiring is correct, replace any failed components.
	Outside air damper not open.	Check outside air damper operation and replace actuator if failed.
	Dx coil is too dirty.	Clean Dx coil.
	Supply airflow is too small.	Check if components (coil, wheel, filter) are too dirty, motor is running at low speed or not and check if there is too much pressure loss in supply duct.
	Refrigerant overcharge.	Charge correct amount of refrigerant.
Low pressure switch is open in cooling operation.	TXV failed in closed position.	Replace TXV.
	Supply blower failure.	Check if wiring is correct, replace any failed components.
	Blocked TXV or filter drier.	Replace TXV or filter drier.
	Insufficient supply airflow.	Check if components (coil, wheel filter) are too dirty, motor is running at low speed or not and check if there is too much pressure loss in supply duct.
	Loss of refrigerant charge.	Check and repair any leaks in the piping and refill refrigerant.
Low pressure switch is open in heating operation.	TXV failed in closed position.	Replace TXV.
	Blocked TXV or filter drier.	Replace TXV or filter drier.
	Lack of water flow (WSHP).	Check if motorized water valve is opening completely and confirm loop water pumps are running.
	Insufficient water flow (WSHP).	Check if pump is sized correctly or if water strainer is blocked.
	Water entering temperature too low (WSHP).	Consult factory for operation out of application range.
	Loss of refrigerant charge.	Check and repair any leaks in the piping and refill refrigerant.

Appendix I: Enthalpy Wheel Pressure Drop vs. Flow Formula and Curves

Enthalpy Wheel Pressure Drop vs. Flow Formula

Flow in cfm = pressure drop measured in inches w.c. / pressure drop coefficient based on enthalpy wheel size

Table H2: Enthalpy Wheel Pressure Drop Coefficient

Enthalpy Wheel Size (diameter x depth in inches)	Pressure Drop Coefficient
5004	0.00013687
5006	0.00018536
5008	0.00023268
6006	0.00012859
6012	0.00022788
6606	0.00010611
6612	0.00018776
7206	0.00088873
7212	0.00015757

Enthalpy Wheel Pressure Drop vs. cfm Curves (based on wheel diameter x depth (inches))

