AirScape®

Residential Make-up Air Unit

A Necessity for Preventing Unsafe Backdrafts and Unhealthy Air

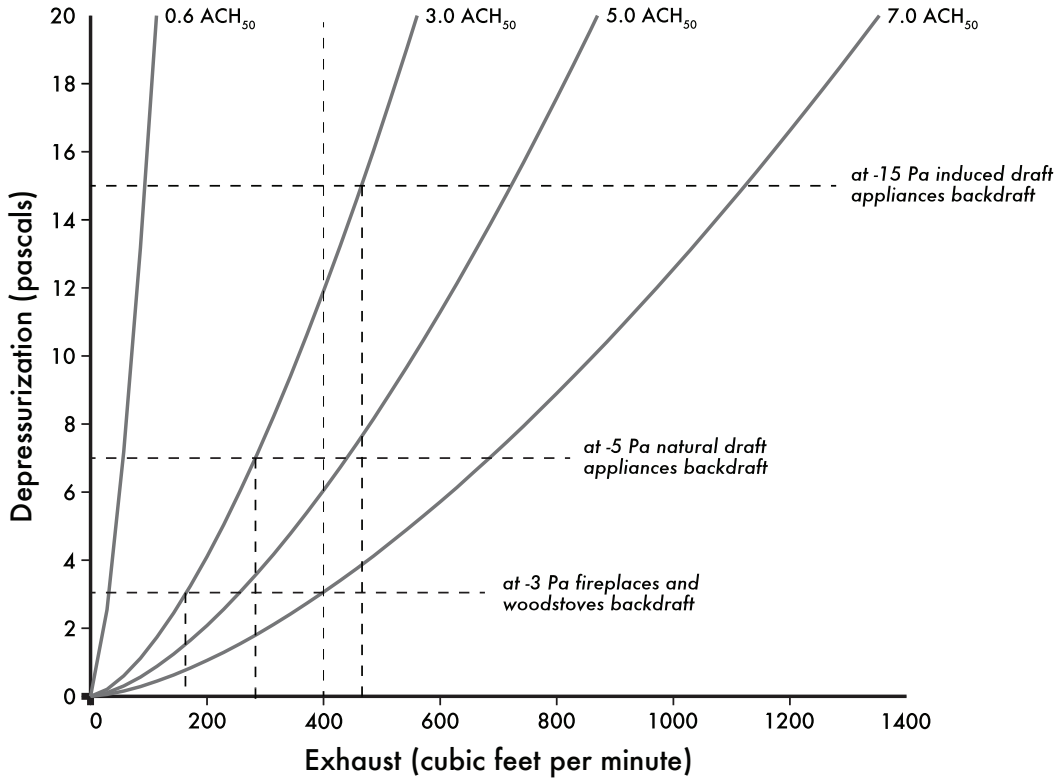
Today's homes are "tighter" than ever before; as well they should be: Proper sealing yields efficiency and comfort gains that substantially exceed the cost thereof. That being said, it has become obvious that homes with high performance insulation require even higher performance ventilation.

Because modern homes simply do not "breathe" (i.e. leak) like those built in the past, it is quite easy for modest exhausts and ordinary living to create unsafe depressurizations and an unhealthy indoor environment or. Since CO, CO_2, VOCs, dust, and other irritants accumulate without exfiltration of stale or infilitration of fresh air, the environment inside modern homes is two to five times MORE polluted than outdoors. And modest mechanical exhausts, or even the stack or wind effects, can easily depressurize the home to an uncomfortable and even unsafe degree.

