



# The “V” in HVAC: Mechanical Ventilation in ENERGY STAR Certified Homes

RESNET 2014


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# Agenda

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- Value of mechanical ventilation and indoor air quality.
- Three major components of mechanical ventilation.
- Completing the HVAC System QI Rater Checklist.
- Draft RESNET standard on testing.
- Question & answer session.

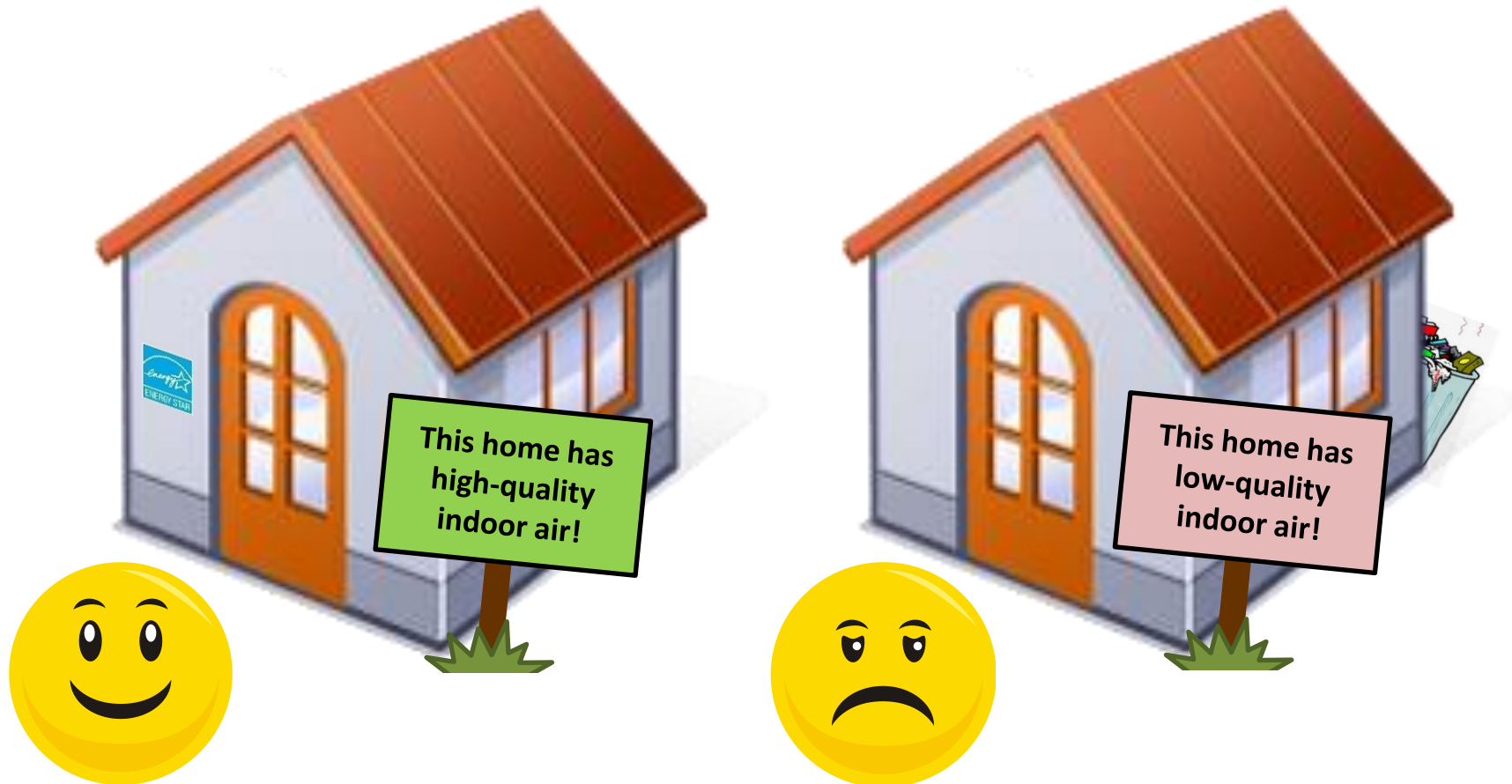
A photograph in the top left corner shows a person in a white t-shirt and blue jeans kneeling on the floor, working on a white mechanical ventilation unit. The person is holding a small electronic device, possibly a smartphone or a diagnostic tool, and is looking at it. The unit has a circular access panel on its side.

# Value of IAQ & Mechanical Ventilation

# Value of mechanical ventilation & indoor air quality



- Consumers place value on indoor air quality.

