

## **Dehumidifier Heat Pipes**

# **ENGINEERING SPECIFICATIONS**

### **Factory Installed Wrap-Around Dehumidifier Heat Pipes DHP Series**

#### 1. GENERAL

- Air Handler(s)  Packaged Air Conditioning Equipment shall be equipped with
  - Standard
  - Tilted Enhanced

Dehumidifier Heat Pipes supplied by Heat Pipe Technology, Inc. to precool the return/outside air and reheat the supply air in a wrap-around configuration. The precool Heat Pipe module shall be located immediately before the cooling coil and the reheat module of the Heat Pipe shall be located immediately after the cooling coil. Heat Pipe circuits comprise multiple tubes connected in series, end-to-end to form a closed, continuous loop. Both vapor and liquid will travel in the same direction around the circuit in a single convectional path, making wicking and capillary action unnecessary for continuous heat transfer. Both Heat Pipe modules shall be inside the equipment cabinet. The interconnecting piping between the Heat Pipe modules shall be located within the assembled access/coil/access sections. If not, the piping shall be external, but enclosed within a removable, insulated enclosure supplied and installed by others. When possible, all interconnecting piping shall be located at the end of the cooling coil opposite from the coil header and piping connections. Any deviation from the specifications must be approved by the engineer no less than ten days prior to the project bid date. No consideration of alternates will be given after that time. Heat pipes shall be completely manufactured and fully assembled at the manufacturer's facility or on site by factory personnel. Conversion of third party coils is not acceptable.

#### 2. CONFIGURATION IN MODULAR AIR HANDLERS

The precool Heat Pipe module shall be located immediately upstream of the cooling coil section and the reheat Heat Pipe module shall be located immediately downstream of the cooling coil section with drain pans, or a single extended drain pan, positioned beneath.  For optimal accessibility between the cooling coil and the Heat Pipe modules, the air handler cooling coil section(s) shall be supplied with two (2) factory installed blank sections located immediately before and after the cooling coil section. Each section shall be provided with an integral condensate drain pan and drain pan condensate connection of the same construction as specified for the cooling coil. The precool Heat Pipe module shall be located within the provided blank section before the cooling coil section, and the reheat Heat Pipe module shall be located within the provided blank section after the cooling coil section.

### 3. OPTIONAL CONTROL VALVE FEATURE

All or a portion [SPECIFY] of the Dehumidifier Heat Pipe circuits shall be equipped with solenoid operated control valves to control the operation of the Heat Pipe circuits. The electrical power required by the solenoid valves shall be:  24 VAC  120 VAC. The solenoid valves shall be wired to a terminal block within a NEMA enclosure located on the:  exterior surface of the equipment cabinet or  interior as indicated.

The Building Automation System shall provide the sensors necessary for determination of heat pipe staged operation and the BAS computer shall be programmed to send the operating control signals to the solenoid valves as required for correct system operation. The control signal shall go through a BAS interface installed near the heat pipe NEMA box. All additional wiring, relays, transformers, power supply etc. necessary to interface with the equipment control system, shall be provided and installed by others. Closing of a valve shall inactivate the Heat Pipe circuit in which it is installed. The valves shall be normally open. The control valves shall be grouped such that each group of valves shall control a designated fraction of the Heat Pipe circuits. With all control valves open, the Dehumidifier Heat Pipe assembly will operate at full capacity. If all the circuits are equipped with control valves, then closing all the valves will stop all Heat Pipe operation. Manufacturer shall provide at least three (3) references for successful controllable wraparound heat pipe installations in operation for at least three (3) years.

