



SPC

SPC HEAT PIPES FZC
www.spcoils.ae



**REFRIGERANT AND
WATER HEAT PIPES**
DEHUMIDIFICATION
AND ENERGY RECOVERY

About SPC

The Company

S & P Coil Products Limited is a UK based specialist manufacturer and supplier of heating and cooling equipment to the public and private sector. Set up in 1979, the business now operates globally, manufacturing in Leicester, UK (30+years), the Middle East (10 years) and China.

We have an extensive range of products to meet the needs of our customers wherever their location including: Heat Pipes, Heating/Cooling Coils, Fan Convectors, UV Air and Coil Sterilisers, Trench Heaters, Radiant Panels, Radiant Conditioning Sails and Air Curtains.

Our task is straightforward; to improve the comfort of indoor environments for those who work in them, whilst ensuring that our expert team is on hand to guide you through the process of specifying and acquiring the right product for your application. The result is a range of products that are economical to run, robust and aesthetic – with all the sales and technical support that you need.

It's a winning combination, and after more than 30 years in business, we've built a worldwide network of satisfied customers.

KEY FACTS ABOUT SPC:

- Major supplier to local government, health, education and the commercial sector
- Regional Sales and Technical Support teams throughout the UK, Middle East and Asia
- Free self-selection software packages and site surveys if required
- ISO 9001 in both the UK and Middle East
- Provider of technical seminars/CPD's

SPC Heat Pipes for Dehumidification and Heat Recovery

Introduction



Heat Pipes are essentially a means of transferring high rates of heat across small temperature gradients, and as such may be considered thermal "super conductors".

The simplest form of heat pipe is a thermosyphon which relies on gravity for its operation, and is hence uni-directional. This means that heat can only be transferred from the lower to the upper end of the heat pipe and not vice versa. Heat Pipes have, however, been manufactured which rely on the capillary action of a "wick" to provide bi-directional operation. The simplicity of the gravity return heat pipe makes this the preferred solution for a wide range of HVAC applications.



The modern day concept of the heat pipe was first proposed in 1942, but was not developed beyond the patent stage until the early 1960's. Early applications in both the United States and United Kingdom were concerned with high temperature Heat Pipes for the atomic energy programme. The NASA space programme in the 1960's promoted further activity and since then there has been a dramatic increase in the number and variety of applications of Heat Pipes, which are now common place within the aerospace, electronics and air conditioning industries.



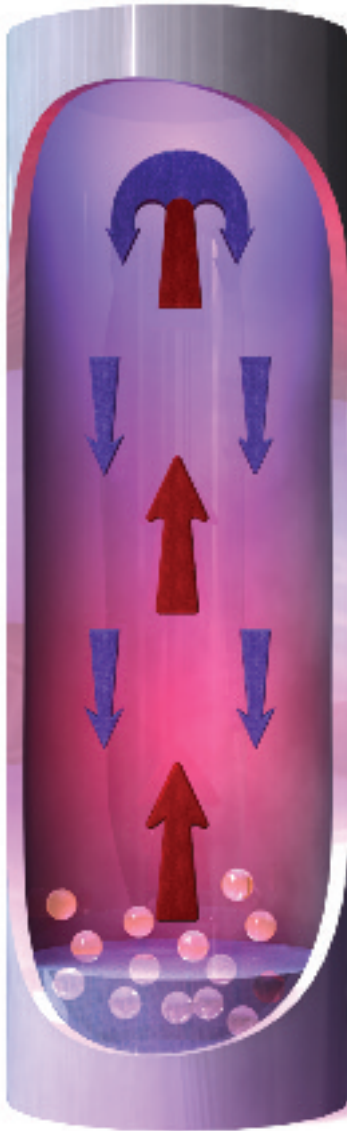
SPC have been supplying heat pipe based heat recovery systems to the HVAC industry for the last 30 years. As major manufacturers of coil heat exchangers and associated equipment, SPC have extensive knowledge and experience of HVAC heat transfer applications.

Our broad based knowledge of the HVAC industry allows us to offer the unique benefits of this patented heat pipe system, providing dramatic savings in energy costs, together with significant improvements in operational effectiveness.



SPC Heat Pipes for Dehumidification and Heat Recovery Technology

Heat Pipes are the most effective passive method of transferring heat available today. In their simplest form, a sealed tube (usually copper) is evacuated and charged with a working fluid. In the case of Heat Pipes for HVAC purposes, refrigerants such as R134A are currently used, though water is now available as an alternative from SPC.



