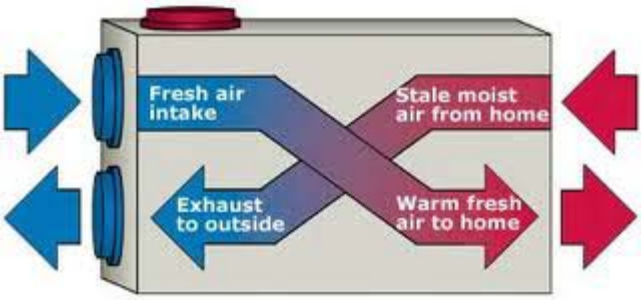
Improving Indoor Air Quality on a Tight Budget

The HVAC system serving our shelter was outdated, extremely inefficient, and constantly malfunctioning, so it was time for new equipment. I researched information pertaining specifically to animal shelters, and everything I found spoke solely to the importance of air exchange. A variety of sources recommend exchange rates anywhere from 10 to 25 complete room changes per hour, depending on the room's intended use. As I began consulting with various HVAC contractors, the universal message I received was that they could achieve those exchange rates, but the upfront cost of the air exchangers and the ongoing utility costs to operate them would be very high. The equipment necessary to get us "close" to 10 air changes per hour would cost nearly $9,500 *not* including installation, and *not* including the cost of the rest of the system. Air exchange is expensive! Being a modest non-profit organization, the shelter faced the challenge of how to attain a meaningful level of air quality on a tight budget. As a result of this obstacle, I learned two valuable lessons: establishing good indoor air quality is actually a three-stage process including air exchange, filtration, and purification, and that you can significantly improve your indoor air quality by utilizing affordable alternatives to high rates of air exchange.

Air Exchange

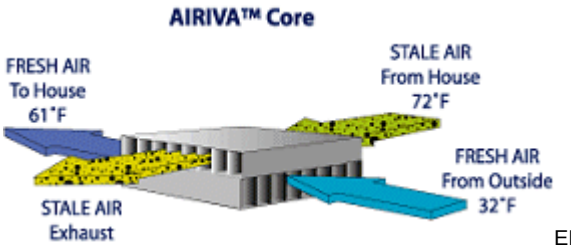
Air exchange is important because a lack of ventilation can contribute to low levels of oxygen and cause an increase of potentially toxic levels of a variety of contaminants. Appropriate ventilation promotes a balance of fresh air while reducing levels of contamination.



Air Exchanger Model

Air-to-air exchangers, or energy recovery ventilators ("ERV"), are intended to bring fresh, outdoor air into the facility and exhaust stale air. The fresh air is usually brought into, and distributed through, the ducting system. ERVs also help to reduce levels of indoor humidity which can contribute to bacterial and mold contamination of the indoor air.

Typically, through a series of small channels located in the "core" of the unit, the incoming and outgoing air streams move closely past each other without mixing. Essentially, one air stream "pre-conditions" the other, which in turn reduces the load on the rest of the HVAC system and helps in reducing operating costs.



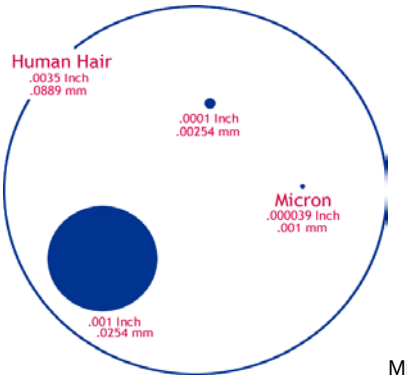
ERV Core Channels

While it is desirable to attain high levels of air exchange, the upfront and ongoing operating costs should be carefully considered. Also, due to modern construction techniques, the “tightness” of a building can play a factor in determining appropriate rates of exchange. To some extent, older buildings passively ventilate due to a lack of tightness. If you cannot afford the recommended high rates of air exchange, work with a reputable HVAC contractor to determine a healthy, reasonable level that you can afford.

Air Filtration – Microns, MERV & HEPA

How Big is a Micron?

A micron is 1 millionth of a meter, or approximately 0.000039 inches. To put the size of a micron into perspective, a strand of human hair averages 100 microns.



Micron Example

When discussing air filtration, understanding measurements in microns is important because airborne contaminants are usually measured in microns. Here are some typical contaminants and their average sizes: pet dander - 0.1-10 microns; viruses and bacteria - 0.005 -10 microns; mold spores - 10 - 30 microns; tobacco smoke - 0.01- 4 microns.

What is MERV?