Figure H1: Pressure drop – Models 50

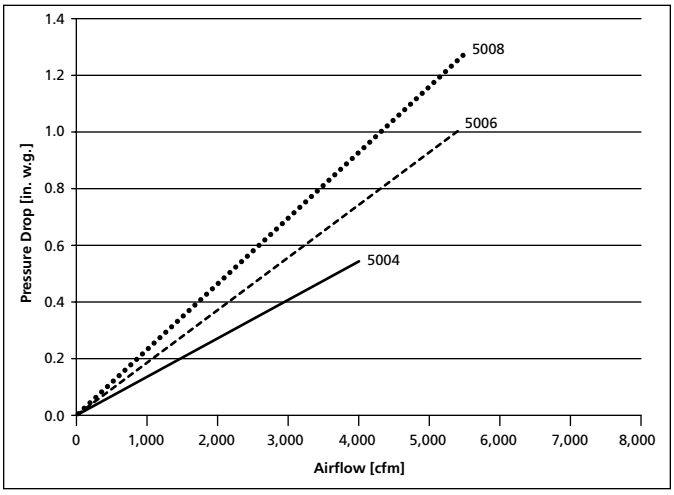


Figure H2: Pressure drop – Models 60

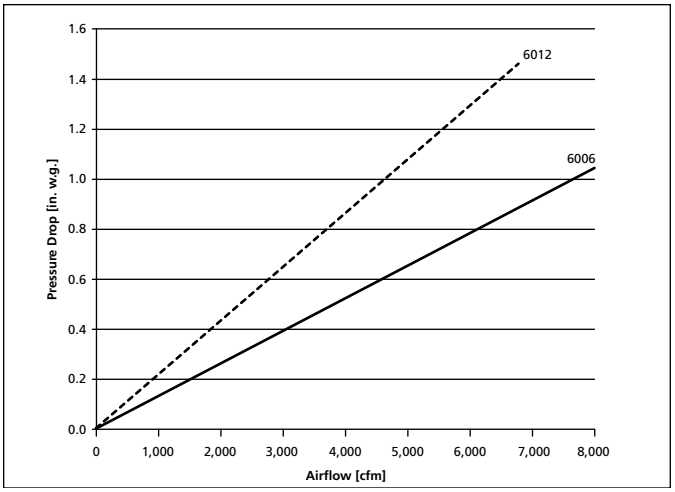


Figure H3: Pressure drop – Models 66

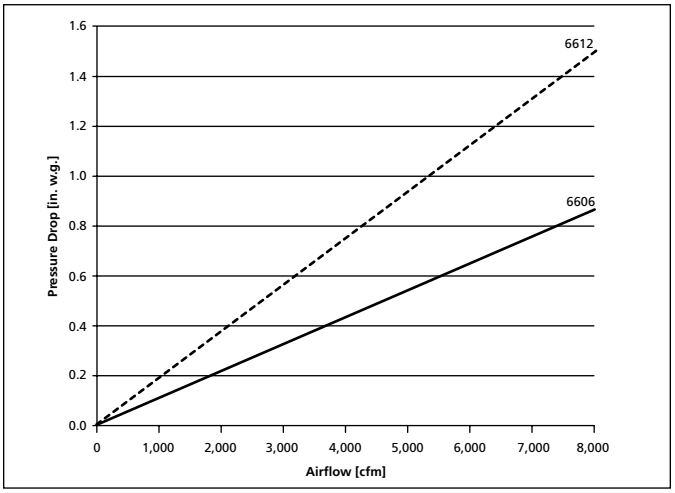
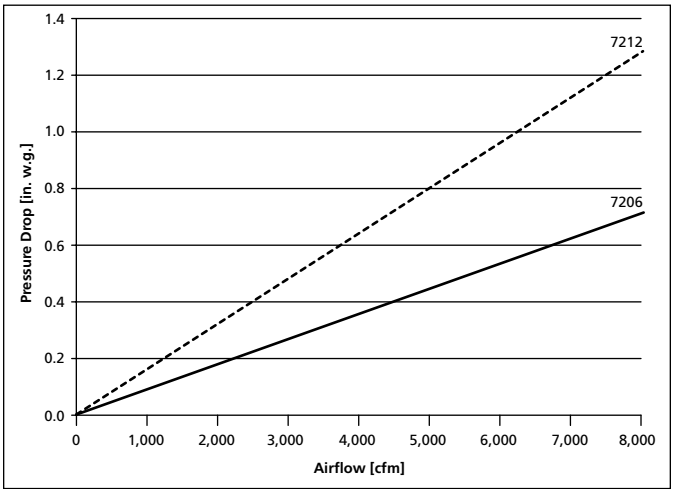


Figure H4: Pressure drop – Models 72

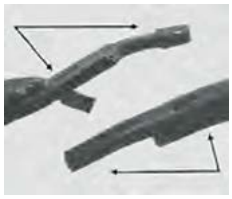


Appendix J: Enthalpy Wheel Multi-link Drive Belt Instructions

How to Measure

Pull belt tight around sheaves to check hand tight length, overlapping the last two tabs with two holes in matching links as shown. Count the number of links and remove one link for every 24 of O/3L, A/4L and B/5L Sections and one link for every 20 of C and D Sections. This gives the correct installed belt length and will ensure optimum belt tension when running.

Figure J1: Multi-link drive belt



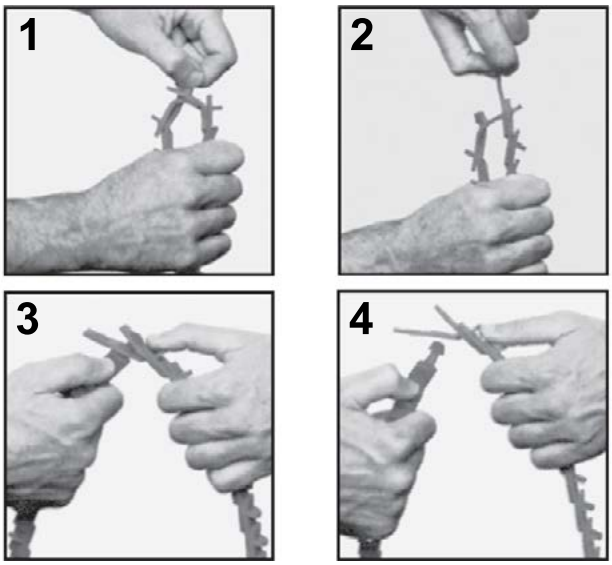
IMPORTANT

Every tenth link is designated with an arrow (←). For multiple belt drives, ensure that each belt has the same number of links.