BASIC OPERATION

This diagram shows the basic structure of a heat pipe and identifies the major steps in the heat pipe process. Heat is absorbed from the incoming warm air stream in the evaporator section, boiling the working fluid. Due to its elevated vapour pressure, the vapour moves rapidly to the cooler condenser section of the heat pipe, carrying with it the absorbed heat.

As the vapour reaches the condensing area of the heat pipe, heat is released to the cooler air and the vapour condenses. The liquid returns by gravity to complete the cycle. The entire heat transfer process occurs with a very small temperature difference along the pipe.

Apart from air conditioners, Heat Pipes have been used in many applications, including the cooling of casting dies, electronic circuitry, nuclear powered generators, energy conservation, defrosting applications and in the food industry.

WORKING FLUIDS

REFRIGERANT

Refrigerant charged heat pipes have been successfully used for many years and provide significant energy saving benefits to all projects in which they have been incorporated. While refrigerant provides a convenient medium for the manufacture of heat pipes, it has long been understood that if water could be used then not only would this provide a greener solution but it would also allow improvements in heat pipe efficiency.

WATER BASED TECHNOLOGY

Single tubed heat pipes have been manufactured for many years based on the use of water as the working fluid. In order to successfully manufacture a water based heat pipe, however, techniques have been used which do not lend themselves to coil based systems.

SPC has undertaken a research program in conjunction with Brunel University with the aim of providing a novel manufacturing solution. The development is now complete, resulting in the latest version of SPC heat pipes being available at commercial prices and relying on water rather than refrigerant as their working fluid. The technology developed by SPC is the subject of a worldwide patent pending, covering the newly developed manufacturing technique.

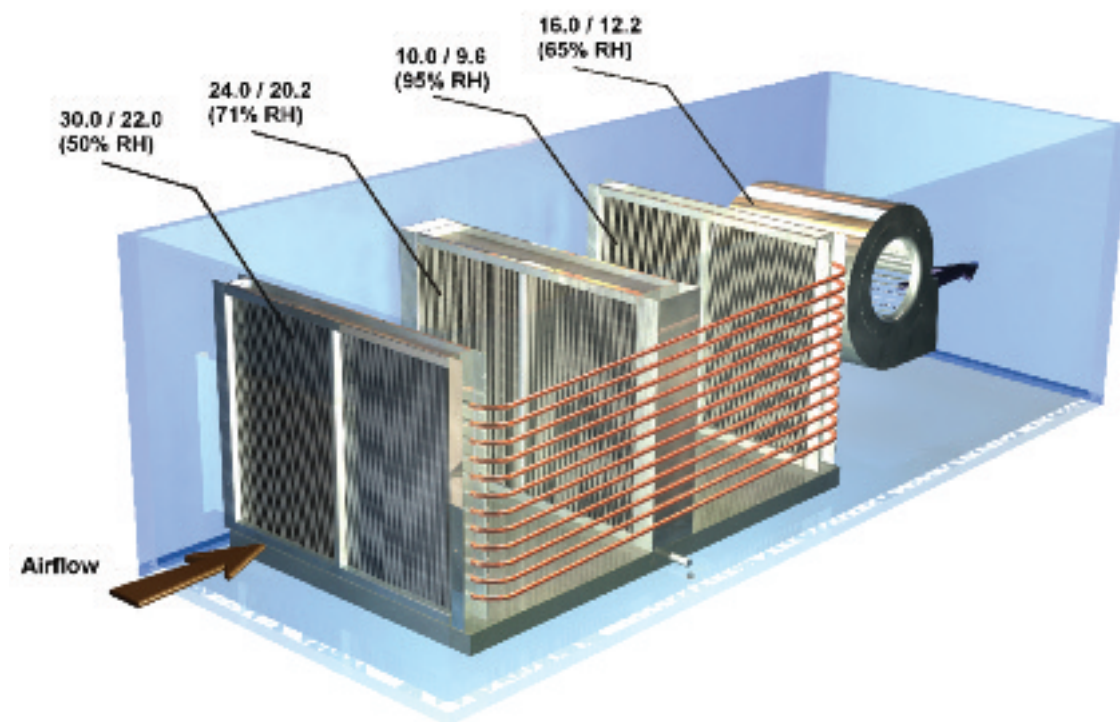
Water is known to be one of the most efficient working fluids at the temperatures typical of air conditioning applications. Its latent heat is considerably higher than other working fluids and more heat per unit mass is transferred along the heat pipe.

