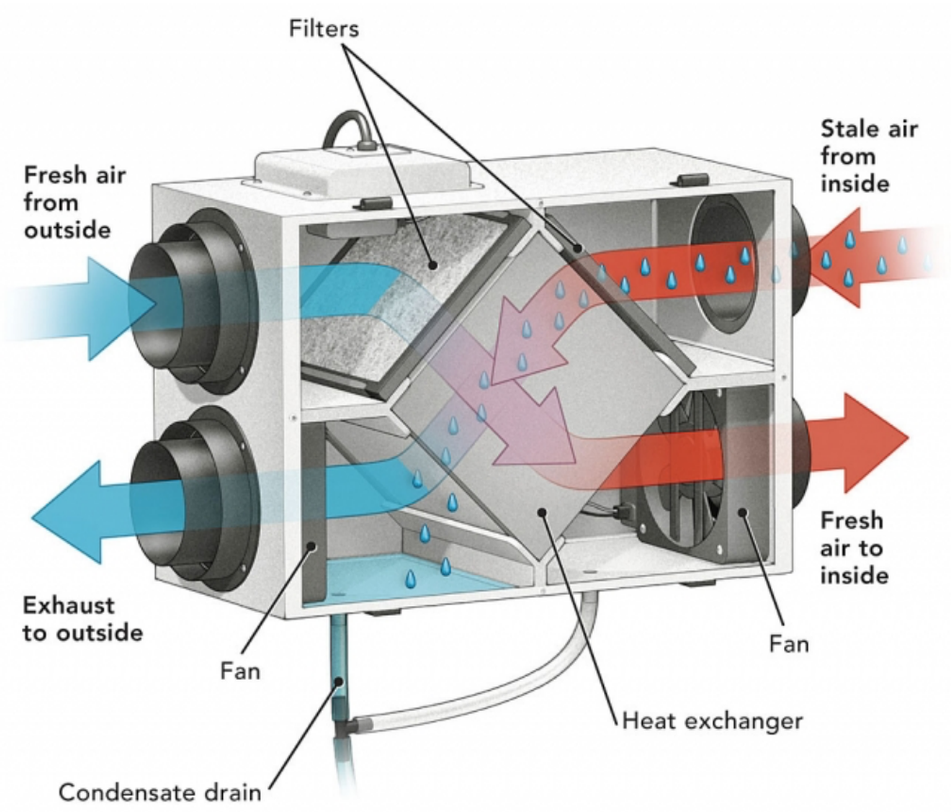
Ventilation Systems



Heat Recovery Ventilators
Energy Recovery Ventilators

Copy of this information available at: keyesweb.com/ventilation

Ventilation

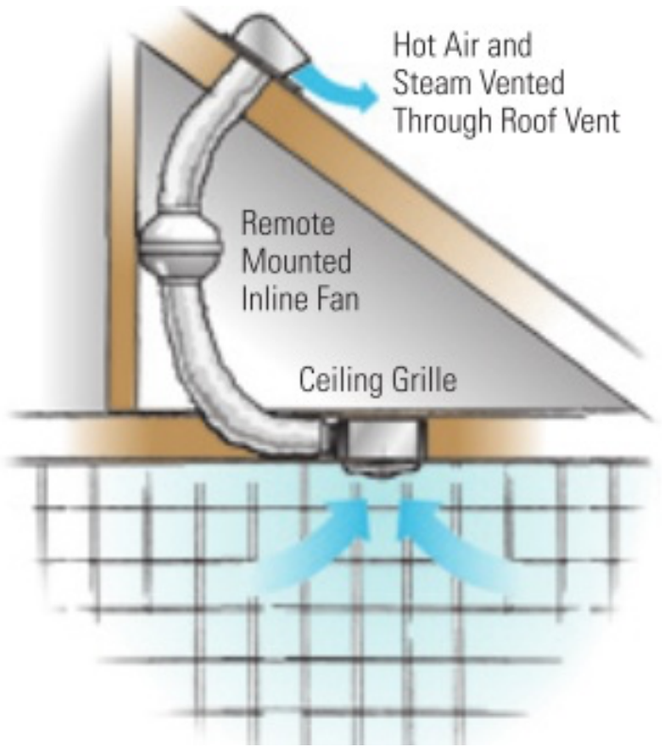
All buildings breathe–exchange air between the interior and exterior. The rate of air exchange is affected by many factors including:

