Building Compliance Certification 2012

This Course

- ❑ Changes in the Standard (IECC 2012/ASHRAE 62.2 – 2010)
- ❑ Alaska Amendments (AA)
- ❑ Review of Standard
- ❑ Mandatory requirements for certification
- ❑ Important Calculations
- ❑ Certification test

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Documents

- ❑ 2012 IECC (International Energy Conservation Code)
- ❑ ASHRAE 62.2-2010
- ❑ Alaska Specific Amendments, April 3rd, 2013

3

This Standard takes effect:

July 1, 2013

- ❑ Applies to all buildings started after this date

IF

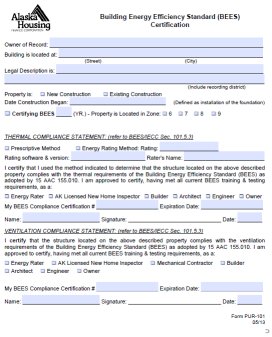
AHFC funding commitment **AND/OR**
Construction began prior to July 1, 2013

THEN use BEES 2009

4

PUR 101

- ❑ Building meets all current standards
- ❑ Signee is liable
- ❑ USE CURRENT FORM
- ❑ Available on AHFC website



Alaska Housing

Building Energy Efficiency Standard (BEES) Certification

Owner of Record: _____

Building is located at: _____ (Street) _____ (City)

Legal Description is: _____ (Include recording district)

Property is: ☐ New Construction ☐ Existing Construction

Date Construction Began: _____ (Defined as installation of the foundation)

☐ Certifying BEES ____ (YR.) - Property is Located in Zone: ☐ 6 ☐ 7 ☐ 8 ☐ 9

THERMAL COMPLIANCE STATEMENT: (refer to BEES/IECC Sec. 101.5.3)

☐ Prescriptive Method ☐ Energy Rating Method: Rating: _____

Rating software & version: _____ Rater's Name: _____

I certify that I used the method indicated to determine that the structure located on the above described property complies with the thermal requirements of the Building Energy Efficiency Standard (BEES) as adopted by 15 AAC 155.010. I am approved to certify, having met all current BEES training & testing requirements, as a:

☐ Energy Rater ☐ AK Licensed New Home Inspector ☐ Builder ☐ Architect ☐ Engineer ☐ Owner

My BEES Compliance Certification #: _____ Expiration Date: _____

Name: _____ Signature: _____ Date: _____

VENTILATION COMPLIANCE STATEMENT: (refer to BEES/IECC Sec. 101.5.3)

I certify that the structure located on the above described property complies with the ventilation requirements of the Building Energy Efficiency Standard (BEES) as adopted by 15 AAC 155.010. I am approved to certify, having met all current BEES training & testing requirements, as a:

☐ Energy Rater ☐ AK Licensed New Home Inspector ☐ Mechanical Contractor ☐ Builder ☐ Architect ☐ Engineer ☐ Owner

My BEES Compliance Certification #: _____ Expiration Date: _____

Name: _____ Signature: _____ Date: _____

Form PUR-101 3/13

Checklist

- ❑ Completing the checklist is Not a Requirement
- ❑ The content of the checklist IS required to meet BEES
- ❑ This policy is evolving – stay tuned!

6

Introduction – Certifying Compliance

- Person who is certifying must:
  - Complete Cold Climate Building Course
  - Complete ventilation training within last 2 years
  - Pass required AHFC tests

7

R103

Construction Documents

- Fully detailed construction documents required, unless waived by the inspector
- Insulation materials and R-values
- U-factors, VT and SHGC
- Equipment efficiencies
- Air sealing details

8

R101.4.5 AA

Change in Space Conditioning

- Replace section with:

"Any non-conditioned space that is altered to become conditioned space shall be required to be brought into full compliance with the version of BEES in place when the house was originally rated."

9

R301

General Requirements

R301.1 AA

General

- Climate Zones
  - Used to determine Chapter 4 Requirements
  - Use tables from AK Amendments
  - Climate Zone 8 no longer splits urban and rural areas

11

Heating Degree Days

- HDD – measure of the heating load over 1 year
- Calculated by subtracting the mean temperature for the day from 65°
- Average temperature difference is added over every day of the year