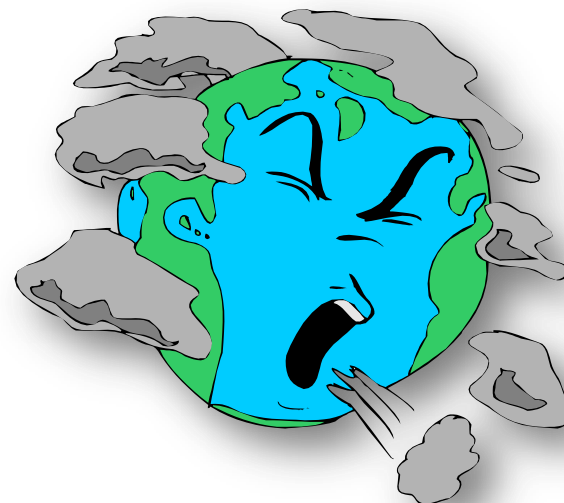


# What is indoor air quality?

1. Homeowner is satisfied (e.g., no odors or irritants).

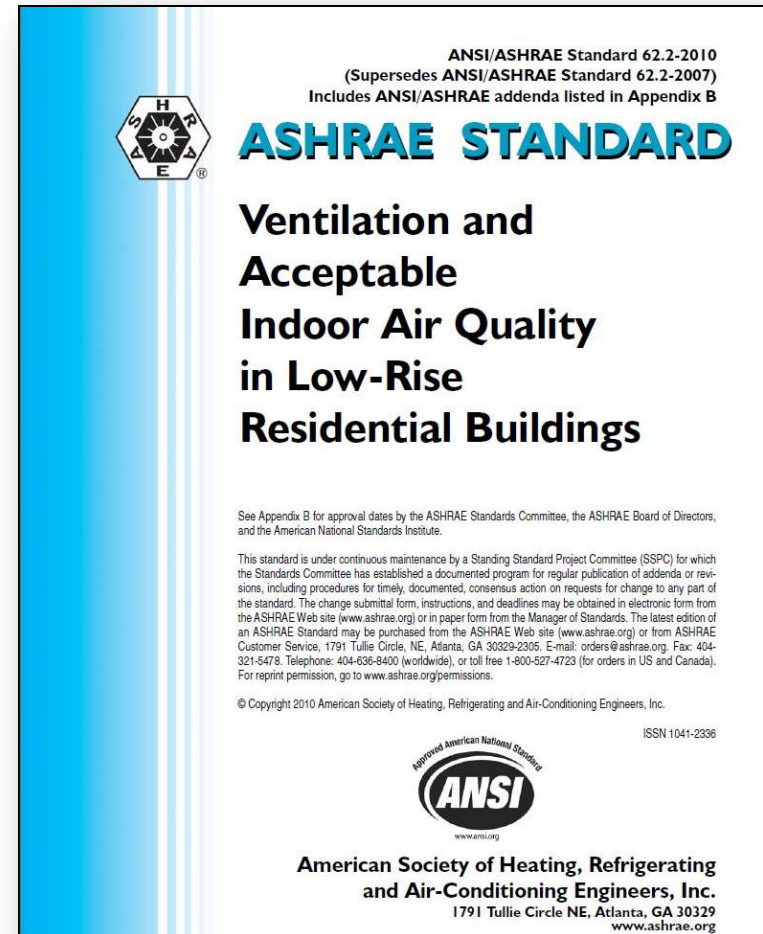


2. Low levels of contaminants known to pose health risks.



# What is indoor air quality?

- This is the basic definition of indoor air quality in the industry standard, ASHRAE 62.2-2010.
- Don't sacrifice indoor air quality in exchange for efficiency.



# What indoor air quality means to the consumer



- Give them the option to exhaust smells and cooking moisture out of the kitchen



# What indoor air quality means to the consumer



- Give them the option to exhaust moisture from the bathroom.





# What indoor air quality means to the consumer



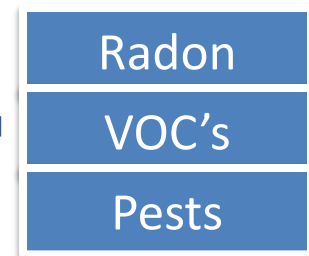
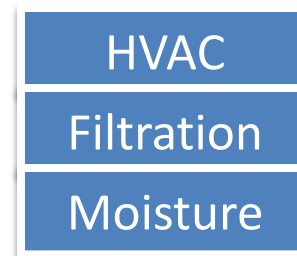
- Homeowners benefit from an automated system for bringing outdoor air into the house.



# How are the ENERGY STAR & Indoor airPLUS programs related?



- Both are voluntary labeling programs run by EPA.
- ENERGY STAR is better than standard practice, while Indoor airPLUS offers a complete indoor air quality package.
- For more information, visit [www.epa.gov/indoorairplus/](http://www.epa.gov/indoorairplus/)



Complete IAQ Protection

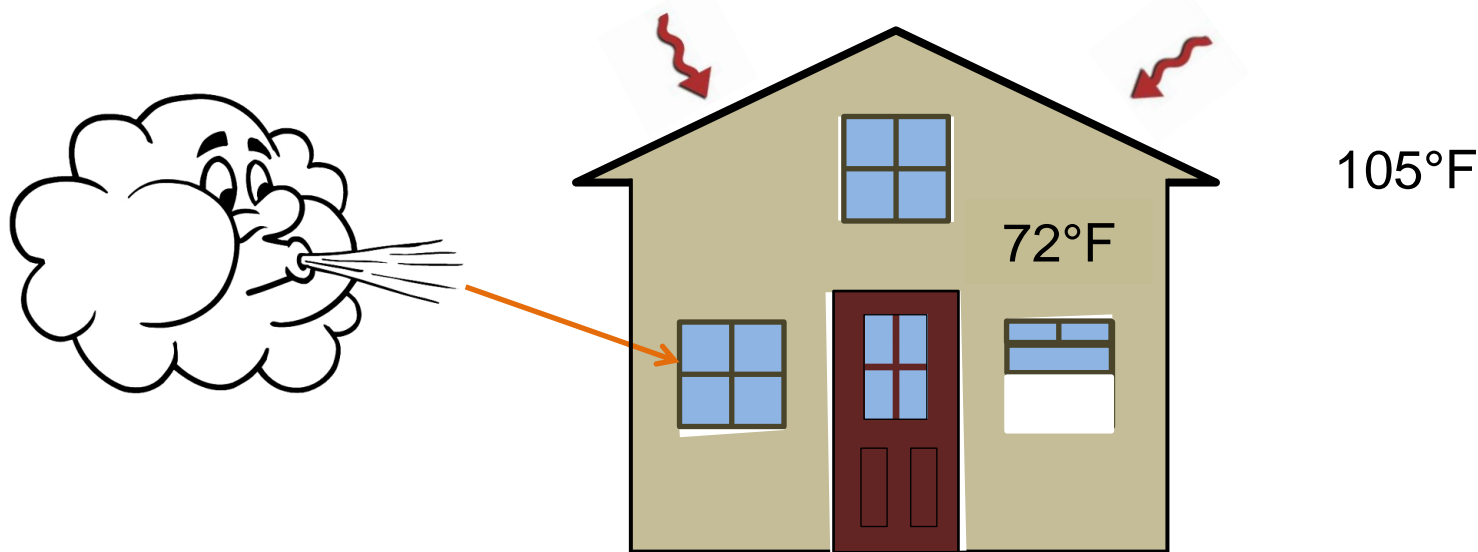
# Non-ENERGY STAR approach

- Some advantages, but mostly disadvantages.
- Advantages of leaky homes:
  - Dilution of contaminants in home.
  - Drying of building components that become wet.