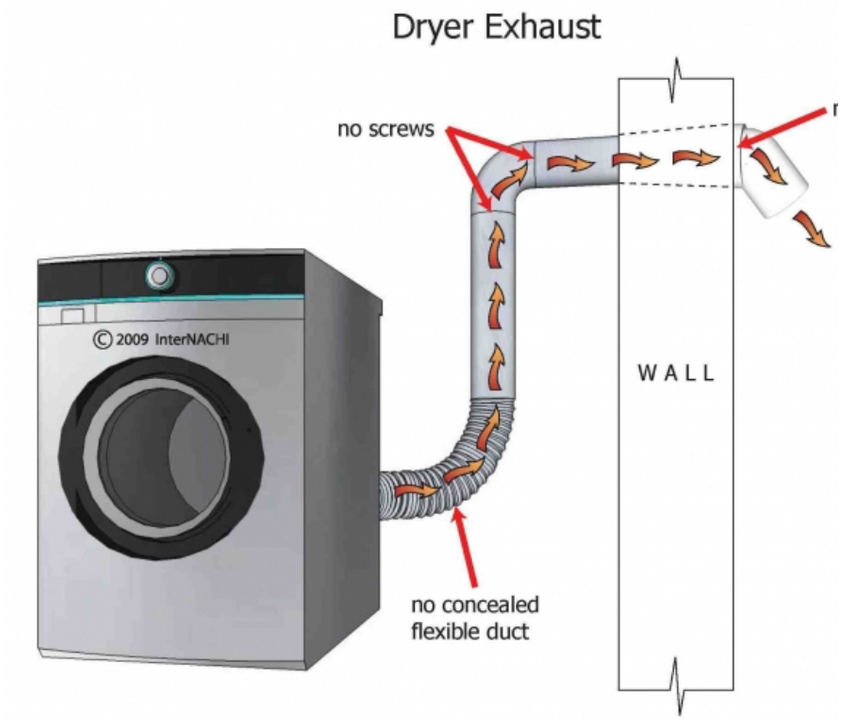
- The quality of the envelope (all the exterior surfaces)*
- Quality of vents/flues (bathroom and kitchen fans heating units, fireplaces, etc.)*
- The temperature delta between the interior and exterior
- The humidity delta between the interior and exterior
- Wind speed and direction
- Building height

Within this list, the quality of the envelope and the quality of the vents/flues are the factors we can reasonably control.

Although these and other factors contribute to making every building unique, it can be generally assumed that the older the building the weaker the envelope–although we've all experienced exceptions.

