

Weatherization at Low-Income Homes

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Mission

Mission of the Weatherization Assistance Program

To reduce energy costs for low-income families, particularly for the elderly, people with disabilities, and families with children, while ensuring their health and safety (H&S).

Low-Income Households

Characteristics of Low-Income Households

- Over 90% of low-income households have annual incomes less than \$15,000.
- More than 13% of these low-income households have annual incomes less than \$2,000.
- According to DOE's Energy Information Administration (EIA), low-income households spend 14.4% of their annual income on energy, while other households only spend 3.3%.
- The average energy expenditure in low-income households is \$1,800 annually.
- The elderly occupy 34% of low-income homes.

Modern WX

- Air-Sealing. Blower door-directed
- Dense-pack sidewall insulation
- Attic insulation
- Heating equipment repair and replacement
- Duct sealing and modification
- Electric base load measures
 - Compact fluorescent light bulbs (CFLs)
 - Refrigerator replacement
 - Water heater modification and replacement

The Energy Audit: Categories of Service



Visual Inspection

- Health and Safety
- Building air leakage
- Building insulation and thermal resistance
- Heating and cooling systems
- Ventilation fans and operable windows
- Baseload energy uses
- The homes physical dimensions: area and volume

Diagnostic Testing

- Blower door test
- Duct leakage testing
- Combustion safety and efficiency testing
- Test for fuel leaks
- Infrared scanning
- Appliance consumption testing

Blower Door Frame

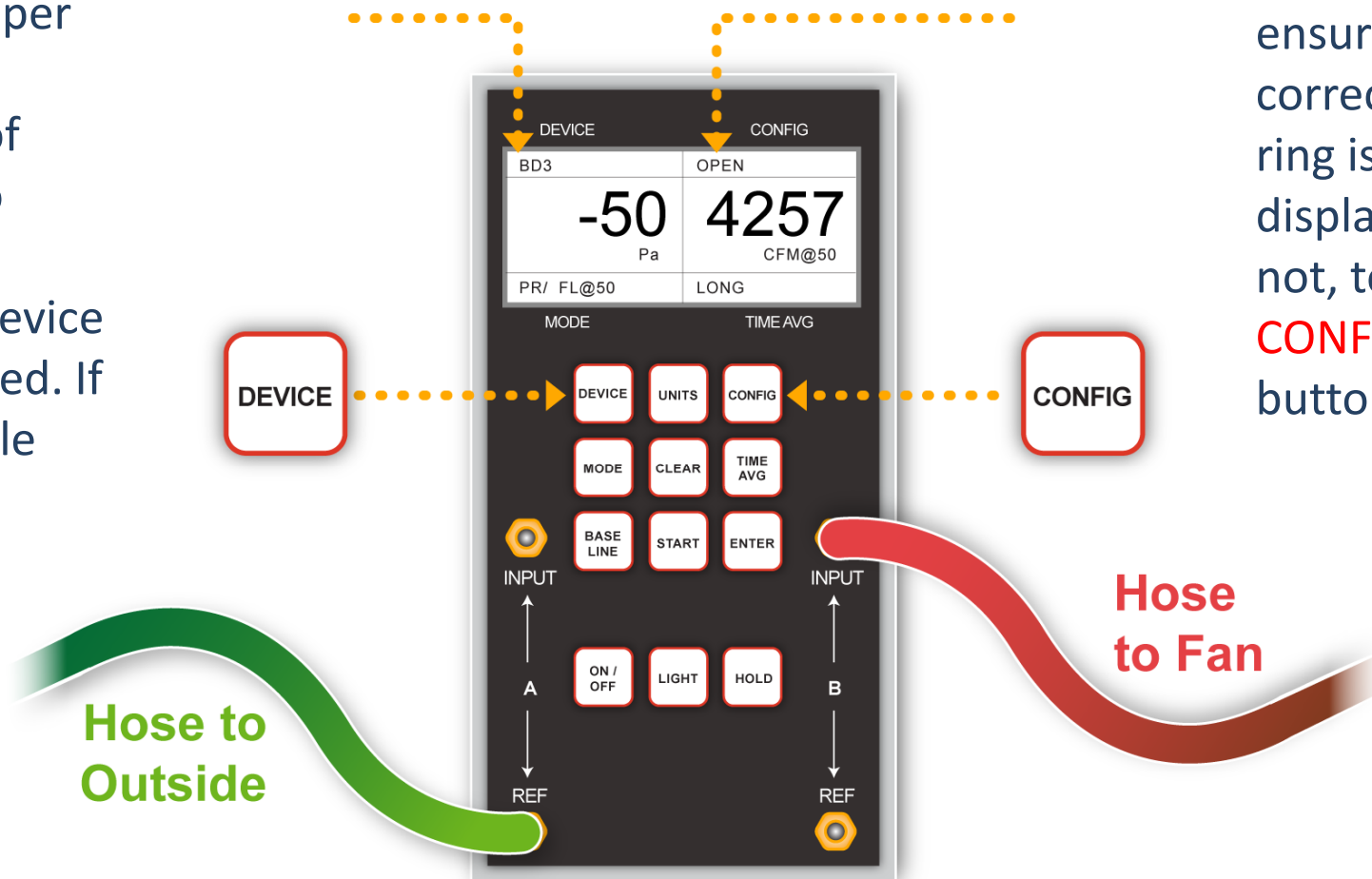


Minneapolis Blower Door
installed in exterior door.

