Energy Recovery Systems
ACT-HP-AAHX Series Passive Air-to-Air Heat Pipe Heat Exchangers

Start Saving Energy Today:
- Substantial energy cost savings in cold or hot climates
- No cross-contamination between isolated airstreams
- Economically improves indoor air quality
- Quick return on investment from energy savings
- Reduce heating or cooling requirements
- Totally passive, no moving parts or system maintenance
- Engineered efficient & compact design
Heat pipes are a proven heat transfer technology with highly dependable operational performance in diverse applications including HVAC, industrial electronics, military and aerospace. ACT has over 200 years of accumulated engineering experience in the design, testing and manufacturing of heat pipes.

**ACT-HP-AAHX Air to Air Heat Exchangers Utilize High Performance Heat Pipes**

**Heat Pipe Operating Principle:**
Heat pipes function by absorbing heat at the evaporator end of the cylinder, boiling and converting the fluid to vapor. The vapor travels to the condenser end, rejects the heat, and condenses to liquid. The condensed liquid flows back to the evaporator, aided by gravity.

This phase change cycle continues as long as there is heat (warm outside air) at the evaporator end of the heat pipe. This process occurs passively (no external electrical energy required). A typical ACT-HP-AAHX moves thousands of Btu/hr of energy between the supply air and exhaust airstreams.

**ACT-HP-AAHX Series Functionality and Performance**

The ACT-HP-AAHX Series Heat Pipe Heat Exchangers feature sensible heat transfer. Typical installations are placed across the supply and exhaust airstreams. ACT heat pipe technology allows passive bidirectional heat transfer to pre-cool or pre-heat airstreams depending upon the season. The system recovers energy in summer or winter without any mechanical adjustments. Installation requires side-by-side duct work. Static pressure drop is minimal. The intake and exhaust airstreams are completely sealed preventing cross contamination.

The ACT-HP-AAHX Series Heat Pipe Heat Exchangers feature no moving parts, minimum cleaning (dust removal) and are hermetically sealed for lifetime operation. There are a variety of sizes and flow rates available.
Exhaust Air Energy Recovery Requirements (Table 1)

<table>
<thead>
<tr>
<th>Zone</th>
<th>% Outdoor Air at Full Design Airflow Rate</th>
<th>Design Supply Airflow Rate (cfm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥30% and &lt;40%</td>
<td>≥5000 and &gt;0</td>
</tr>
<tr>
<td>3B, 3C, 4B, 4C, 5B</td>
<td>≥40% and &lt;50%</td>
<td>≥5000 and ≥12000</td>
</tr>
<tr>
<td>1B, 2B, 5C</td>
<td>≥50% and &lt;60%</td>
<td>≥5000 and ≥2500</td>
</tr>
<tr>
<td>5B</td>
<td>≥60% and &lt;70%</td>
<td>≥5000 and ≥1000</td>
</tr>
<tr>
<td>1A, 2A, 3A, 4A, 5A, 6A</td>
<td>≥70% and &lt;80%</td>
<td>≥5000 and &gt;0</td>
</tr>
<tr>
<td>7, 8</td>
<td>≥80</td>
<td>≥5000 and &gt;0</td>
</tr>
</tbody>
</table>

ANSI/ASHRAE/IES Standard 90.1-2010

Energy Recovery Example:

Just about every location in the United States can benefit from the transfer of energy from the building’s exhaust air stream via an air-to-air heat pipe heat exchanger to either pre-cool or pre-heat the incoming outside air. Thousands of Btu/hr can be recovered to greatly reduce operating costs and in most cases down-size the initial air handling system. The ASHRAE Standard 90.1 specifically calls out where exhaust air energy recovery should be applied.

For example in Zone 5-A (Northern Climate) with an air handling system that is designed at ≥ 50% to <60% Outside Air, systems greater than 3,500 cfm should take advantage of energy recovery. Another example is Zone 2A (Southeastern Climate) where the direct outside airflow is ≥ 60% to <70%. In this application, systems greater than 2,000 cfm should utilize energy recovery. So, both warm and cold climates benefit.
The ACT-HP-AAHX recovers the energy from the conditioned exhaust airstream and transfers the energy to the supply airstream to reduce heating or cooling plant loads. The captured BTUs can save thousands of dollars per year in heating and cooling costs. Payback on larger units, 10,000 cfm and up, is typically under one year. The optional ACT-HP-AAHX-T features an integrated pivot that allows the unit to shift from summer favorable tilt to a winter favorable tilt so that energy can be recovered year round. Winter time frost protection on the exhaust stream coil can be accommodated through the building automation control system. As frost potential temperatures are reached the system briefly tilts to warm up the exhaust stream coil.

Depending upon airflow and regional location, ASHRAE 90.1, 2010 (Table 1) highlights applicable system CFM sizes where the ACT-HP-AAHX product is most beneficial. These recommendations are also followed by local building codes.