MERV stands for Minimum Efficiency Rating Value. This is an industry standard rating method that allows for the evaluation of a filter's efficiency and effectiveness at trapping and reducing contaminants in the 0.3 - 10 micron range, and helps in determining what level of filtering capacity is desirable for a given application. The following chart shows MERV ratings and performance efficiency for different particle size ranges:

MERV Rating	Efficiency @ 0.3 – 1.0 Microns	Efficiency @ 1 – 3 Microns	Efficiency @ 3 – 10 Microns
1 - 4	n/a	n/a	Less than 20%
5	n/a	n/a	20% - 34%
6	n/a	n/a	35% - 49%
7	n/a	n/a	50% - 69%
8	n/a	n/a	70% - 85%
9	n/a	Less than 50%	85% or better
10	n/a	50% - 64%	85% or better
11	n/a	65% - 79%	85% or better
12	n/a	80% - 89%	90% or better
13	Less than 75%	90% or better	90% or better
14	75% - 84%	90% or better	90% or better
15	85% - 94%	90% or better	90% or better
16	95% or better	95% or better	95% or better

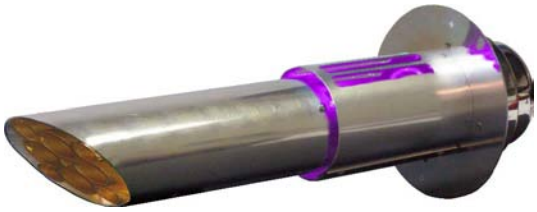
While extremely good results can be obtained using filters with high MERV ratings, it is very important to check and change the filters frequently. Due to their high capture rate, these filters can reach capacity quickly, impede air flow, and potentially cause damage to the HVAC system.

Why not use HEPA Filtration??

HEPA filters are generally recognized as the "gold standard" of filtration technology due to their extreme efficiency at arresting airborne contaminants. This technology goes beyond MERV standards due to its ultra-high efficiency. To be considered a "true HEPA filter", it must remove contaminants down to 0.3 microns at an efficiency rating of 99.99%. While this level of efficiency is impressive, it is neither practical, cost-effective, nor commonly used for traditional HVAC systems. In fact, according to U.S. EPA studies, HVAC systems employing high-MERV rated filtration can achieve capture levels comparable to HEPA systems at a fraction of the upfront and ongoing costs. Although the capture rate of a MERV filter is not as efficient as that of a HEPA filter, systems incorporating higher-efficiency MERV filters can process more air over a given time period due to decreased airflow resistance, which can result in an *overall* particulate capture rate comparable to a HEPA filter.

Air Purification

While filtration media works to physically trap contaminants in the air, duct-mounted air purification equipment seeks to kill pathogens and neutralize contaminants through oxidation and, in some cases, ionize airborne particulate so that they aggregate and are more easily trapped on the filter media.



REME+ Purification Module

One of the latest technologies developed by the RGF Environmental Group in conjunction with Sandia National Labs, incorporates Reflective Electro-Magnetic Energy ("REME"). This technology creates ionized hydroperoxides which are extremely effective against a broad range of pathogens and contaminants. An airborne plasma comprised of environmentally safe ionized hydroperoxides destroys pathogens by disrupting a cell's structure through a process known as lysis, or, with contaminants such as odors and VOCs, neutralizes them by altering their molecular structure. Also, this technology incorporates a device that uses high voltage to ionize, or electrically charge, airborne particulates. In turn, the charged particles are attracted to each other resulting in larger particles that are more easily trapped on filtration media. Additionally, as they settle out of the air and collect on surfaces, ionized hydroperoxides have the potential to reduce surface contamination.

While boarding kennels and grooming businesses are beginning to embrace this technology for odor control, there are, unfortunately, no published studies addressing the technology's efficacy against pathogens specific to animal shelters. However, REME technology is currently used across numerous industries such as hospitals, cruise lines, school systems, and resorts, and has been proven effective against infectious agents such as Norovirus, H1N1, MRSA, and Stachybotrys. While this technology may not solve every air quality issue, it does provide a cost effective option to aid in creating a healthier environment for the animals in a shelter's care, as well as for staff and customers.

Affordable Air Quality

Working within the shelter budget, we installed a system that provides an air exchange rate of two complete room changes per hour, incorporates two independent filtering systems utilizing high efficiency 13 MERV filtering media, and two RFG REME+ air purification modules. The improvement is outstanding. Most notably, many staff members, volunteers and customers have commented on how "neutral" the cat and dog adoption rooms now smell. Due to the

purification units' efficacy at reducing odors, the shelter is able to stop using a deodorizing agent that cost approximately $500 per year. Furthermore, we have observed a modest decrease in the rate of feline URI – the current average is about twelve percent, while prior to the installation of the new system, the rate averaged between seventeen and twenty percent. And due to the efficiency of the new equipment, we have seen a decrease in our electricity costs and expect a similar decrease in natural gas expense during the winter. Therefore, through the use of technologies that provide cost-effective alternatives to high rates of air exchange, it is not that difficult to significantly improve indoor air quality on a limited budget.