HEAT PIPE TECHNOLOGY

HRM

Heat Pipe Energy Recovery Modules

Installation, Operation & Maintenance

Publication: SC151101
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6904 Parke East Blvd. Tampa, FL 33610, USA • Phone: (813)470-4250 • Fax: (813)470-4252 • Email: info@heatpipe.com

Safety Instructions

Warning

The heat pipe heat exchanger must be level when lifted and moved. The Heat Pipe contains liquid and tilting the heat pipe will cause the center of gravity to shift to one side creating an imbalance. Also, the heat Pipe could weigh hundreds of pounds which may lead to serious injury should the heat pipe fall over.

Caution

The heat pipe heat exchanger contains liquid and vapor under high pressure. Do not drill into or puncture the heat pipe tubes as doing so will release the contents from a high pressure. Refer to **Appendix 2** for guidance or where to drill or attach screws, as needed.

Do not touch the fins. The fins are sharp and may easily cut through skin.

The heat pipe must be adequately supported in the installed position. Inadequate support strength may cause the support structure to fail under the weight of the heat pipes, possibly causing damage and injury

Product Nomenclature

Please refer to **Appendix 1** of this manual for product nomenclature for Heat Recovery Module (HRM)

Introduction

The HPT Heat Recovery Module (HRM) is a heat exchange system for moving heat from one air stream to another to recover heat in winter or remove heat in the summer for either comfort or process applications. Refrigerant passively travels back and forth from the supply air end to the exhaust air end where it changes phase from a liquid to a gas and back to a liquid, as long as there is a temperature difference between those two airstreams.

Each heat exchanger is constructed of multiple circuits, individually charged for maximum heat transfer and reliability. The HRM can be ordered with multiple rows to suit design requirements. Most systems fall between six and eight rows.

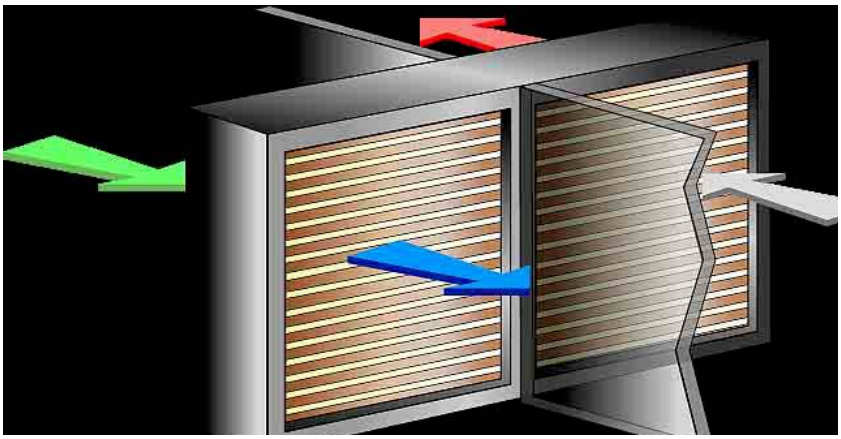

Fig 1 - HRM Showing Air Stream Separation

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Construction is of copper tube and either aluminum or copper fins. They are encased on top, bottom and ends with heavy gauge galvanized or stainless sheet metal. Copper tubes are mechanically expanded into the fins for maximum heat transfer.

A divider section is added to separate the air streams, which will also provide structural support. This separation comprises two center sheet metal pieces either back to back, or separated. This area is finless. Optional foam fill can be applied to the area reducing the chance of any cross contamination to a minimum. There may also be other structural supports along the finned length of the heat exchanger. For best performance, one air stream must be counter to the other. Inside an air handler, the HRM is placed through an opening in the wall separating two halves of the air handler. One half would be in the path of supply air and the other side would be in the path of leaving exhaust air.

Responsibilities

The heat pipes can arrive at the site either as a module or pre-installed in an air handler. It is the responsibility of the receiving party to install the heat pipe system correctly. The installing party shall provide all the material and labor according to HPT's instructions.

Unpacking

The heat pipes are thoroughly inspected prior to leaving the factory. Upon arrival, the heat pipes should be unpacked and inspected for visible and concealed damage as soon as possible. Lifting brackets are installed on top of each HRM for ease of movement and installation. The coils should only be lifted using these brackets. The brackets are removed after they are no longer needed. If damage is found, it is the responsibility of the receiving party to file a claim with the freight carrier. HPT can help with paperwork.

The HRM will be shipped with two or more lifting brackets on top for rigging-see Fig. 2. Ensure you have the proper equipment to handle the weight of the HRM. **Never lift the HRM by its center only;** both sides must be supported- See Fig 3.

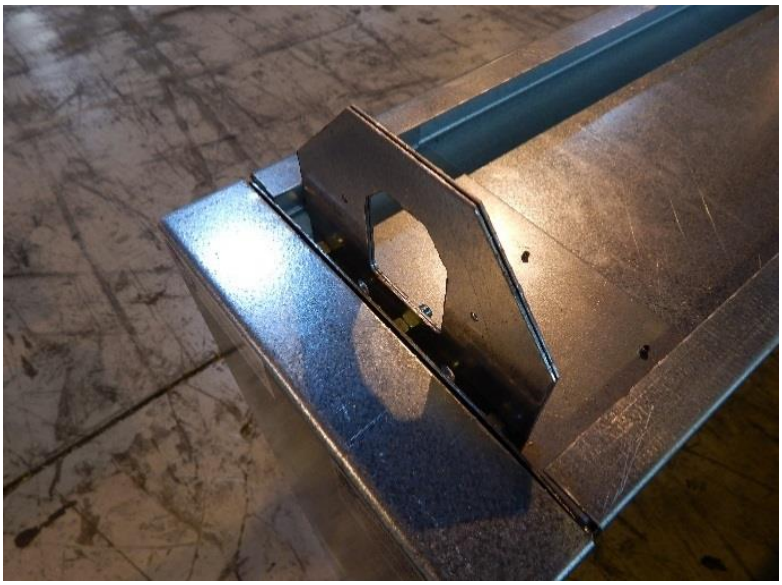

Fig 2-Lifting Bracket

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On occasion web slings are provided by HPT in lieu of lifting brackets. Every effort is made to install slings correctly before shipping, but it is the riggers responsibility to check for safety before lifting.