SELECTING ACT-HP-AAHX SYSTEM:
This ACT-HP-AAHX Selection tool www.1-ACT.com/HVAC/AAHX, is intended to provide the HVAC designer with the capability to perform a system design selection and to evaluate energy recover performance at various design points. It is also intended as a system design collaboration tool to clearly communicate project requirements, goals, and preliminary selections with ACT applications engineers.

DOCUMENTING AND EVALUATING YOUR WORK:
There are two useful output options. One is a “Print to PDF”, which will capture the on screen data in a PDF format. The other is a “Submit to ACT” which again captures the screen data, including your optional project information. The PDF arrives at ACT where it can be evaluated and potential recommendations can be made for system design optimization. The final selection can be the basis for a quotation.
ACT-HP-AAHX Series Passive Air-to-Air Heat Pipe Heat Exchangers

Air-to-Air Heat Pipe Heat Exchanger Dimensional Specifications

Front View Dimension Table

<table>
<thead>
<tr>
<th>Fin Height “MUST” be in multiples of 0.625”</th>
<th>FH: Fin Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Specified</td>
<td>FL1: Fin Length</td>
</tr>
<tr>
<td>User Specified</td>
<td>FL2: Fin Length</td>
</tr>
<tr>
<td>Typically 2.0” or as specified</td>
<td>C: Center Divider Width</td>
</tr>
<tr>
<td>Minimum of 1.5” or as specified</td>
<td>E1 - E2: Side Flange</td>
</tr>
<tr>
<td>Minimum of 1.0” or as specified</td>
<td>E3 - E4: Top - Bottom Flange</td>
</tr>
</tbody>
</table>

Side View 2 - 4 - 6 Row Heat Pipe Heat Exchangers

Side View Dimension Table by Number of Rows

<table>
<thead>
<tr>
<th>Rows</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>W*</td>
<td>1.5”</td>
<td>3.0”</td>
<td>4.0”</td>
<td>5.0”</td>
<td>6.0”</td>
<td>7.0”</td>
<td>8.0”</td>
<td>9.25”</td>
<td>10.5”</td>
<td>11.5”</td>
</tr>
<tr>
<td>FW</td>
<td>1.08”</td>
<td>2.17”</td>
<td>3.25”</td>
<td>4.33”</td>
<td>5.42”</td>
<td>6.49”</td>
<td>7.58”</td>
<td>8.66”</td>
<td>9.75”</td>
<td>10.83”</td>
</tr>
</tbody>
</table>

Note: W* Indicates Minimum Width other Widths can be specified.
The ACT Air-to-Air Heat Pipe Heat Exchanger (HP-AAHX) shall be part number series ACT-HP-AAHX as manufactured by Advanced Cooling Technologies, Inc. The heat pipe shall transfer heat between the outgoing and incoming airstreams in a counter flow arrangement, and shall be labeled for direction of airflow, noting inlets and outlets of exhaust and supply. The heat pipe heat exchanger shall be a passive device, requiring no other means for heat transfer, and shall be capable of operating at temperatures ranging from –50°F minimum to 180°F maximum.

Heat Pipe Heat Exchanger performance data is derived from laboratory testing in accordance with AHRI testing standards for Air-to-Air heat exchangers. Air-to-Air Heat Pipe Heat Exchanger performance shall be rated in accordance with applicable AHRI testing procedures.

Manufacturers of alternate equipment must be approved to bid via addendum, in writing by the specifying engineer, at least two weeks prior to bid time in order for their bid to be accepted by the contractor. If the equipment is not pre-approved then under no circumstances shall the contractor invest time or money in receiving submittals or considering the equipment.

The HP-AAHX shall be installed vertically: with the warmer air stream under the cooler air stream. If the air stream at the top is warmer than the bottom, the HP-AAHX will not transfer heat in reverse.

The HP-AAHX shall be installed horizontally: with 1/8 to 1/4 inch per foot tilt angle with the warmer stream passing through the lowest end of the HP-AAHX and the cooler stream passing through the highest end. With this type of installation, if the warmer stream changes to the highest end, the HP-AAHX will not transfer heat in reverse.

The HP-AAHX shall be installed horizontally: level to within 1/8 inch end-to-end for heat transfer in either direction depending on which stream is warmer.

Costs associated with dimensional, performance, or other deviations from the specified equipment, including engineering costs to evaluate such deviations, shall be paid by the contractor.

The manufacturer must have a quality management system in place, equal to the quality management system in accordance with ISO–9001–2008, for the design, manufacture, and service of heat exchangers. The manufacturer must also have a net worth greater than five times the value of the equipment being bid and must have been a manufacturer of heat pipes and heat pipe assemblies for at least five years prior to bid time. The heat pipe heat exchanger must be manufactured in the United States of America. The manufacturer shall have a 5-YEAR PARTS & LABOR WARRANTY – 20 YEAR HEAT PIPE PERFORMANCE WARRANTY.