12

Climate Zones

Table A301.1(1) Climate Zones for Alaska by Census Area			
Zone 6	Zone 7	Zone 8	Zone 9
Juneau	Aleutians East	Bethel	North Slope
Ketchikan Gateway	Aleutians West	Denali	
Prince of Wales	Anchorage	Fairbanks North Star	
Sitka	Bristol Bay	Nome	
Skagway-Hoonah-Angoon	Dillingham	Northwest Arctic	
Wrangell-Petersburg	Kenai Peninsula	Southeast Fairbanks	
Yakutat	Kodiak Island	Wade Hampton	
Haines	Lake and Peninsula	Yukon-Koyukuk	
	Matanuska-Susitna		
	Valdez-Cordova		
HDD 7200 - 9000	9,000 – 12,600	12,600 – 16,800	16,800 – 21,000

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R303

Material, Systems and Equipment

- R303.1 Identification – Same as 2009 Standard, **EXCEPT:**
  - Fenestration labeling – NFRC rated
    - U-factor
    - Solar Heat Gain Coefficient (SHGC)
    - Visible Transmittance (VT)
  - Not labeled/rated?
    - Use default values in Tables R303.1.3(1-3)

14

R303.1.1

Insulation Identification

- Provide type, manufacturer, and R-value of installed insulation.

15

Insulation Certification

- For blown insulation:
  - Initial thickness
  - Settled thickness
  - Settled R-value
  - Density
  - Coverage area
  - Number of bags

16

R303.1.1.1

Insulation Certification

- Roof/ceiling insulation:
  - Depth marker required every 300 square feet
  - One inch lettering

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R303.2.1

Insulation Protection

- Exterior foundation insulation protected from UV
- Covered above grade
- Extend a minimum of 6 inches below grade

18

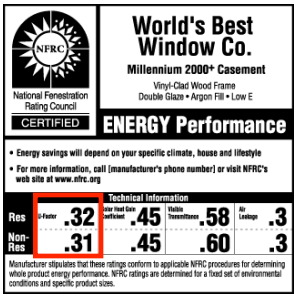
R303.1.3

Fenestration (Windows)

- ❑ Windows NFRC rated
- ❑ If not, must use default values in the code

19

Fenestration (Windows)



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Fenestration (Windows)

- ❑ U-factor measures how well a window prevents heat from escaping
- ❑ Lower U-factor = greater insulating value

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Fenestration (Windows)

- ❑ Example: R-value of 5 = U-factor of .20
- ❑ 1/5 = .20
- ❑ Example: R-value of 3 = U-factor of .33
- ❑ 1/3 = .33

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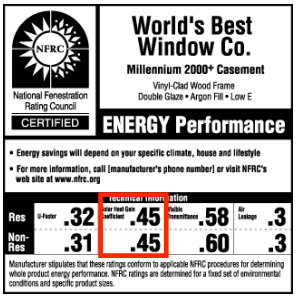
Fenestration (Windows)



23

Fenestration (Windows)

- ❑ Solar Heat Gain Coefficient (SHGC) measures how well a product blocks heat caused by sunlight
- ❑ A number between 0 and 1.
- ❑ The lower a window's solar heat gain coefficient, the less solar heat it transmits

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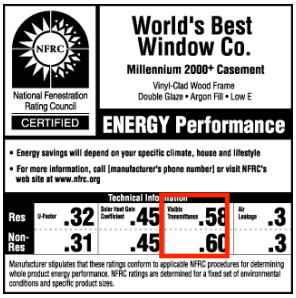
Fenestration (Windows)



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Fenestration (Windows)

- Visible Transmittance (VT) is a measure of how much light passes through a window
- A number between 0 and 1
- Higher number = more light

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TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE R303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

New Table for BEES 2012

TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

Remaining sections of Chapter 3 are unchanged

The checklist WAS a requirement

- ❑No longer the case
- ❑The content of the checklist is required to pass BEES
- ❑Might be helpful for you to use
- ❑AHFC wants us to use it in training

Checklist Item Number

- *Checklist Text
- Standard Section Reference
- *Indicates a change from previous standard

Item 1

- *Heating and cooling equipment is correctly sized by an approved method.

  IECC/AA R403.6

Item 2

- *A safety inspection of all combustion appliances has been completed in accordance with the BPI standard.
- AA 403.11 - .11.1

Item 3

- Heating and cooling systems (except solid fuel stoves) are controlled by thermostats. The thermostats are programmable unless for radiant in-floor heating.
- IECC/AA R403.1 - .1.1

Item 4

- HVAC piping is entirely within the building thermal envelope or insulated to ≥ R-3.
- IECC/AA 403.3

Item 5

- Any supply and return ducts not completely inside the building thermal envelope are insulated to at least the R-value specified in Table A402.1.1 for the portion of the envelope assembly (i.e. wall, floor, or ceiling) penetrated by the duct.
- IECC/AA R403.2

Item 6

- *All joints and seams of air ducts, air handlers, and filter boxes are sealed.
- IECC R403.2.2