Disassembly

1. Hold belt upside down. Bend back as far as possible; hold with one hand. Twist one tab 90 degrees parallel with slot.
2. Pull end of link over tab.
3. Rotate belt end with tab 90 degrees.
4. Pull belt end through two links.

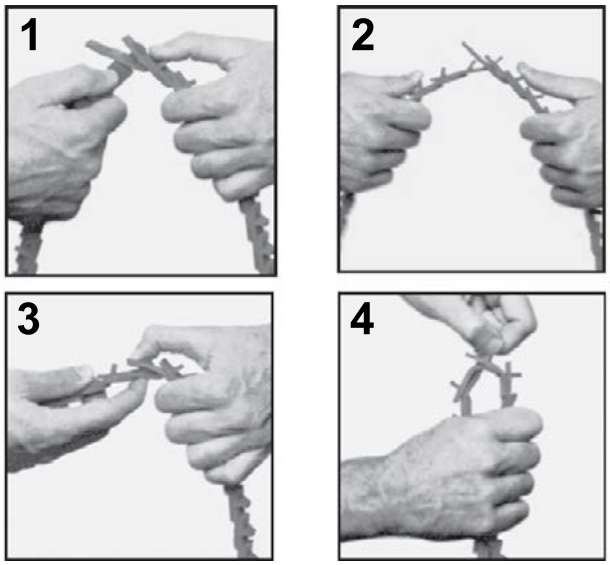
Figure J2: Disassemble multi-link drive belt



Assembly

1. Hold belt with tabs pointing outward.
2. Place end tab through two links at once.
3. Flex belt further and insert second tab through end link by twisting tab with thumb.
4. Ensure tab returns to position across belt. Reverse belt so tabs run inside.

Figure J3: Assemble multi-link drive belt



Installation

IMPORTANT

Turn belt inside out (as shown) to ensure easy assembly and disassembly.

1. Turn belt with tabs to the inside before installing.
2. Determine direction of drive rotation.
3. Align belt directional arrow (←) with drive rotation.
4. Fit belt in nearest groove of smaller sheave.
5. Roll belt onto larger sheave, turning the drive slowly. Belt may seem very tight; this is okay. Do not jog motor.
6. Check to see all tabs are still in their correct position and are not twisted out of alignment.
7. For multiple belt drives, work belt from groove to groove. On particularly wide drives, it may be easier to install half the belts from the inboard side and half from the outboard.

IMPORTANT

With drive ratios around 1:1, it may be necessary to add back one link to allow belts to be rolled on. This does not apply if using Alternative Installation Method.