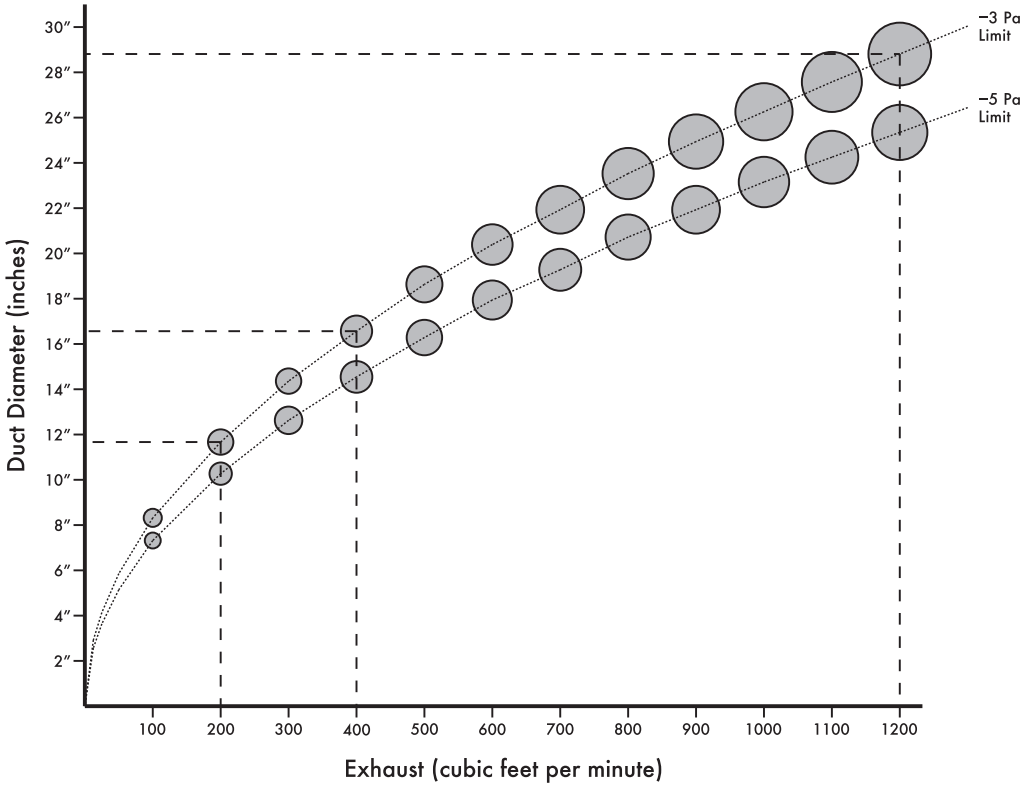
No one should have to live in an uncomfortable or unsafe environment simply because their home is properly sealed. That's why AirScape created its new Residental Make-up Air Unit. These extraordinary devices provide enough make-up air for the largest residential exhausts, use ultra-accurate pressure controls to prevent even the most minute depressurization, provide continuous indoor air filtration at the press of a button, and can even boost the efficiency of a home's heating and cooling systems.

Mechanical Exhaust Depressurization Potential

(20,000 ft³ house)



Minimum Duct Sizing for Passive Make-up Air



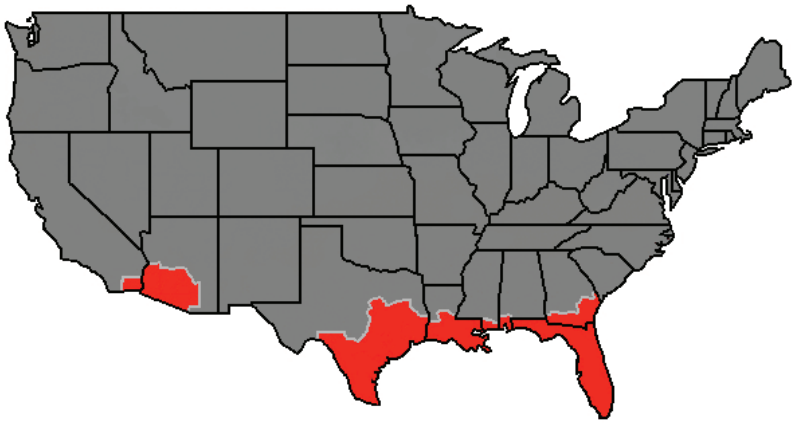
The Make-up Air Problem

Whenever an exhaust is used, air is forced out of the house and the indoor air pressure begins to drop relative to outdoors. Unless this depressurization is relieved with by "make-up air" (i.e. air brought into the house to replace the air exhausted), negative consequences inevitably follow: Doors open with difficulty. Dirt, debris, and insects are "sucked" into the home through various openings. Pilot lights operate erratically. Backdrafts occur.