The HRM circuits will be fully charged with a working fluid and should be handled carefully. Before setting in place, it is strongly recommended that the HRM is inspected once again for visible damage or sources of possible leaks. Repairs, if needed, should be made while it is still easily accessible. For Summer Winter operation, the heat pipe system must be installed level end to end to ±1/8”.

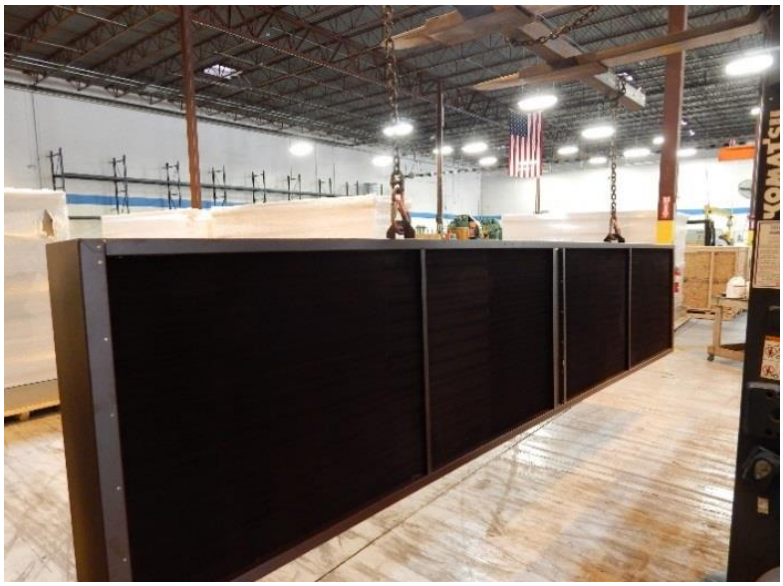

Fig 3-Using lifting brackets to hoist the heat pipe heat exchanger

Installation

When installing the HRM in an air handler or ductwork, there are several considerations to be taken into account:

- A drain pan similar to the one in **Appendix 3** is required (not provided by HPT). It will need to fit wall to wall on the bottom of the duct.
- The bottom of the pan should be insulated. If the duct is to be internally insulated, the duct should be made big enough so the HRM will fit inside the insulation.
- The condensate outlet needs to be high enough above the floor so that a trap can be made in the line to ensure proper flow of the condensate. Depending on application and geography, the HRM will condense moisture on the exhaust side in winter heat recovery mode, and on the supply side in summer cooling recovery mode.

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A transition from the duct size to the flange size should be fabricated so that turbulence will not cause uneven air flow through the coil. The slope of the transition should be no more than 45 degrees. The area between the two ducts and in the drain pan at the divider should also be sealed to prevent air from flowing from one air stream to the other.

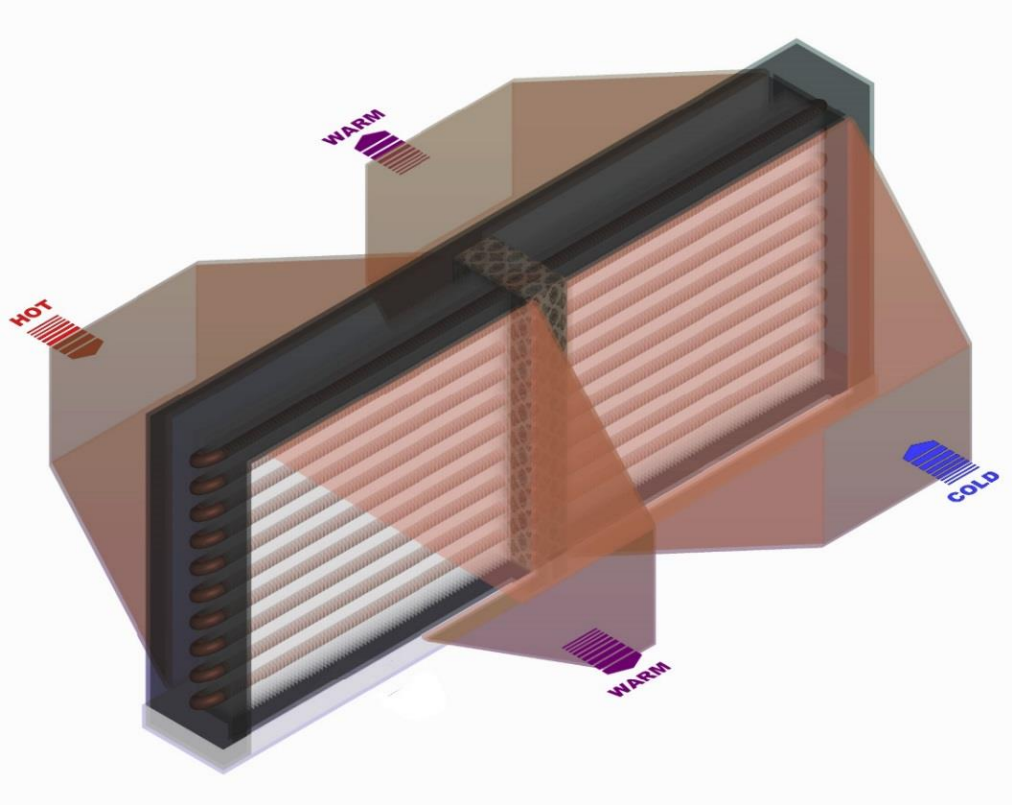

Fig 4- HRM Installed in Ductwork

Fastening Instructions:

Whether installed inside an air handlers or ductwork, HRMs need to be supported by attaching them to other structures. It is paramount that HPT fastening instructions are carefully read and followed. Otherwise tube punctures may result in losing multiple heat pipe circuits. Please refer to **Appendix 2** of this document for details on fastening instructions.