Water has not been traditionally used due to the additional manufacturing issues which must be addressed. SPC has resolved these issues and developed a patented manufacturing technique in conjunction with Brunel University. For the first time this allows water based small bore tubes to be used as a viable alternative to conventional refrigerant tubes without cost penalty.

SPC Heat Pipes for Dehumidification and Heat Recovery

Dehumidification

When applied to HVAC, Heat Pipes provide significant dehumidification enhancement and improved indoor air quality. The additional benefit of energy saving occurs in many situations, especially where reheat is required. Depending on conditions, Heat Pipes can double the amount of moisture removed by an air conditioner's cooling coil.



By circuiting Heat Pipes in sections before and after the cooling coil (as above diagram) heat is removed from the air stream before it encounters the cooling coil. This passively pre-cooled air means less sensible cooling is required by the coil, providing more latent capacity, and superior dehumidification ability. The now "over-cooled" air passes across the re-heat section of the heat pipe, bringing the air temperature to a comfortable supply condition.

This free reheat is provided by the same heat energy which was absorbed from the incoming air stream. In the case of fresh air treatment, Heat Pipes can be used to pre-cool the incoming outside air before it is cooled and dehumidified by the cooling coil. The heat pipes then reheat the air to the "neutral" supply temperature.

Heat Pipes are particularly useful in displacement ventilation systems where air is supplied directly into the occupied space at low level. When combined with ceiling cooling systems the primary air must be dehumidified to prevent sweating of the ceiling as well as reheated to a few degrees below the space temperature. Incorporation of heat pipes allows substantial energy saving to be realised.

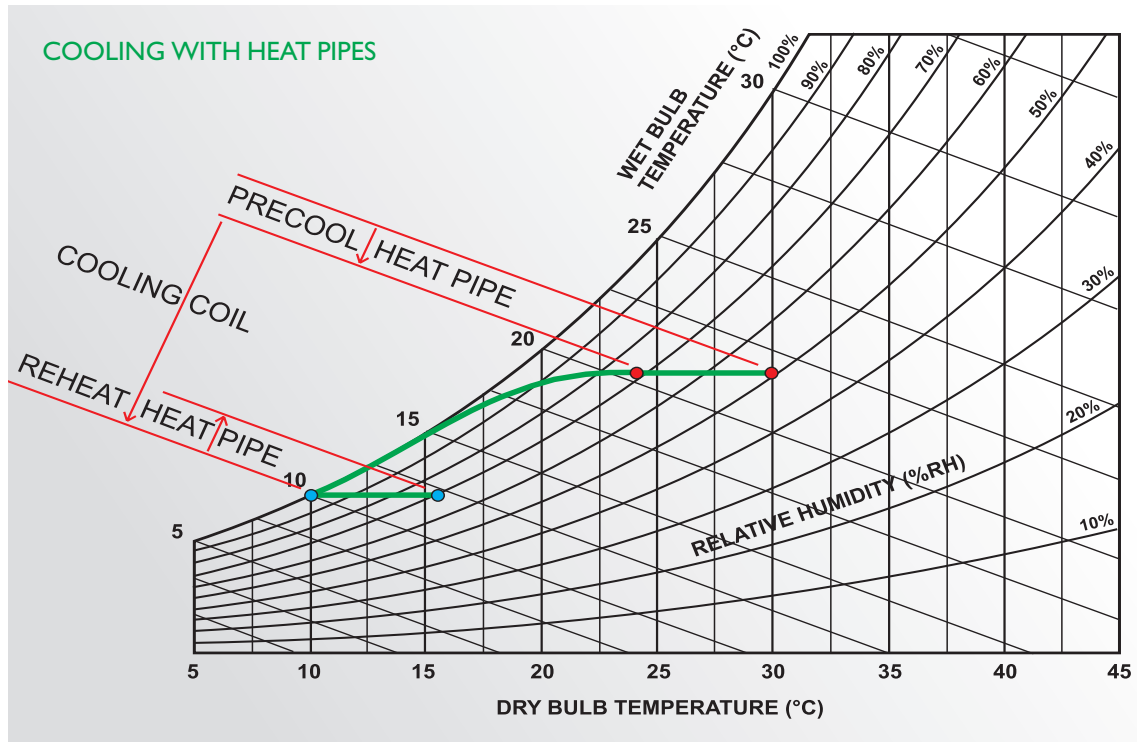
SPC Heat Pipes for Dehumidification and Heat Recovery

Dehumidification

HEAT PIPES AS APPLIED TO AIR CONDITIONING

The cooling coil in the standard air conditioner provides both sensible and latent cooling. The following chart shows how the heat pipe provides pre-cooling before the cooling coil. This then increases the latent cooling ability of the coil before the heat pipe re-heats the air back up to a comfortable condition.