Ventilation





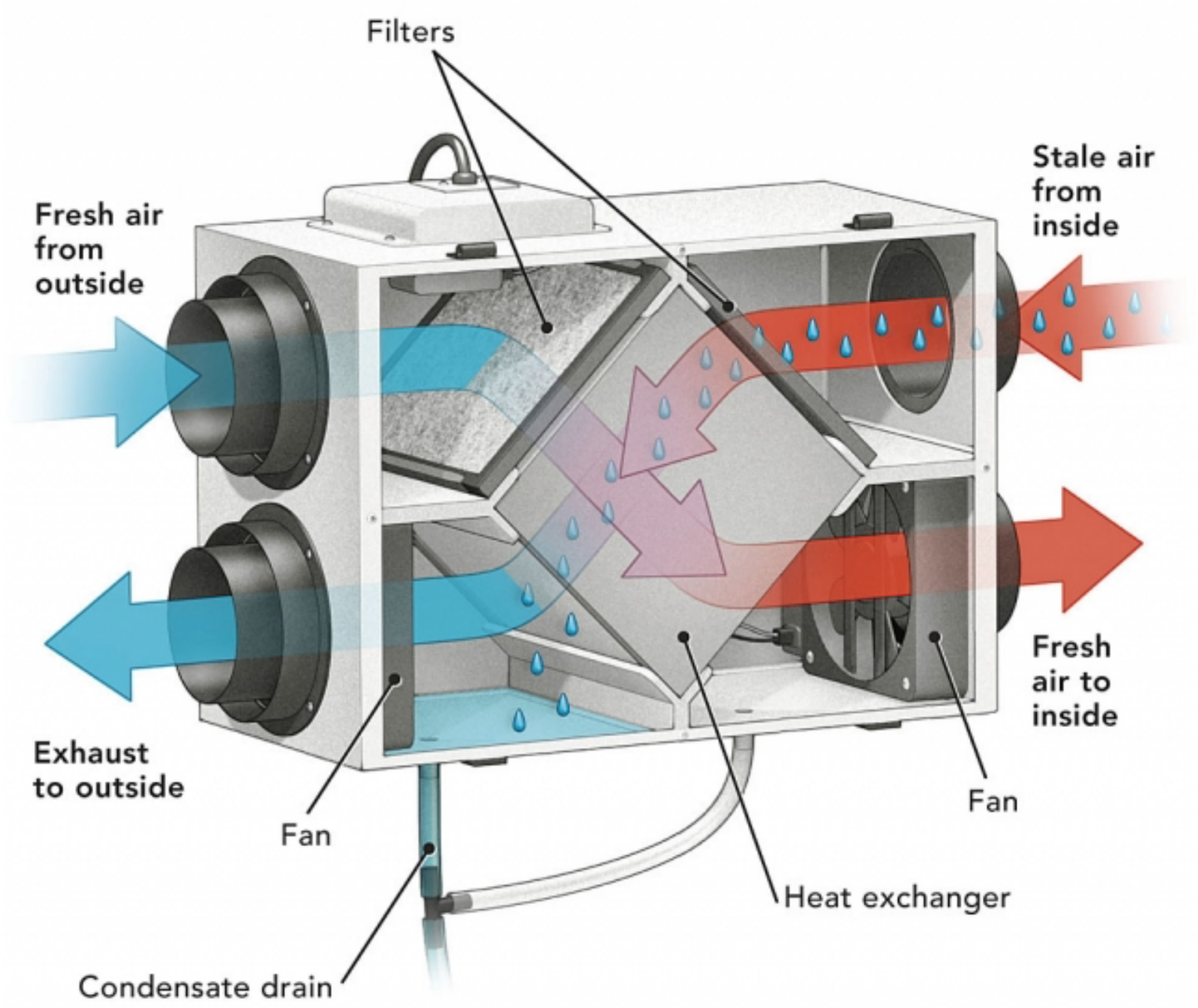
Bathroom
50 - 100 CFM

Range
300 - 1,200 CFM

Clothes Dryer
100- 200 CFM

Exhaust systems remove contaminated air from the building. In the systems shown above, the air exhausted is replaced indirectly, usually through infiltration.

Ventilation



Heat and energy recovery ventilators exhaust air from the building while providing replacement fresh air. The ventilator uses an exchanger to transfer heat (and moisture in an ERV) between the exhaust and make-up replacement air.

Ventilation

Definitions

Name	*Description*	*Units*	*Notes*
ACH	Air changes per hour	AC / hour	
CFM	Cubic feet per minute	ft^3 / minute	
CFH	Cubic feet per hour	ft^3 / hour	
Area	Conditioned floor area	ft^2	
Volume	Conditioned volume	ft^3	
Density	Occupancy density	Number of people	Number of bathrooms + 1
HRV	Heat recovery ventilator		Sensible heat exchange
ERV	Energy recovery ventilator		Sensible and latent heat exchange

Sample Calculation

Sample Residence Data
Total conditioned space: 3,000 sq. ft. with 7.5 ft ceilings
Three bedrooms: Occupancy density 3 + 1 = 4
Total cubic volume: 3,000 ft^2 x 7.5 ft = 22,500 ft^3

ASHRAE Standards
Formula factors the total conditioned floor area and occupancy density based on the number of bedrooms. Based on our sample residence:

CFM = [0.03 x conditioned floor area ft^2] + [7.5 x (no. bedrooms + 1)]
CFM = [0.03 x 3,000 ft^2] + [7.5 x 4]
CFM = [90] + [30] = 120 CFM

Sample Calculation

Sample Residence Data
Total conditioned space: 3,000 sq. ft. with 7.5 ft ceilings
Three bedrooms: Occupancy density 3 + 1 = 4
Total cubic volume: 3,000 ft^2 x 7.5 ft = 22,500 ft^3

Massachusetts Building Code from the International Mechanical Code
Two formulas are used, one based on conditioned volume and one based on occupancy density. The code states using the conditioned volume formula but no less than the occupancy density calculation.