Flashing Instructions

To get the maximum performance out of the heat pipe heat exchanger, air must go through the supply and exhaust side of the HRM only. After installing in place, provisions to be made to flash around the heat exchanger to stop any potential air leaks or bypasses. Refer to **Appendix 3** of this document for full details.

Optional Equipment

An optional bypass damper/actuator assembly on the supply end is used for control of the heat transfer. Opening the damper will bypass air around the supply side of the coil, thus

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reducing the overall performance of the heat pipe. Although available from HPT, it is often supplied and installed by air handler manufacturers. Refer to submittal data for details if provided by HPT, or click on the links below to go directly to www.heatpipe.com/IOM for Damper, Actuator and Actuator Mount detail.

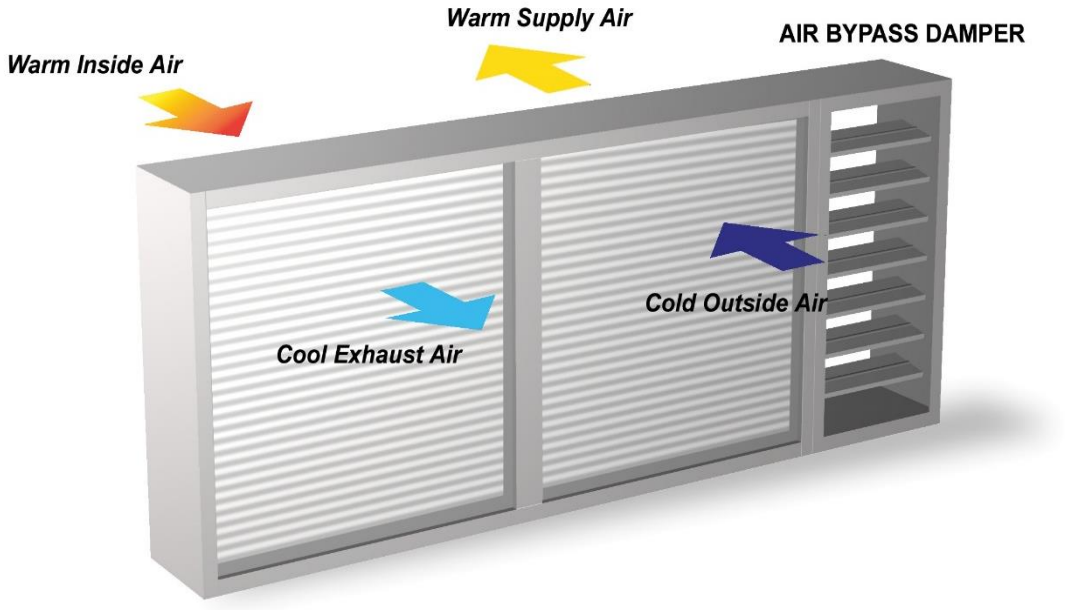

Fig 5-HRM with Factory Installed Bypass Damper

Modulating System Performance

There will be times when the heat pipe performance needs to be modulated to take advantage of favorable weather conditions, or to prevent frosting on the exhaust side at extreme cold conditions. A bypass damper assembly can be added to the supply side of the HRM. The damper actuator must be controlled by the building Automation System (BAS). The BAS can monitor the temperatures entering and leaving the HRM through temperature sensors (supplied and installed by others) and determine when to start opening the bypass damper. To shut off the heat pipe system performance, a face damper needs to be installed (not supplied by HPT), to act in unison with the face damper

AIR Filters

Air filters should be installed upstream of both supply and exhaust sections. Filters need to be changed on a regular basis to maintain the integrity of the heat pipe. The design engineer shall select the proper efficiency of the air filter to match the application.

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Operation

Control Strategy

The design engineer for the system is responsible for providing the set points for operation.

Refrigerant Circulation

For a level HRM, the system transfers heat from the warmer to the cooler end in either direction. Seasonal changeover happens automatically. Generally, the higher the temperature differential between entering air streams, the higher the heat pipe performance.

Bypassing the air around one section of the HRM reduces the amount of airflow through that end of the heat pipe thereby reducing the heat that will be absorbed and transferred to the opposite side. As such, operation of heat pipes is automatic. The heat pipes are made to be leak resistant and will give many years of trouble-free operation.

Defrost

Whenever supply air conditions are extremely cold, usually below zero degrees Fahrenheit, enough heat will be removed from the exhaust section to cause this side to start building frost. If the frost is not prevented, it will build to the point of blocking the exhaust air flow. This is most prevalent when there are six or more rows in the HRM and usually under ambient conditions below zero degrees Fahrenheit. Opening the outside air bypass damper will reduce the heat transfer to a rate that will not cause frost to form while still transferring as much heat as possible. By monitoring the leaving air temperature from the exhaust heat recovery module, frost can be prevented. As the leaving air temperature drops below 36 deg F, the damper should modulate and be fully open at 35 deg F. For example, a 6-row HRM with typical airflow of 500 FPM and 68 deg F exhaust temperature, the coil may not frost until:

6 rows	-2 deg F
4 rows	-20 deg F
2 rows	<-50 deg F

System Performance

Periodic checks of the system performance (or Effectiveness) based on BAS readings is an effective method of checking whether the system is operating properly. Trend data should be kept so that spot checks of the effectiveness can be made while the temperatures are at the most extreme. If any problems arise with the heat pipes, a drop in effectiveness will be the first indication.

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Effectiveness

The effectiveness of the Heat Pipe system expressed in a percent is the ratio of the amount of heat transferred to the amount of heat available.