# Non-ENERGY STAR approach

- Disadvantages of leaky homes:
  - Rate of outdoor air is not controlled.
  - Source and path of outdoor air is unknown.
  - Outdoor air may cause discomfort if not first conditioned.
  - Excess outdoor air increases energy use.



# ENERGY STAR approach

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1. Build the home tight to improve efficiency & comfort.
2. Remove contaminants using occupant-controlled exhaust fan in kitchens & bathrooms and a filter in HVAC system.
3. Bring in outdoor air in a controlled way to dilute contaminants.
4. Include key durability details relating to water management.



# Summary of value

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- Indoor air quality is valued by consumers.
- ENERGY STAR addresses efficiency without sacrificing indoor air quality or durability through:
  - Tight homes.
  - Removal of contaminants.
  - Dilution of contaminants with outdoor air.
  - Durability details related to moisture.

A small inset image in the top left corner shows a person in a blue shirt using a flashlight to inspect the ceiling of a room, likely checking for mechanical exhaust components.

# Concepts of Local Mechanical Exhaust

# Local mechanical exhaust: Overview of requirements

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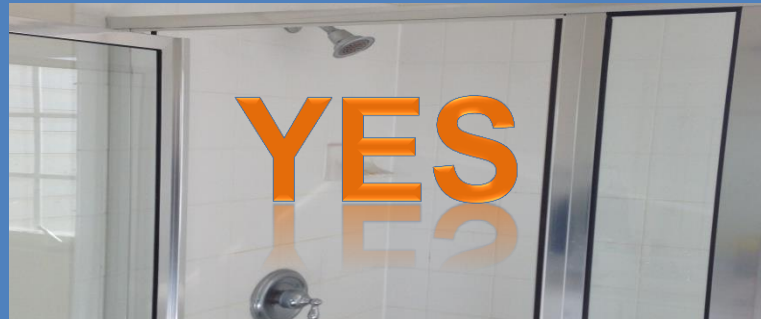
- Include an exhaust fan in each kitchen:
  - Achieve a minimum measured air flow rate or use a prescriptive duct design.
- Include an exhaust fan in most bathrooms.
  - Achieve a minimum measured air flow rate.
  - Achieve a maximum rated sound limit.



# Local mechanical exhaust: Bath fans

- Only bathrooms with a bathtub, shower, spa, or similar source of moisture must have an exhaust fan.

Does this bathroom need a fan?



# Local mechanical exhaust: Bath fans



- Two requirements for bath fans:
  - Achieve a minimum measured air flow rate.
  - Achieve a maximum rated sound limit.

Summary of Airflow Requirements for Bath Fans		
Fan Type	Measured Airflow	Rated Sound
Intermittent	$\geq 50$ CFM	$\leq 3$ sones

# Local mechanical exhaust: Bath fans



- Installation quality impacts the airflow.

## HVI PERFORMANCE

4" Duct			3" Duct				
0.1 Ps	Static Pressure (inH <sub>2</sub> O)		0.25 Ps	0.1 Ps	Static Pressure (inH <sub>2</sub> O)		0.25 Ps
Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)	Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)
80	1.1	25.7	61	70	1.3	25.7	55.3

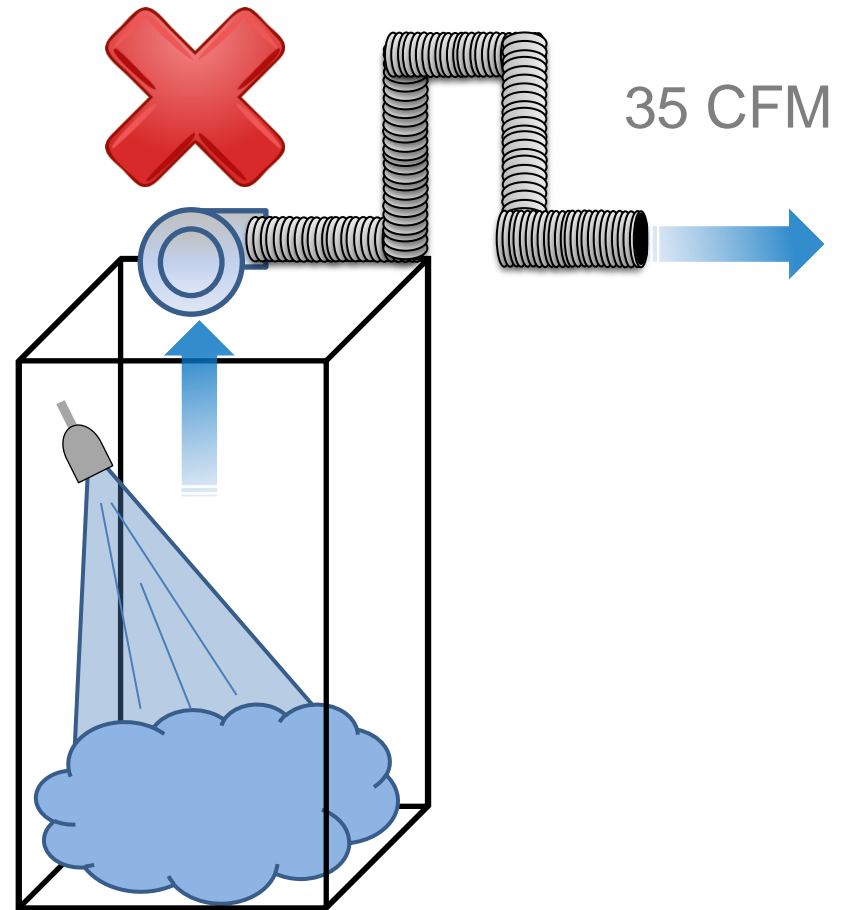
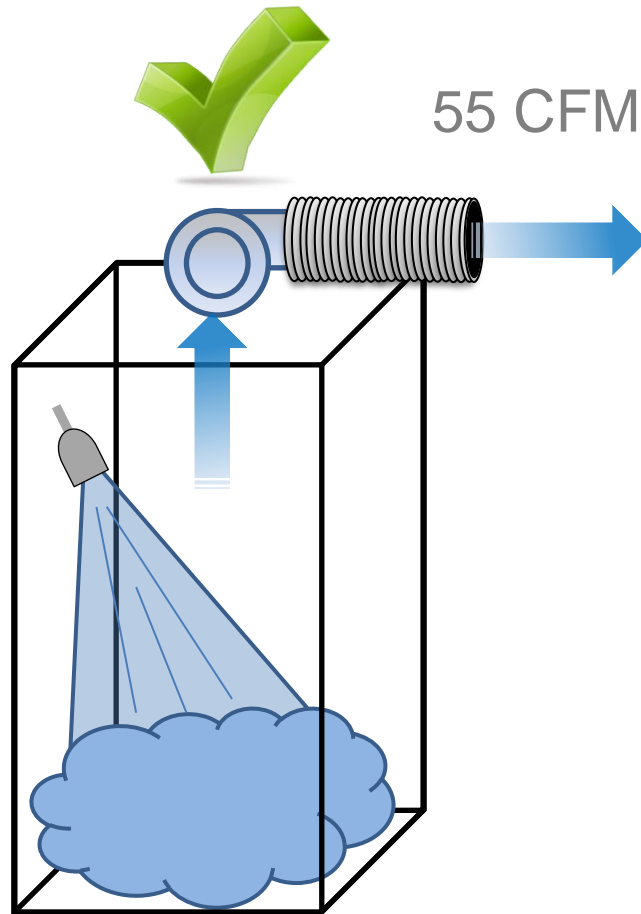