Conditioned volume calculation
CFH = 0.35 ACH x conditioned volume
CFH = 0.35 ACH x 22,500 ft^3
CFH = 7,875 ft^3 / hour
CFM = CFH / 60 min/hr
CFM = [7,875 ft^3 / hour] / [60 min/hr] = 131 CFM

Sample Calculation

Sample Residence Data
Total conditioned space: 3,000 sq. ft. with 7.5 ft ceilings
Three bedrooms: Occupancy density 3 + 1 = 4
Total cubic volume: 3,000 ft^2 x 7.5 ft = 22,500 ft^3

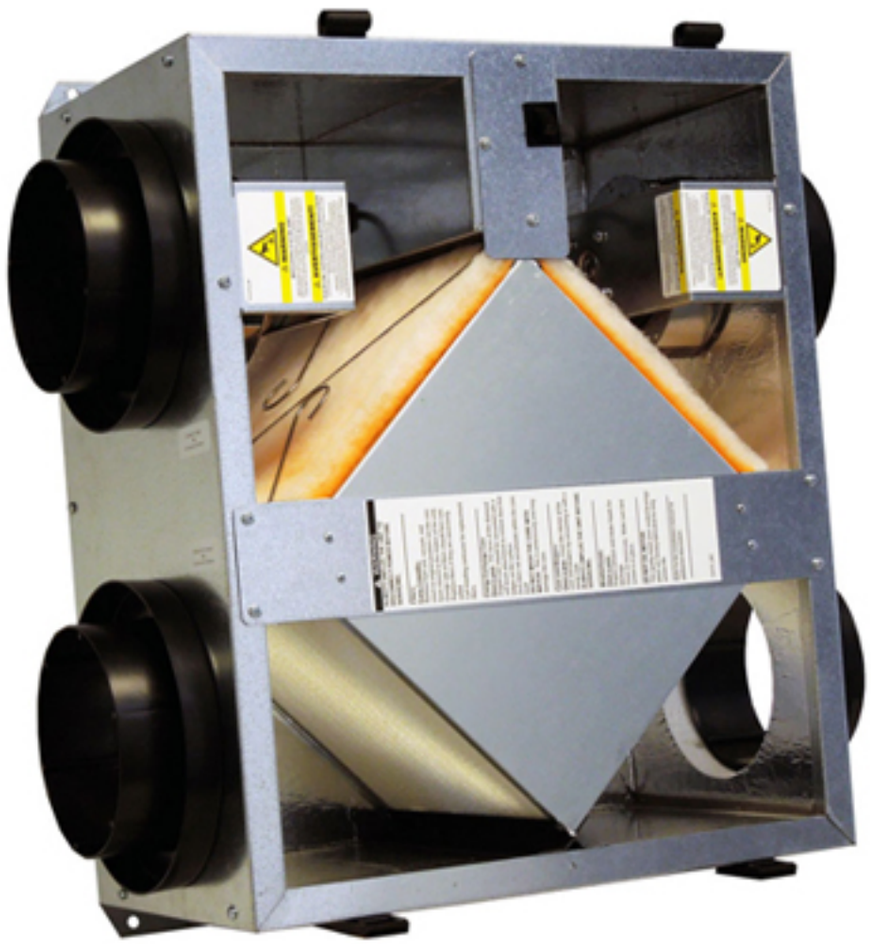
Massachusetts Building Code from the International Mechanical Code
Two formulas are used, one based on conditioned volume and one based on occupancy density. The code states using the conditioned volume formula but no less than the occupancy density calculation.

Occupancy density calculation
CFM = 15 CFM per Occupant
CFM = [15 ft^3 / minute] x [4] = 60 CFM

Therefore the required ventilation using the Mass Building code is 131 CFM, which is greater than the 60 CFM calculated density calculation.

Sample Calculation

The ASHRAE and Mass Building Code calculations suggest ventilation rates of 120 CFM and 131 CFM respectfully.



Readily available residential HRVs and ERVs range from 40 to 300 CFM.

