Controllable Dehumidifier Heat Pipes Systems

Factory Installed Controllable Dehumidifier Heat Pipes

Site Installed Controllable Dehumidifier Heat Pipes

U-Frame Controllable Dehumidifier Heat Pipes

Features

Wrap-around heat pipes are normally installed as passive devices designed to match the requirements of their installation. Sometimes the need for maximum sensible cooling overrides the need for humidity control. Because of this, it is necessary to temporarily lower or shut off the reheat action of the heat pipe.

However, when reheat is shut off, the precool also shuts off, increasing the load on the cooling coil. Unless the cooling coil has extra capacity, the cooling coil leaving air temperature and dewpoint will be higher than with the heat pipe operating. There will still be more sensible cooling available than with the heat pipe operating, just not as much as it would first appear. For example, many cooling coils have a 55° F saturated leaving air temperature. With a typical two row wrap-around heat pipe, the reheat is about 10° F, warming the air to 65° F. Shutting off the reheat and the precool means a cooling coil with a fixed capacity, or one already operating at maximum capacity, may only be able to cool the air to a dew point between 58° F and 62° F. The need for the heat pipe performance to be less than the maximum but more than zero brings about the need for controllable heat pipes.

Applications

Typically used for applications where there is limited cooling capacity or where dehumidification needs to be closely controlled.

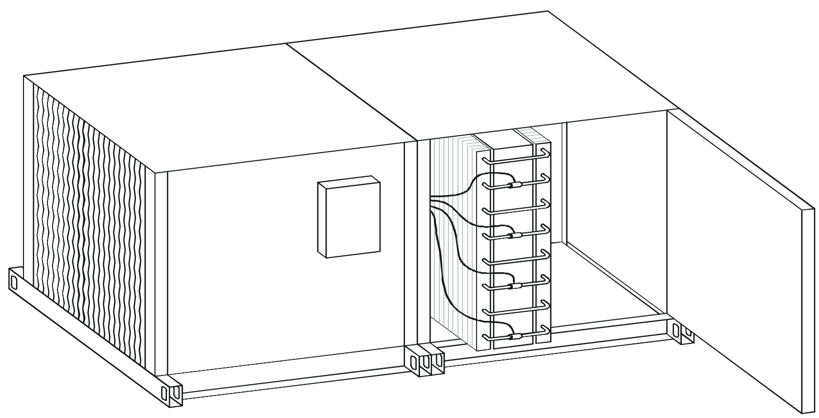
There are five methods for controlling the operation of a wrap-around heat pipe.

1. Manual Control Valves

For applications such as a 24-hour industrial process with constant airflows and loads, the reheat needed will also be a constant value. The heat pipe can be designed with a slight excess capacity and manual refrigeration ball valves installed in some or all of the circuits. When the heat pipe is installed and the system is running, circuits are shut until the reheat matches the desired value. Normally this is a one-time adjustment on applications that can use this type of control.

2. Electrically Operated Solenoid Valves

For remote control of an operating heat pipe, normally open (NO) electric solenoid valves can be installed in the liquid return lines of the individual heat pipe circuits. The number of valves needed is determined by the size of the heat pipe, the number of rows, and the degree of control desired. It may not be necessary to install controls on all circuits if partial control is sufficient. The total heat pipe system can have a mix of controlled and uncontrolled circuits for systems that do not require shutting off 100% of the heat pipe operation.



Solenoid Valve Controlled Heat Pipe System

Each control valve is operated by either a 24 VAC or 115 VAC digital output (DO) from The Building Automation System. Depending on the number of solenoids, they can be operated in ganged stages to provide multi-step operation of the heat pipe.

Total No. of Circuits	Circuits w/ Valves	% Heat Pipe Effect
5	5	0, 20, 40, 60, 80, 100
10	5	50, 60, 70, 80, 90, 100
20	5	75, 80, 85, 90, 95, 100

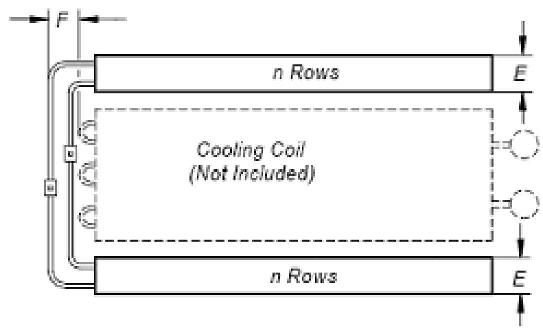
Valve Control Examples

As the heat pipe size and/or number of rows increase, the number of valves increases, adding to the cost of the installation. When the installation calls for approximately 15 or more solenoids, the 30 Watts of electrical power needed to operate each also becomes an important consideration.