HVI-2100 CERTIFIED RATINGS comply with new testing technologies and procedures prescribed by the Home Ventilating Institute, for off-the-shelf products, as they are available to consumers. Product performance is rated at 0.1 in. static pressure, based on tests conducted in a state-of-the-art test laboratory. Sones are a measure of humanly-perceived loudness, based on laboratory measurements.

# Local mechanical exhaust: Bath fans



- Measured airflow is usually less than rated airflow.



# Local mechanical exhaust: Bath fans



## A Failure That Stalls the Certification of Many Energy Star Homes

The new commissioning procedures in Version 3 of the program have exposed a well-known air flow deficiency

Posted on Aug 28 2013 by [Allison A. Bailes III, PhD, GBA Advisor](#)

Subject: Emailing: A Failure That Stalls the Certification of Many Energy Star Homes GreenBuildingAdvisor.com

***You got'to-be' HOSIN-ME!***

This is almost making me cry.




# Local mechanical exhaust: Bath fans



- Sound levels, in sones, quantify how much sound a fan will make.
- Sones don't have to be measured in the field. Instead use the rated value from the product label or documentation.

**HVI PERFORMANCE**

4" Duct				3" Duct			
0.1 Ps - Static Pressure (inH <sub>2</sub> O)		0.25 Ps	0.1 Ps - Static Pressure (inH <sub>2</sub> O)		0.25 Ps		
Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)	Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)
80	1.1	25.7	61	70	1.3	25.7	55.3

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# Local mechanical exhaust: Bath fans



- Continuous bath fans have different airflow and sound targets.

Summary of Airflow Requirements for Bath Fans		
Fan Type	Measured Airflow	Rated Sound
Intermittent	$\geq 50$ CFM	$\leq 3$ sones
Continuous	$\geq 20$ CFM	$\leq 1$ sones

# Local mechanical exhaust: Kitchen fans



- Like bath fans, kitchen fans must meet a minimum airflow and should meet a maximum sound rating.
- Requirements depend on whether the fan is intermittent or continuous, and whether it's integrated with the range.

Summary of Airflow Requirements for Kitchen Fans			
Fan Type	Integrated with Range?	Measured Airflow	Recommend. Rated Sound
Intermittent	Yes	$\geq 100$ CFM	$\leq 3$ sones
Intermittent	No	Greater of $\geq 100$ CFM or 5 ACH	$\leq 3$ sones
Continuous	n/a	$\geq 5$ ACH	$\leq 1$ sone



Use this option!



# Local mechanical exhaust: Rev. 07 kitchen fans update



- Kitchen exhaust fan requirements enforced for homes permitted on or after 01/01/2014.
- Two alternative compliance options have been provided for kitchen exhaust fans:
  - One option for fans where the airflow is difficult to measure.
  - One option for fans that have no airflow rating.
- Kitchen exhaust some limits are recommended, but not required.
- Note that these revisions apply to kitchen exhaust, bath exhaust requirements remain unchanged.

# Local mechanical exhaust: Kitchen fans



- Prescriptive duct sizing option for fans with a rated airflow that's hard to measure.
- Maximum length for **smooth ductwork**

Diameter (inches)	Fan Rating (CFM @ 0.25 IWC)				
	50	80	100	125	>125
3	5	X	X	X	x
4	105	35	5	X	x
5	NL	135	85	55	x
6	NL	NL	NL	145	145
7	NL	NL	NL	NL	NL

- Include 15ft per turn or elbow in the duct.

# Local mechanical exhaust: Summary

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- An exhaust fan is required for each kitchen and most bathrooms.
- Each fan must meet a minimum airflow rate.
- Bath fans must meet a maximum rated sound level. Kitchen fans are recommended, but not required, to meet a maximum rated sound level.
- This helps homeowner maintain indoor air quality.

A small inset image in the top left corner shows a person in a blue shirt looking up and using a flashlight to inspect the ceiling of a room.