For the HRM with any amount of rows: $Eff\ \% = \frac{CFMsa}{CFMmin} \times \frac{\mathrm{T2} - \mathrm{T1}}{T3 - T1}$

Example:

T1: Supply Air Entering Temp = 10°F

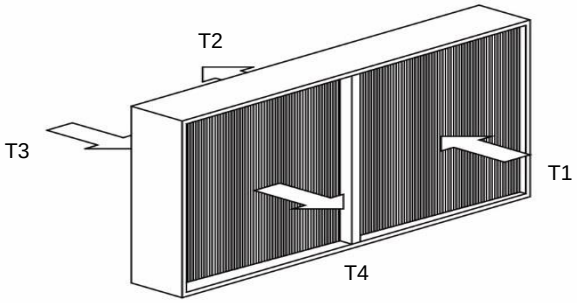
T2: Supply Sir Leaving Temp = 40°F

T3: Exhaust Air Entering Temp = 70°F

T4: Exhaust Air Leaving Temp = 40°F

CFMsa: Supply Airflow

CFMmin: Minimum (Supply or Exhaust Airflow)



$$\text{Supply } Eff\ \% = \frac{CFMsa}{CFMmin} \times \frac{\mathrm{T2} - \mathrm{T1}}{T3 - T1}$$

$$\text{Supply} Eff\ \% = 1 \times \frac{40 - 10}{70 - 10} = 50\%$$

Above example assumes equal airflows on the supply and exhaust side and no condensation on either side.

The predicted effectiveness is calculated for the system based on the engineer's specs prior to the installation of the system. Several factors go into the calculation, and if these factors change, the expected effectiveness can change. Construction variables such as difference in coil dimensions between supply and exhaust will affect the calculated effectiveness. Unequal airflows between the supply and the exhaust will also impact the effectiveness.

System Check

The heat transfer must balance. BTUH in one side must equal BTUH out of the other side. If the airflow through the supply end is the same as the airflow through the exhaust end, then the temperature change across each side must be the same (unless condensation occurs on either side). However, if there is more air through the supply end than the exhaust end, which is common with fresh air systems, then the temperature change across the supply end, and the related effectiveness, will be lower than that across the exhaust end. It is a good practice to measure the total heat transfer across each Heat Pipe section to ensure accurate measurement. If BTUH for one side: BTUH=(1.05)(ΔT)(CFM) equals BTUH for the other side and no condensation is taking place, and no air leaks, then the measurement variables can be considered accurate.

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Maintenance

Since heat pipes are passive devices, very little maintenance is required. However, the following is recommended to guarantee full performance and maximum benefits from the heat pipes for the life of the product:

- The heat pipes are sealed and should be leak free for the life of the equipment; however, they should be checked for leaks annually, during a shutdown, with a Halide Leak Detector. The most likely place for a leak to occur is at each end of the heat pipe. The ends should be checked by inserting the detector into the sheet metal covers at each end. Any build up inside the cover will cause the detector to alarm. Check for leaks at the face with a dragging motion. Since the HRMs comprise multiple circuits, although rare, a single leak will not have an appreciable impact on performance.
  Leak repairs are done with factory authorization and instruction.
- Check the Damper assembly in accordance with manufacturer's literature (if supplied) to insure proper operation.
- Change filters regularly on a time schedule or more often as their loading indicates.
- Annually clean the heat pipes or as often as the situation calls for cleaning. This will insure proper airflow.
  Debris stuck on the intake side can be removed by blowing air or low pressure water in the reverse direction.
  Heat pipes can be cleaned with ordinary dishwasher detergent and hot water or any commercial coil cleaner. Caution should be used so that the fins are not damaged. Any damage to the fins should be straightened out using appropriate fin combs. **Do not use Alkaline-based cleaning agents on aluminum fins. Corrosion may result adversely affecting the integrity and performance of the system.**
- Check and clean condensate drain pan to ensure proper drainage**.**
- Check the performance of the Heat Pipe annually. Perform the tests during the same period each year and under similar temperature conditions. Repeat the tests at different locations on the unit face. Keep a record of all readings for comparison.

Parameters to measure

T1: Supply air entering
T2: Supply air leaving
T3: Exhaust air entering
T4: Exhaust air leaving
Supply air CFM and Exhaust air CFM

Above readings are to be taken at multiple locations in a grid-like fashion approximately 6" away from the fins, then averaged out. If averaging sensors are used for temperature measurement, then record those readings.

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Heat Recovery Heat Pipes HRM Performance Check List

The form below is to be filled out and sent to HPT for the purpose of trouble shooting heat pipe performance. Guidelines above to be used for measurement.

Company: _____

Phone: (____) _____

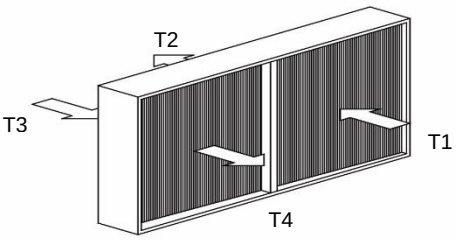
Project Identification: _____

Model #: _____

Serial #: _____

Date Installed:_____

Test Performed By: _____ Date: _____



Test		Summer / Cooling				Winter / Heating			
		Temp. °F DB	Temp. °F WB or RH	Press. in. w.g.	CFM	Temp. °F DB	Temp. °F WB Or RH	Press. In. w.g.	CFM
Air Side	Entering Air @ 1 *								
	Leaving Air @ 2 *								
	Entering Air @ 3 *								
	Leaving Air @ 4 *								
	HRM Dimensions Finned area only	SUPPLY Finned H_____"_Finned L _____"				EXHAUST Finned H_____"_Finned L _____"			

* If averaging sensors are installed in the system, record temperatures from BAS. Otherwise take multiple measurements across the module in each section and average the readings.

Check to make sure the heat exchanger is level end to end to within ±1/8".

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Energy Recovery Heat Pipes (Module Only)
Five-Year Limited Warranty

Subject to the following conditions, **Heat Pipe Technology, Inc. (HPT)**, warrants this product to be free from defects in material and workmanship for a period of FIVE YEARS for the heat exchanger only from the date of installation not to exceed 90 days from date of shipment. Dampers and HPT provided controls carry a 12 month warranty. This warranty is in lieu of all other warrants not expressly set forth herein, whether expressed or implied by operation of law or otherwise. In the event this product fails under normal use and service within the applicable period, HPT will correct, repair or, at its sole discretion, replace the defective product or refund the purchase price of products which are returned freight prepaid to HPT for inspection, when accompanied by proof of purchase and written claims of defect, and which upon inspection by HPT, do comply with the terms of this warranty.

