Installation, Operation and Maintenance Manual

BPE-XE-MIR, Air-to-Air Heat Exchangers

Eco Air Anywhere® Product Line

2020 edition

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Installation

Airflow Configuration

For normal operating conditions, i.e., air-to-air heat exchanger (AAHX) used for energy recovery ventilation (comfort-to-comfort), all outdoor airflows must be passed through the heat exchanger by the inlets and outlets labeled as AIRFLOW 1; all exhaust and/or return airflows must be passed through the heat exchanger by the inlets and outlets labeled AIRLFOW 2. For applications that involve natatoriums (pools), dehumidification, reheat, process-to-comfort, and/or process-to-process heat exchanger application please consult the application specific BPE manuals, or contact BPE Technical Support at (201) 722-1414.

Optimal performance will only occur if the BPE air-to-air heat exchanger is in counter-flow operation. Counter-flow operation can be up to 99% effective whereas cross-flow or parallel flow can only be as high as 75% and 50%, respectively (*ASHRAE Handbook – HVAC Systems and Equipment*, Chapter 44: Air-to-Air Energy Recovery, 2004). For counter-flow applications, BPE products should be installed as per Figure 1 below.

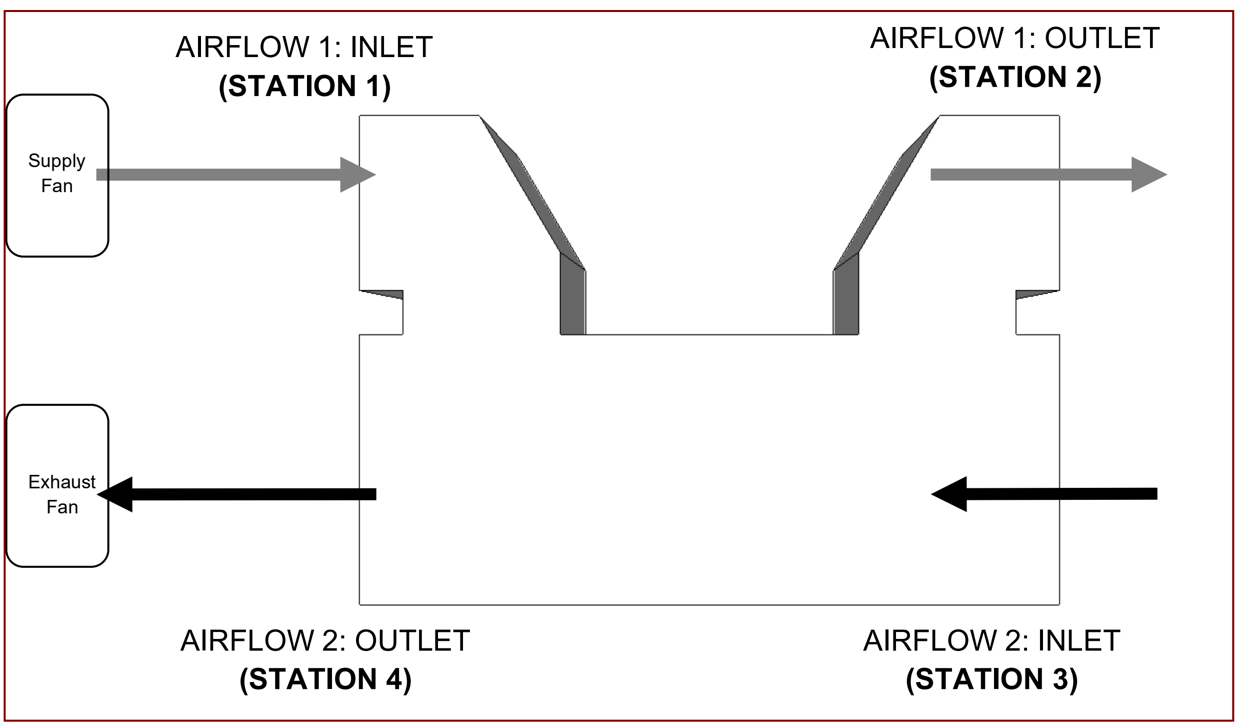


Fig. 1 – Counter-flow Arrangement (Side View), "Stations" based upon AHRI Guideline V, Generic Configuration of an Air-to-Air Heat Exchanger used for Energy Recovery Ventilation Applications

Fan Configuration

When used in a comfort-to-comfort or process-to-comfort application, it is essential that the fans are placed in the proper configuration to prevent cross contamination and for optimization of the Regenerative Condensate Return® (patented latent effect technology). Fans should be installed so that they produce the following effect: AIRFLOW 1 (or Outdoor Air) is positively pressurized, and AIRFLOW 2 (Return/Exhaust Air) is negatively pressurized (suction side of fan). For installations applicable to Figure 1, the AIRFLOW 1 fan would be located on the inlet (left side); AIRFLOW 2 fan would be located after the outlet (left side). Fans are recommended to be installed at a minimum of 5 duct diameters from the ERV for best performance. *<u>NOTE</u>: For all counter-flow, comfort-to-comfort or process-to-comfort applications, supply and exhaust fans will always be located on the same side of the heat exchanger with airflows traveling in opposite directions (see Figure 2).*

BPE heat exchangers are not provided as a packaged ventilation system. Fans, when included in the purchase of BPE units, are typically provided as loose items. BPE recommends installing fans that are high-efficiency, type D – ducted inlet, ducted outlet, mixed flow impeller, and 100% speed controllable fans suitable for temperatures up to 140°F and accompanied by a minimum three year factory warranty. All fans, no matter the installation method, should be installed with vibration isolation damper as per manufacturers recommendation or local code, whichever is more stringent.

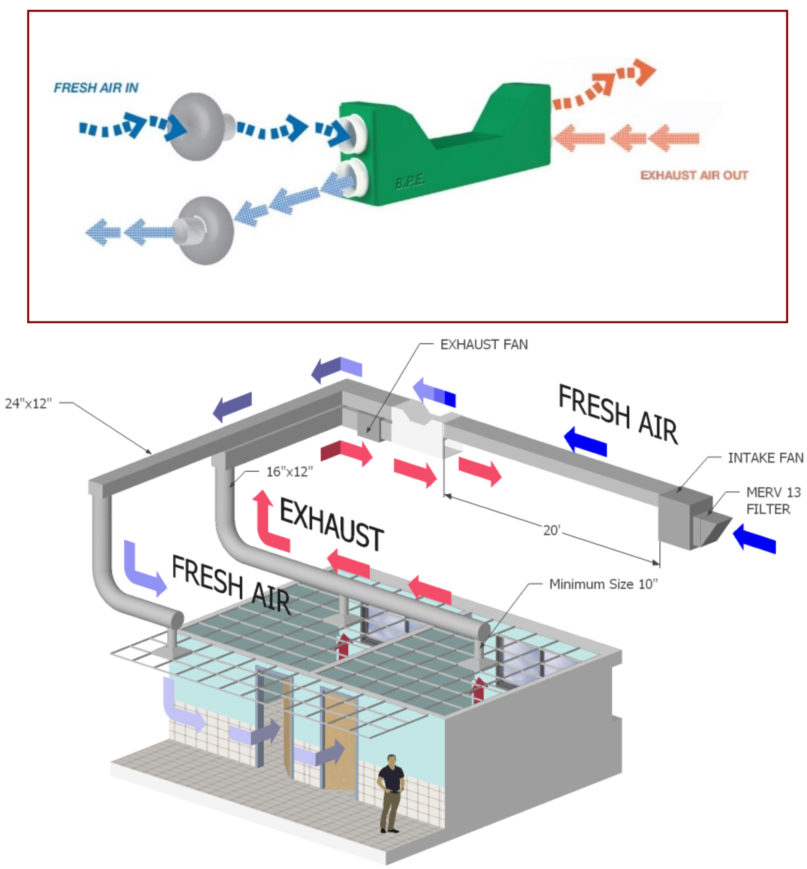


Fig. 2 – Typical Fan Configuration Comfort-to-Comfort and Process-to-Comfort Applications

Note: The BPE-XE-MIR-200i has integral fans.

The BPE-XE-MIR-300i and BPE-XE-MIR-400i have separate fans that plug into to the body to the BPE-XE-MIR-300i and BPE-XE-MIR-400i have separate fans that plug into the body of the ERM. This provides a lot of flexibility and the ability to just unplug and change out a fan in less than 5 minutes. BPE takes a modular approach and allows a contractor to build even a 20,000 cfm unit on top of any existing building with only elevator or stair access to the roof top mechanicals.