# Options for Whole-House Mechanical Ventilation

# Whole-house mechanical ventilation: Overview

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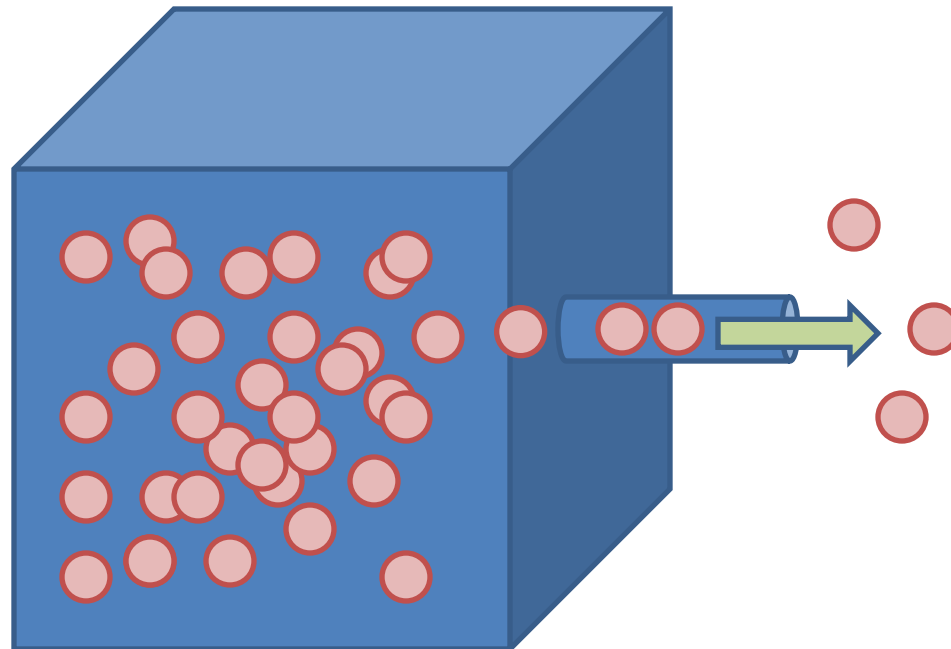


- Goal is to bring outdoor air into the house in a controlled, automatic, way.
- Three ventilation strategies:
  - Exhaust-only ventilation.
  - Supply-only ventilation.
  - Balanced ventilation.

# Whole-house mechanical ventilation: Strategy 1: Exhaust-only ventilation



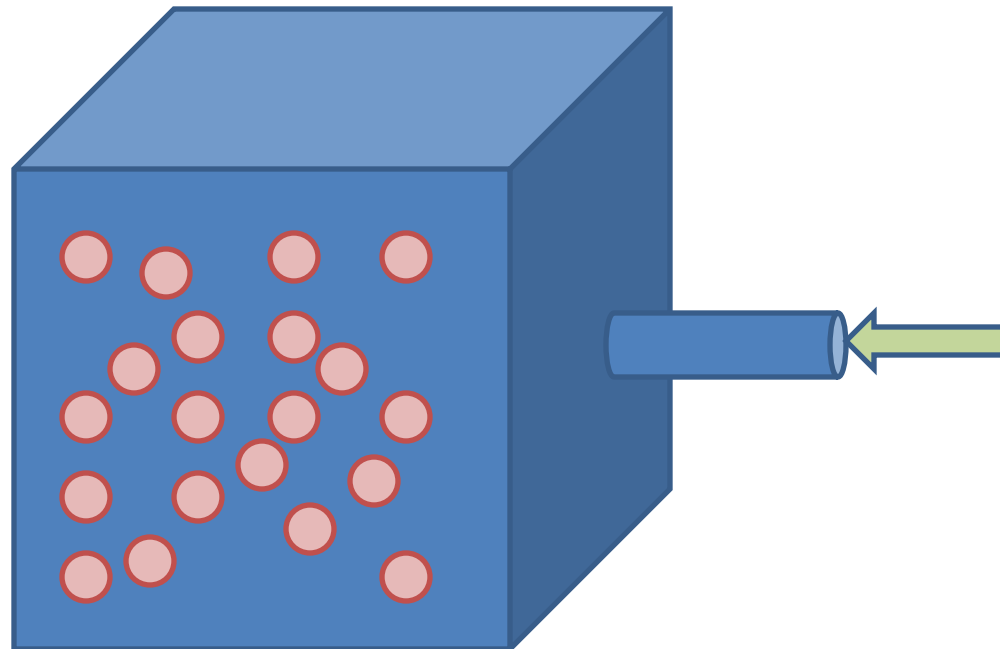
- Use a fan (typically a bath fan) to remove air from the home.
- Draws outdoor air into the home through cracks in the building envelope or a fresh air intake.
- Frequently used in colder climates.



# Whole-house mechanical ventilation: Strategy 2: Supply-only ventilation



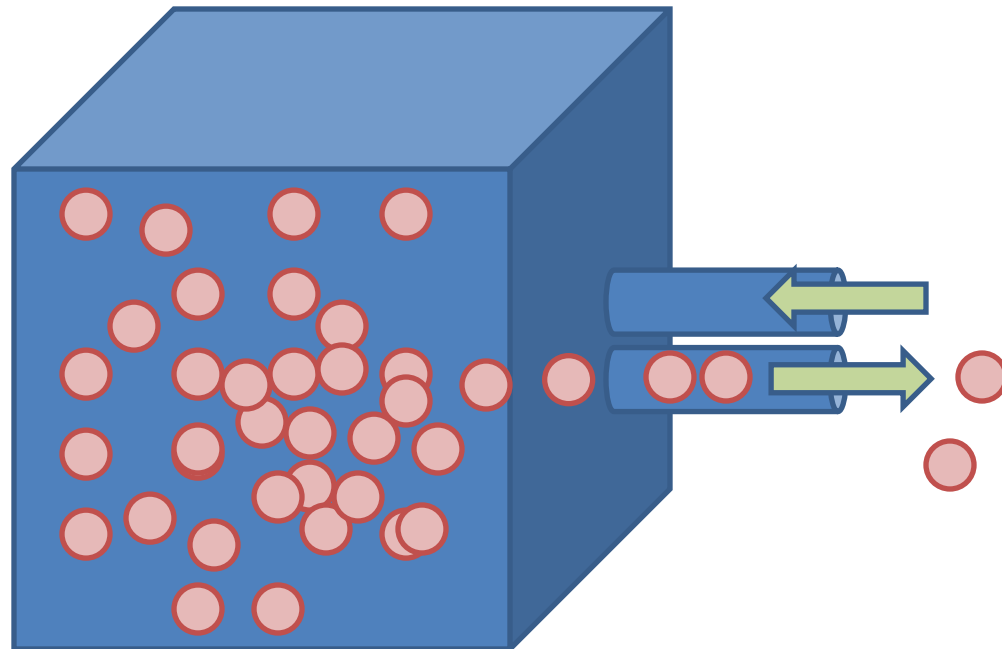
- Draw in outdoor air on the return side of the air handler.
- Indoor air is forced out through leaks in the building shell.
- Frequently used in warmer climates.