This warranty applies to the first retail buyer and extends to any subsequent owners of the systems.

The cost of replacement parts or components shall be determined by the price schedule in effect at the time of submission of warranty claim.

Repair or replacement parts will be furnished F.O.B. factory in all cases.

If HPT elects to replace or provide a refund, the defective product must be returned to HPT free and clear of liens or other encumbrances.

Limitations on Liability

This warranty does not cover and no warranty is made with respect to:

A. Failures not reported to HPT within the period specified above;

B. Failures or damage due to misapplication, misuse, abuse, improper storage or handling, abnormal conditions of temperature, water, dirt, corrosive substances or other contaminants;

C. Products which have been repaired with parts or materials not furnished or approved by HPT or by its authorized dealers or representatives, or products which have been in any way tampered with or altered;

D. Products damaged in shipment or storage or otherwise without fault of HPT;

E. Normal maintenance as outlined in the installation and servicing instructions or owner's manual including coil cleaning, filter cleaning and periodic flushing of systems;

F. Damage or repairs required as a consequence of faulty installation or application by others;

G. Damage or repairs required as a consequence of any misapplication, abuse, improper servicing, unauthorized alteration or improper operation;

H. Damage as a result of floods, winds, fires, lightning, accidents, corrosive atmosphere or other conditions beyond the control of HPT;

I. Damage resulting from freezing of domestic water or condensate, inadequate or interrupted water supply, use of corrosive water, fouling or restriction of the water circuit by foreign material or like causes;

J. Damage resulting from operation with an inadequate supply of air or water;

K. Dampers or other mechanical options.

HPT total responsibility for any claims, damages, losses or liabilities related to the product covered hereunder shall not exceed the purchase price of such product. In no event shall HPT be liable for any special, indirect, incidental or consequential damages of any character, including but not limited to loss of use of productive facilities or equipment, lost profits, property damage, transportation, installation or removal, lost production, or personal injury whether suffered by Purchaser or any third party. HPT disclaims all liability for any and all costs, claims, demands, charges, expenses or other damages, either direct or indirect, incident to personal injury or property damage arising out of any cause of action based on strict liability.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the exclusion or limitation above of consequential damages or the limitation of time above on implied warranties may not apply to you.

This warranty gives you specific legal rights and you may have other rights which may vary from state to state.

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Energy Recovery Heat Pipes (Module Only)

Warranty Registration

To insure your warranty protection, please fill in the Warranty Registration Form and mail, or e-mail it to:

Heat Pipe Technology, Inc.

6904 Parke East Blvd.

Tampa, FL 33610

heatpipe@heatpipe.com

WARRANY REGISTRATION FORM	
Customer Name:	
Customer Address:	
Phone: ( ) -	Fax: ( ) -
Serial No:	Model No:
Type of Product:	
Date of Installation:	Contractor/Installer:
Customer Signature:	

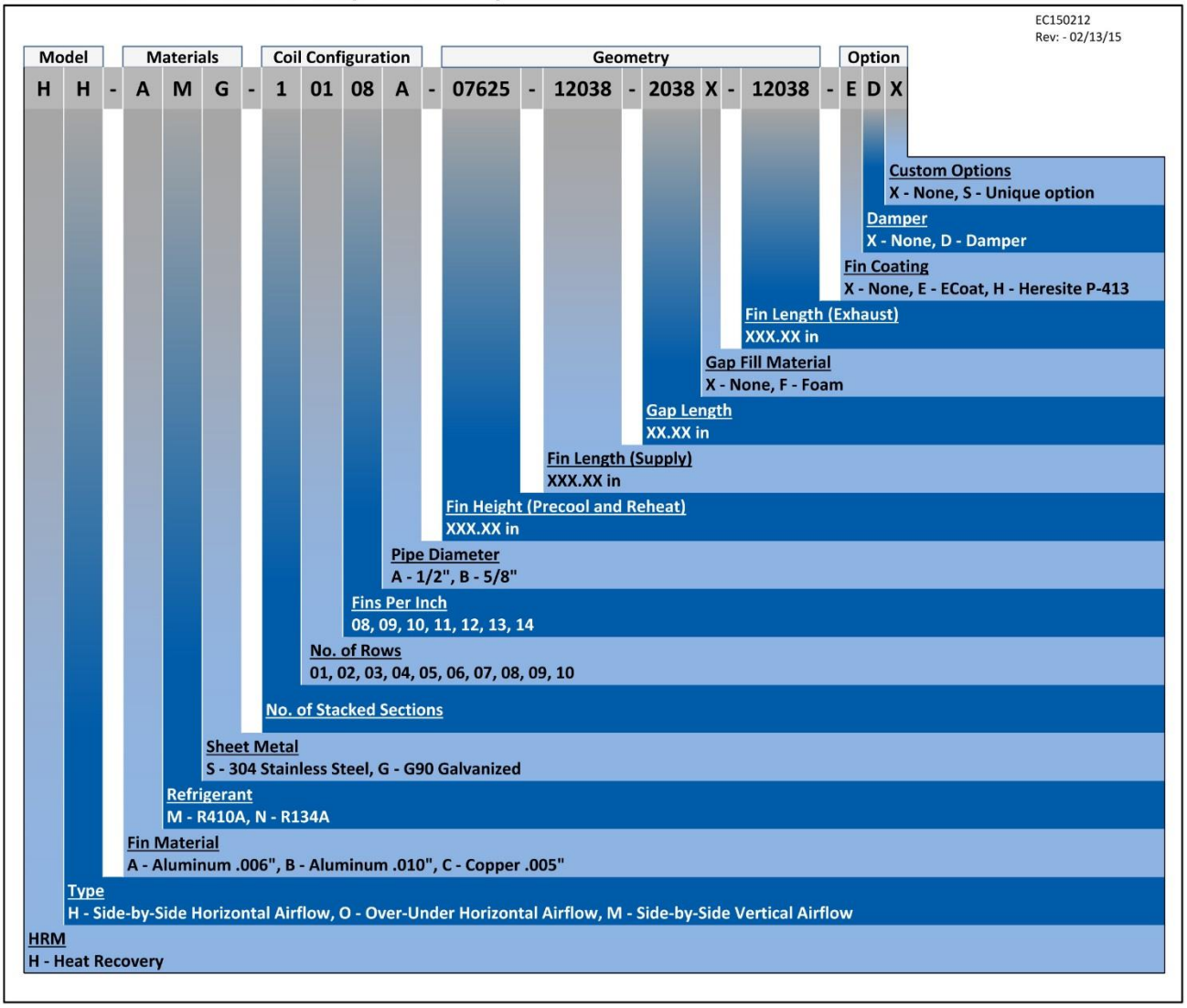
HPT reserves the right to change product design and specification without notice