Ductwork, Louvers, and Filtration Sizing

Ductwork connected to the BPE heat exchangers should follow the following guidelines:

- With the exception of fan and heat exchanger connections and inlet/outlet, all ductwork within the system should be sized for providing air velocities of less than 500 linear feet per minute (fpm).
- For fans intended for ducted systems, the duct, including transition and any flex duct, should meet the requirements for 100% effective duct length, L_e (*ASHRAE Handbook – Fundamentals*, Chapter 35: Duct Design, 2005). Effective length is the minimum recommended distance of ductwork from a fan inlet or outlet for prevention of fan system effects and establishment of a uniform velocity profile.

  For $_o$>2,500 fpm

  L_e = ve.

ERV Inlet and Outlet Connections

All connections to the ERV inlet and outlets of both airflows should be completed in the following manner:

1. Fabricate Z-Clips (typical) for sliding over the inlet/outlet edges of the ERV (see example on next page) below for BPE-XE-MIR 2000 and 1000. Z-Clips are not required for the BPE-XE-MIR 200 and 500 as these models are manufactured with round collars.
2. Slide Z-Clips onto all four sides of the ERV inlet/outlet and fasten to the ERV surface with sheet metal screw of the appropriate length. See figure 3.
3. Slide flanges of connecting duct into the Z-Clip.
4. Fasten connecting ductwork to Z-Clip with sheet metal screw spaced 6" O.C.. Repeat for all sides. See figure 4.
5. Seal all seams between Z-Clip and ERV surface as well as Z-Clip and connecting ductwork.

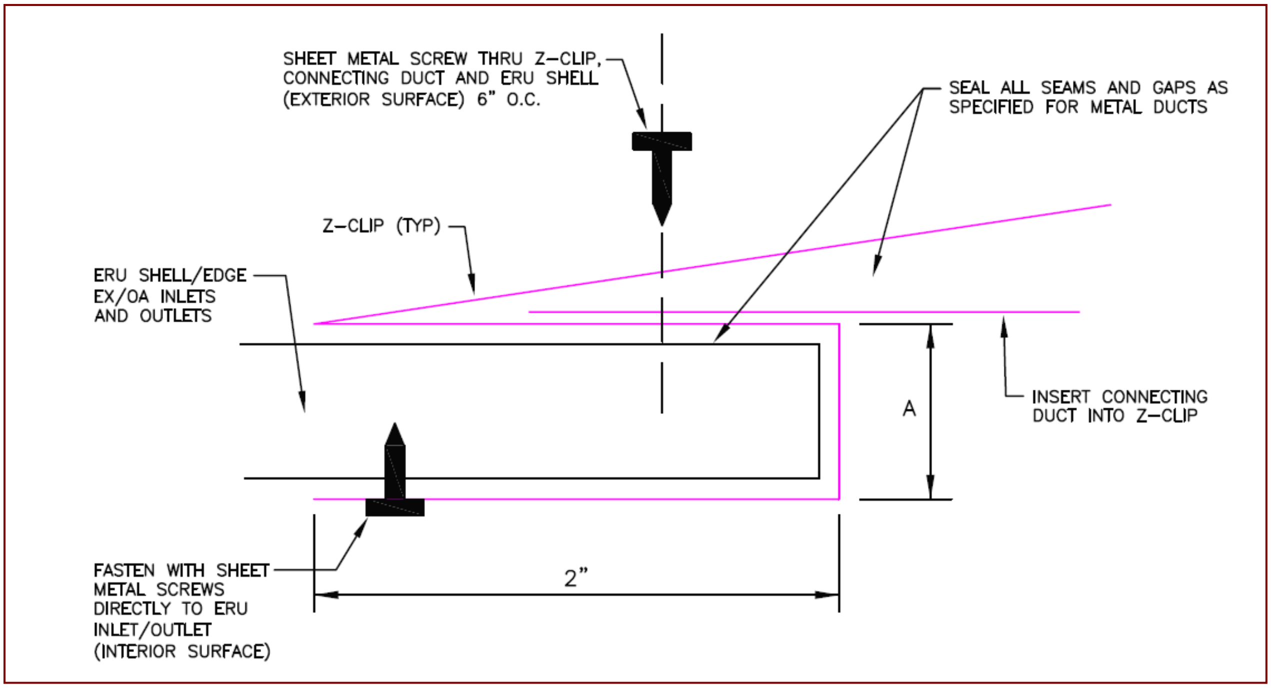


Fig. 3 – Z-Clip Configuration

Clip length should be determined based upon model size and airflow.

Note: Dimension “A” will vary depending on the Airflow. Airflow 1 (supply air) connections will be 3/8 in. whereas Airflow 2 (exhaust air) connections will be 3/4 in.

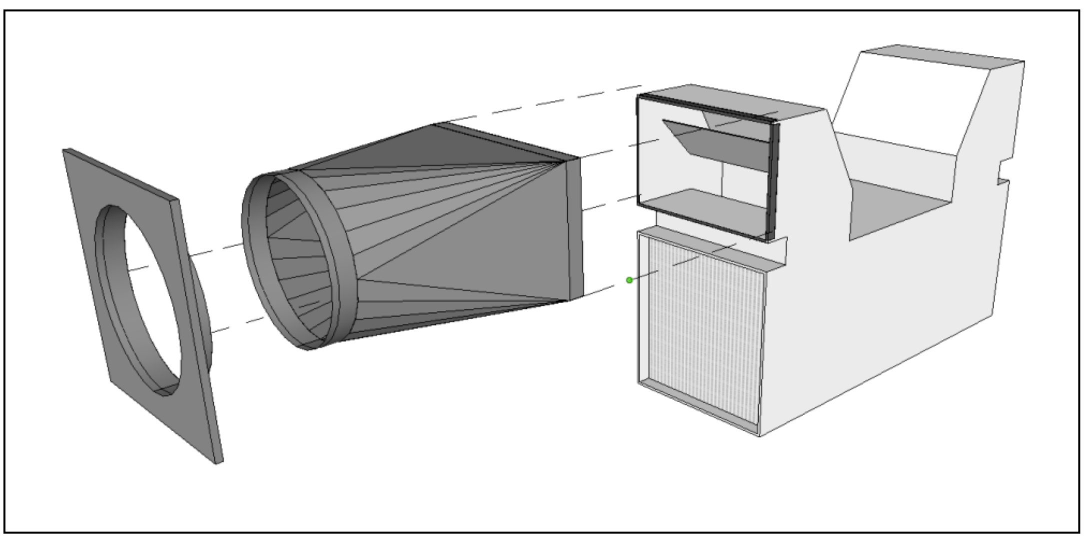


Fig. 4 – Exploded View of Airflow 1 Connection Assembly (from left to right: Faceplate/Collar, Round-to-Square Transition, Z-Clips, ERV)

Outdoor Air Louvers, Screens, and Filtration

Figure 5 shows the side view of the louvered intake connected to the fresh air intake duct. There should be a flow of less than 500 fpm, or the maximum amount of air flow needed to eliminate water droplets being pulled in through the fresh air intake. See manufacturer's instructions for specific installation guidelines. *Note: Clips, fasteners, and additional hardware must be supplied by your local contractor.*