As no house is perfectly airtight, air will work its way in through cracks in roofs and walls, and arround windows and doors. These cracks are then further erroded by the moisture, dirt, and dust carried by the air moving through them. Most perversely, working against a depressurization renders the exhausts that cause it ineffective, wasting electricity and allowing fumes, odors, and pollutants that should be removed to linger.

The only way to prevent depressurization effects is to provide exhausts with make-up air. The International Residential Code ("IRC") recognizes this fact by requiring kitchen exhausts in excess of 400 cfm to be provided with make-up air. However, in homes built to modern airtightness standards, much less than 400 cfm of exhaust can can cause a hazardous depressurization. Undersized exhausts do not alleviate the true need for make-up air.

The IRC requires homes in climate zones 3-8 (which cover the vast majorty of the U.S.) to be built to a ≤ 3.0 ACH_{50} standard. At this tightness, a 20,000 ft^3 home (2500 ft^2 with 8 ft ceilings) will be depressurized to -3 Pa by less than 160 cfm of exhaust, and to -5 Pa by less than 250. This is enough to backdraft fireplaces, wood stoves, and draft appliances—and these levels of depressurization can just as easily be caused by wind or stack effects as mechanical exhausts.



In the map at left, areas of the country in which homes are required to be built to the ≤ 3.0 ACH_{50} standard are shown in grey. Areas in which home are required to be built to a ≤ 5.0 ACH_{50} standard are shown in red.

In reality, 400 cfm is a very modest amount of exhaust for a gourmet kitchen—exhausts from 600 to 1200 cfm are common. As is shown in the the graph above, the depressurization of a home increases exponentially with the amount of exhaust. Less than 640 cfm of exhaust is enough to depressurize a home built to the ≤ 3.0 ACH_{50} standard to -25 Pa. This much depressurization can backdraft even sealed-combustion appliances.

A common attempt at providing make-up air involves simply installing a round duct with an actuated damper between the outdoors and living space. Such ducts are promoted as "passive" solutions. While an intuitive approach, they are inadequate. As shown in the graph at left, supplying even 400 cfm of make-up in such fashion would require a nearly 17 inch diameter duct to prevent a depressurization in excess of -3 Pa.

At a not-uncommon 1200 cfm exhaust rate, a nearly 29 inch duct would be required to prevent the same depressurization. These diameters, in whole or in part, are obviously too large to contemplate installing in today's high-performance building envelopes.

The only viable solution is mechanically-introduced Make-up Air

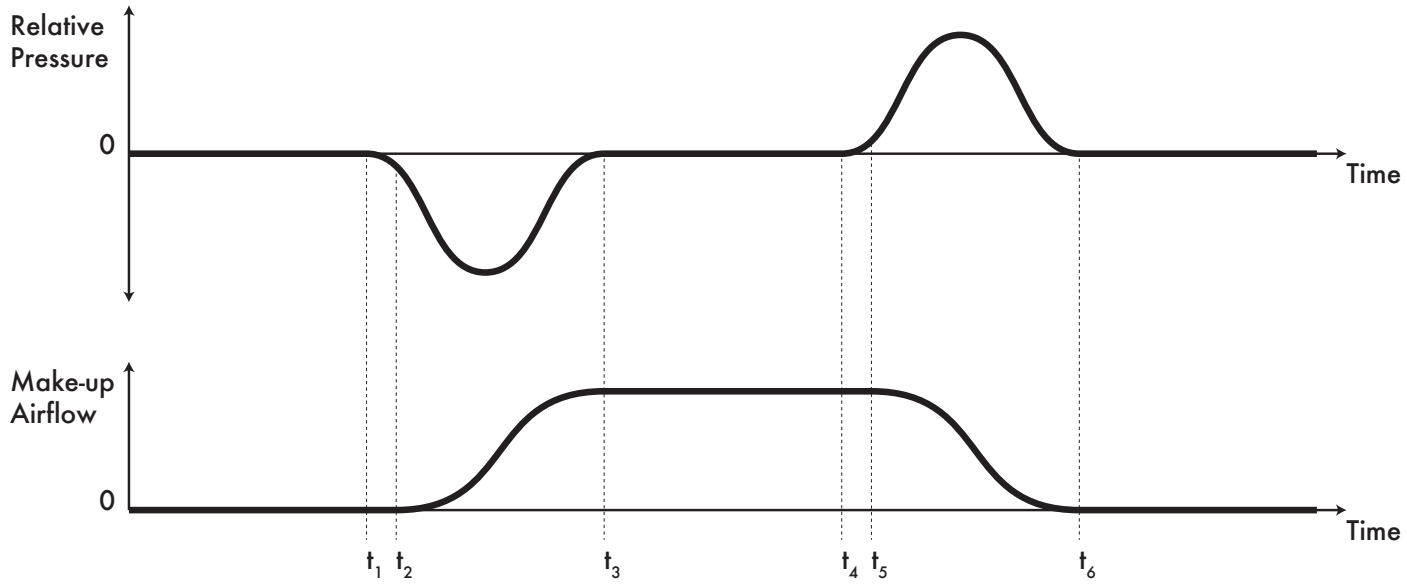
The AirScape Advantage: Powerful ECM Fans + Digital Pressure Controls