For more info on this and other HPT products, please visit:

www.heatpipe.com

Appendix 1: Product Nomenclature

Order Code - HRM (General)



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Appendix 2: Fastening Instructions

HRM-H Fastening Instructions

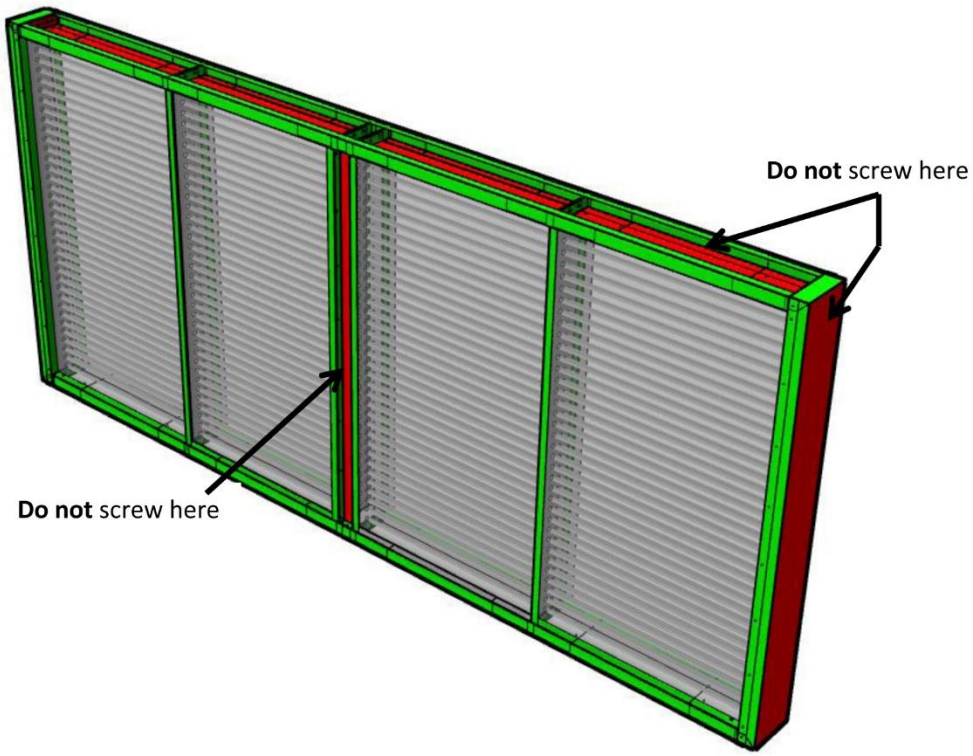
Author: Lorenso Roman Checked By: Jacob Fisher

In many applications, the HRM installer wishes to attach sheet metal flashing or secure the unit with screws. This document identifies which surfaces can be penetrated with screws and which shall not be penetrated with screws.

The illustrations below are color coded to indicate this:

Green Faces – Sheet metal screws ½" **or shorter** can be used. These areas have at least ½" clearance from internal piping.

Red Faces – No screws shall be used on these surfaces. Pressurized pipes are less than ½" away from these faces and can be inadvertantly damaged.



If in doubt, please call Heat Pipe Technology on (813) 470-4250 or (800) 393-3464 and ask to speak with an Applications Engineer.

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Appendix 3: Flashing Instructions

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Approved for External Use

Engineering Communication

Publication: EC150828
Revision: 09/16/15

HRM-H Flashing Instructions

Author: Jacob Fisher Checked By: Marcus D'Arcy

Scope

This document defines how a Heat Recovery Module with Horizontal airflow (HRM-H) should be installed to prevent air leakage across the coil and between airstreams.

A specific solution is described in this document. Alternative solutions are acceptable and the installer shall take responsibility for ensuring air does not leak and water drains correctly.

Introduction

In this document, a two-stacked HRM-H is shown installed in an Air Handling Unit (AHU), with drain pans at each leaving air section.

Typical HRM-H applications allow clearance so the HRM-H can be lowered or slid into an AHU or duct work; that clearance needs to be sealed to prevent air bypass and cross-flow. HRM-H face heights are selected in increments of 1.25 inches. If the HRM-H total selected height is less than the tunnel height, flashing shall make up for that height difference. Stacked HRM-H frame joints shall be flashed to avoid leakage.

Drain Pan

Drain pans are required on each leaving air side of the HRM-H. Drain pan designs shall meet the requirements as stated in ASHRAE 62.1.

Fasteners

Fasteners shall meet the requirements in document EC140828 HRM-H Fastening Instructions. If you do not have this document, contact Heat Pipe Technology at (813) 470-4250 and ask to speak with an Applications Engineer.