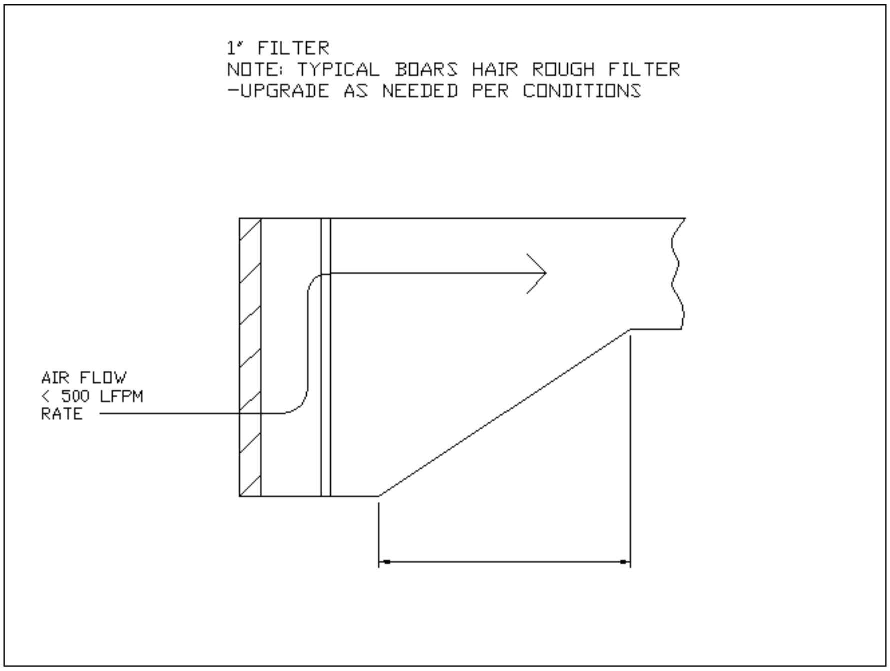
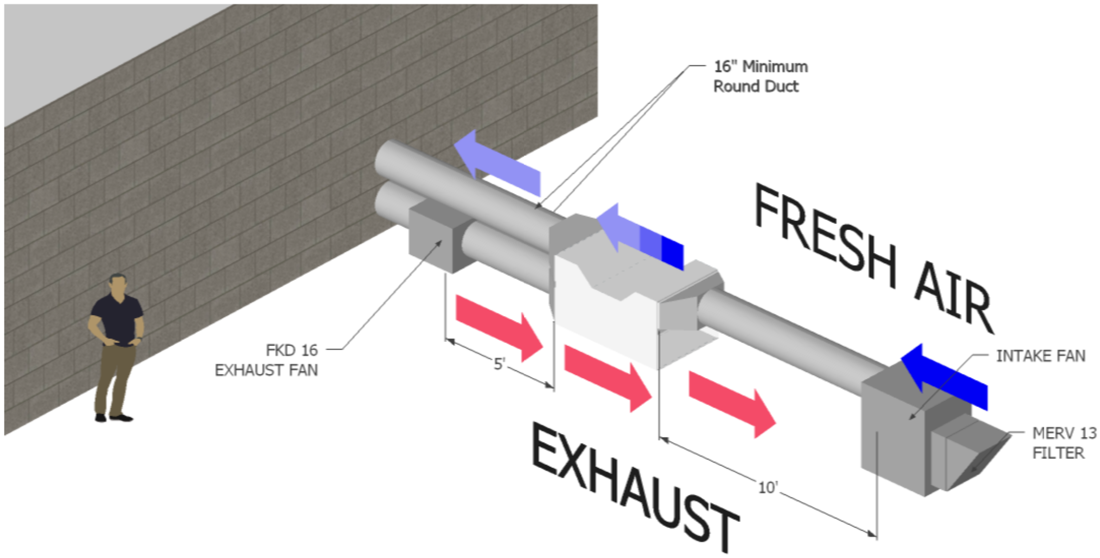


Fig. 5 – Recommend Louver Dimensions and Characteristics (Side View)

It should be noted that more gentle transitions will provide more even air flow into the ERM and increase the efficiency of the energy recovery system. A little extra cost in ductwork could increase the efficiency of the energy recovery system to pay for the extra cost in ductwork in less than a year or every year for the life of the project. Short efficient ductwork systems with generously sized cross section areas that keep the Linear Flow Rates per Minute below 500 linear feet per minute will dramatically reduce noise and increase EER of the energy recovery system.

Short straight runs with minimal static pressure losses will greatly reduce energy losses from fan power working to overcome higher than needed static pressure. A sharp bend without the proper vanes can generate as much static pressure as an inline filter and increase the fan power need to move the specified air flow.



Note that, for contaminated air, having exhaust directed at 90 degrees from the fresh air intake is preferred. For medical applications, the separation could be 20 feet or more. Always work with a local licensed professional engineer familiar with type of work.

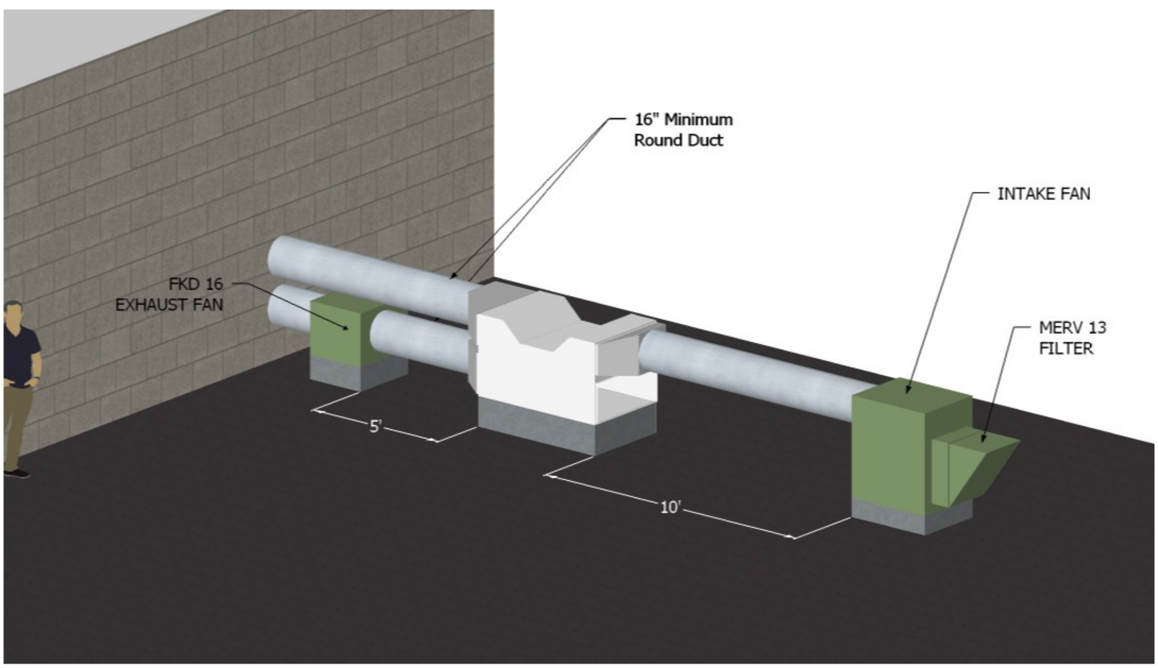


Fig. 6 & 7

This shows general duct sizing and location of equipment. Generally exhaust should be directed away from area of fresh air intake.

Sharp bends in ductwork shall be avoided, where absolutely needed inline vanes can be added, see detail as follows:

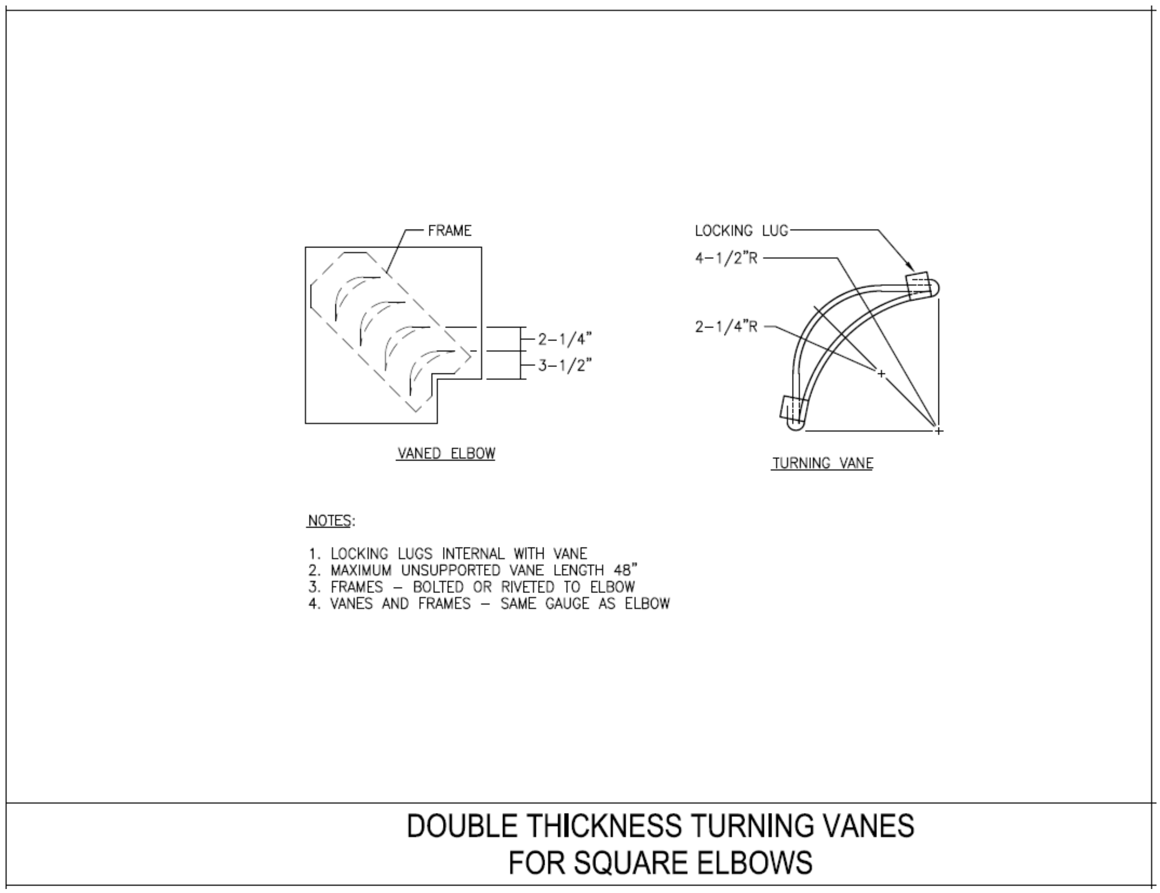


Fig. 8

Vanes can drop the static pressure to round a sharp corner by as much as 85% and allow for more even air flow distribution especially when be introduced in the inlet of the ERM.