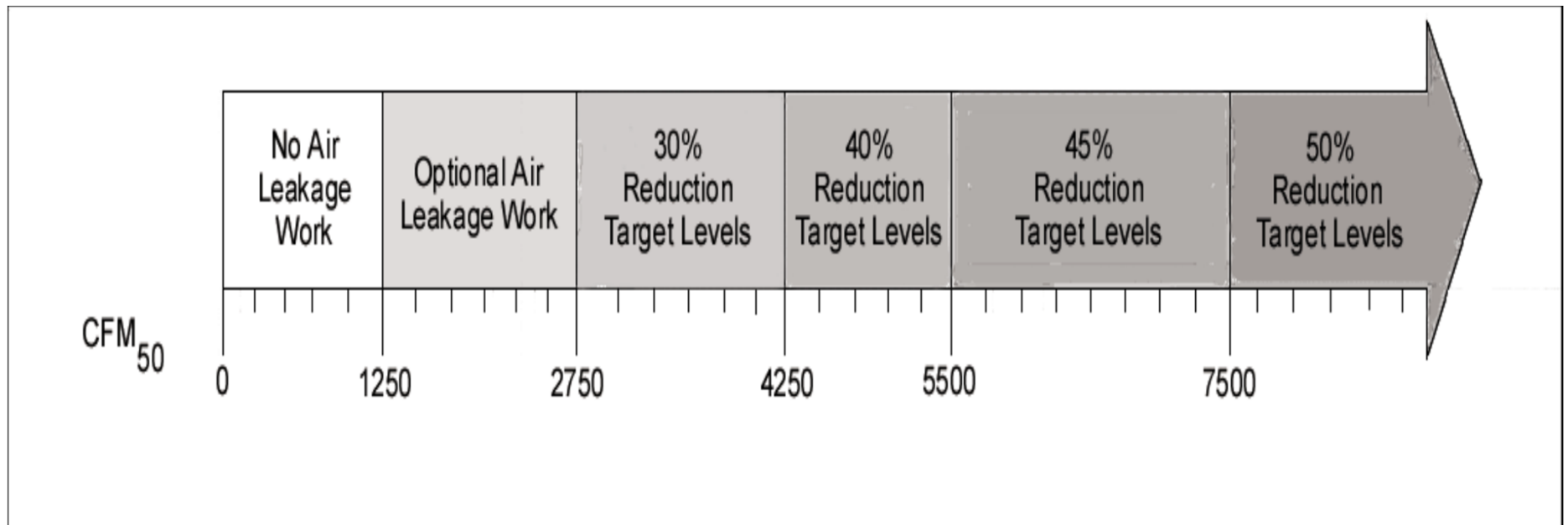
Blower Door Setup

Check upper left portion of screen to ensure correct device is displayed. If not, toggle **DEVICE** button.

Check upper right portion of screen to ensure the correct flow ring is displayed. If not, toggle **CONFIG** button.