Alternative Installation Method

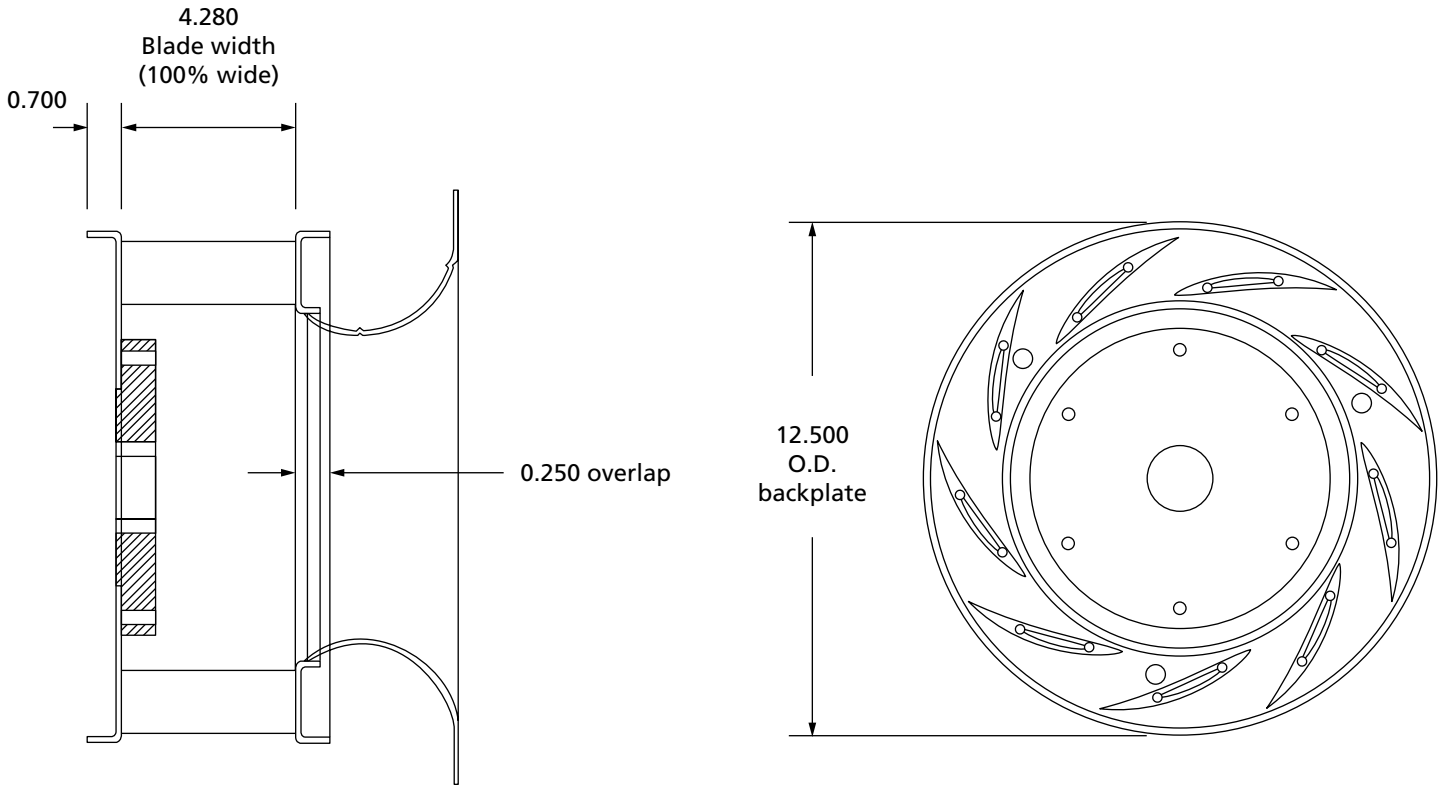
1. Set motor in mid position of adjustment range and mark base clearly.
2. Determine required belt length as described in How to Measure section.
3. Push motor forward to minimum center distance.
4. Install belts as in Installation section.
5. Pull motor back to previously marked mid position.

Retensioning

Like all high performance V-belts, PowerTwist Plus V-belts require the maintenance of correct drive tension to operate efficiently. Experience indicates that drive tension should be checked after 24 hours running at full load. A retension may be necessary depending on the severity of the drive. Any initial belt stretch is then taken up. Subsequently, belt tension should be checked periodically and adjusted when necessary.

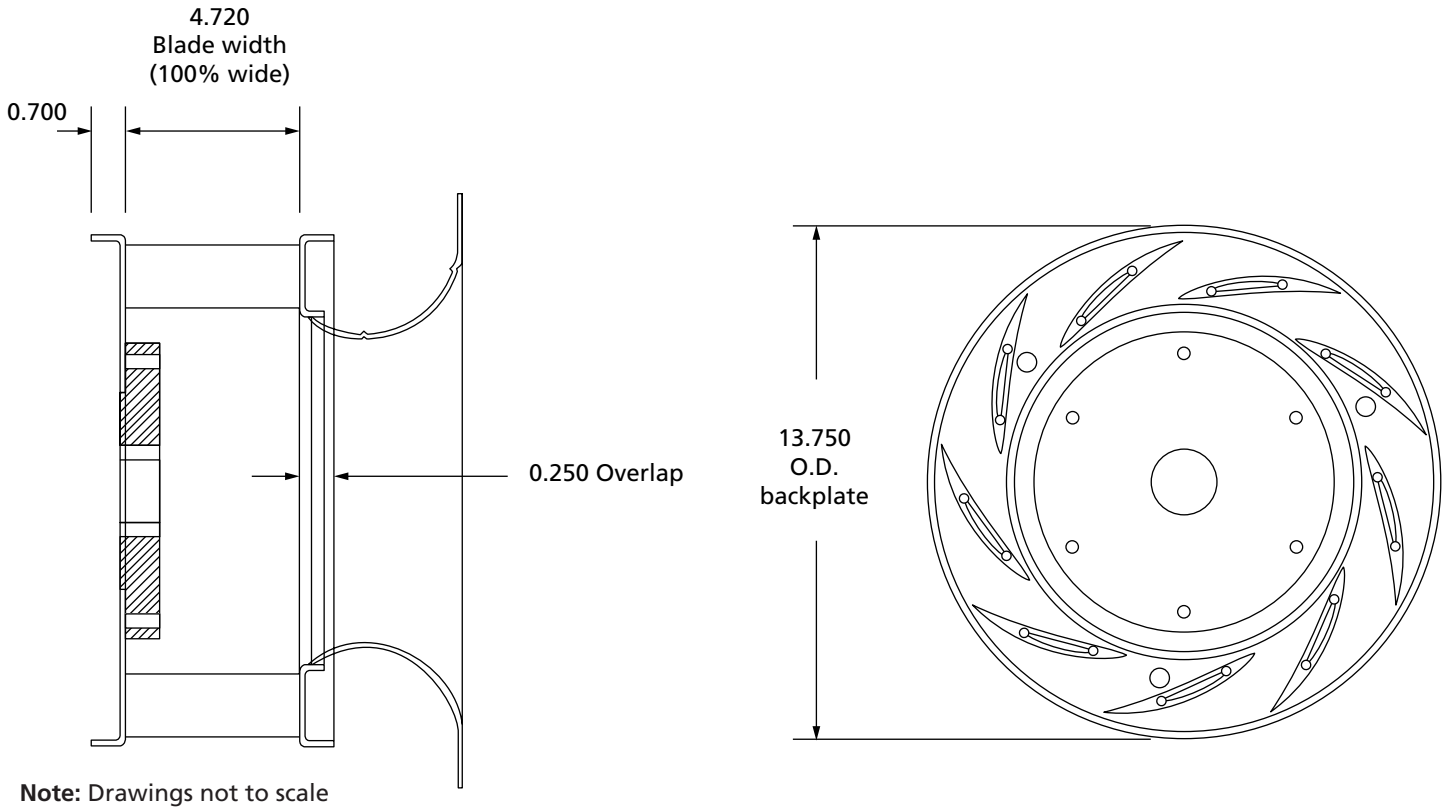
Appendix K: FANWALL® Supply Fan Inlet Cone Alignment