### 4. HEAT PIPES

- 1) The Heat Pipe supplier shall have a minimum of 5 years of experience designing and installing Heat Pipes specifically for dehumidification applications.
- 2) The tubes shall be 1/2" OD copper, of specific design for Heat Pipe application, permanently expanded onto the fin collar to form a firm, rigid, and complete pressure contact at all operating conditions. Aluminum tubes will not be allowed.
- 3) The fin surface shall be continuous plate type  aluminum  copper fins of specific design to produce maximum heat transfer efficiency for Heat Pipe applications. Airside pressure loss shall be as given on the schedule, or otherwise specified. Fin density and the number of rows of tubes shall be as specified.
- 4)  The Heat Pipe modules shall have an optional protective coating of  E-Coat, similar to Electrofin or  phenolic, similar to Heresite. Heat pipes shall be dipped and completely submerged to insure full coverage of coating - spray coatings are not acceptable.
- 5) Heat transfer fluid shall be classified as Safety Group A1 in ASHRAE Standard 34-2013.
- 6) Heat Pipe capacities, entering and leaving dry and wet bulb temperatures, and face velocity shall be as specified.
- 7) The Heat Pipes shall be installed as shown on the submittal drawings.
- 8) Frames, mounting structure, and drain pan extensions (if required) shall be minimum 16 gauge  galvanized steel  stainless steel.

- 9) Heat Pipe interconnecting piping and circuitry shall be as specified by Heat Pipe Technology design. Each circuit shall be individually processed, charged, hermetically sealed, and tested.
- 10) Scheduled effectiveness or heat recovery shall be met at a minimum and total pressure drop shall not be exceeded. The resulting Recovery Efficiency Ratio, or RER, shall therefore be met at a minimum.
- 11) The Heat Pipes shall be ETL listed to UL standard 207 and CSA C22.2.140.3.
- 12) The Heat Pipe heat exchanger shall have a five (5) year limited warranty. All components such as valves and dampers shall carry a 12 month warranty.

### ***U-Frame Dehumidifier Heat Pipes (Installed by Other OEMs)***

#### **1. GENERAL**

- Air Handler(s) shall be equipped with
  - Standard
  - Tilted Enhanced

Dehumidifier Heat Pipes supplied by Heat Pipe Technology, Inc. to precool the return/outside air and reheat the supply air in a wrap-around configuration. The Dehumidifier Heat Pipes shall be pre-fabricated in a U-Frame arrangement comprised of precool Heat Pipe and reheat Heat Pipe heat exchangers together in one assembly such that the assembly may be inserted into an air conditioning unit with the legs of the U-Frame unit on either side of the cooling coil of the air conditioning unit. The U-Frame assembly shall be configured such that the precool Heat Pipe shall be located immediately before the cooling coil and the reheat Heat Pipe shall be located immediately after the cooling coil. Heat Pipe circuits comprise multiple tubes connected in series, end-to-end to form a closed, continuous loop. Both vapor and liquid will travel in the same direction around the circuit in a single convectional path, making wicking and capillary action unnecessary for continuous heat transfer. The interconnecting piping between the Heat Pipe modules shall be located within the U-Frame unit. Any deviation from the specifications must be approved by the engineer no less than 10 days prior to the project bid date. No consideration of alternates will be given after that time. Heat pipes shall be completely manufactured and fully assembled at the manufacturer's facility or on site by factory personnel. Conversion of third party coils is not acceptable.

#### **2. OPTIONAL CONTROL VALVE FEATURE**

All or a portion [SPECIFY] of the Dehumidifier Heat Pipe circuits shall be equipped with solenoid operated control valves to control the operation of the Heat Pipe circuits. The electrical power required by the solenoid valves shall be:  24 VAC  120 VAC. The solenoid valves shall be wired to a terminal block within a NEMA enclosure located on the exterior surface of the equipment cabinet. All additional wiring, relays, transformers, and power supply etc. necessary

to interface with the equipment control system, shall be provided and installed by others. Closing of a valve shall inactivate the Heat Pipe circuit in which it is installed. The valves shall be normally open. The control valves shall be grouped such that each group of valves shall control a designated fraction of the Heat Pipe circuits. With all control valves open, the Dehumidifier Heat Pipe assembly will operate at full capacity. If all the circuits are equipped with control valves, then closing all the valves will stop all Heat Pipe operation. Manufacturer shall provide at least three (3) references for successful controllable wraparound heat pipe installations for at least three (3) years.