DESIGN AND CONSTRUCTION FEATURES
1. Air-to-Air Heat Pipe Heat Exchanger:
Heat pipes shall be 0.5 inch outer diameter, seamless, internally rifled copper tubes. The finned tube coils shall have aluminum fins, 0.006” minimum thickness, with enhancement (corrugated wave, sine wave, or louvered) to meet the performance and pressure drop requirements. Fin density shall be 10-12 fins per inch. Heat pipes shall be a maximum of 1.25 inches on center in the face and shall be 1.08 inches on center row-to-row.

Heat pipes shall be individually processed, individually charged, and hermetically sealed. HP-AAHX Heat Pipe Heat Exchangers shall be installed as shown on the manufacturer’s submittal drawings.

2. Protective Heat Pipe Heat Exchanger Enclosure:
The heat exchanger frame shall be fabricated from minimum 16-gauge galvanized steel. The frame shall be supplied with a minimum of 1.50 inch wide flanges on all four sides, both front and back. Intermediate heat pipe supports and lifting points shall be furnished as required.

The heat exchanger shall be provided with a partition to isolate the outgoing and incoming airstreams; there shall be no cross contamination. The partition shall be fabricated from a minimum 16-gauge, galvanized steel and shall extend beyond the finned surface with a 3.0 inch mid-seal (1.5 inches to supply side and 1.5 inches to exhaust side).

End cover plates shall be provided to protect the heat pipe ends from possible installation damage. End plates shall be fabricated from minimum 16-gauge galvanized steel.

Note: Drain pans are recommended under all coils and are not standard.

3. Working Fluid:
The Air-to-Air Heat Pipe Heat Exchanger working fluid refrigerant shall be selected on the basis of heat pipe operating temperature and compatibility with heat pipe tube material. Heat pipe heat exchanger refrigerant used shall be classified as ASHRAE safety group A1.

4. HP-AAHX Protective Coating (When Specified):
E-Coat to protect against corrosion: Coating to be factory applied to entire unit after final fabrication.
Optimize Your Dedicated Outdoor Air Installations

- **Reduce Overall HVAC System Heating and Cooling Requirements**: Size of the heating and/or cooling systems can be downsized based on our Air-to-Air heat pipe heat exchanger performance efficiency. The energy used to heat or cool air leaving a facility can now be safely recovered and passively transferred to boost HVAC system performance.

- **Meet Standards & Codes**: ACT’s Heat Pipe Heat Exchangers enable HVAC system designers to meet ASHRAE Standards 62.1 and 90.1, increasing building comfort while saving the building owner thousands of dollars per year.

- **Easily Specified**: ACT–HP–AAHX Series Heat Pipe Heat Exchangers feature a thin planar profile construction. The slim profile provides ease of installation in new or existing AHU equipment, industrial or commercial energy recovery applications. Multiple, individually sealed high capacity heat pipes offer reliable lifetime performance. Each installation is sized for optimum performance for the highest practical Btu/hr transfer between air streams.

- **Care and Operational Costs**: Since our Energy Recovery systems are totally passive (zero external electrical power to operate), your energy saving add up year after year. There are no periodic maintenance requirements needed for typical operating conditions other than keeping the heat pipe coils free of dust and debris.

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**Air-to-Air Heat Pipe Heat Exchanger Installation Options:**

- FLAT
- VERTICAL
- HORIZONTAL

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**Air-to-Air Heat Pipe Heat Exchanger System Sensible Heat Transfer Performance**

Every ACT Air-to-Air Heat Pipe Heat Exchanger is designed to yield the optimal effectiveness in BTU/hr savings. ACT’s energy recovery systems are custom engineered for each project to yield the best ratio of cost versus performance. Typical system payback is in under two years.
Other Energy Recovery Products:

ACT-HP-WAHX Wrap Around Dehumidification Systems

ACT-HP-WAHX Wrap-Around Heat Exchangers with Enhanced Dehumidification offer custom engineered performance to enhance an AHUs energy efficiency and greatly reduce energy costs.

ACT-HP-WAHX Wrap-Around systems can be designed for installation into nearly all AHUs on the market. For retrofitting existing system AHUs, ACT will ship a fully functional-design fitted system that is ready for on-site installation.

ACT offers the following installation options: ACT Factory, OEM Factory and On-Site Retrofit. Typical payback periods of 1–2 years.

Climate Test Chamber Thermal Performance Testing

ACT’s Climate Test Chamber provides thermal performance testing of Wrap-Around Dehumidification and Air-to-Air Heat Pipe Heat Exchangers per AHRI specified test conditions.

Heat Pipe Systems Provide Benefits to help meet or Achieve:

- ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality
- ASHRAE I 89.1 Standard for the Design of High-Performance green Buildings
- LEED Points possible for: Energy and Atmosphere, Indoor Environmental Air Quality, innovation in design
- ISO 5000: Energy Management Standard: public and private sector organizations with management strategies to increase energy efficiency, reduce costs and improve energy performance.

Note: USDOE Reference: www1.eere.energy.gov/lmp/technologies/heat_wraparound_pipes.html

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