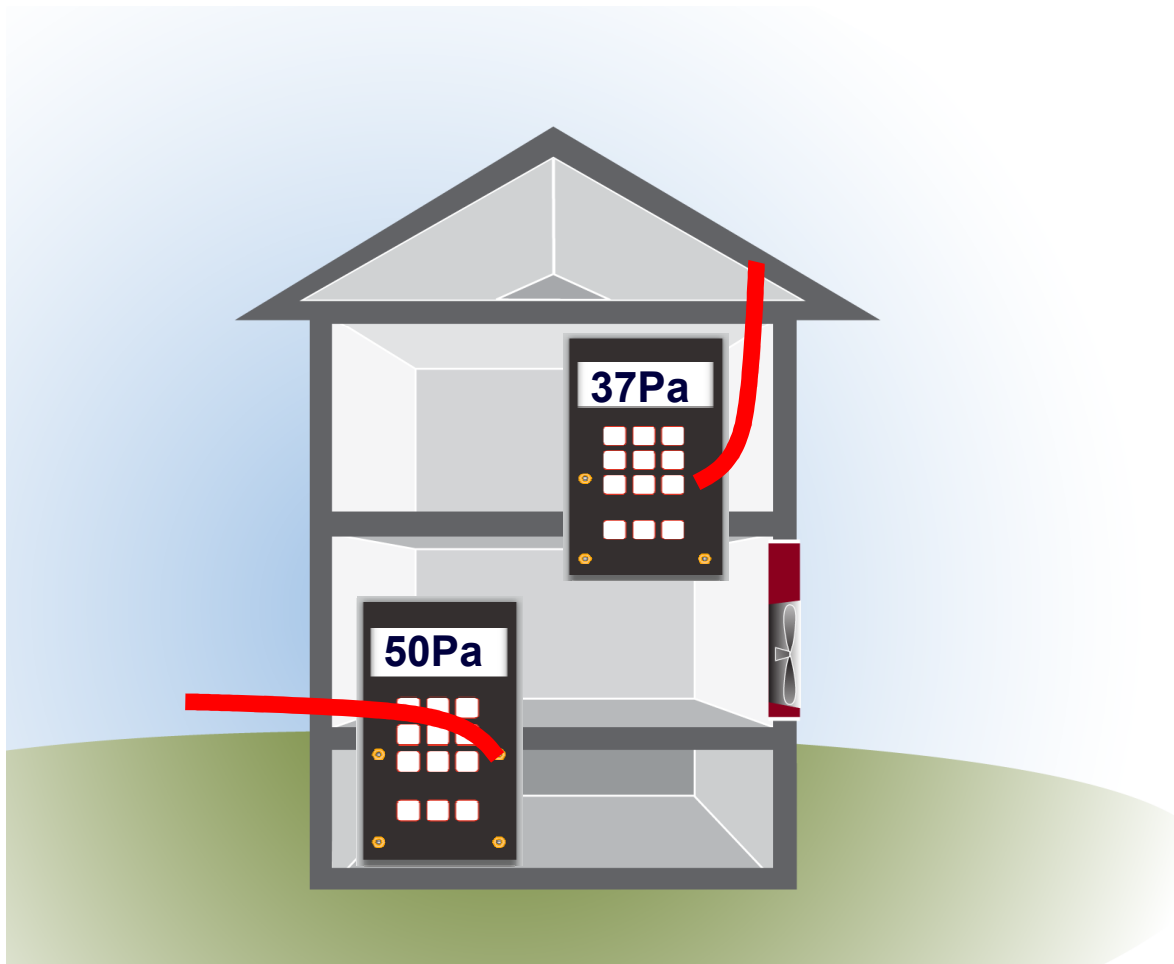


Target Reduction



$$4500 \text{ CFM}_{50} \times 0.6 = 2700 \text{ CFM}_{50}$$

Relative Leakiness



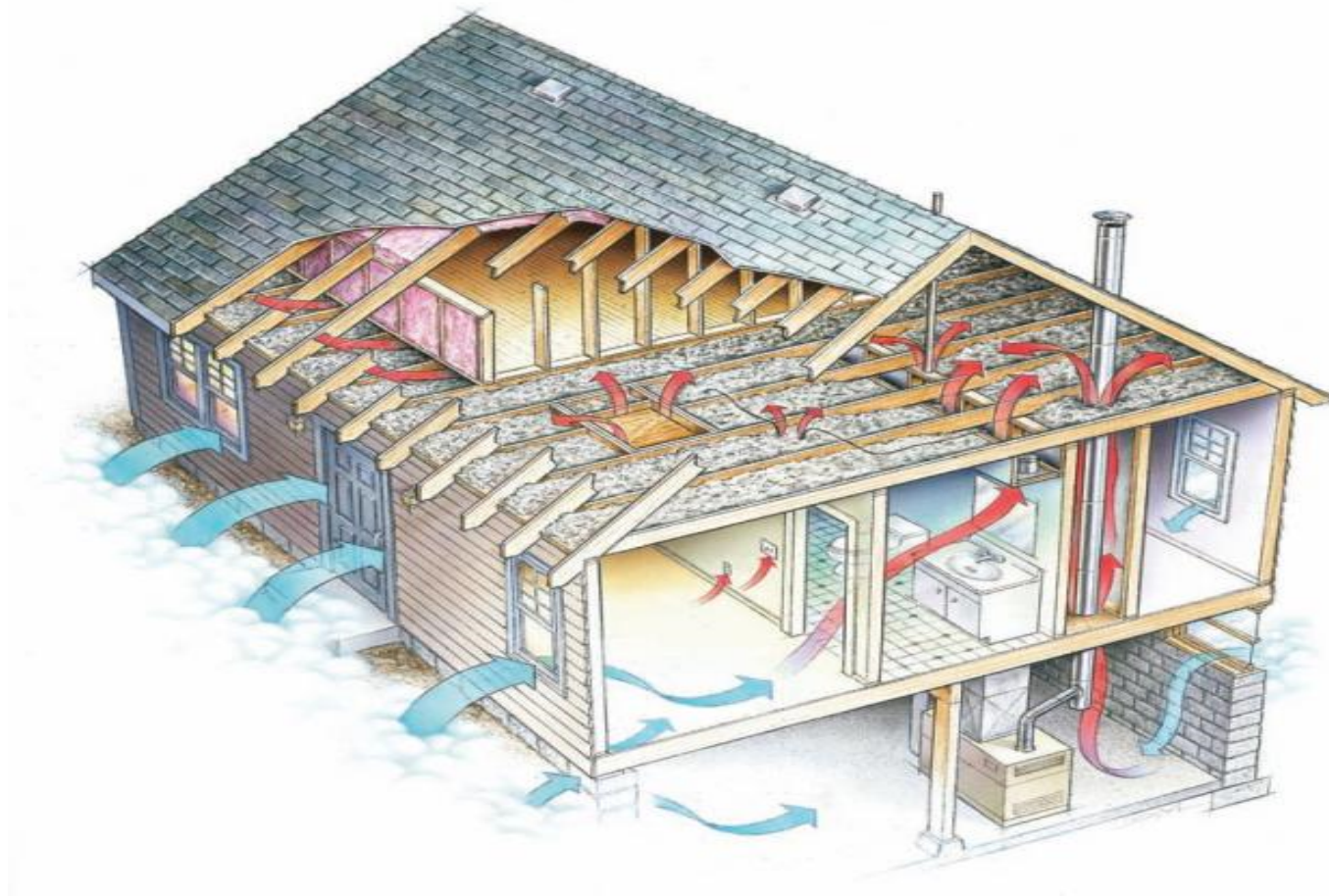
Pressure house
to attic = **37Pa**

Pressure attic to
exterior must be
13Pa

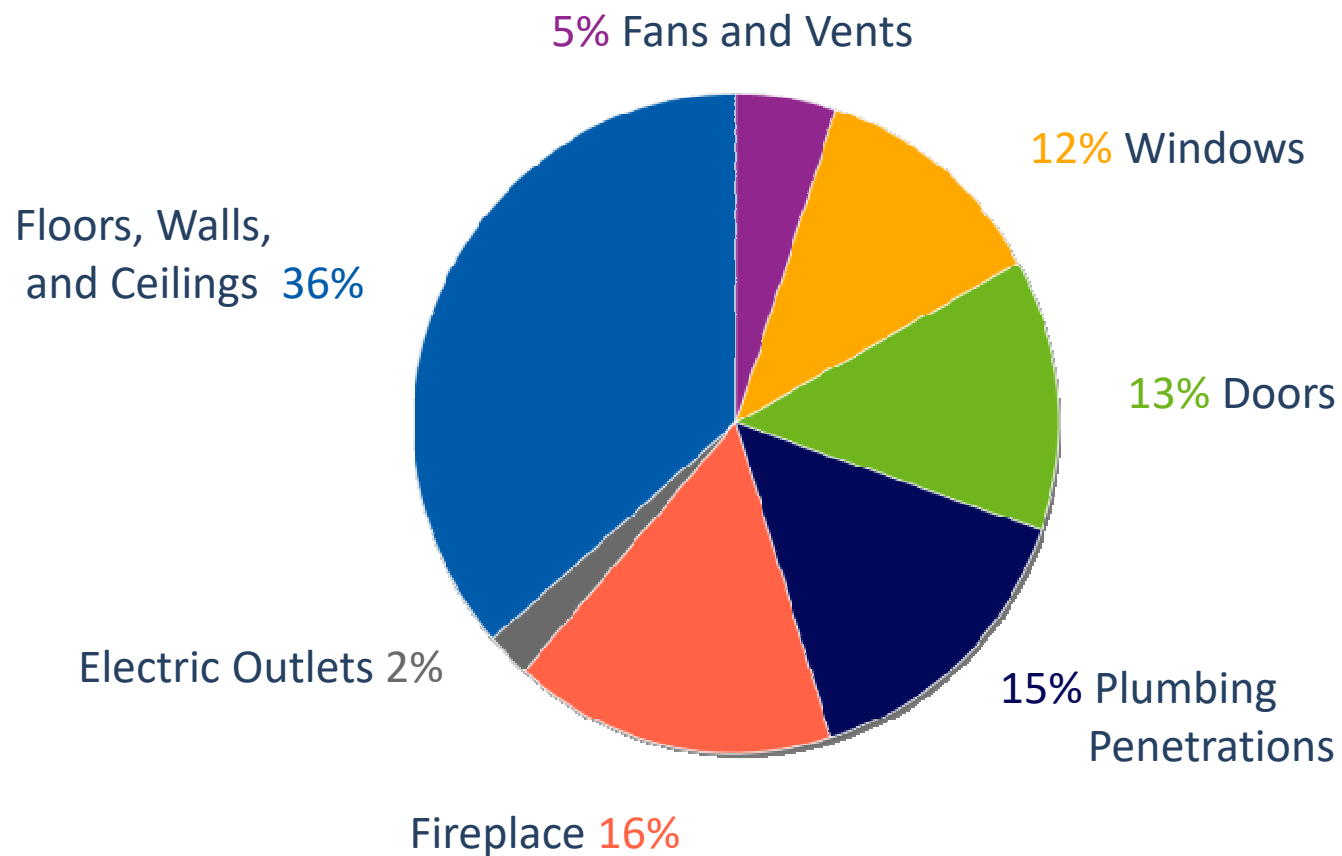
$(50\text{Pa} - 37\text{Pa} = 13\text{Pa})$