Using Heat Pipes will increase the latent cooling capacity at reduced cost.



BENEFITS AND COST ADVANTAGES

In addition to the above cost savings, Heat Pipes have no moving parts to break or wear out and are virtually maintenance free. Because of simplicity in design, Heat Pipes will most likely outlast the air conditioning equipment itself.

Because the cooling coil has less work to do, a reduction in size of coil may be achievable. Also the heat pipe is not using any external energy, so is effectively free to operate. As a result very short pay-backs can be achieved.

SPC Heat Pipes for Dehumidification and Heat Recovery

Indoor Air Quality

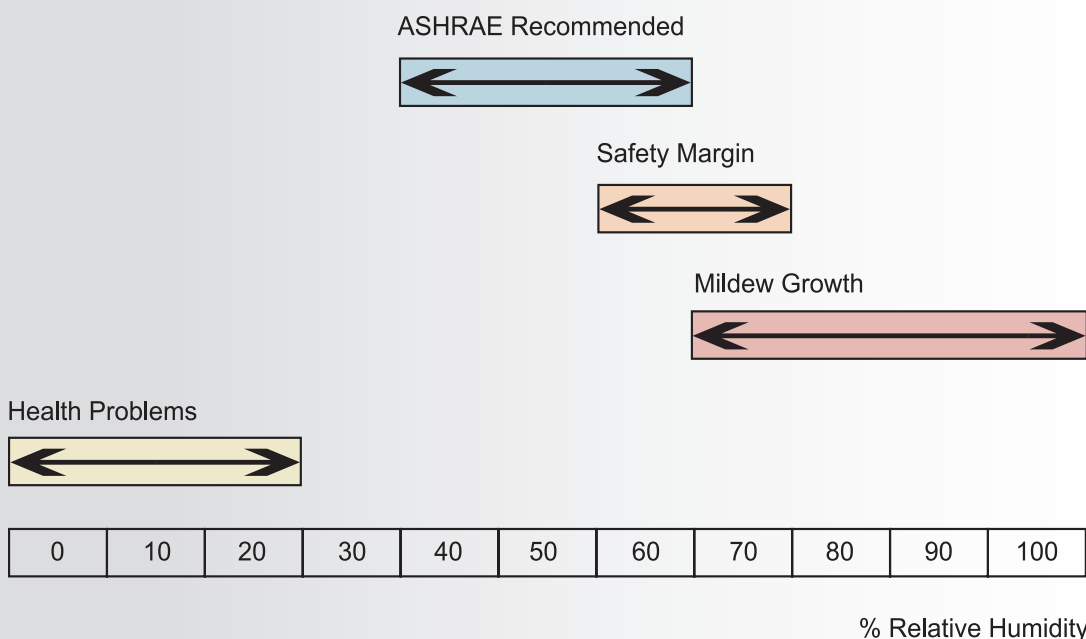
HEALTH BENEFITS

Depending upon environment, Heat Pipes can increase an air conditioner's moisture removal capability by 50 to 100%. Because many of today's primary indoor air quality concerns are humidity related, the health benefits of Heat Pipes are paramount. The unique ability of the Heat Pipes to perform effective dehumidification whilst saving energy is a substantial "bottom line" bonus.

Along with the heat pipes ability to remove excess moisture and hence control the humidity level within the space, the reheat that they generate helps to prevent health problems.

A conventional system cools and dehumidifies air with the resultant air being fed to the ductwork in a saturated state. As the heat pipe reheats the air its relative humidity is reduced below the level at which mould, mildew and fungus are encouraged to grow. This ensures that the inside surfaces of the ducting do not become sources of contamination to the spaces that they serve.

