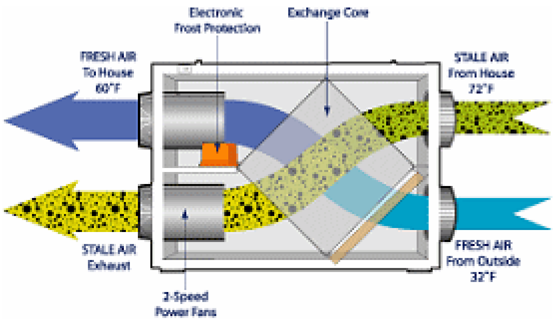
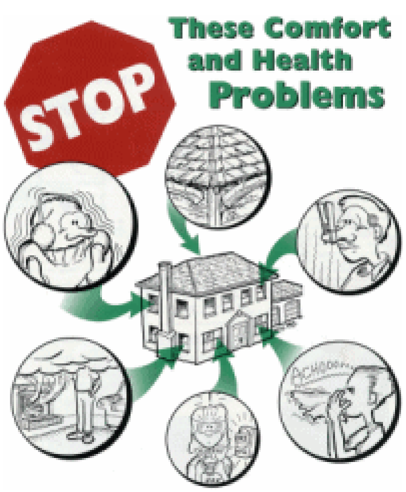


Air Exchanger Basics

With the emphasis on energy conservation and efficiency, new home construction can create a problem of indoor air pollution. Vapor barriers, thermal windows, weather-stripping and caulk have reduced or stopped fresh air from infiltrating and replacing stale air. Entering and exiting the house through doors isn't always enough air changes. Cooking, aerosol sprays, cleaning agents, paints, and in some cases excess humidity if the house is sealed too tightly can create an undesirable environment. Keeping windows or doors open does not conserve energy. A device known as an air-to-air exchanger is used to recover heating or cooling and improve air quality.

There are many different designs of air exchangers, depending on the manufacturer, but the principle is the same. Fresh air is drawn in from a port open to the outside of the building, and passed through a chamber, also know as the exchanger, that is surrounded by indoor air. Highly conductive metal or other materials removes the energy (heat) from the warmer air and gives it to the cooler air. The fresh air is then ducted into the house, and the indoor air is ducted to a port and expelled outside. Up to 80% of the energy can be exchanged. During the energy exchange, moisture (humidity) can condense into water. A drain pan inside the cabinet will allow the water to be collected for removal. If the unit is installed in the basement, a condensate pump might be used to eject the water outside.

Air Exchanger Ratings



Because the Air to Air exchanger does not produce heat or cooling, the usual furnace and air conditioner efficiency ratings do not apply. However, the efficiency of temperature transfer between the air coming in, and the air getting exhausted is most important. This transfer can be in the range of 50 to 85 percent and is a critical measure of the economy of the unit. Usually, the slower the blower speed the higher the efficiency because the air has a more time to exchange energy. The amount of electricity consumed by the blower motor should also be taken into account.

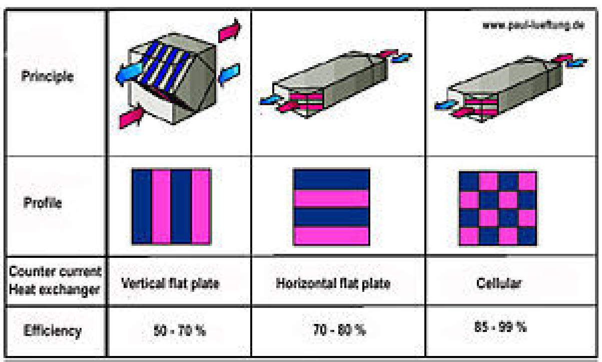
Unlike your heating and cooling system, the air to air exchanger should run when the outside temperatures are at their mildest. Running the air exchanger at night during the summer will bring in cooler air than during the afternoon; likewise; running the air exchanger during the day in the winter months will bring in the warmest air.

Common Air Exchanger Questions

Question: Does an Air to Air Exchanger heat or cool the air?

Answer: Not really. The air exchanger uses air exhausted from your house to pre-treat outside air being brought into your house. Besides the "exchange" of temperature that takes place within the exchanger, it does not heat or cool the air.

Question: Will the Air to Air exchanger lower my fuel bill?
Answer: NO. The air to air exchanger will increase your fuel bill. Not only does it require electricity to run the air exchanger, but the air exchanger brings outside air into your house; and this air must be brought up to temperature. It only lowers your fuel bill as compared to bringing outside air directly into your house instead of thru an exchanger.
Question: Can I connect the Air Exchanger to an existing central ducting system?
Answer: Yes, but there are a few negatives to this application. The speed of the air flowing thru the exchanger is critical to efficient performance, and is affected by the blower from your existing system. Also, your existing system runs the most when the outside temperatures are at their worst; this will result in your air exchange operating during the worst outside conditions.
Question: If the Air Exchanger doesn't heat or cool the air, what does the efficiency rating mean?
Answer: The efficiency rating refers to the effectiveness of the temperature transfer between the incoming air and the outgoing air. If the outside temperature is 20 degrees with the indoor temperature 70 degrees, this results in a 50 degree differential. If the Air Exchanger is 80 percent efficient, it will raise the temperature of the incoming air (.8 X 50) 40 degrees Therefore, fresh air at 60 degrees is entering your house instead of fresh air at 20 degrees.