*Q: What does
this tell us?*

General Air Leakage



Primary Air Infiltration Sites



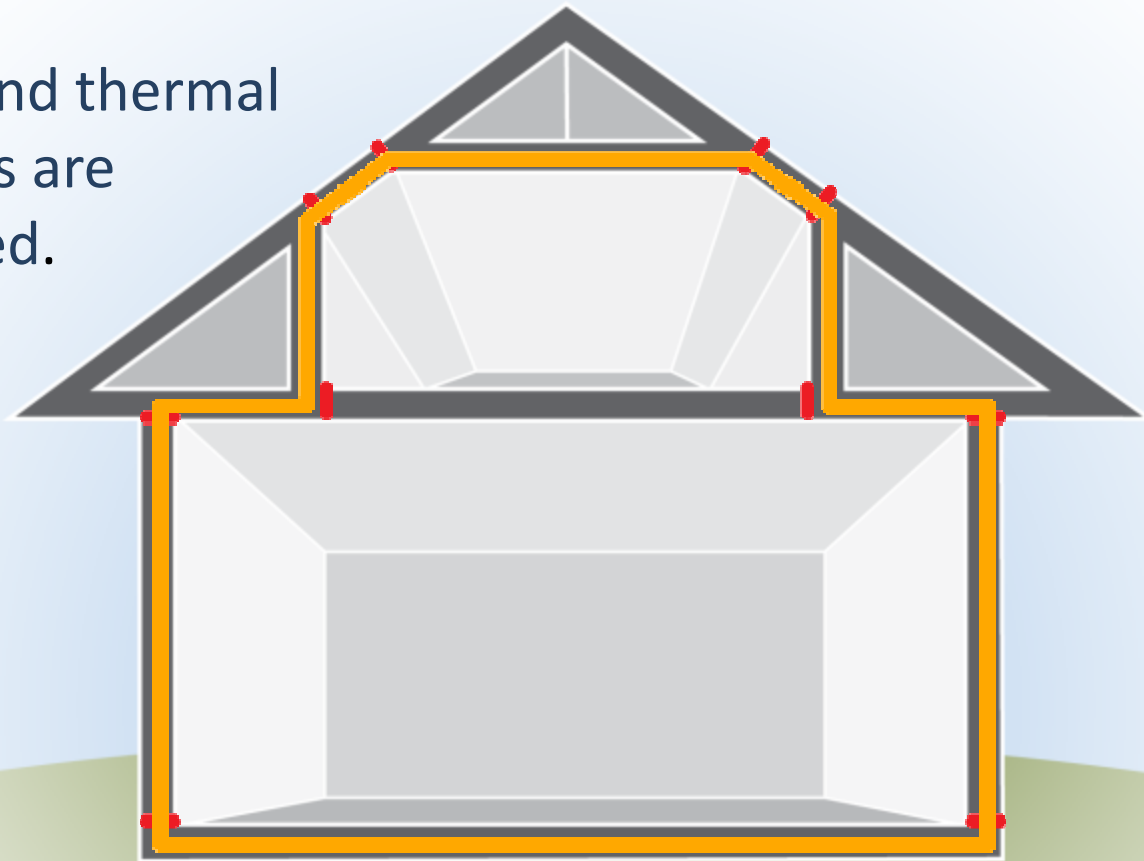
Attic Specifications



Seal all bypasses

Cape Attic

Pressure and thermal boundaries are now aligned.



Graphic developed for the U.S. DOE WAP Standardized Curricula

Sidewalls

Specify the following for uninsulated wood-framed wall cavities:

- Dense-pack insulation installed at a density of 3.5 lb. per cu. ft.
- Special attention to critical junctures within the building envelope

It is generally not cost-effective to re-insulate walls with existing fiberglass insulation.