ASHRAE Standard 90.1 Energy Standard for Building Except Low-Rise Residential Buildings could require this to meet the current local energy efficiency standards. It is also good practice for layout ductwork where sharp bends cannot be avoided.

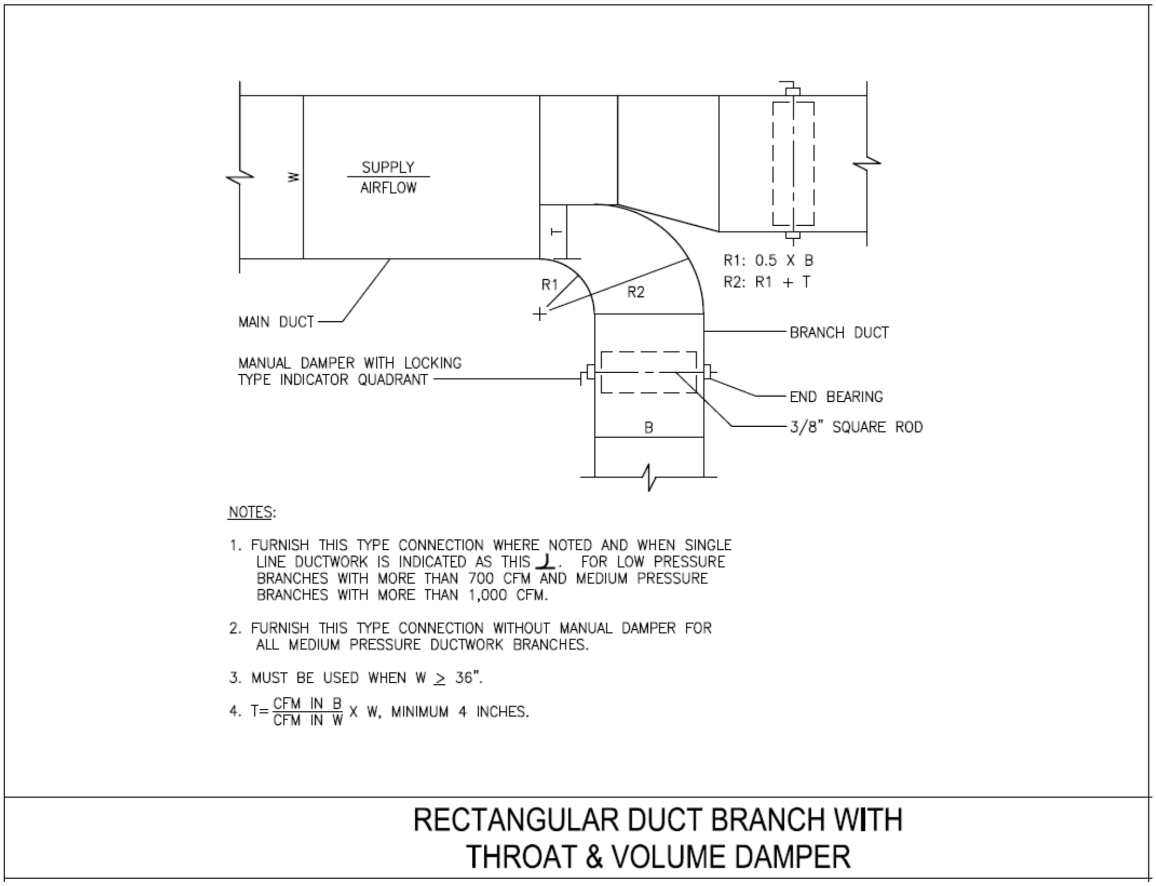


Fig. 9

Notice the gentle sweeping bends and the gentle transitions along with flow rates that are below 500 LFPM this will keep the ventilation ductwork system relatively low static pressure and quiet. Always refer to a licensed professional engineering and local codes when installing ductwork modifications or new systems. While we believe this information to be accurate, we cannot address all code requirements for all locations. Local, State and Federal building standards and codes will change depending on the type of project and the intended use for different applications and locations.

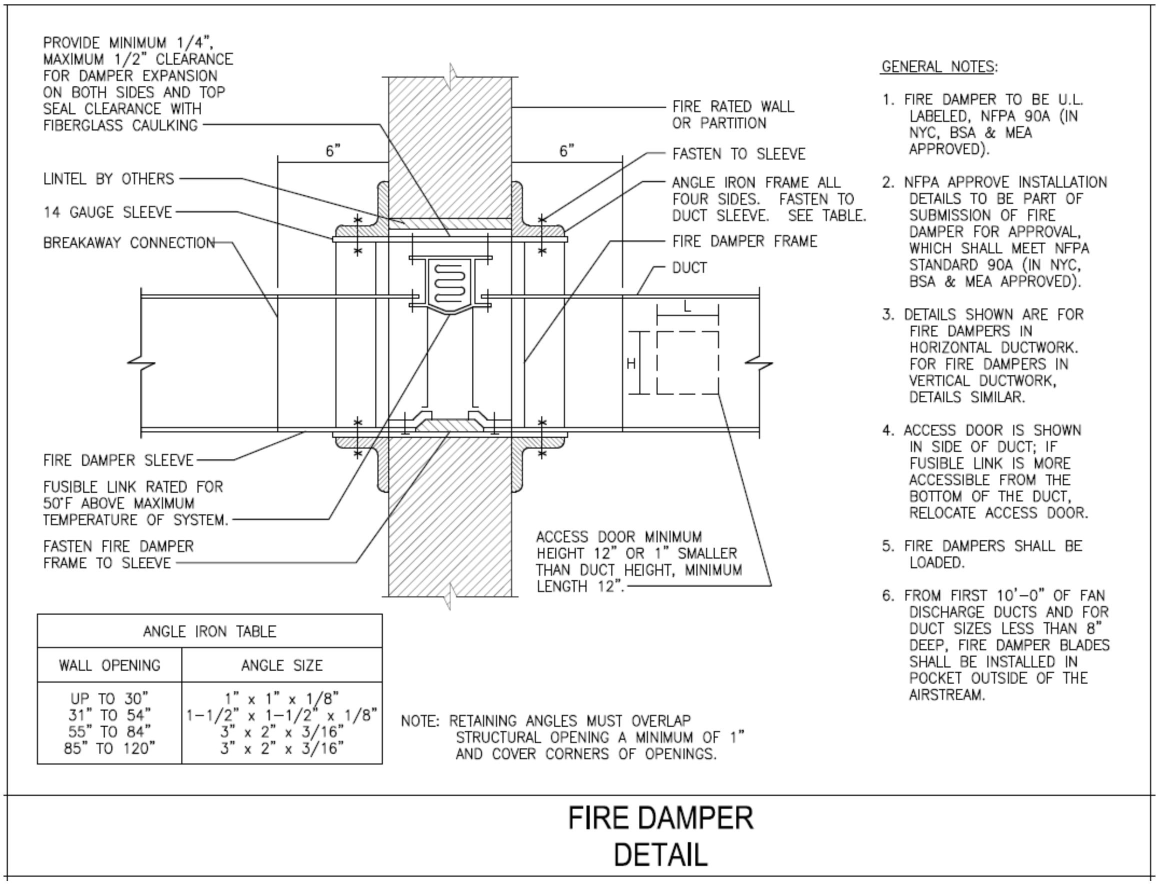


Fig. 10

Fire dampeners are a reasonable way to deal with penetrations that could affect the fire rating of a wall or separation. The actual type of fire dampener will depend on the actual application and should be engineered by a local licensed professional engineer.