In this case consideration should be given to 115 VAC solenoids to avoid the added cost of having to install large power transformers, or to consider a different control option.

Heat pipes with control solenoids can be installed in factory installed wrap-around heat pipes and in U-frames (preassembled heat pipes which are installed by others). The size of the solenoids adds considerable depth to the heat pipe center section. The cooling coil may need to be ordered shorter than normal, or the AHU section ordered wider than normal, in order to accommodate the solenoids. In some cases, where this is not possible, an outside enclosure is built to house the connecting section of the heat pipes. In addition, this area must have access after the AHU is installed. One row of solenoids (for a one or two row heat pipe) needs a center section depth of 5 inches; two rows of solenoids (for a three or four row heat pipe) need a depth of 9 inches. These dimensions are illustrated below.

Rows	E	F W/O Valves	F Valves
1	2.00	1	5
2	2.75	1.5	5
3	4.00	2.5	9
4	5.25	3	9

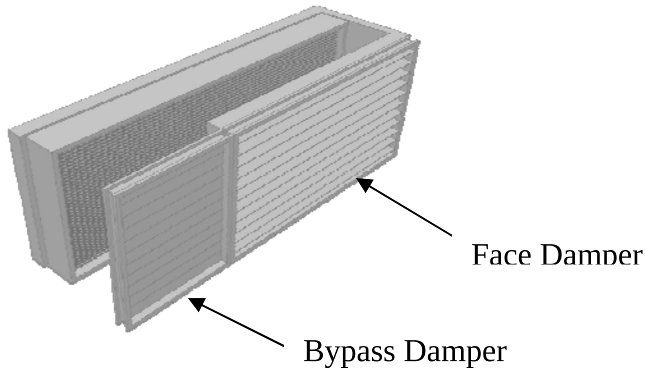


Dimensions for wrap-around heat pipes with solenoid valves

The circuiting required for installing solenoids lends itself to building the heat pipe with multiples of two rows only. A three row controllable requires the same number of solenoids as a four row controllable.

3. Face and Bypass Dampers on the Precool Section

Another method of controlling heat pipe operation is to bypass air around one side of the heat pipe, normally the precool side. In order to fit into a normal size AHU, the precool heat pipe is built with a finned length about 80% of the cooling coil finned length, with a bypass damper installed. Air is bypassed around this heat pipe, lowering the overall heat pipe performance. Due to the tight spacing, it is usually necessary to install a face damper on the precool finned area which can be shut to force all the air through the bypass damper. The precool heat pipe should be spaced away from the cooling coil to allow room for better air distribution across the cooling coil face or turning vanes between the heat pipe and the cooling coil. Alternatively, any AHU manufacturer's standard internal or external F&BP arrangement with spacer sections can be used.



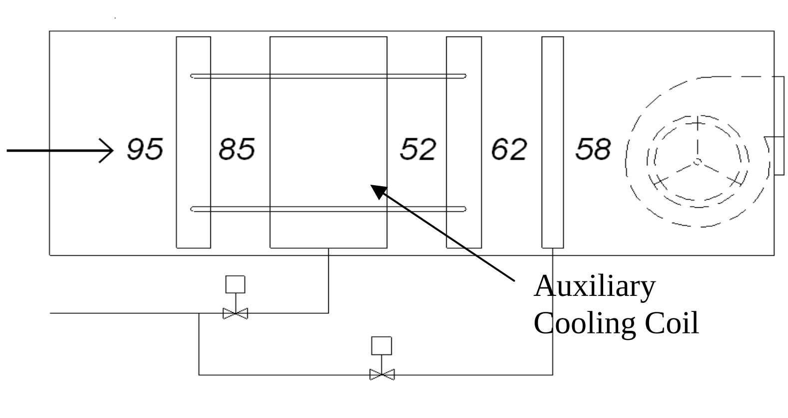
Wrap-Around Heat Pipe with Face and Bypass Dampers

The damper actuators use less power than a large bank of solenoid valves. Opening the bypass will change the static pressure of the supply system and can change the total air flow. The reverse connected damper linkage uses a single analog output (AO) common control signal.