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Flashing Details

The illustrations in this document are color coded to indicate the following:

Blue – HRM-H Heat Pipe Yellow – Flashing metal and sealant Gray – AHU or ductwork

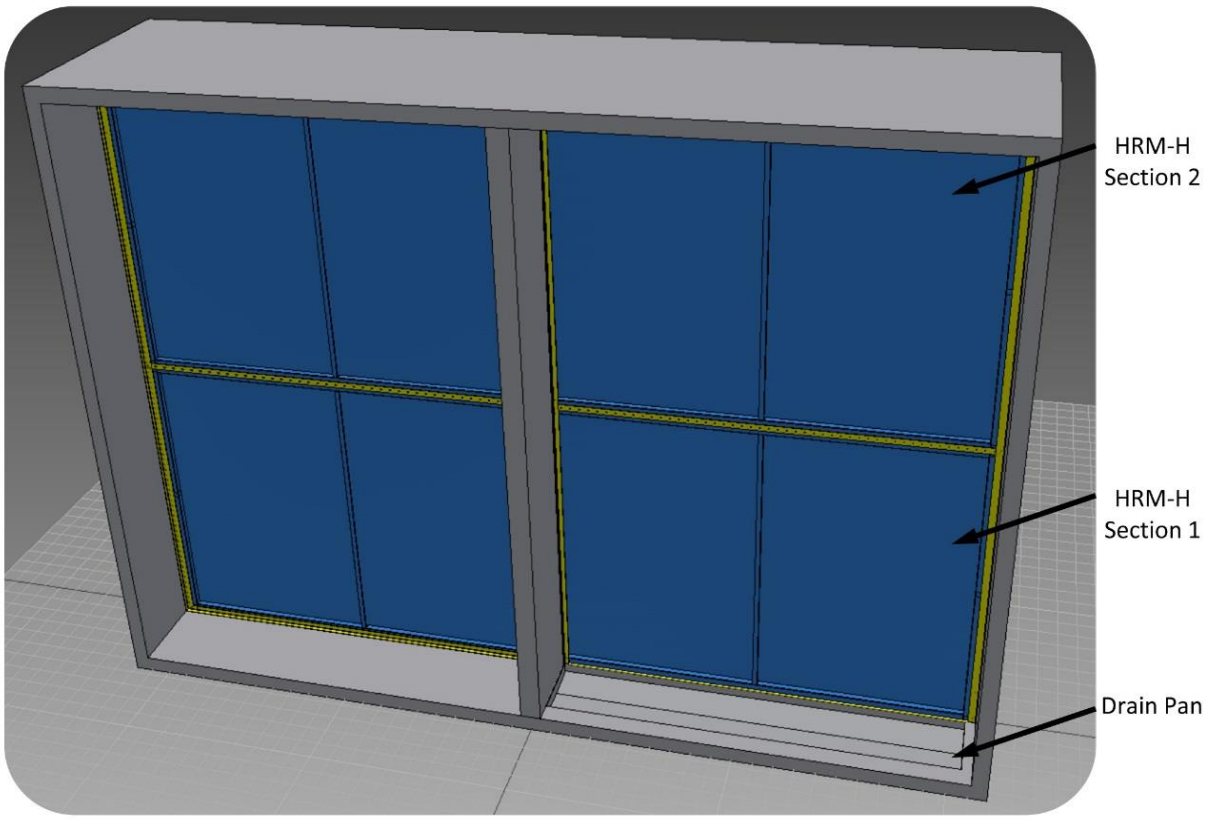

Figure 1: HRM-H Installed 3D View

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To prevent air leakage, seal all four entering and leaving sides with metal flashing. On each side, flashing shall be placed between the HRM-H frame and the AHU walls. Metal flashing is not needed between the HRM-H frame and the drain pan; a bead of sealant shall be used instead. When stacking multiple sections additional flashing is needed on the intersection between the upper and lower frames. All flashing shall be backed with sealant to completely fill voids that could allow leakage. For jobs where cross-contamination is critical, add a second line of defense by filling the top and bottom frame channels with a plug of foam where the AHU wall meets the HRM-H.