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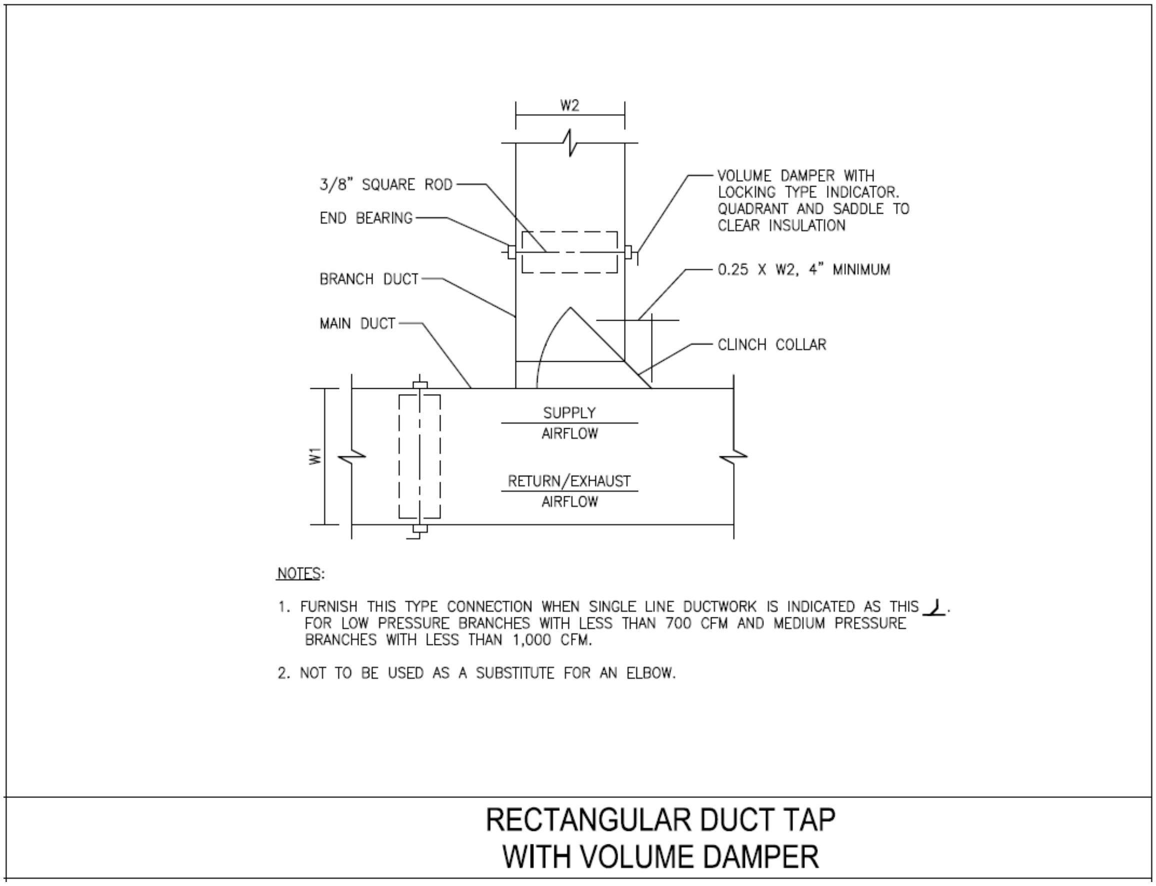

Fig. 11

Dampeners can be very useful in balancing a larger duct system that covers several branches or a larger area.

Always refer to a licensed professional engineering and local codes when installing ductwork modifications or new systems. While we believe this information to be accurate, we cannot address all code requirements for all locations. Local, State and Federal building standards and codes will change depending on the type of project and the intended use for different applications and locations.

Drain Pan and Piping

For use in conditions below -10F and/or above 40% relative humidity we recommend the ductwork being sealed and sloped towards the ERV, the ERV should be sloped as well. The slope should be uniform and must not be less than one-eighth unit vertical in 12 units horizontal (1-percent slope) or to local building code, whichever is more stringent. A drain is recommended to be installed in the ductwork in humid conditions.

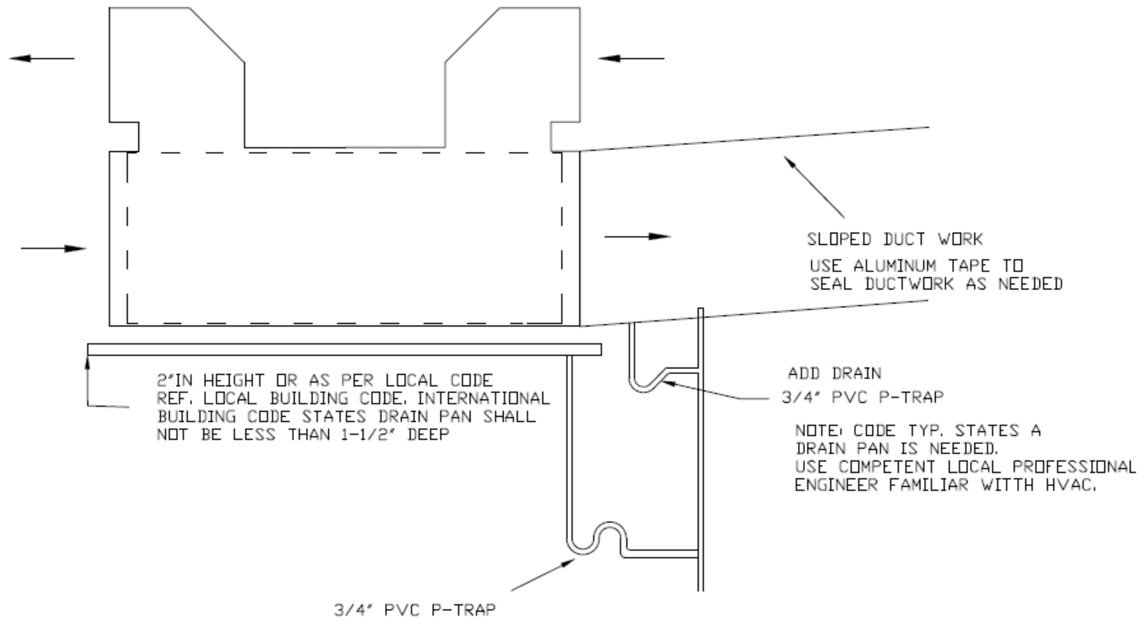

Fig. 12 – ERV Drain Detail

The drain should be no less than ¾" piping the full length to the drain. The drain pan must be at least 2" deep and is a minimum of 3" larger than the unit in both directions. We recommend the pan being made of galvanized sheet metal at least .0276" thick. If the unit is operating with high humidity, we recommend a float switch or water level detector to be installed in case the pan begins to fill, the BPE ERV will shut down temporarily until the drain pan is empty again. The drain pan will also be connected to the main drain as shown in Figure 12. Drain pans are always recommended when installing an ERV in interior space. All drain piping and drain pans shall meet the specifications of local building codes.

System and Equipment Specifications of ASHRAE *Standard 62.1* – 2019

Plenum Systems: When the ceiling or floor plenum is used both to recirculate return air and distribute ventilation air to ceiling-mounted or floor-mounted terminal units, the system shall be engineered such that each space is provided with its required minimum ventilation airflow.

Designing for Air Balancing: The ventilation air distribution system shall be provided with mean to adjust the system to achieve at least the minimum ventilation airflow as required by ASHRAE Standard 62.1-2019 or local code, whichever is more stringent.

Exhaust Duct Location: Exhaust ducts that convey potentially harmful contaminant shall be negatively pressurized relative to spaces through which they pass, so that exhaust air cannot leak into occupied space; supply, return, or outdoor air ducts; or plenums.

Ventilation System Controls: Mechanical ventilation systems shall include controls, manual or automatic, that enable the fan system to operate whenever the spaces served are occupied. The system shall be designed to maintain the minimum outdoor airflow as required by Section 6 of ASHRAE Standard 62.1 – 2019 or local code, whichever is more stringent.

Airstream Surfaces: All airstream surfaces in equipment and duct in the heating, ventilating, and air-conditioning system shall be designed and constructed to be resistant to erosion.

Outdoor Air Intakes: Ventilation system outdoor air intakes shall be designed in accordance with the following:

> **Location:** Outdoor Air intakes, including doors and windows, shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source shall be equal to or greater than the separation distance listed in Table 5-1, Air Intake Minimum Separation Distance, of ASHRAE Standard 62.1 – 2019.
>
> **Rain Entrainment:** Outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage rain entrainment. Outdoor air intakes should be designed for 400 fpm for flows of 7,000 cfm or greater and 300 fpm for flows below that range. FPM shall refer to the face velocity of outdoor air into the intake or louver in feet per minute.
>
> **Rain Intrusion:** Air-handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow.
>
> **Snow Entrainment:** Where climate dictates, outdoor air intakes that are part of the mechanical ventilation system shall be designed to manage melted snow blown or drawn into the system.
>
> **Bird Screens:** All outdoor air intakes shall include a screening device designed to prevent penetration by a 0.5 in. diameter probe. The screening device material shall be corrosion resistance. The screening device shall be located, or other measures shall be taken to prevent bird nesting within the outdoor air intake.
>
> **Maintenance:** Suitable access door should be provided to filters and equipment to permit cleaning.