# Whole-house mechanical ventilation: Strategy 3: Balanced ventilation



- Draw in outdoor air, while exhausting air from indoors.
- An equal amount of air is exhausted and supplied to the home, so air is not forced through cracks in the home.
- Used in both warm and cold climates.





# Whole-house mechanical ventilation: Summary

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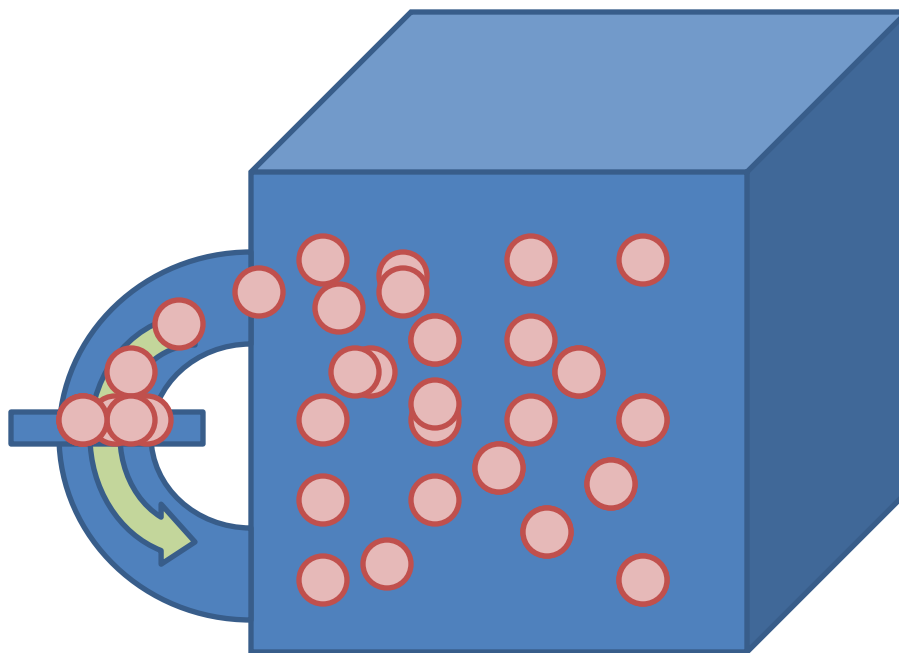
- Three ventilation strategies:
  - Exhaust-only.
  - Supply-only.
  - Balanced.
- Purpose is to bring outdoor air into the house in a controlled, automatic way.



# Filtration

# Filtration

- Purpose is to remove contaminants from the air and protect the HVAC equipment.




A small inset image in the top left corner shows a technician in a blue shirt looking up and using a tool to inspect the ceiling area of an HVAC system.

# Completing the HVAC System QI Rater Checklist

# HVAC System QI Rater Checklist



Page 1


 ENERGY STAR Qualified Homes, Version 3 (Rev. 06)  
HVAC System Quality Installation Rater Checklist <sup>1</sup>

Section 1

Section 2

Section 3

Page 2

 ENERGY STAR Qualified Homes, Version 3 (Rev. 06)  
HVAC System Quality Installation Rater Checklist <sup>1</sup>

Section 4

Section 5

Section 6

Section 7

Section 8

Section 9

Section 10

Section 11



# HVAC System QI Rater Checklist

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- Section 5: Whole-home delivered ventilation.
- Section 6: Controls.
- Section 7: Ventilation air inlets & ventilation source.
- Section 8: Local mechanical exhaust.
- Section 9: Vent. & exhaust fan ratings.
- Section 11: Filtration.

# Section 5:

## Whole-home delivered ventilation

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- Measure ventilation airflow and verify that it's within 100-120% of the design value.
- Many Raters are starting to compare the measured value directly with ASHRAE 62.2.
- This Item can be challenging because:
  - Raters are still gaining experience measuring ventilation airflows.
  - The ventilation airflow in the field may not match the design.

# Section 5:

## Whole-home delivered ventilation

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- New RESNET standard being developed for measuring ventilation airflows.



# Section 5:

## Whole-home delivered ventilation

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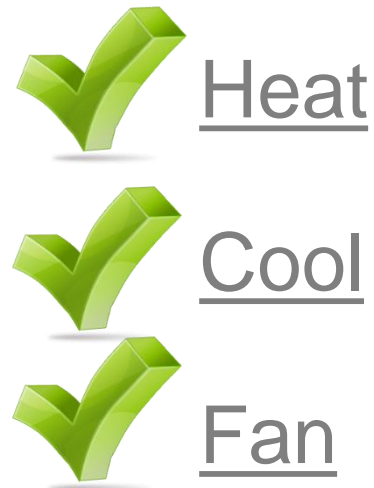


- Including commissioning controls is really helpful.
- Exhaust-only system:
  - Commission by increasing or decreasing the runtime in the field.
  - For maximum flexibility, design the system to not run continuously.
- Supply-only system:
  - Commission by using a fixed damper to adjust airflow.
  - For maximum flexibility, design the system to deliver excess ventilation, then use the damper to dial it down.

# Section 6: Controls



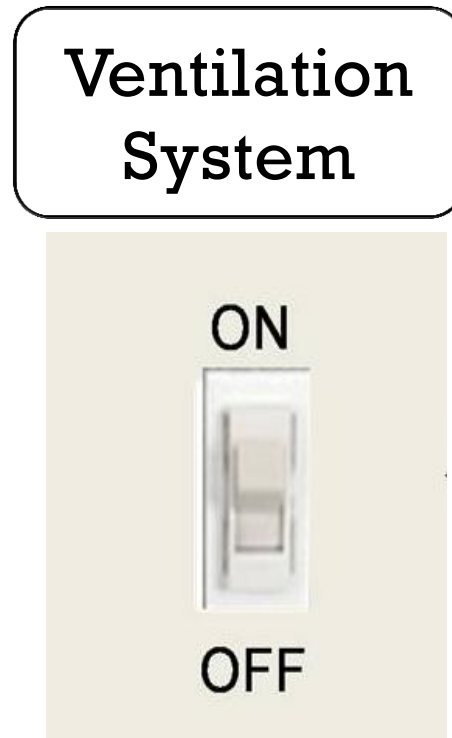
- Quick assessment of heating, cooling, & vent. controls.
- Items 6.1 – 6.3: Check that heating, cooling, and fan settings on thermostat are operational.