Wheel/Cone Alignment Size 12 Wheel



Note: Drawings not to scale

Wheel/Cone Alignment Size 14 Wheel



Note: Drawings not to scale

Appendix L: Forward Curved Exhaust Fan Bearing Relubrication Schedule

Fan Model	ATL1 9-6 & ATL1 9-7		ATL1 10-7 & ATL1 10-9		ATL1 12-9		ATL1 12-12	
Class	T2		T2		T2		T2	
Bearing Size	3/4		3/4		1		1 3/16	
Bearing Model	P2B-SCAH-012-FF		P2B-SCAH-012-FF		P2B-SCAH-100-FF		P2B-SCAH-103-FF	
Relubrication Grease Qty. (oz.)	0.09		0.09		0.11		0.14	
	RPM	Frequency of Relubrication (weeks)	RPM	Frequency of Relubrication (weeks)	RPM	Frequency of Relubrication (weeks)	RPM	Frequency of Relubrication (weeks)
	800	88	700	96	600	98	800	89
	1,280	78	1,120	85	940	87	1,280	79
	1,760	67	1,540	74	1,280	75	1,760	68
	2,240	57	1,960	63	1,620	64	2,240	68
	2,720	47	2,380	52	1,960	53	2,720	48
	3,200	37	2,800	40	2,300	42	3,200	37

Grease type: NLGI #2 Lithium complex grease.

Fan Model	ATL1 15-11 & ATL1 15-15		ATL1 18-13		ATL1 18-18	
Class	T2		T2		T2	
Bearing Size	1 3/16		1 3/16		1 7/16	
Bearing Model	P2B-SCAH-103-FF		P2B-SCAH-103FF		P2B-SCAH-107FF	
Relubrication Grease Qty. (oz.)	0.14		0.14		0.17	
	RPM	Frequency of Relubrication (weeks)	RPM	Frequency of Relubrication (weeks)	RPM	Frequency of Relubrication (weeks)
	500	100	400	106	400	97
	780	89	660	94	660	86
	1,060	77	920	82	920	75
	1,340	66	1,180	70	1,180	64
	1,620	54	1,440	58	1,440	52
	1,900	43	1,700	45	1,700	41

Grease type: NLGI #2 :Lithium complex grease.