Drainage: Outdoor air ductwork or plenums shall pitch to drains designed in accordance with the requirements of Section 5.11 of ASHRAE Standard 62.1 – 2007.

Installing Ducts, Registers, and Diffusers

CAUTION
If ducts have to go through an unconditioned space, always use insulated ducts (purchase separately). **HINT: When penetrating a roof, coordinate with existing roofer to keep entire roof under roof warranty whenever possible. Coordinating Trades to maintain any existing roof warranty is good practice.**

Stale Air Exhaust Ductwork

WARNING !!!
Never install a stale air exhaust register in a room where a combustion device operates, such as a gas water heater, a gas furnace or a fireplace.

1. Install the stale air exhaust register(s) in the main area where the contaminants are produced. Position the register(s) as far from the stairway as possible and in such a way that the air circulates in all the frequently occupied spaces in the building.

2. Install the register(s) 6 to 12 inches (152 to 305 mm) from the ceiling on an interior wall OR install it in the ceiling.

3. Attach one end of the flexible duct to the fresh air distribution register, and the other end to the unit's "Return Air In" port, using tie wrap and duct tape.

Fresh Air Distribution Ductwork

1. Install the fresh air distribution register(s) in a large open area in the lowest level to ensure the greatest possible air circulation. Keep in mind that the fresh air register(s) must be located as far as possible from the stale air register(s).

2. Install the register(s) in the ceiling OR 6 to 12 inches (152 to 305 mm) from the ceiling on an interior wall. The duct length should be at least 15' (4.6 m). (The cooler air will then cross the upper part of the room and mix with the room air before descending to occupant level.)

Exterior Opening(s) Installation - Locating 2 Soffits or Wall Grills

If this unit is installed in the attic, choose an appropriate location for installing the Soffit grills.

WARNING !!!

Make sure the fresh air intake grille is at least 10 feet away from any of the following:

- **High efficiency furnace vent.**
- **Gas meter exhaust, gas barbecue-grill.**
- **Any exhaust from a combustion source.**
- **Garbage bin and any other source of contamination.**

- The prevailing winds should not blow the stale air towards the fresh air intake grill.
- There must be a minimum distance of 10 feet (3.048 m) between the grills to avoid cross-contamination.

CAUTION

Make sure the insulated ductwork vapor barrier does not tear during installation.

- For each exterior hole, using a jig saw, cut the proper diameter hole in the soffit or wall. Pull back the insulation to expose the flexible duct. Run each flexible duct through its respective hole.
- Using provided screws, attach the flexible duct to the ring of the grill. Carefully seat with duct tape. Assemble the grills to the Soffit or wall.

Receiving

All BPE heat exchangers are packaged at the factory. Upon arrival, remove the scratch prevention covering and inspect the units. Report any damage immediately to the transportation company. Also, check to insure that the model numbers are as ordered. Alert your local sales representative or Building Performance Equipment, Inc. ® at (201) 722-1414 to report any discrepancies.

Mounting and Hanging

Consult your local engineer or architect for specific standards and code appliances. Locate the BPE air-to-air heat exchanger (AAHX) in close proximity to a fused power source. If the unit is installed independent of a forced air system, locate the ductwork near the center of the air distribution system. If the ERM is installed in conjunction with a forced air system, mount the unit near the indoor or outdoor equipment. It is recommended that the AAHX be installed on the rooftop of the building or within a mechanical room where the equipment is located. Make sure that the equipment is correctly sized to take into account the load reduction of the AAHX. In order to connect to an existing A/C unit, the system must have adjustable balancing dampers installed. Also be sure to provide easy access to the ERM to allow for cleaning and inspecting. The preferred method of installation is by mounting and fastening the unit to a set of suitable mounting stanchions or by hanging the unit(s) from threaded rod.

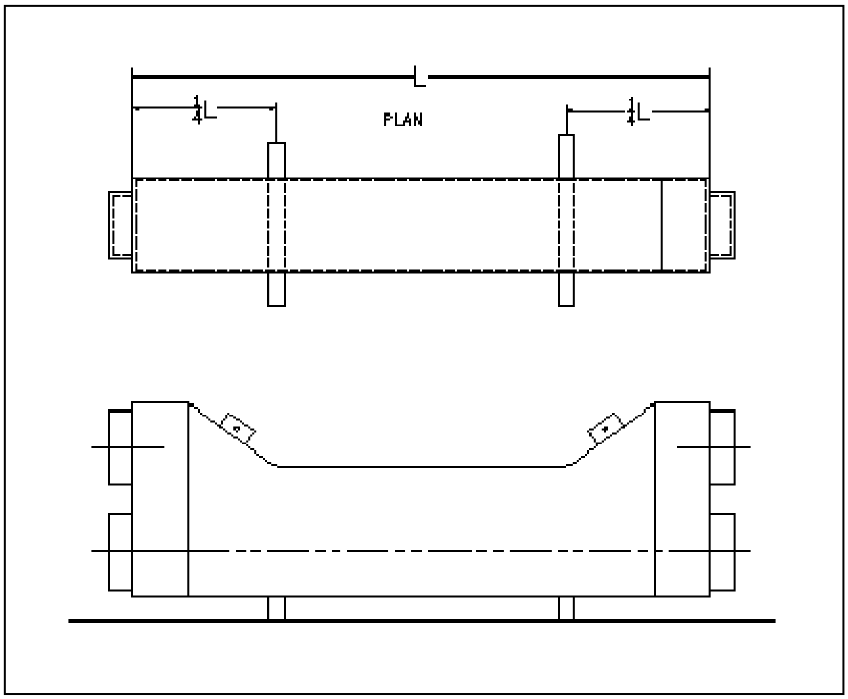

Fig. 13 – Mounting and Hanging Positions (Top: Bird’s Eye | Bottom: Side View)

<u>Note</u>: Be sure to apply vibration isolation and ensure all fastening provides enough structural integrity to meet local code requirements. Consult with your engineer or architect for details and instructions.

Basic Installation Parameters

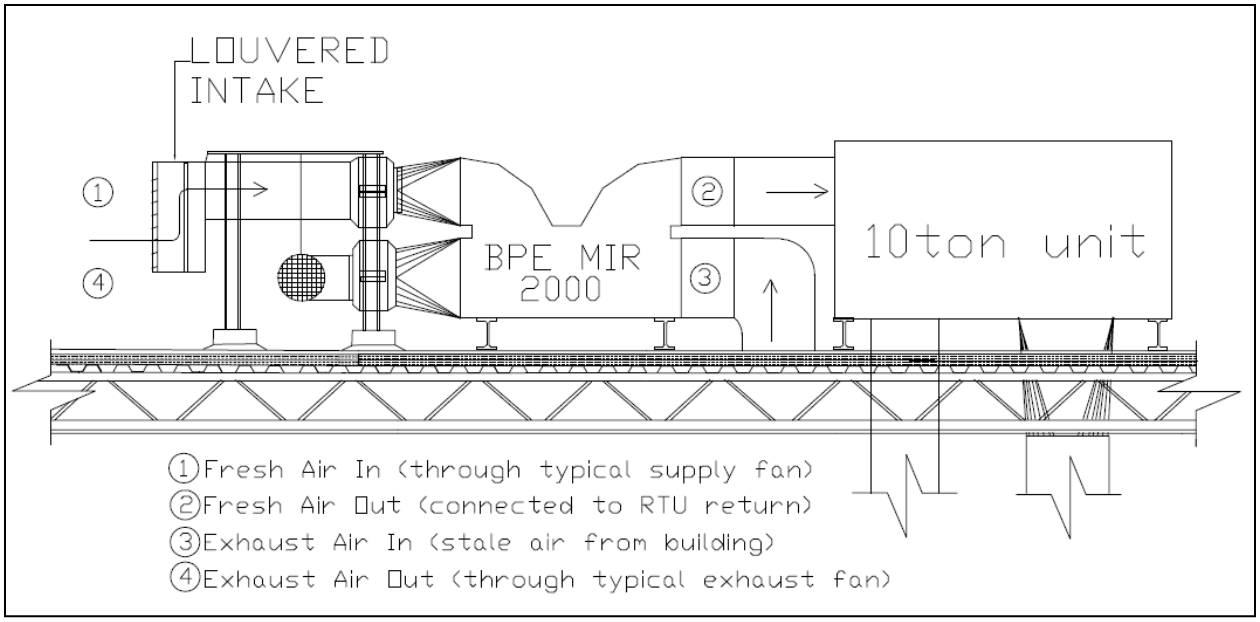

Fig.14 – Typical RTU Installation, Side View

<u>Note</u>: It is recommended that there be a minimum of 10 feet of separation, or the minimum required by code (whichever is higher), between points 1-(Fresh Air In) and 4-(Exhaust Air Out) in order to prevent cross contamination between the air streams. Installing hoods and/or an inlet screen are necessary to protect the duct openings from rain and animals. See Figure 5 for a detailed drawing of the louvered intake.