Porches and Additions

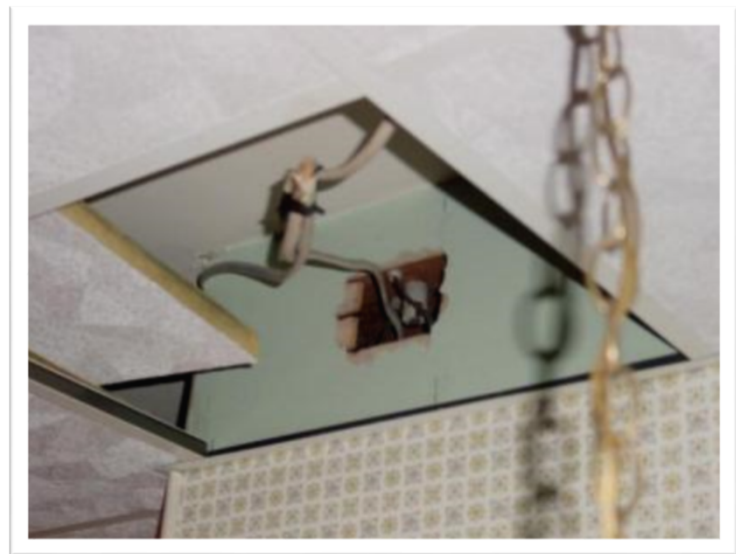


Porch roof cavity open to wall cavities

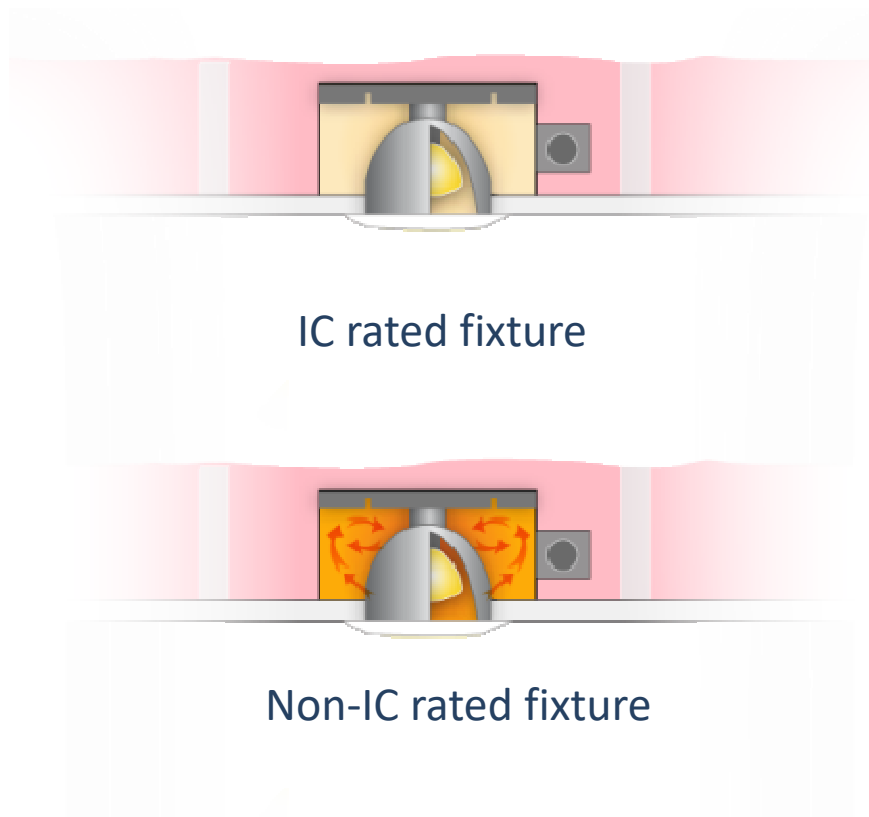
Interior Air Leakage Sites

In older homes, interior leaks, as shown on right, are often linked through complicated framing directly to outside.

Sealing big air leaks results in massive air leakage reduction at relatively low cost for materials and labor.

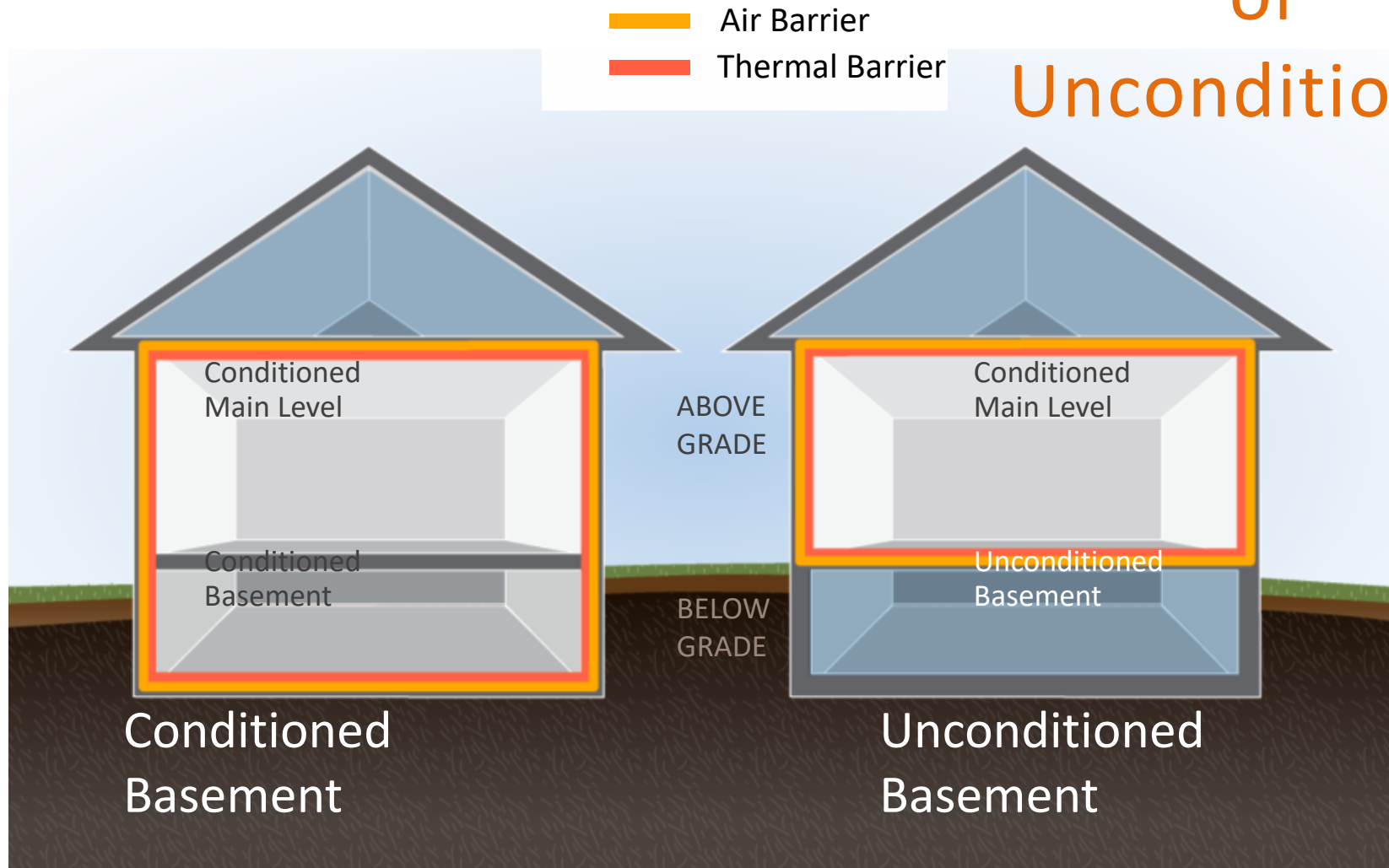


Recessed Light Fixtures



- IC rated fixtures can be covered in insulation.
- Non-IC rated fixtures cannot.
- Covering non-IC rated fixtures leads to heat build up:
 - Reduces bulb life.
 - Produces fire hazard.