Heat recovery ventilation

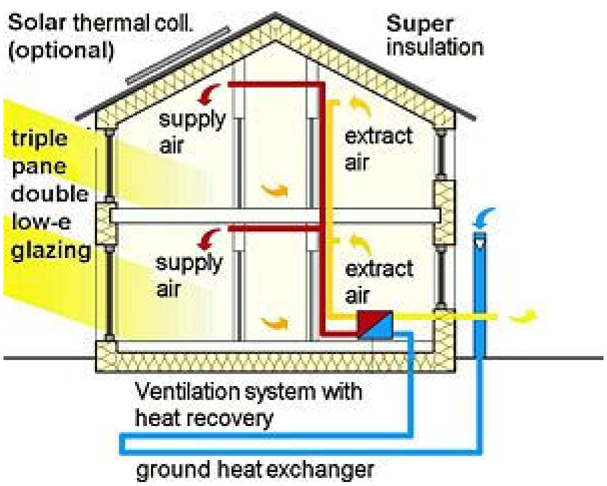
Heat recovery ventilation (also known as a **heat exchanger**, **air exchanger** or **air-to-air exchanger**) is a ventilation system that employs a counter-flow heat exchanger between the inbound and outbound air flow. HRV provide fresh air and improved climate control, while also saving energy by reducing the heating (or cooling) requirements.
Heat recovery ventilators (HRVs), as the name implies, recover the heat energy in the exhaust air, and transfer it to fresh air as it enters the building. Energy recovery ventilators (ERVs) are closely related; however ERVs also transfer the humidity level of the exhaust air to the intake air.

Benefits

As building efficiency is improved with insulation and weather-stripping, buildings are intentionally made more air-tight, and consequentially less well ventilated. Since all buildings require a source of fresh air, the need for HRVs has become obvious. While opening a window does provide ventilation, the building's heat and humidity will then be lost in the winter and gained in the summer, both of which are undesirable for the indoor climate and for energy efficiency, since the building's HVAC systems must compensate. HRV technology offers an optimal solution: fresh air, better climate control and energy efficiency.

Technology

HRVs and ERVs can be stand-alone devices that operate independently, or they can be built-in, or added to existing HVAC systems. For a small building in which nearly every room has an exterior wall, then the HRV/ERV device can be small and provide ventilation for a single room. A larger building would require either many small units, or a large central unit. The only requirements for the building are an air supply, either directly from an exterior wall or ducted to one, and an energy supply for air circulation, such as wind energy or electricity for a fan. When used with 'central' HVAC systems, then the system would be of the 'forced-air' type.



Air to air heat exchanger

There are a number of heat exchangers mostly used in HRV devices:

- cross flow heat exchanger up to 60% efficient (passive)
- counter current heat exchanger up to 99% efficient (passive) (see image)
- Rotary heat exchanger (requires motor to turn wheel)
- heat pipes / thin multiple heat wires

Earth-to-air heat exchanger

The air coming into the heat exchanger should be at least 0 degrees Celsius (32 Fahrenheit). Otherwise, the condensed water from the outgoing air would freeze and block the outgoing air. Therefore, it is necessary to warm the incoming air to at least 0 °C. This can be done by an earth warming pipe, usually about 30 m to 40 m long and 20 cm in diameter. It is buried about 1.5 m below ground level. In Germany and Austria this is a common configuration for earth to air heat exchangers. It can also be achieved by re-circulating the air (loss of air quality) when required or using a very small heat pump 1 kW on the air outlet (stays above 5 degrees Celsius) after the HRV heat exchanger dumping heat to the air inlet after the heat exchanger. This may be also used to supplement the solar hot water system. Photovoltaic panels can run the heat pump during daylight.

The EAHX is particularly problematic in high humidity areas where internal condensation can lead to fungal/mould growth in the tube and contamination of the air. Precautions can be taken such as running the pipes to a low (drainage) point, cleaning the tubes regularly, and using pipes with an imbedded bactericide coating such as silver ions (non-toxic for humans), using air filters F7 / EU7 (>0,4 micrometers) which traps mold (size between 2 & 20 micrometers), and/or a UV lamp system. The pipes must be a smooth bore internally to minimize pressure loss and retention of water.

An alternative to the earth to air heat exchanger is the "water" to earth heat exchanger. This is typically similar to a geothermal heat pump tubing embedded horizontally in the soil (or could be a vertical configuration) to a similar depth of the EAHX. It uses approximately double the length of pipe, 35 mm i.e. around 80 meters, compared to an EAHX. A heat exchanger coil is placed before the air inlet of the HRV. Typically a brine liquid (heavily salted water) is used as the heat exchanger fluid.

In temperate climates in energy efficient building, such as a passive house, this is more than sufficient for comfort cooling during summer without resorting to an air-conditioning system. In more extreme hot climates a very small air to air heat pump in reverse (an air conditioner) on the air inlet after the HRV heat exchanger dumping heat to the air outlet after the heat exchanger will suffice.

Bypass

At certain times of the year it is more thermally efficient to bypass the HRV heat exchanger or the earth to air heat exchanger (EAHX).

For example, during the winter, the earth at the depth of the earth to air heat exchanger is ordinarily much warmer than the air temperature. The air becomes warmed by the earth before reaching the air heat exchanger. In the summer, the opposite is true. The air becomes cooled in the earth to air exchanger. But after passing through the EAHX, the air is warmed by the heat recovery ventilator using the warmth of the outgoing air. In this case, the HRV can have an internal bypass such that the inflowing air bypasses the heat exchanger maximizing the cooling potential of the earth.

In autumn and spring there may be no thermal benefit from the EAHX, it may heat/cool the air too much and it will be better to use the external air directly. In this case there is a bypass such that the EAHX is disconnected and air taken directly from outside. A differential temperature sensor with a motorized valve can control its functioning.