It's easy enough to find a big fan and simply blow air into a space, but no homeowner wants to do that every time they cook. The key to an well-designed make-up air system is a control package that activates its fan automatically whenever an exhaust is operated.

This has usually been accomplished by interlocking a make-up air fan with the kitchen hood using a current relay. In today's tight homes this approach is inadequate. Since even a small exhaust (such as from a bathroom fan) can depressurize the home, make-up air should be provided for more than just the kitchen.

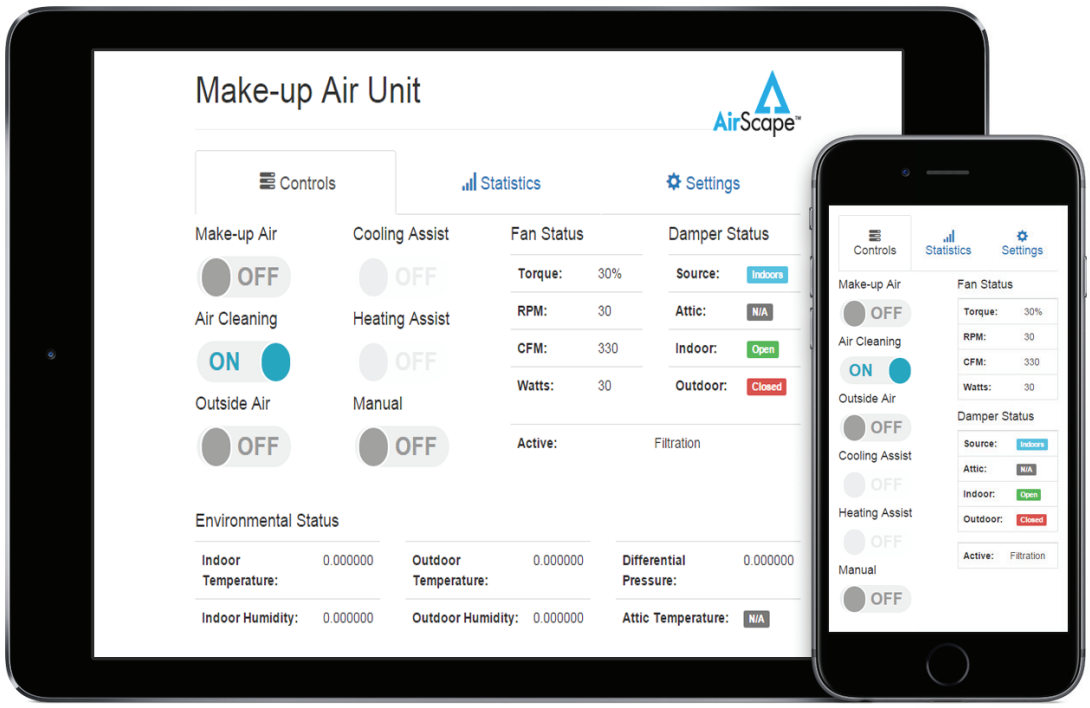
AirScape's make-up air units use powerful ECM motors to provide enough make-up air for the largest exhausts, and, unlike any other on the market, employ sophisticated digital pressure sensors to control them. These sensors constantly measure the relative indoor/outdoor air pressure. When a depressurization is detected, the unit's controls activate its fan, which then speeds up or down to provide the right amount of make-up air to balance the pressure. The graph at the top of the next page shows this in practice:

- At time t_1, the homeowner turns on an exhaust and the relative pressure begins to drop. By t_2 this is detected by the unit's sensors, in response to which its fan turns on and begins to speed up. At t_3 the unit has arrived at the correct speed to balance the exhaust.
- When the homeowner turns off their exhaust at t_4, the make-up air unit is still introducing air into the home, so the relative pressure begins to rise. The unit's sensors detect this change at t_5, and begin to reduce the fan's speed and then turn it off entirely. By t_6 the relative pressure is balanced again.



This approach has many advantages:

- Pressure controls allow the make-up air unit to relieve depressurization caused by any exhaust: the kitchen hood, bathroom fans, even the wind or stack effects. This provides homeowners with the best possible defense against back-drafts and poor indoor air quality.
- Digital controls are easily programmed to meet every homeowner's unique needs using an intuitive interface accessible on any tablet, smartphone, or computer. For example, homeowners with open fireplaces can tighten the unit's depressurization limits to achieve maximum protection against backdrafts.
- Professionals will appreciate that digitization means the unit's controls are truly "plug and play": no high voltage wiring is required to install the unit.
- The software underlying the unit's controls allow it to provide functionality beyond make-up air. The unit can be used to continuously recirculate and filter indoor air, periodically introduce fresh outdoor air into the home, and provide "free cooling" using outdoor in place of air conditioning.



How the AirScape MUA improves Indoor Air Quality

Human beings breathe an average of 3,000 gallons of air each day. Very little of that air is as clean as it could be. We've long recognized the effects of outdoor air pollution on our health and the environment, but the air inside our homes is generally TWO to FIVE times MORE polluted than the air outside. Just how bad is this? Indoor air pollution causes or aggravates 50% of all illnesses, and is responsible for about 200,000 ER visits each year!

Paradoxically, indoor air pollution is particularly severe in homes built to modern standards. Today's new homes are built so "tight" that fresh air does not naturally infiltrate, allowing contaminants such as dust, CO, CO_2, and VOCs to accumulate unexhausted. To meet this challenge, AirScape has designed its make-up air units to provide much more than just make-up air. Here's how our make-up air units improve the indoor air quality of the entire home:

Dual-function dampers

Unlike other available make-up air solutions, AirScape units' outdoor air dampers have been designed to allow the fan to recirculate and filter indoor air when not drawing in outdoor air. Homeowners can program the unit to provide a set number of recirculations per hour and also to periodically introduce fresh air from outdoors.