Basements: Conditioned or Unconditioned





Conditioned Crawl Space Retrofit

Spray foam insulation



Fiberglass insulation



Combustion Safety Tests

Combustion-Safety Observations

wiring

venting

temp rise

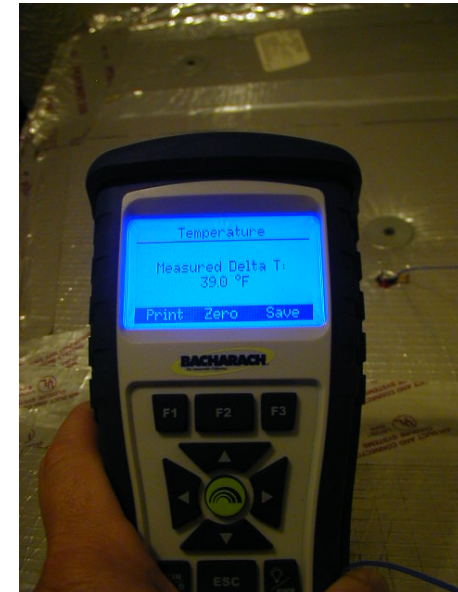
pilot safety drop-out

gas pressure

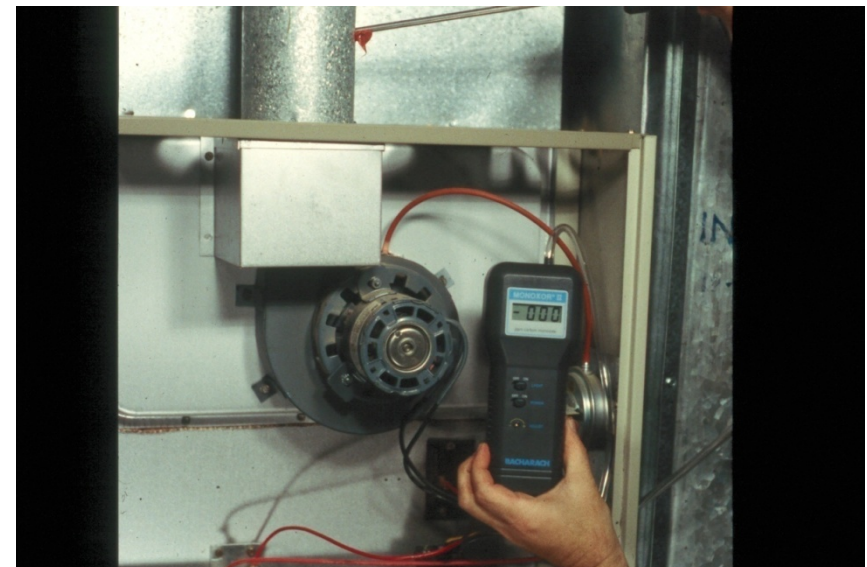
Leak-Testing Gas Piping

Carbon Monoxide Testing

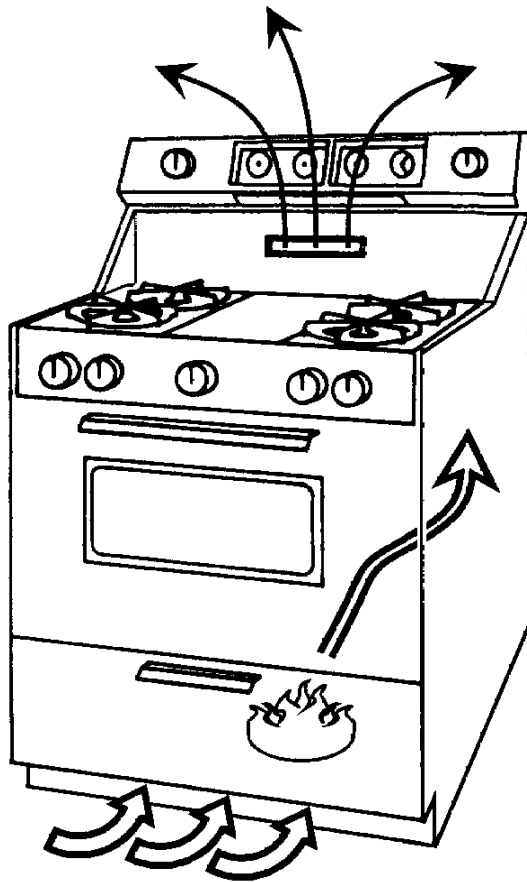
Worst-Case-Draft Testing



Understand your instrument



Sources of Carbon Monoxide



Unvented appliances (20%)

Unvented or “Room Vented?”