### 3. HEAT PIPES

- 1) The Heat Pipe supplier shall have a minimum of 5 years of experience designing and installing Heat Pipes specifically for dehumidification applications.
- 2) The tubes shall be ½” OD copper, of specific design for Heat Pipe application, permanently expanded onto the fin collar to form a firm, rigid, and complete pressure contact at all operating conditions. Aluminum tubes will not be allowed.
- 3) The fin surface shall be continuous plate type  aluminum  copper fins of specific design to produce maximum heat transfer efficiency for Heat Pipe applications. Airside pressure loss shall be as given on the schedule, or otherwise specified. Fin density and the number of rows of tubes shall be as specified.
- 4)  The Heat Pipe modules shall have an optional protective coating of  E-Coat, similar to Electrofin or  phenolic, similar to Heresite. Coils shall be dipped and completely submerged to insure full coverage of coating - spray coatings are not acceptable.
- 5) Heat transfer fluid shall be classified as Safety Group A1 in ASHRAE Standard 34-2013.
- 6) Heat Pipe capacities, entering and leaving dry and wet bulb temperatures, and face velocity shall be as specified.
- 7) The frame shall be minimum 16 gauge  galvanized steel  stainless steel.
- 8) Heat Pipe interconnecting piping and circuitry shall be as specified by Heat Pipe Technology design. Each circuit shall be individually processed, charged, hermetically sealed, and tested. Interconnecting piping shall be fully enclosed to provide complete protection.
- 9) Scheduled effectiveness or heat recovery shall be met at a minimum and total pressure drop shall not be exceeded. The resulting Recovery Efficiency Ratio, or RER, shall therefore be met at a minimum.
- 10) The Heat Pipes shall be ETL listed to UL standard 207 and CSA C22.2.140.3.
- 11) The Heat Pipe heat exchanger shall have a five (5) year limited warranty. All components such as valves and dampers shall carry a 12 month warranty.

## **Factory or Site Installed Wrap Around Dehumidifier Heat Pipes DHP-V Series**

### **1. GENERAL**

Air handlers shall be equipped with Dehumidifier Heat Pipes supplied by Heat Pipe Technology, to precool the return/outside air and reheat the supply air in a wrap-around configuration. Heat Pipe system shall be comprised of one, two, three, four or more circuits. Both Heat Pipe modules shall be located inside the equipment cabinet. The interconnecting piping- supplied and installed by others- between the Heat Pipe modules shall be located  within the air handler, or  external, but enclosed within a removable, insulated enclosure supplied and installed by others. All interconnecting piping shall be located at the back end of the cooling coil (not the headers end). Any deviation from the specifications must be approved by the engineer no less than ten days prior to the project bid date. No consideration of alternates will be given after that time. Heat pipes modules shall be designed, manufactured and assembled at the manufacturer's facility by factory personnel. Conversion of third party coils is not acceptable.

### **2. CONSTRUCTION**

Heat Pipe coil tubes shall be oriented vertical and the fins run horizontal. Each two rows shall be manifolded together into one liquid line at the bottom and one vapor line at the top and constitute one circuit. Combining headers of multiple circuits into one common vapor header and one common liquid header will reduce performance and is not permissible. Each heat pipe section shall be installed level end to end. Reheat section shall be installed with an elevational offset relative to the precool section, as specified by HPT, in order to enhance performance.

Extended drain pans (provided by others) to be installed under and downstream of the precool section, or  A moisture eliminator shall be installed immediately downstream of the precool section of the heat pipe to capture condensate that may spit from the heat pipe fins. Condensate shall drain out of the bottom into a drain pan (supplied by others). The moisture eliminator shall be capable of capturing at least 99.75% of condensate when the coil is producing condensate at a rate of 0 to 15 lbs. water/sqft/hour and coil airflow is  $\leq$  700 SFPM. Static pressure loss shall not exceed 0.18 in.wg. at 500 SFPM.

The moisture eliminator blades will be constructed of ABS plastic and meet UL Standard 94 classification V-0, which requires blades to self-extinguish within 10 seconds. It will incorporate an additive that protects against fungal and bacterial deterioration to provide long-term protection against fungal and bacterial attack and help prevent surface growth, permanent staining, embrittlement and premature product failure. The anti-fungal and anti-bacterial additive shall be mixed with the polymer and shall not be a coating, which could wear off over time.