High MERV Filters

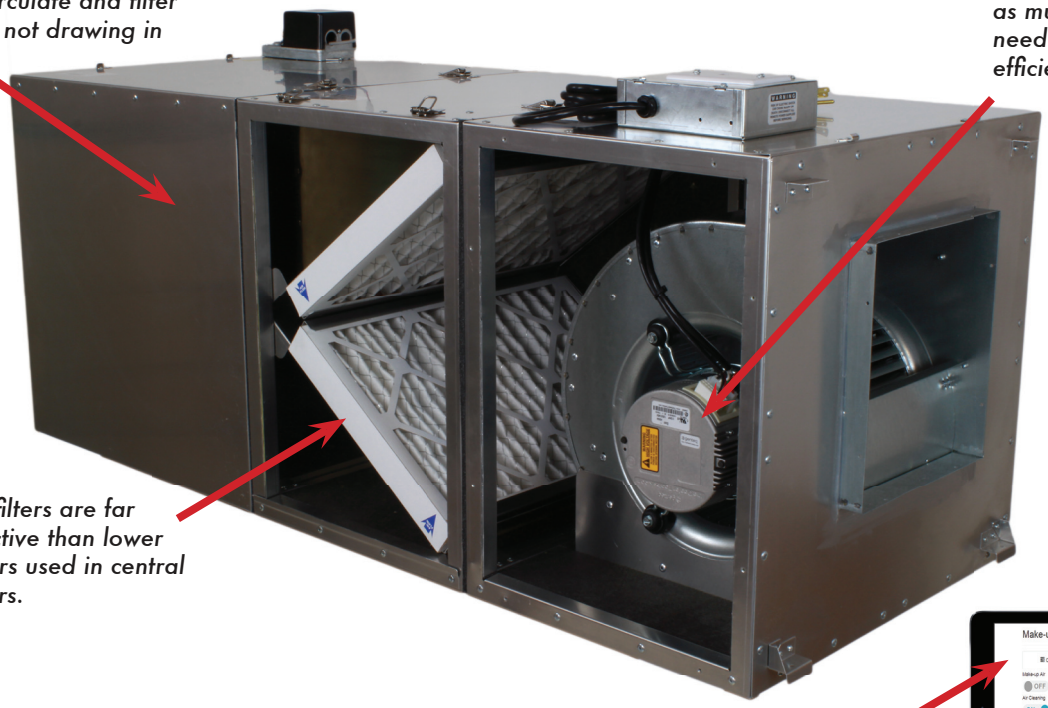
Central air handlers are often used to recirculate and filter indoor air, but their filters are very low arrestance, which makes this approach very ineffective. The MERV-13 filters used in AirScape make-up air units are among the highest arrestance available for residential applications, making these units ideal for recirculating and filtering air. Even with these high MERV filters, the units' ECM motors provide as much airflow as needed with maximum efficiency.

Pressure-controlled Make-up Air

Exhausts are critical to prevent indoor air contaminants from accumulating, but they do not operate effectively against negative pressure. As smaller exhausts such as bathroom fans and dryer vents are just as important in this regard as their larger cousins, AirScape's pressure controls are particulary advantageous: Providing making adequate make-up air to every exhaust in the home allows each one to provide the maximum benefit.

Damper module allows the unit's fan to recirculate and filter indoor air when not drawing in outdoor air.

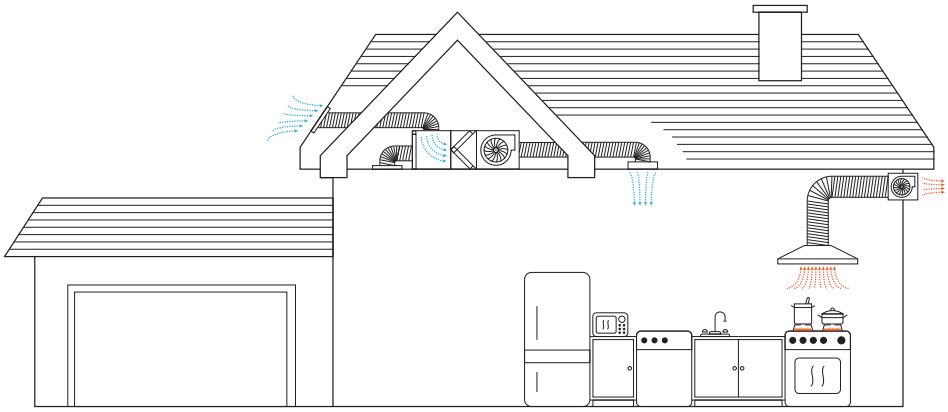
ECM fan motors provide as much airflow as needed with maximum efficiency.



MERV-13 filters are far more effective than lower grade filters used in central air handlers.

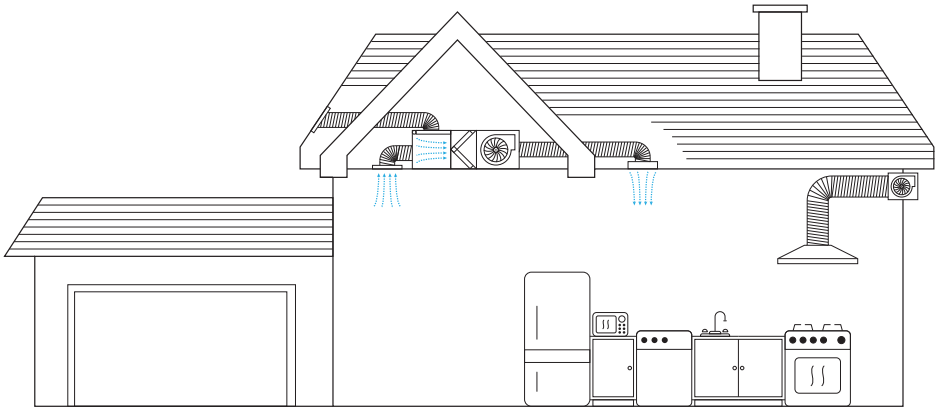
A unit that doesn't get programmed doesn't clean the air. AirScape make-up air units' digital controls are easily programmed using an intuitive interface accessible by any tablet, smartphone, or computer.