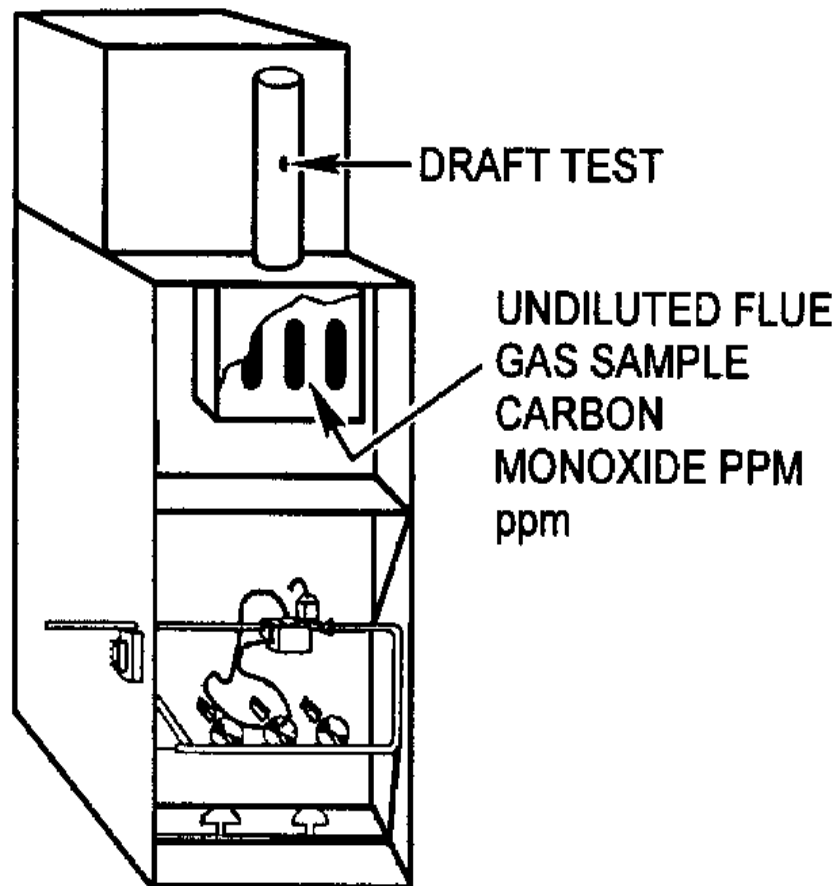


Gas fired, atmospheric and forced air

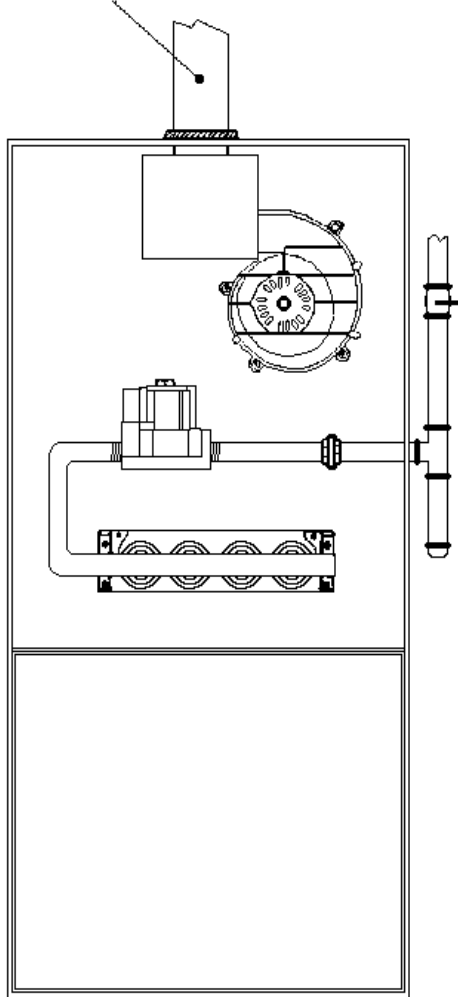
O₂ 5-10%

CO 200ppm

Stack temp 350°-475°



O₂, CO, Draft,
Stack Temperature



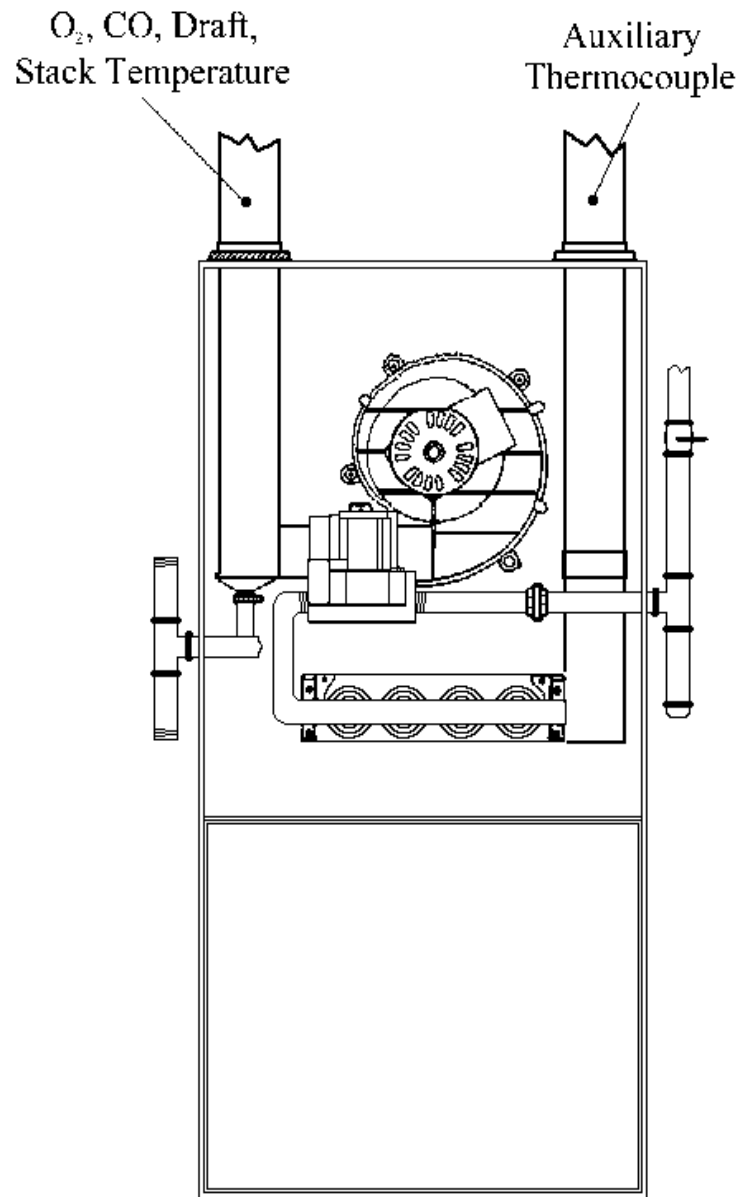
80% Fan Assist Furnace/Boiler

Gas fired, fan assist and forced air

O₂ 4-9%

CO 200ppm

Stack temp 325-450°



90% Condensing Furnace/Boiler

High Efficiency, Condensing Furnace

O₂ 4-9%
CO 200ppm
Stack temp 120°

ASHRAE 62.2 2016

Alternative Compliance Supplement
(Already existing dwelling)

Calculating Base Formula

Base formula, step by step:

Multiply the number of bedrooms + 1 or the number of people by 7.5 CFM per person:

$$4 \text{ people} * 7.5 \text{ CFM/person} = 30 \text{ CFM}$$

Calculate 3 CFM per 100 square feet of floor area:

$$1500 \text{ ft}^2 * 0.03 \text{ per required CFM} = 45 \text{ CFM}$$

Add them together:

$$30 \text{ CFM} + 45 \text{ CFM} = 75 \text{ CFM continuous}$$

But what if they don't have adequate local ventilation?