THE EFFECTS OF ROOM HUMIDITY ON HEALTH

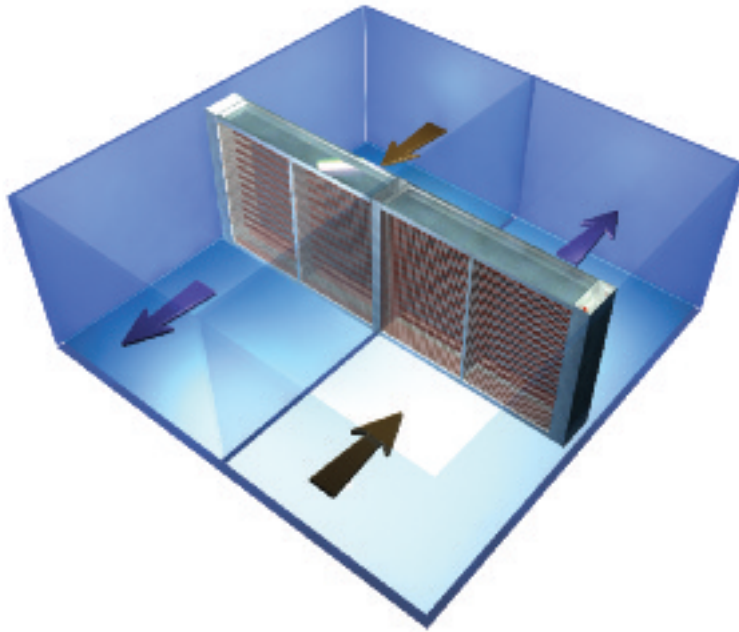


SPC Heat Pipes for Dehumidification and Heat Recovery

Heat Recovery

HEAT PIPES FOR HEAT RECOVERY

With increasing demands for energy efficient buildings, it is essential that energy is not wasted. Utilising a heat pipe, thermal energy can be recovered from warmer air and added to cooler air. In temperate climates this permits energy saving to be realised through preheating of the outside air. Conversely, in hot climates the savings are associated with pre-cooling of the outside air.



Heat Pipes can be arranged with airstreams side by side using tubes sloping down to the warmer air. Alternatively the air streams can be stacked with the warmer airstream at the bottom. This coupled with flexibility of sizing to suit the ductwork or air handling unit makes Heat Pipes the ideal heat recovery solution.

BASIC COMPARISON INFORMATION

Many types of heat exchangers are available for heat recovery applications. However each type of heat exchanger has certain advantages and drawbacks:

RUN-AROUND COILS are relatively inexpensive, but require a pump pack and expansion tank to operate. Run-around loops used in cold climates must be charged with anti-freeze to prevent frost damage significantly reducing their effectiveness. They are however the best solution for 'separate' air streams.

PLATE TO PLATE heat exchangers are quite effective, but are bulky, expensive and very difficult to clean. They can trap condensate resulting in the growth of moulds.

HEAT RECOVERY WHEELS are maintenance intensive and prone to cross contamination and do not effectively drain condensation.

Only Heat Pipes offer all the benefits combined: no moving parts, high effectiveness, low air-pressure drop, easy drainage of condensation, no direct energy requirement and heat transfer without cross-contamination. They are also proven to be long lasting and virtually maintenance-free.

Additionally, Heat Pipes can be treated to withstand corrosive environments such as swimming pools and some process applications.

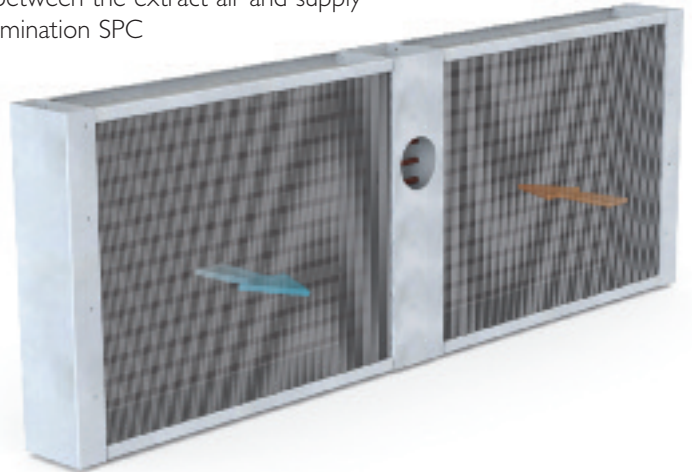
SPC Heat Pipes for Dehumidification and Heat Recovery