# Section 6: Controls



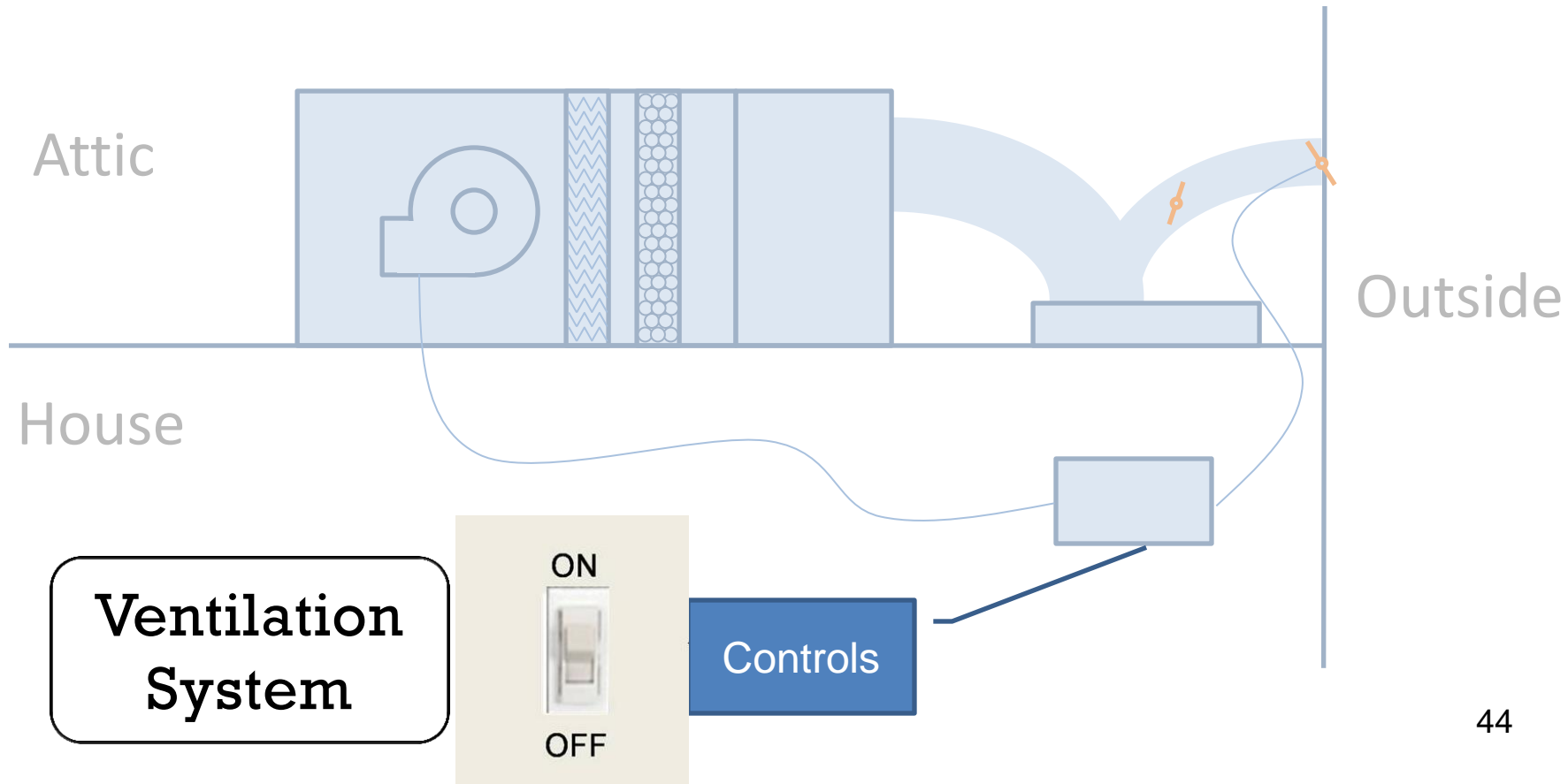
- Item 6.4: For each continuously operating exhaust or whole-house vent. system, verify that there's a readily accessible override control.



# Section 6: Controls



- Item 6.5: Verify that the function of the ventilation system controls is obvious (e.g., bathroom fan) or labeled (e.g., over-ride switch for return-side motorized damper).



# Section 7:

## Ventilation air inlets & vent. source



- If home has a ventilation air inlet, verify the following:
  1. Not near contamination sources:
    - a) If it's in the wall,  $\geq 3$  feet from dryer exhausts and contamination sources exiting through the roof.
    - b)  $\geq 10$  feet from other contamination sources.



# Section 7:

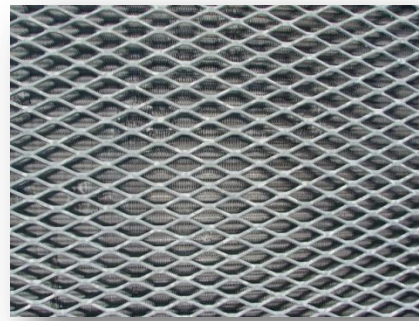
## Ventilation air inlets & vent. source



2. Verify that vent air inlet meets height requirements and is not obstructed at time of inspection:

2009 IECC Climate Zone	Height Above Grade or Roof Deck
1-3	$\geq 2$ feet
4-8	$\geq 4$ feet

3. Verify that inlet has screen with  $\leq 0.5$  inch mesh.



4. Verify that inlet pulls in air directly from the outside.

# Local mechanical exhaust: Overview of requirements

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- Include an exhaust fan in each kitchen:
  - Achieve a minimum measured air flow rate or use a prescriptive duct design.
- Include an exhaust fan in most bathrooms.
  - Achieve a minimum measured air flow rate.
  - Achieve a maximum rated sound limit.
- This helps homeowner maintain indoor air quality.