### **3. CONFIGURATION IN MODULAR AIR HANDLERS**

The precool Heat Pipe module shall be located immediately upstream of the cooling coil section and the reheat Heat Pipe module shall be located immediately downstream of the cooling coil section.  For optimal accessibility between the cooling coil and the Heat Pipe modules, the air handler shall be supplied with two (2) factory installed blank sections located immediately before and after the cooling coil section. Each section shall be provided with an integral condensate drain pan and drain pan condensate connection of the same construction as for the cooling coil. The precool Heat Pipe module shall be located within the provided blank section before the cooling coil section, and the reheat Heat Pipe module shall be located within the provided blank section after the cooling coil section.

#### 4. OPTIONAL CONTROL VALVE FEATURE

All or a portion [SPECIFY] of the Heat Pipe circuits shall be equipped with modulating control valves to control the operation of the Heat Pipe circuits. Each circuit shall have one modulating step motor valve in the lower liquid line in an accessible location. Each valve will connect to a printed circuit board in a NEMA 12 enclosure that contains the number of control boards to control all valves in the system and the appropriate power conversion. The customer supplied electrical power to the control panel power supply transformer shall be:  120 VAC  208 VAC  230 VAC 1 phase 60 Hz. The NEMA box shall be located on the  exterior or  interior surface of the equipment cabinet as indicated  or on a nearby surface.

The Building Automation System (BAS) shall provide the sensors necessary for determination of heat pipe modulation operation and the BAS computer shall be programmed to send the operating control signals to the modulating valves' control boards as required for correct system operation. The control signal shall go through a BAS interface installed near the heat pipe NEMA box. The BAS control signal provided shall be  0 to 10 volt DC or  4-20 mA.

All additional wiring shall be provided and installed by others. With all control valves open, the wrap around heat pipe assembly will operate at full capacity. Modulating one valve closed restricts the liquid return flow and reduces the heat transferred by the heat pipe until closing the valve shuts off that circuit.

#### 5. HEAT PIPES

- 1) The Heat Pipe supplier shall have a minimum of 5 years of experience designing and installing Heat Pipes specifically for dehumidification applications.
- 2) The tubes shall be 1/2" OD copper, of specific design for Heat Pipe application, permanently expanded onto the fin collar to form a firm, rigid, and complete pressure contact at all operating conditions. Aluminum tubes will not be allowed.
- 3) The fin surface shall be continuous plate type  aluminum  copper fins of specific design to produce maximum heat transfer efficiency for Heat Pipe applications. Airside pressure loss shall be as given on the schedule, or otherwise specified. Fin density and the number of rows of tubes shall be as specified.

- 4)  The Heat Pipe modules shall have an optional protective coating of  E-Coat, similar to Electrofin or  phenolic, similar to Heresite. Heat pipes shall be dipped and completely submerged to insure full coverage of coating - spray coatings are not acceptable.
- 5) Heat transfer fluid shall be classified as Safety Group A1 in ASHRAE Standard 34-2013.
- 6) Heat Pipe capacities, entering and leaving dry and wet bulb temperatures, and face velocity shall be as specified.
- 7) The Heat Pipes shall be installed as shown on the submittal drawings.
- 8) Frames, mounting structure, and drain pan extensions (if required) shall be minimum 16 gauge  galvanized steel  stainless steel.
- 9) Heat Pipe interconnecting piping and circuitry shall be as specified by Heat Pipe Technology design. Each circuit shall be, pressure tested, vacuumed, charged, and sealed.
- 10) Scheduled effectiveness or heat recovery shall be met at a minimum and total pressure drop shall not be exceeded. The resulting Recovery Efficiency Ratio, or RER, shall therefore be met at a minimum.
- 11) The Heat Pipes shall be ETL listed to UL standard 207 and CSA C22.2.140.3.
- 12) The Heat Pipe heat exchanger shall have a five (5) year limited warranty. All components such as valves and dampers shall carry a 12 month warranty.