Make-up Air Unit Functions



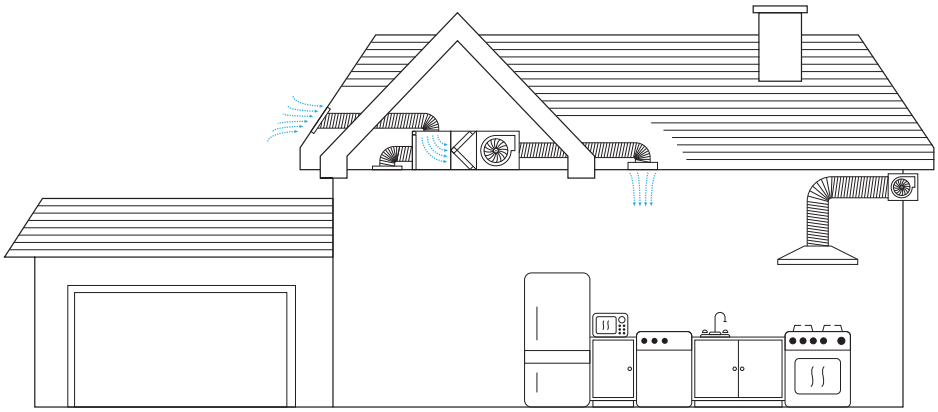
Make-up Air

The unit's sensor package continuously monitors relative indoor/outdoor air pressure. When an exhaust or combustion appliance causes a depressurization in excess of the programmed limit, the MUA unit's outdoor damper opens and its air handler turns on to relieve it. This function can also be interlocked with specific appliances.



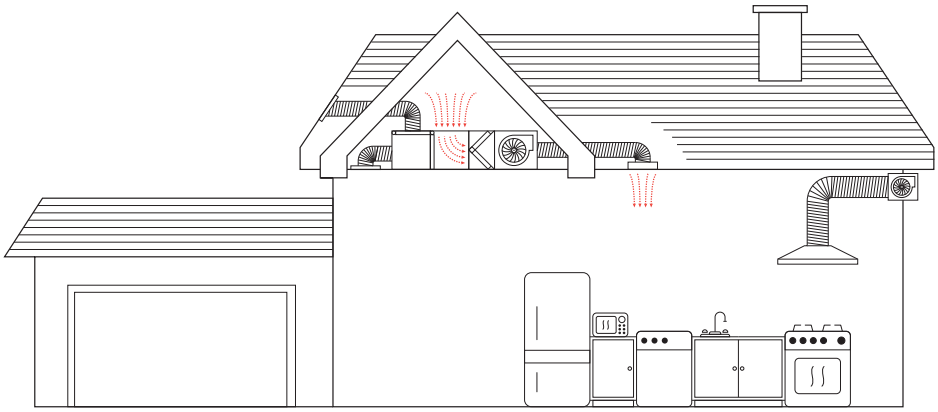
Indoor Air Quality

This function opens the unit's return air damper and uses its air handler to recirculate and filter the home's indoor air according to a programmed number of air changes per hour. Additionally, in this mode, the unit can periodically open its outdoor damper to introduce a programmed percentage of fresh air into the home from outside.