The alternative compliance supplement calculation lets you take the inadequate CFM delivery or total lack of required local ventilation fans into account.

- Kitchen requires 100 CFM on demand or 5 ACH continuous, based on kitchen volume.
- Bathroom requires 50 CFM on demand or 20 CFM continuous. Not required in ½ baths.
- Operable windows in those rooms reduce deficit by 20 CFM. Only one deficit reduction per room.
- Deficit cannot drop below zero.

Sum all deficits and divide by 4. Add the result to the continuous whole building ventilation CFM requirement.

Worst-Case Draft

CAZ depressurization is the leading cause of backdrafting and flame roll-out.

WCD testing uses the home's exhaust fans, air-handler, and chimneys to create worst-case depressurization.

Acceptable Draft Chart

Heating Unit Type	Draft Gauge Probe Placement	Worst Case Acceptable Draft Readings at Listed Outdoor Temperatures (F)				
		<20	21-40	41-60	61-80	>80
Gas Atmospheric Appliances (Furnace, Space Heater, Boiler Floor Furnace)	Flue (after diverter)	-5 Pa	-4 Pa	-3 Pa	-2 Pa	-1 Pa
		-.02 wc"	-.016 wc"	-.012 wc"	-.008 wc"	-.004 wc"
Gas Fan-Assisted	Flue (1 ½ times the diameter of the flue from the flue collar or elbow)	-5 Pa	-4 Pa	-3 Pa	-2 Pa	-1 Pa
		-.02 wc	-.016 wc"	-.012 wc"	-.008 wc"	-.004 wc"
Oil Burners	Flue (before Barometric Damper)	-15 Pa	-13 Pa	-11 Pa	-9 Pa	-7 Pa
		-.06 wc"	-.052 wc"	-.044 wc"	-.036 wc"	-.028 wc"
Gas 90+ Furnace	Exhaust Pipe	N/A	N/A	N/A	N/A	N/A

CAZ Pressure Test

A pressure of -5 pa is not allowed in a CAZ with atmospheric appliances.

A pressure of -10 pa or more is not allowed in a CAZ with all induced draft and sealed combustion appliances.

Energy Audits

An energy audit includes:

- Assessment and analysis.
- Recommendations energy saving measures.
- Recommendations for incidental repairs and health and safety improvements.

The energy audit provides the justification and basis for the work order.

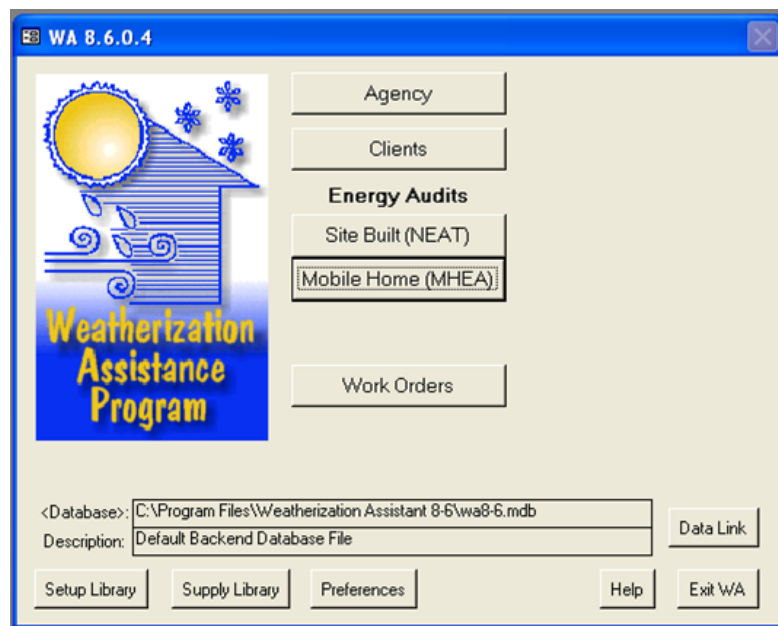
Federal Rules

10 CFR § 440.21 - Weatherization materials standards and energy audit procedures addresses:

- Cost-effectiveness
- Other energy audit requirements
- Priority lists and general heat waste reduction materials
- Approval requirements for audit procedures and priority lists
- Appendix A

[Web link to 10 CFR 440.21](#)

Weatherization Assistant



- A DOE-approved measure selection tool for single family (NEAT) and mobile homes (MHEA)
- Calculates savings and SIR
- Users set up libraries

Audit Software Tool - Results

Audit software lists measures with allowable SIR.

Auditor creates work order for the home.



NEAT Recommended Measures

Agency State Run On RunID
 Client ID Version AuditID
 Audit Name Audit Date
 Client Name Auditor
 Weather File Setup Library Name
 Comment

Annual Energy and Cost Savings

Index	Recommended Measure	Components	Heating (MMBtu)	Heating (\$)	Cooling (kWh)	Cooling (\$)	BaseLoad (kWh)	BaseLoad (\$)	Total (MMBtu)
1	Infiltration Redc'n		3.5	27	24	2	0	0	3.6
2	Wall Insulation	WALLE,WALLN,WALL S,WALLW	17.2	132	285	23	0	0	18.2
3	Refrigerator Rplcmnt		0.0	0	0	0	714	58	2.4
4	Low-E Windows	WINN2,WINE2,WINW2	10.9	84	199	16	0	0	11.6

Energy Saving Measure Economics

Index	Recommended Measure	Components	Measure Savings (\$/yr)	Measure Cost (\$)	Measure SIR	Cumulative Cost (\$)	Cumulative SIR
1	Infiltration Redc'n		29	100	2.5	100	2.5
2	Wall Insulation	WALLE,WALLN,WALLS,WALLW	156	836	2.9	936	2.9
3	Refrigerator Rplcmnt		58	519	1.3	1455	2.3
4	Low-E Windows	WINN2,WINE2,WINW2	100	1518	1.0	2973	1.7

Questions?

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