Operation

Industrial Settings

Though BPE's air-to-air heat exchangers can withstand many different contaminants, make sure to consult with the manufacturer if a proposed application contains harmful chemicals and contaminants unsuitable for the units. The ERM can also endure a great amount of chlorine in pool applications, though an installation for a pool environment should be handled strictly. Take into account that for a pool application, fans for the ERMs should be installed on opposite sides of the units (as opposed to on the same side as seen in Fig. 2).

Safety Considerations

Installation and servicing of this equipment can be hazardous due to mechanical and electrical components. Only trained and qualified personnel should install, repair, or service this equipment.

Untrained personnel can perform basic maintenance functions such as cleaning and replacing filters. All other operations must be performed by trained service personnel. When working on this equipment, observe precautions in the literature, on tags, and on labels attached to or shipped with the unit and other safety precautions that may apply.

Follow all safety codes. Installation must be in compliance with local and national building codes. Wear safety glasses, protective clothing, and work gloves. Have a fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions included in literature and attached to the unit.

Recognize safety information. This is the safety-alert symbol ⚠. When you see this symbol on the unit and in instructions or manuals, be alert to the potential for personal injury. Understand these signal words; DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **may** result in minor personal injury or product and property damages. <u>NOTE</u>: This is used to highlight suggestions which **will** result in enhanced installation, reliability, or operation.

Maintenance

WARNING!!!
ELECTRIC SHOCK HAZARD
<u>Failure to follow this warning could result in personal injury or death.</u>
Before installing or servicing system, always turn off main power to system. There may be more than one disconnect switch.
CAUTION
CUT HAZARD
<u>Failure to follow this caution may result in personal injury.</u>
Sheet metal parts may have sharp edges or burrs. Use care and wear appropriate protective clothing and gloves when handling parts.

The BPE ERV requires little to no maintenance because it is constructed of polypropylene – classified as a "non-stick" plastic due to its very low surface energy. Because of its "non-stick" material construction and high airflow design makes it extremely resistant to fouling.

Polypropylene's low surface energy also renders it relatively chemically inert and resistant to a wide range of corrosive substances.

The hydrophobic quality of the polypropylene core and shell makes the ERV far less susceptible to fouling, increases energy transfer and makes the ERV more effective in dehumidification and condensation applications.

Due to the low surface tension and inert characteristics of the heat exchanger materi

al (polypropylene), small particles and dust can easily pass through the core without clogging or fouling the unit. However for non-traditional applications such as dust collectors, metal shops, or greasy (oil, fuels, cooking) environments, BPE recommends cleaning the unit as often as necessary. BPE recommends cleaning the unit when performance (flow and/or effectiveness) has been altered by 10%.

With a bird screen, appropriate filtration and condensate drainage, the ERV can operate virtually maintenance free in many applications.

Where maintenance is required, simply hosing out or vacuuming out the unit is sufficient. The most important item is to ensure that any condensate drainage system employed be kept clean, just as with any device removing moisture from the air.

Preventative maintenance for all BPE air-to-air heat exchangers requires careful observation over the following aspects:

- Bird Screens
- Filtration (Outdoor and Return/Exhaust Air)
- Flow and/or Effectiveness

Inspecting:

We recommend inspecting the unit about once a year for any filter changing needs.

A handheld telescopic mirror and flashlight would be sufficient and will simplify and accelerate the process.

To inspect the ERV unit, access the unit through the door in the ductwork. If using a mirror and flashlight, follow the same steps above inspecting each section of the core for fouling. Be sure to inspect both the Exhaust Air and Outdoor Air sections of the heat exchanger core.

For typical school or office environments, changing filters is the only needed maintenance. If longer intervals is desired, insect screen along with Hepa Vacuum can be used every 5 years or so depending on the amount of lint and material in the air.

Be sure to close each section and duct work when complete.

Cleaning:

When cleaning the BPE heat exchanger core, the only things that are required are a water supply and a power washer or a HEPA vacuum.

1. Access the unit through access door in the ductwork.

2. When using the HEPA vacuum, be sure to thoroughly clean the interior of both airflow paths.

3. When using a power washer, be sure to thoroughly clean the interior of both airflow paths and take proper steps to contain the water draining from the ERV unit.

4. For smaller ERVs, it may be most convenient to remove the ERV to an outside location for power washing. It is easiest to dry the ERV unit by placing it in a vertical position. Reinstall the heat exchanger in its same position and close all duct work that has been opened.