Cooling Assist

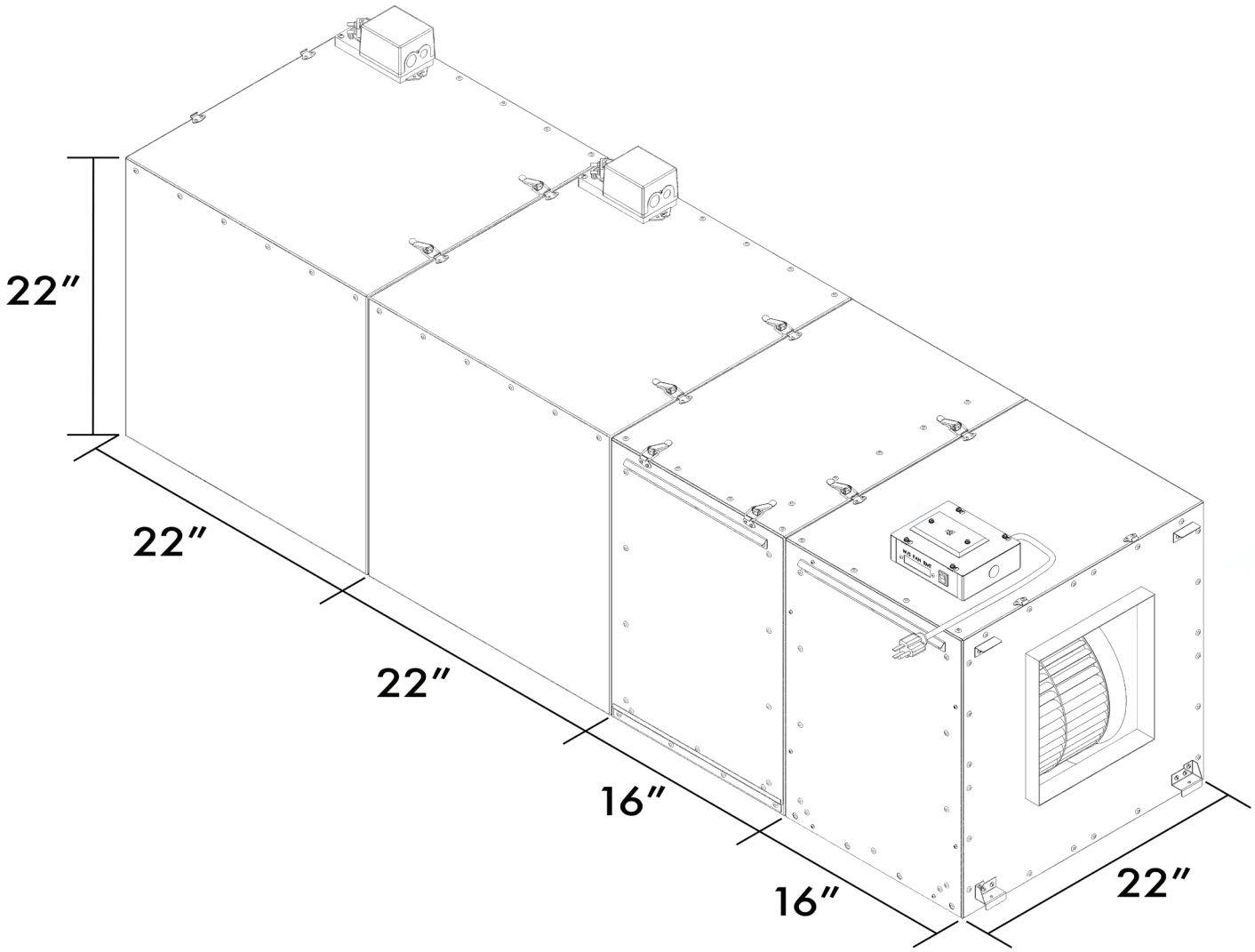
When the outdoor temperature is lower than the desired indoor temperature, the outdoor air damper opens and the unit introduces cool, filtered outdoor air into the home until the set-point is achieved, replacing a portion of the air conditioner's cooling load with a far more efficient alternative.



Heating Assist

With an optional second damper module, the unit can be used to supply the home with "free heating" from the attic. When the home's thermostat is set to heat, and the attic air temperature is greater than the set-point, the attic air damper opens and the unit introduces warm, filtered attic air until the set-point is achieved.

Unit Dimensions



Specifications

Airflow (min–max): 295–1173 cfm
Power (min–max): 15–252 watts
Filter Rating: MERV 13