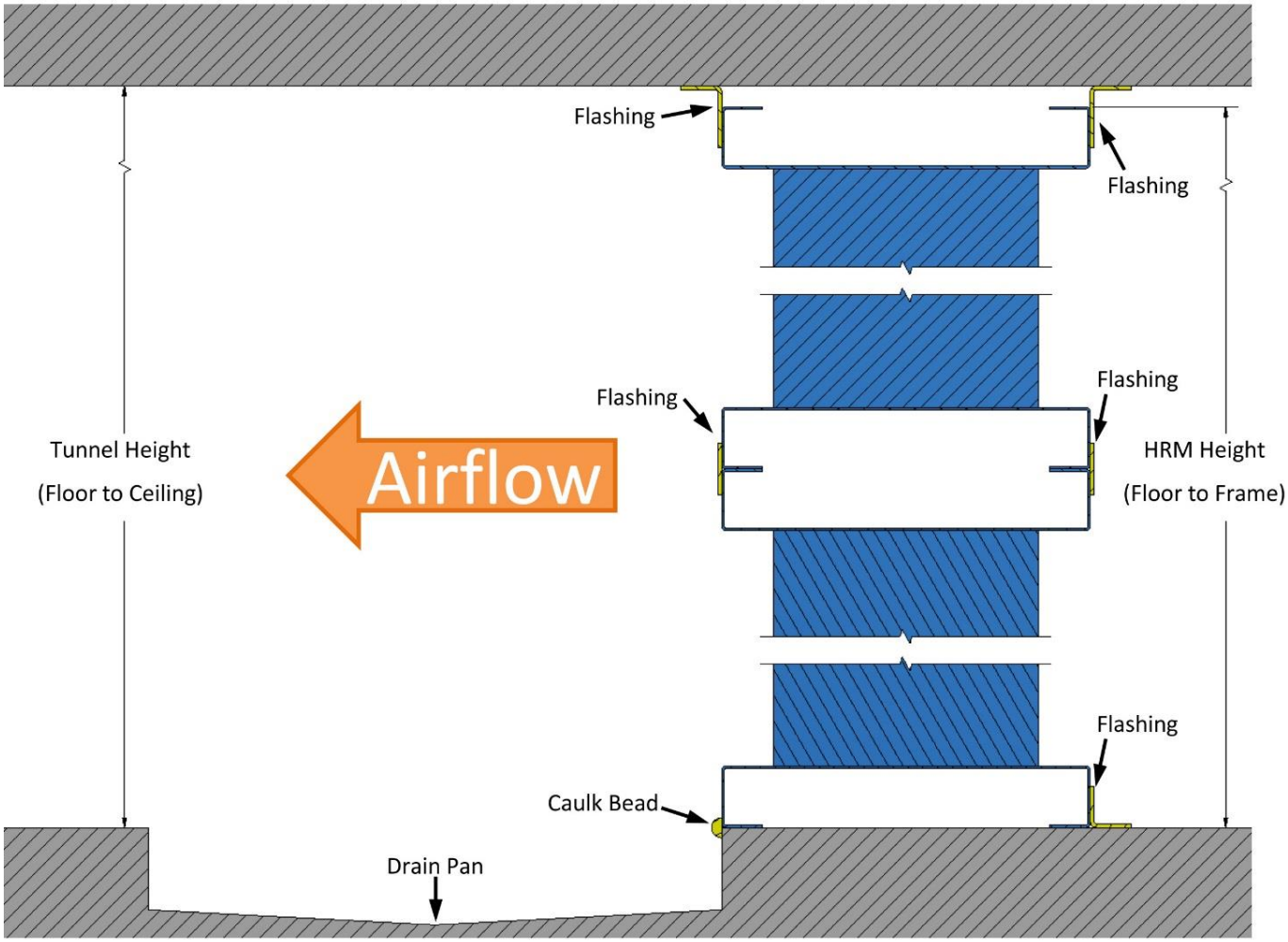

Figure 2: Side Cross Section

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Figure 3 shows a close up on the flashing between the HRM-H and AHU. Figure 4 shows a close up on the flashing between the HRM-H and drain pan.

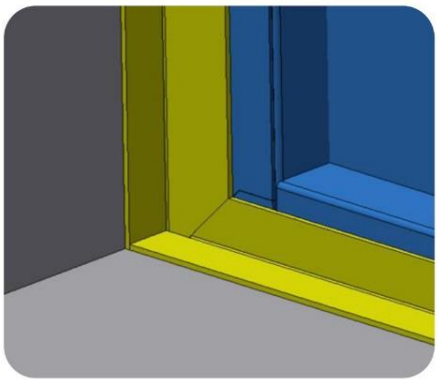

Figure 3: Flashing between HRM-H and AHU

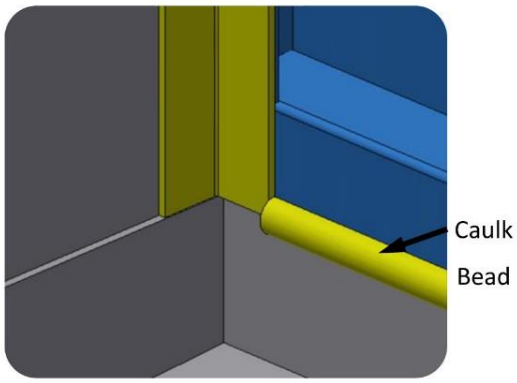

Figure 4: Flashing between HRM-H and drain pan

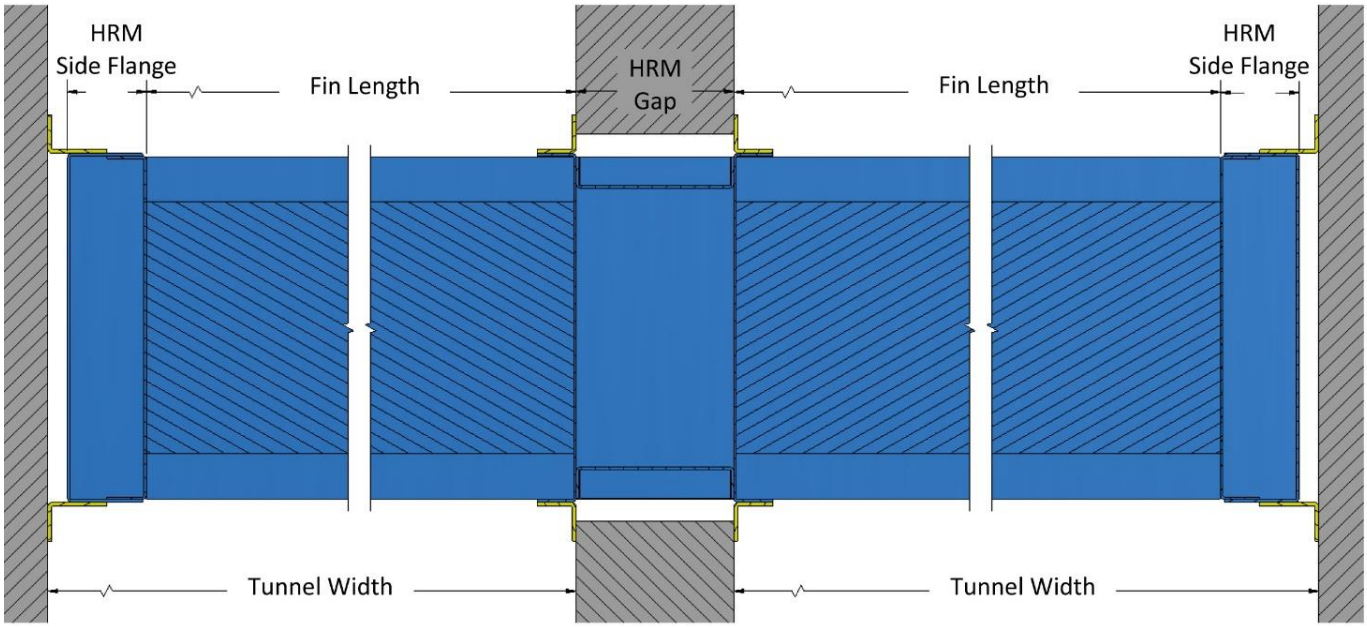

Figure 5: Top Cross Section

Figure 5 shows a plan view of an HRM-H flashed against the AHU walls. The gaps between the walls and HRM-H frame are shown in white. Leaving these gaps for install clearance is acceptable; however, the installer is responsible for flashing and sealing these gaps.

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