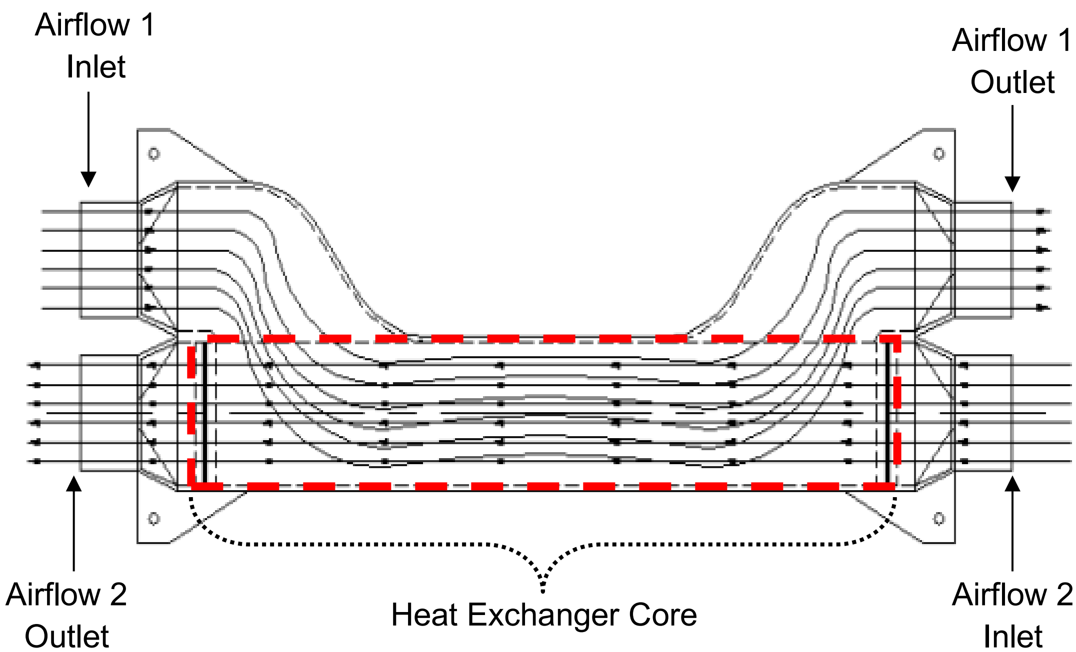

Fig. 15 – Typical ERV Inside Structure

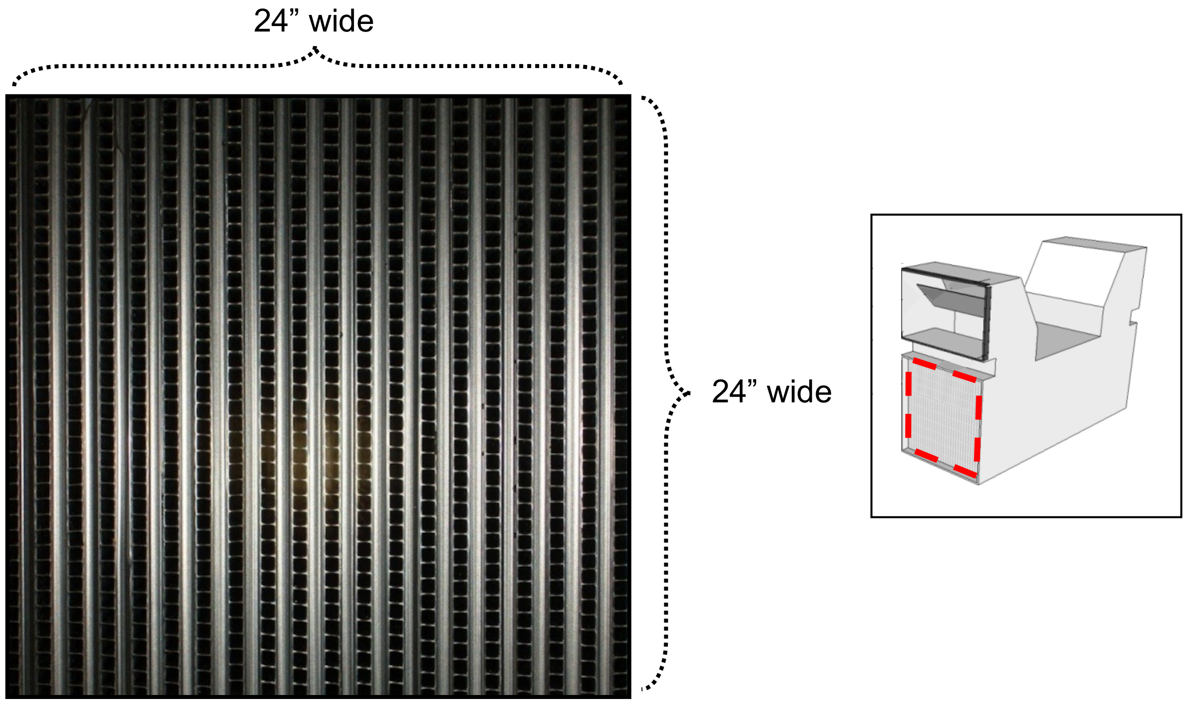

Fig. 16 – Front view of BPE-XE-MIR 2000 ERV heat exchanger core

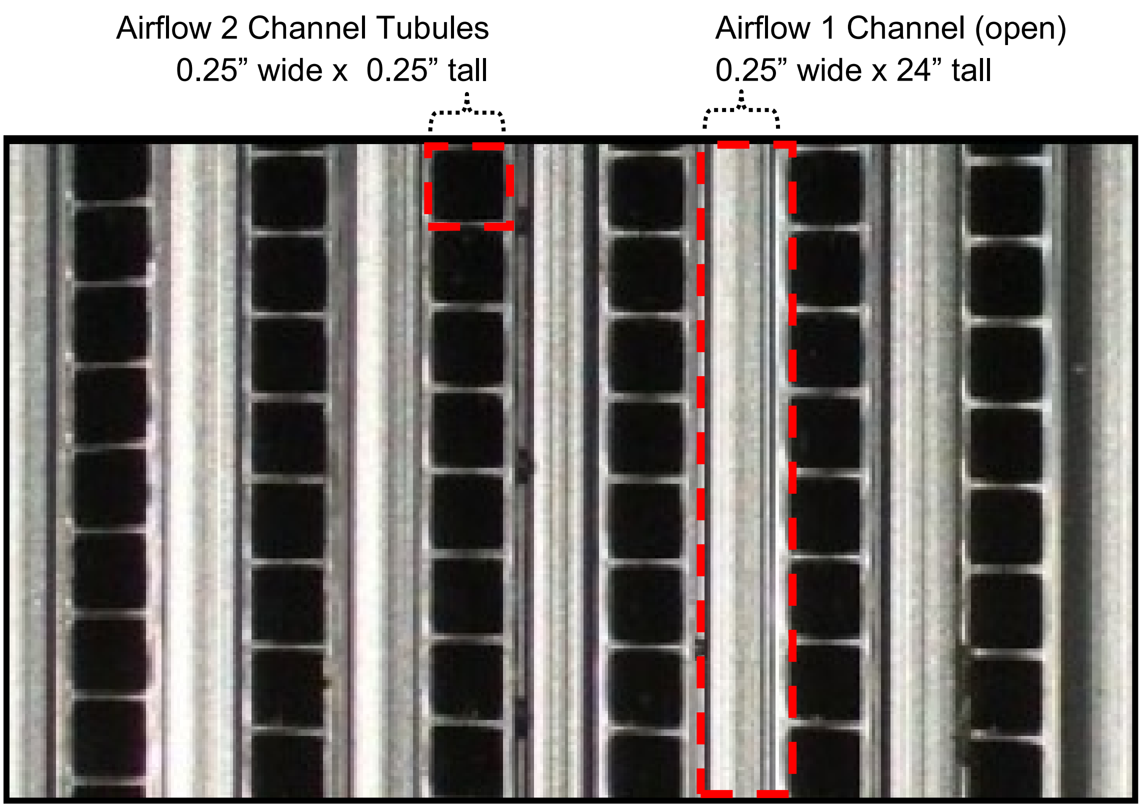

Fig. 17 – Close up view of ERV heat exchanger core showing dimensions

GLOSSARY OF TERMS

Hours of operation:
The hours during the day when the building is ventilated with outdoor air—typically the time when the building is occupied.

Days per week:
Days per week that the building is ventilated with outdoor air.

CFM of outdoor air:
The rate of outdoor air ventilation during the hours of operation.

Electric Rate:
Expected cost for electricity in $/kWh. (Default $.09/kWh)

Peak Demand Charge:
Expected electric demand charge in $/kW. (Default: $10/kW)

Months of Peak Demand Charge:
The number of months the utility assesses a demand charge during the year. (Default: 6 months)

Gas rate:
Expected cost for gas in $/therm. (Default: $1.20/therm)

Heating Efficiency:
The heating efficiency for the heating system. (Default: 81%)

Cooling Efficiency:
The cooling efficiency rating for the HVAC system. (Default is 10 EER.)

BPE ERM Total Effectiveness:
BPE total energy recovery wheels generally recover over 80% of the difference in sensible and can recover over 34% of the latent energy (total energy) between the building exhaust and incoming ventilation air streams. This effectiveness can vary depending on the system. People are more sensitive to thermal effectiveness, BPE ERM properly sized can be standalone without additional coils in line, as long as the space is conditioned by standard HVAC systems.

HVAC Fan Power (% of Total System):
In most DX systems, fan power represents approximately 15% of total energy consumption. Energy Recovery ventilation enables a smaller DX system to be installed. As a result, significant operating savings can be attributed to operating a smaller fan in the smaller system.

Installed Cost per Ton:
Estimated installed cost for the HVAC system on a per ton basis.

Installed Cost per cfm for ERM:
The installed cost for the energy recovery system. This number will vary depending on size and system design. $4 per cfm is a general average but may vary between $2 and $6 per cfm.

BPE ERM Cooling Capacity:
BPE energy recovery ventilators provide significant cooling capacity. Consequently, a system with energy recovery will require less mechanical tonnage than one without.

BPE ERM Heating Capacity:
BPE energy recovery ventilators provide significant heating capacity. Consequently, a system with energy recovery will require less mechanical mbh capacity than one without.

Peak Demand Reduction:
The cooling capacity reduction also translates into reduced peak demand (kW), which in turn reduces operating cost and may qualify for utility rebates.

Annual Cooling Energy Saved:
Estimate of savings in kWh of using a system with energy recovery versus one without.

Annual Heating Energy Saved:
Estimate of savings in Mbtu of using a system with energy recovery versus one without.

Cooling Operating Cost (Savings):
Estimated net change in annual operating cost that energy recovery contributes during the cooling season.

Heating Operating Cost (Savings):
Estimated net change in annual operating cost that energy recovery contributes during the heating season.

Cost (Savings) to operate smaller unit fan:
When a DX/ERM system is properly right sized, there are operating savings for the resulting smaller system fan. The system fan generally represents 15% of the total system energy consumption. This variable can be adjusted in the input section.

Cost (Savings) to run ERM fan:
An energy recovery wheel increases static pressure on the HVAC system. Fan

power is necessary to overcome this static pressure. The program estimates the cost to operate those fans with approximately 0.8 inches of pressure drop across the BPE energy recovery core. In many applications with lower flow velocities this can be well under ½” of water column.

Cost of HVAC Unit:
An HVAC unit with energy recovery will have smaller mechanical capacity than one without energy recovery. This field estimates the incremental first cost reduction from installing this smaller mechanical system. It is critical that systems be right sized with energy recovery in order to maximize payback as well as overall performance.

Cost of ERM:
Estimated incremental cost to add energy recovery ventilation to the system.

Net Capital Expenditure:
Cost of HVAC added with Cost of ERM

Payback Period:
Net Capital Expenditure divided by Annual Operating Savings.

Annual ROI:
Operating Savings divided by Net Capital Expenditure