Heat Recovery

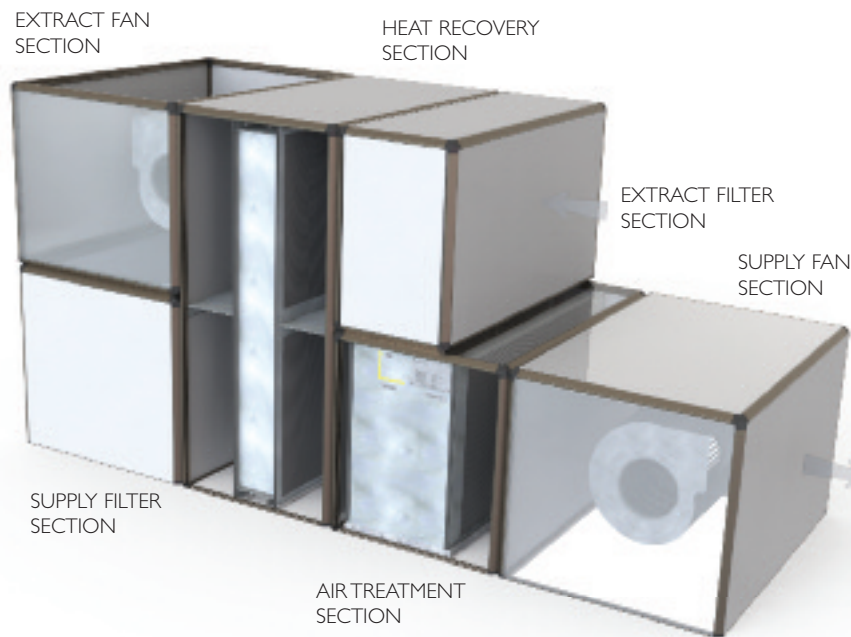
HEAT PIPE HEAT RECOVERY FOR CRITICAL APPLICATIONS

Heat recovery solutions in environments such as hospitals, other healthcare facilities, pharmaceutical industries and other critical areas have special requirements for purity and cleanliness.

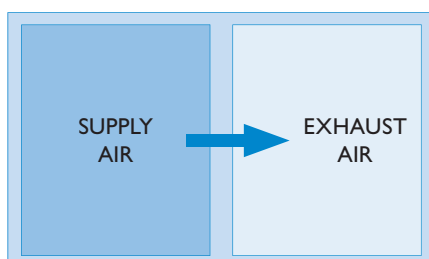
In these special environments risks of leak between the extract air and supply air cannot be tolerated. To ensure no contamination SPC offers a heat pipe heat recovery solution with a sealed separation between supply and extract sections. The centre partition provides a double skin separation with foam supplied on the inner heat pipe array. With this enhanced security and no mechanical parts in the air streams no pollutants or bacteria carried in the exhaust air can infect the supply air stream. This solution is ideal where both hygiene and energy recovery are crucial.



APPLICATION OF HEAT RECOVERY



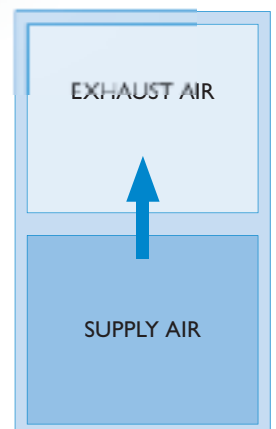
HORIZONTAL SUPPLY AIR PRE-COOLED



ORIENTATION

- Available in both vertical and horizontal arrangements
- The warmer airstream must be at the bottom in the vertical mode
- Can also be installed 'flat' to suit vertical airstreams

VERTICAL SUPPLY AIR PRE-COOLED



SPC Heat Pipes for Dehumidification and Heat Recovery

Standard Specification

1.1 GENERAL

Heat pipes for enhanced dehumidification shall be of the 'wrap-around' type included in the AHU around the main cooling coil. The heat pipes shall consist of a precool fin block upstream of the cooling coil linked to a reheat fin block downstream of the cooling coil by means of 'wrap-around' pipes. Heat pipes will be delivered to the AHU manufacturer fully factory charged and sealed. Where necessary, dehumidifier heat pipes may be incorporated in the ductwork to and from the AHU. In this incarnation the heat pipes will be of the straight type as described below.

Heat pipes for energy recovery will be of the straight type and included within the AHU or within the supply and extract ductwork. The heat pipe shall straddle the airways in the supply and extract decks of the AHU or the supply and extract ductwork and will incorporate a dividing plate to separate the two air streams. The two airways shall be adjacent to one another with minimum separation. The heat pipes will comprise a supply fin block directly coupled to an extract fin block and the two airstreams shall be arranged to be in counter flow as they pass through the heat pipe. The heat pipe shall be suitable for either side by side mounting between the two adjacent ducts (horizontal heat pipe) or top and bottom mounting (vertical heat pipe). The lengths of the heat pipes in the supply and extract sections need not be equal and shall be selected to suit the respective air volumes. The number of heat pipes in each section shall be identical. Heat pipes will be delivered to the AHU manufacturer or contractor fully charged and sealed.

1.2 FINS

The external fins shall be of aluminium with a minimum thickness of 0.11mm. Fins shall be of the continuous plate type to maximize the external surface area rather than individually finned tube pattern. The fins shall be of the rippled or louvered type to suit the application and spaced at such a distance as required by the conditions specified. If necessary, fin spacing may differ between the two sections of the heat pipe. In corrosive atmospheres copper fins, vinyl precoated aluminium, or Blygold/Heresite post coated aluminium may be used.