4. Auxiliary Cooling Coil

In chilled water systems, an additional cooling coil with its own valve (on-off or modulating) can be installed immediately after the reheat heat pipe, in order to counteract some or all of the heat pipe's reheat. Whether the auxiliary cooling coil is operating or not, the heat pipes are still fully working as long as the main cooling coil is operating.

The auxiliary cooling coil only cancels the reheat in the heat pipe operation. This may seem like an energy inefficient design, but, for comparison, if the heat pipe system is turned off with a different control mechanism, the system loses the heat pipe precool effect, requiring an increase in cooling coil water flow to maintain the same cooling coil leaving temperature. This increased chilled water flow is exactly the same GPM the boost coil needs to counteract the sensible performance of the heat pipe reheat coil. A schematic of the auxiliary cooling coil setup can be Seen below.



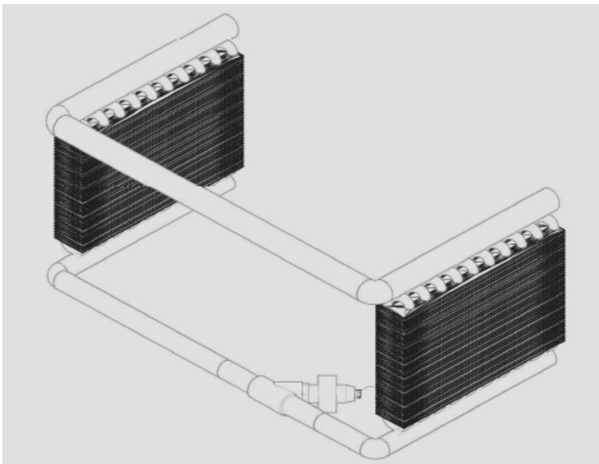
Auxiliary Cooling Coil Schematic with Typical Air Dry Bulb Temperatures

If there are circumstances when no reheat is needed, the auxiliary cooling coil may be designed to completely cancel out the reheat done by the heat pipe. In most cases, though, the auxiliary cooling coil is only negating a fraction of the reheat from the heat pipe. This allows for control of the exact dry bulb temperature desired for supply air while maintaining the dew point.

5. Manifolded Heat Pipes

The manifolded heat pipe allows controllability by using a different heat pipe construction method. The heat pipe coils are built with vertical tubes manifold together at the top and at the bottom, creating a vapor line at the top and a liquid line at the bottom. There are only two lines per circuit crossing over between the two heat pipe coils, although they are quite a bit larger than the normal ½ inch crossover tubes used in regular heat pipe systems. The vapor line is typically 1.625 or 2.125 inches OD while the liquid line is typically 1.375 inches OD. By installing a proportional control electronic refrigeration valve in the liquid line, the liquid return can be controlled thus controlling the heat pipe performance. These heat pipes can be installed in multiple banks high.

An electric step motor valve is typically used to provide modulating control. The valves are controlled from a separate HPT furnished control box including microprocessor(s), with signals originating from the Building Automation System, which provides the sensors and is programmed to operate the heat pipe as designed.



Schematic of a Manifolded Controllable Heat Pipe

This design only uses electric power when the valve setting is changing. The top and bottom manifolds do reduce the available finned area, making this design most suitable for large installations. In units up to about 30 inches of finned height, solenoid valves should be considered; for larger units, manifolded heat pipes should be considered.

When Should Each Control be Used?

Manual Control Valves	When loads, air flow, and reheat are constant such as in a constant industrial process
Electric Solenoid Valves	On smaller air handling units and one or two row heat pipe systems
Face and Bypass Dampers	In a larger AHU if additional floor length is available
Auxiliary Cooling Coil	When reheat needs to be lowered without lowering the precool performance. Reduces AHU length and cross section compared to f & BP dampers
Manifolded Vertical Tubes	On larger air handling units with multiple heat pipe rows