Ventilation

Ventilation

Ventilator intake hood - where fresh air enters the system

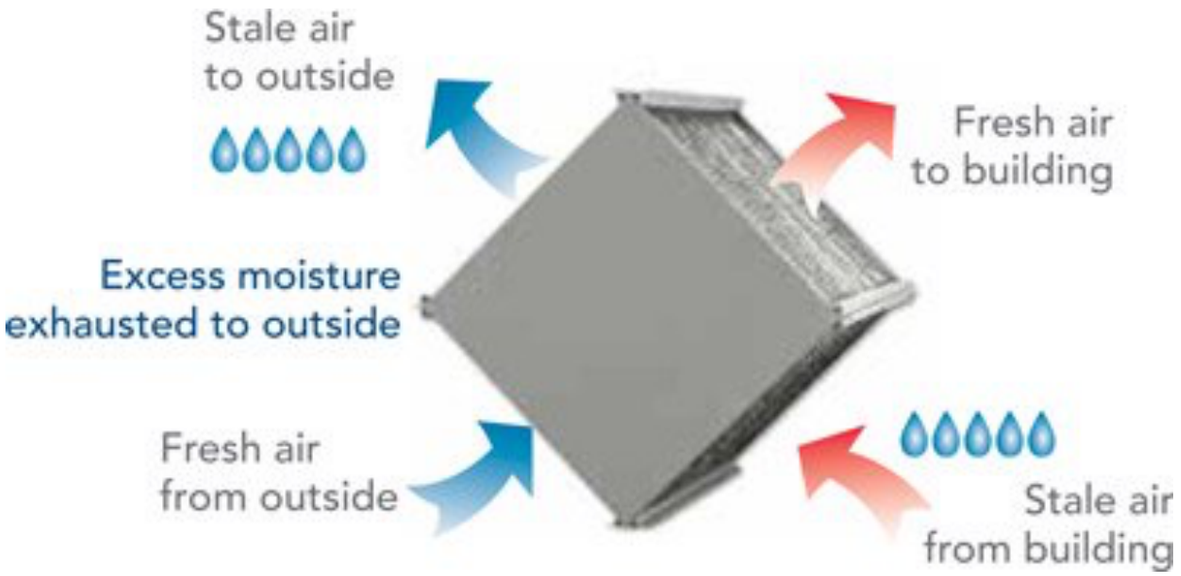
The condition of that intake hood

Ventilation

Interior of the ventilator - intake chamber

Ventilation

HRV - Heat recovery ventilator



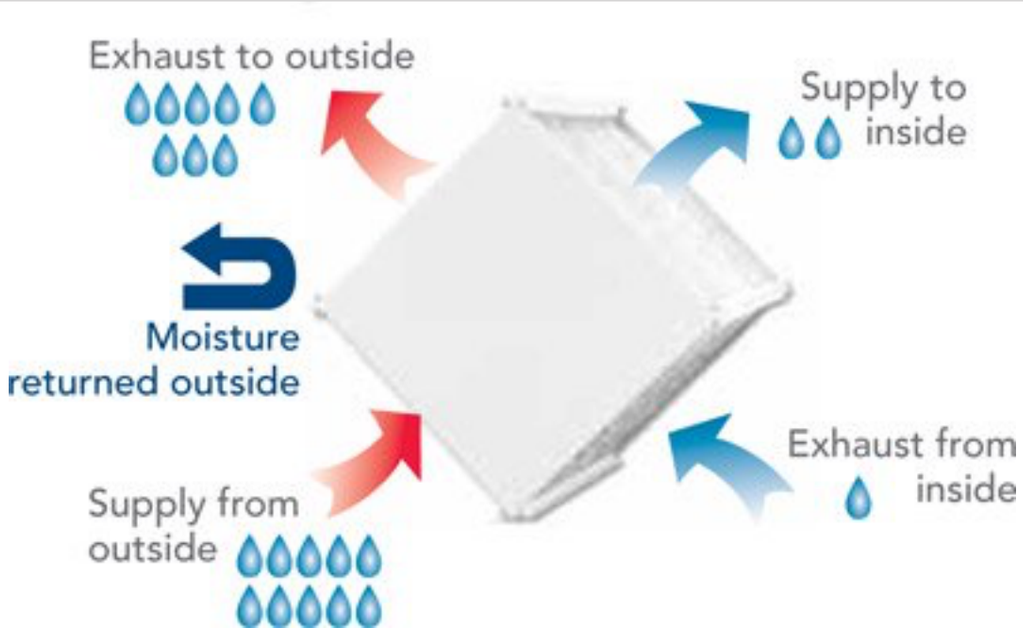
Year Round Operation

An HRV's exchange medium transfers **only heat** the between the exhausting stale air and the incoming fresh air.

An ERV's exchange medium transfers **both heat and moisture** between the exhausting stale air and the incoming fresh air.

ERV - Energy recovery ventilator

Winter Operation



Summer Operation