1.3 TUBES

Tubes shall be of refrigeration standard seamless copper C106 for heat exchanger use. Tube diameter shall be a minimum of 12mm with a grooved inner surface to enhance the internal surface area and prevent pooling of liquid. The minimum root thickness of the tube shall be 0.35mm. The number of rows of tubes shall be selected to suit the application. Multiple row heat pipes shall have tubes in a staggered, equilateral pattern to optimise the airside heat transfer.

1.4 CASING

Casings shall be from galvanized sheet steel with a minimum thickness of 1.2mm. The casing shall incorporate tube plates, sideplates and intermediate stiffening plates as required. Straight heat pipes will incorporate a centre dividing plate to prevent cross-contamination between the two airstreams. Should the conditions allow moisture to be condensed on the surface of straight heat pipes then, unless overall catchment is provided in the AHU, the heat pipe shall be complete with an integral drainpan. Vertical, straight heat pipes with drainpans shall be complete with moisture eliminator blades to trap moisture blown off the horizontal fin surfaces. Coverboxes shall be provided around the ends to protect the exposed pipes and rigidly join the two sections of wrap-around heat pipes.

1.5 WORKING FLUID

The working fluid shall be water or refrigerant R134a. The heat pipe circuits shall be factory charged with the calculated weight of water / refrigerant and hermetically sealed. Individual heat pipes shall be manufactured in such a way as to ensure that all non-condensable gases are removed from the tubes.

SPC Heat Pipes for Dehumidification and Heat Recovery

Standard Specification

1.6 CIRCUITRY

Wrap-around heat pipes shall be formed from an array of complete loops such that the working fluid flows around the loop in only one direction i.e. liquid and vapour flow in the same direction to ensure that returning liquid is not entrained by the vapour. There will be a multitude of loops in the height of the heat pipe and each loop shall be individually charged. Heat pipes with header assemblies containing a single circuit are not suitable as a single leak will render the entire heat pipe inoperative. When multiple row heat pipes are used the rows shall be connected together in a counter flow orientation to optimise the heat pipe performance. Rows shall not be manifolded together. Heat pipe loops shall be arranged to slope down to the precool side to allow gravity assisted liquid return to maximize the internal heat transfer.

Straight heat pipes shall be formed from an array of complete loops, each loop straddling the supply and extract airways with the same number of tubes per loop in both sections. There shall be a multitude of loops in the height/width of the heat pipe and each loop shall be individually charged. Heat pipes with header assemblies containing a single circuit are not suitable as a single leak will render the entire heat pipe inoperative. When multiple row heat pipes are used tubes in different rows shall not be connected together; this will ensure correct counter flow between the airstreams and optimise the performance of the heat pipe. Rows shall not be manifolded together. Heat pipe loops shall be arranged to allow gravity assisted liquid return to maximize the internal heat transfer. Vertical heat pipes will have the warmer air flowing over the bottom of the heat pipe and horizontal heat pipes will incorporate a slope from the warmer side up to the cooler side.

1.7 PERFORMANCE

Heat pipes shall be designed to comply with the specified conditions when subject to the air volumes given in the specification. Heat pipe performance shall be independently type tested and certified in line with the requirements of British Standards BS 5141 pt I / European Standards EN 305 & 306 for testing and rating of heat exchangers. Alternative acceptable and equivalent standards are AHRI 410 and AHRI 1060 respectively. All software used to predict the performance of heat pipes shall be based upon the results of these independent tests.

1.8 INSTALLATION

Wrap-around heat pipes shall be designed to fit around the main cooling coil within the AHU and its dimensions will be selected so as to allow this. Both the heat pipe and cooling coil shall be blanked-off to ensure that there is no air bypass around the fin blocks of either the heat pipe or cooling coil. The base of the air treatment section of the AHU shall form a drainpan.

Energy recovery heat pipes for AHU mounting shall be designed to fit within the supply and extract sections with flanges on the centre dividing plate sized to match the thickness of the panels separating the two decks. The heat pipe shall be sized to maximize the available finned surface area when fitted in the AHU. Once installed within the AHU the heat pipe shall be blanked-off to ensure that there is no air bypass around the fin blocks of either the supply or extract section. This must be on both entering and leaving air faces.