Appendix M: VHC-72 Maintenance Summary Chart

Table M1: VHC-72 Maintenance Summary

Item	No.	Description	Note	Monthly	Quarterly	Semi-annually	Annually
General	1	Inspect the general condition of the unit.		x			
	2	Remove any dirt or debris.		x			
	3	Check interior liners and partition for dirt buildup and clean.			x		
	4	Check for unusual noise or vibration.		x			
	5	Lubricate the door latches.					x
Air filters	6	Replace prefilter.	1				
	7	Replace final filters.			x		
	8	Inspect holding frames/sliding track.			x		
Forward curved exhaust fans	9	Check bearing, fan and sheave set screw tightness.	2		x		
	10	Check fan and motor mounting bolt tightness.	3		x		
	11	Check sheave and fan belt condition and alignment.			x		
	12	Adjust belt tension.	4	x			
	13	Lubricate fan bearings.	5				
	14	Lubricate motor base adjusting screws.				x	
	15	Check condition of flexible connection.				x	
	16	Check for dirt buildup and clean.					x
	17	Check motor voltage and current.				x	
Supply FANWALL® array	18	Check the fan wheel to inlet cone alignment for possible noise from the wheel rubbing against the inlet cone.	6	x			
	19	Check fan and motor mounting bolts and pedestal bolts for tightness.	3		x		
	20	Check motor bearings for possible binding noise or overheating.				x	
	21	Check fan wheels for dirt and grease accumulation. Clean as necessary. Do not use any caustic cleaning solutions.				x	
	22	Examine fan housings and motor pedestal for corrosion. Clean and touch up with paint as necessary.					x
	23	Check motor voltage and current to each motor.				x	
Plenum fan	24	Check fan and motor mounting bolts and pedestal bolts for tightness.	3		x		
	25	Check motor bearings for possible binding noise or overheating.				x	
	26	Check fan wheels for dirt and grease accumulation. Clean as necessary. Do not use any caustic cleaning solutions.				x	
	27	Examine fan housings and motor pedestal for corrosion. Clean and touch up with paint as necessary.					x
	28	Check motor voltage and current to each motor.				x	

Notes

1 Check filters weekly after initial start-up until construction dust has cleared and to gauge required interval.

2 Check set screws at start-up, after 24 hours, then monthly for the initial three months, then quarterly.

3 Check mounting bolts at start-up, after 24 hours, then quarterly.

4 Check and adjust belt tension at time of start-up, daily for the first week until they should acquire their permanent set, then monthly.

5 See Appendix L for forward curved exhaust fan relubrication schedule.

6 See Fan Wheel/Cone Alignment section for instructions.

7 Check and adjust belt tension at time of start-up, then after 24 hours of operation until they should acquire their permanent set, then quarterly.

Table M1: VHC-72 Maintenance Summary

Item	No.	Description	Note	Monthly	Quarterly	Semi-annually	Annually
Enthalpy wheel	29	Verify wheel is rotating freely.		x			
	30	Check motor mounting bolts and drive sheave set screw for tightness.	2		x		
	31	Check condition and tension of drive belt.	7		x		
	32	Check condition of brush seals.			x		
	33	Check for dirt buildup and clean.				x	
	34	Check condition of media, rim and spokes.			x		
Dampers	35	Check damper actuator mounting and linkage fasteners for tightness.			x		
	36	Lubricate jackshaft.					x
	37	Inspect for dirt or leakage.					x
Coils	38	Clean the coils.					x
	39	Clean the drain pan.				x	
	40	Winterize water coils.				x	
	41	Clean the drain trap.				x	
	42	Check fluid level in drain trap.			x		
Refrigeration	43	Check for refrigeration leak, look for oil on components.			x		
	44	Verify proper superheat.			x		
	45	Verify refrigeration site glass and moisture indicator is full and clear under operation.			x		
	46	Inspect condition of condenser fans.				x	
Electrical	47	Verify all electrical connections, tighten if necessary.					x
	48	Verify all fuse holders.					x
	49	Verify all motor overload settings.					x
	50	Verify system operation in all control modes.					x

Notes

1. *Check filters weekly after initial start-up until construction dust has cleared and to gauge required interval.*
2. *Check set screws at start-up, after 24 hours, then monthly for the initial three months, then quarterly.*
3. *Check mounting bolts at start-up, after 24 hours, then quarterly.*
4. *Check and adjust belt tension at time of start-up, daily for the first week until they should acquire their permanent set, then monthly.*
5. *See Appendix L for forward curved exhaust fan relubrication schedule.*
6. *See Fan Wheel/Cone Alignment section for instructions.*
7. *Check and adjust belt tension at time of start-up, then after 24 hours of operation until they should acquire their permanent set, then quarterly.*

IMPORTANT

For gas-fired furnace module maintenance, see Appendix D and for electric coil maintenance, see Appendix G.

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