# Section 8:

## Local mechanical exhaust requirements



Most Common Compliance Path for Bath Fans		
Fan Type	Measured Airflow	Rated Sound
Intermittent	$\geq 50$ CFM	$\leq 3$ sones

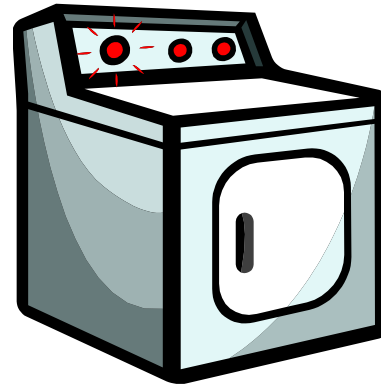
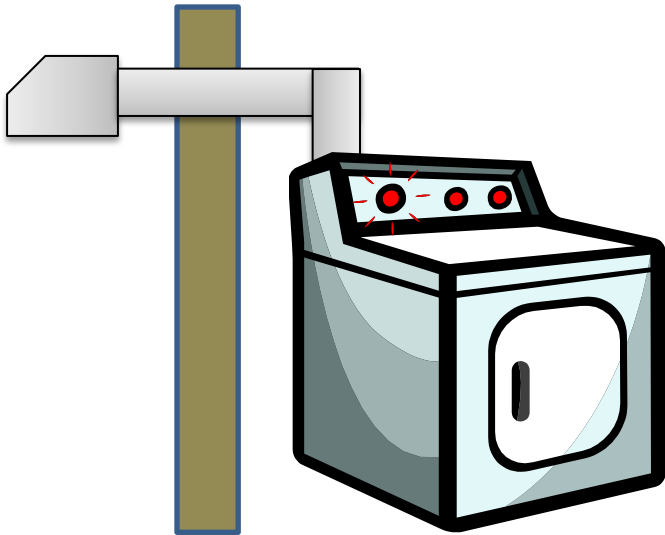
Most Common Compliance Path for Kitchen Fans			
Fan Type	Integrated with Range?	Achieved Airflow	Recommend. Rated Sound
Intermittent	Yes	$\geq 100$ CFM	$\leq 3$ sones



# Section 8: Local mechanical exhaust



- Verify that clothes dryer exhausts directly to outdoors.




# Section 9: Ventilation & exhaust fan ratings



- Sound ratings quantify how much sound a fan will make.
- Sones don't have to be measured in the field. Instead use the rated value from the product label or documentation.

**HVI PERFORMANCE**

4" Duct			3" Duct				
0.1 Ps - Static Pressure (inH <sub>2</sub> O)			0.25 Ps	0.1 Ps - Static Pressure (inH <sub>2</sub> O)			0.25 Ps
Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)	Airflow (CFM)	Sound (Sones)	Power (Watts)	Airflow (CFM)
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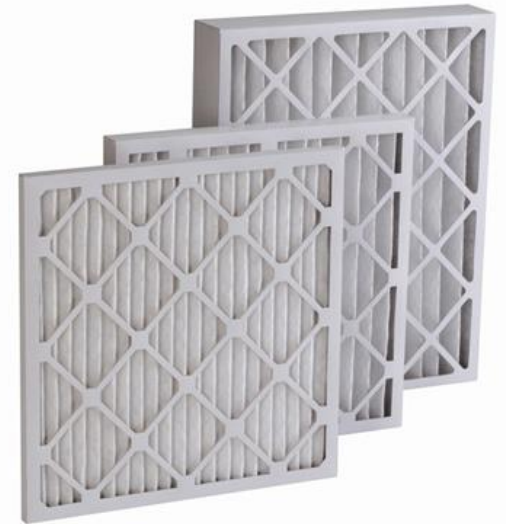
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- For bath fans used as a whole-house mechanical ventilation system, verify that it's ENERGY STAR certified; unless rated flow rate  $\geq$  500 CFM.

# Section 11: Filtration



- Verify the four basic filtration requirements:
  1. **MERV 6 or better** filter in each ducted mechanical system.
  2. All return air and mechanically supplied outdoor air passes through **filter prior to conditioning**.
  3. **Filter is accessible** to occupants and able to be serviced.
  4. **Filter must be gasketed** to prevent bypass.



# Summary

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- Let's add up how long verifying these items should take for a typical home:
  - Section 5: Whole-Building Delivered Ventilation
    - **5-20 minutes** (field verification)
  - Section 6: Controls
    - **5 minutes** (field verification & visual inspection)
  - Section 7: Ventilation Air Inlets & Ventilation Source
    - **5 minutes** (visual inspection)

# Summary

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- Let's add up how long verifying these items should take for a typical home (Continued):
  - Section 8: Local Mechanical Exhaust
    - **10-20 minutes** (field verification)
  - Section 9: Ventilation & Exhaust Fan Ratings
    - **5 minutes** (visual inspection)
  - Section 11: Filtration
    - **5 minutes** (visual inspection)
  - Total: **About 30-60 minutes, but it depends on the house**

# Summary

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- Don't sacrifice indoor air quality in exchange for efficiency.
- Three major concepts:
  1. Bath and kitchen fans remove contaminants.
    - Generally, turned on and off by occupants.
    - Must meet airflow and sound requirements.
  2. Whole-house mechanical ventilation removes contaminants and/or dilutes them with outdoor air.
    - System operates automatically.
    - System types: exhaust-only, supply-only, & balanced.
    - Must meet airflow requirements.
  3. Filters trap contaminants.

## Summary continued

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- 6 Sections on the HVAC QI System Rater Checklist
- 3 require simple visual inspection
- 3 require measurements
- In total 30-60 minutes to complete

# ENERGY STAR Certified Homes



## Web:

Main: [www.energystar.gov/newhomespartners](http://www.energystar.gov/newhomespartners)  
Technical: [www.energystar.gov/newhomesguidelines](http://www.energystar.gov/newhomesguidelines)  
Training: [www.energystar.gov/newhomestraining](http://www.energystar.gov/newhomestraining)  
HVAC: [www.energystar.gov/newhomesHVAC](http://www.energystar.gov/newhomesHVAC)

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