For duct-mounted energy recovery or dehumidifier applications heat pipes shall be sized to match the area of the supply and extract/return ducts. Whenever necessary, ducting transformation pieces shall be fitted by the installer upstream and downstream of the heat pipe so as to ensure the correct air velocity. The casing of the heat pipe shall be complete with flanges for mating to the adjoining ductwork. Mating faces shall be screwed or riveted and sealed in line with standard ductwork practice.

SPC Heat Pipes for Dehumidification and Heat Recovery

Examples



British Museum, UK



Royal Victoria Hospital, UK



Royal Mirage, Dubai



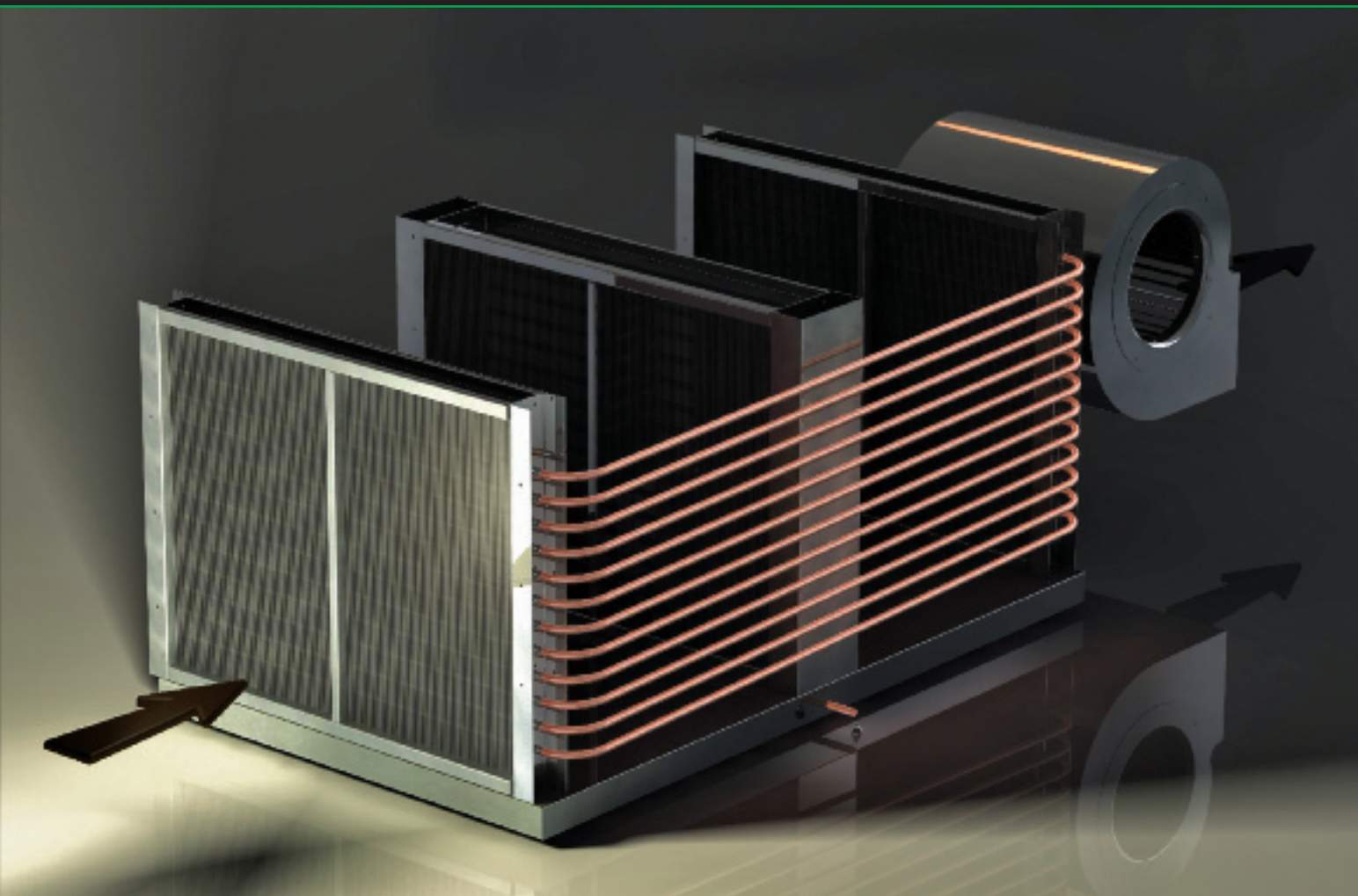
Mankhool Towers, Dubai



One Peking, Hong Kong



Polar Adventure, Hong Kong Ocean Park



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