Item 7

- *Ducting is entirely within the building thermal envelope, or a duct tightness test was performed with a result of ≤4 cfm/100 ft^2 across the system or ≤3 cfm/100 ft^2 without air handler @ 25 Pa.
- IECC R403.2.2

Item 8

- *Wood burning fireplaces have tight fitting flue dampers and outdoor air for combustion.
- IECC R402.4.2

Item 9

- *Circulating service hot water systems have automatic or accessible manual controls.
- IECC R403.4.1

Item 10

- Any building cavities used as ducts or plenums comply with the conditions listed in 403.2.3
- AA 403.2.3

Item 11

- *Blower door test of air leakage at 50 Pa. ≤4 ach.
- AA R405.3

Item 12

- *Recessed lighting fixtures are sealed at housing/interior finish, IC rated and labeled to indicate ≤2.0 cfm leakage at 75 Pa.
- IECC R402.4.4

Item 13

- Fenestration that is not site built is listed and labeled as meeting AAMA /WDMA/CSA101/ I.S. 2/A440 or has infiltration rates per NFRC 400 that do not exceed code limits.
- IECC/AA R402.4.3

Item 14

- *Building ventilation complies with ANSI/ ASHRAE Standard 62.2-2010
- AA 403.5

Item 15

- *Automatic or gravity dampers are installed on all outdoor air intakes and exhausts.
- IECC/AA 403.5

Item 16

- *Air handler leakage designated by manufacturer at ≤2% of design air flow.
- IECC R403.2.2.1

Item 17

- *Exposed earth in crawlspace foundations is covered by a continuous vapor barrier
- AA R402.4.1.3

Item 18

- *Energy efficiency certificate is posted.
- IECC R401.3

Item 19

- *75% of lamps in permanent fixtures or 75% of permanent fixtures have high efficacy lamps.
- IECC R404.1

Item 20

- Automatic controls are installed on any snow- and ice-melting systems.
- IECC R403.8

Item 21

- *Heated pools and permanent spas have a vapor retardant cover, timers and on-off switches on their heaters.
- IECC R403.9 - .9.3

Thermal Standard - Mandatory Measures for the Prescriptive and Performance Methods

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Mandatory Measures

- ❑ 401.3 Certificate
- ❑ R402.4 Air Leakage
- ❑ R402.5 Max. U-Factor, SHGC
- ❑ R403.1 Controls
- ❑ R403.1.2 Heat Pump Supp. Heat
- ❑ R403.2.2 Sealing (Ducts)

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Mandatory Measures Continued

- ❑ R403.2.2.1 Sealed Air Handler
- ❑ R403.2.3 Building Cavities
- ❑ R403.3 Mech. Sys. Pipe Insulation
- ❑ R403.4.1 Circ. Hot Water Systems
- ❑ R403.5 Mechanical Ventilation
- ❑ R403.6 Equipment Sizing

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Mandatory Measures Continued

- ❑ R403.7 Sys. Serv. Multi Units
- ❑ R403.8 Snow Melt Controls
- ❑ R403.9 Pools & Perm. Installed Spas
- ❑ R403.11.1 Combustion Safety Testing
- ❑ R404.1 Lighting Equipment
- ❑ R404.1.1 Lighting Equipment

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For reference

- ❑ Highlight following sections as mandatory
  - ❑ Exam aid
  - ❑ Project reference
- ❑ Referenced sections of the standard are indicated on the upper left corner of each slide.

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R401.3

Certificate

- ❑ Certificate posted on electrical panel
- ❑ List
  - ❑ R-values
  - ❑ U-factors
  - ❑ SHGC
  - ❑ Appliance efficiencies

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Component	Type	Depth	Density	R-value
Sub slab				
Slab edge				
Found 1				
Found 2				
Wall 1				
Wall 2				
Attic 1				
Attic 2				
Hot Roof				
Primary Glazing U-Factor:_____ SHGC:_____ VT:_____				
Exterior Door 1 U-Factor:_____			Exterior Door 2 U-Factor:_____	
Exposed Duct R-Value: _____				
Building Envelope Air Leakage:_____				
Duct System Leakage:_____				
Space Heat Type:_____ Fuel:_____ Efficiency:_____				
Hot Water Type:_____ Fuel:_____ Efficiency:_____				
Gas-fired unvented heater:__ Electric furnace:__ Electric baseboard:__				

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Component	Type	Depth	Density	R-value
Sub slab				
Slab edge				
Found 1				
Found 2				
Wall 1				
Wall 2				
Attic 1				
Attic 2				
Hot Roof				
Primary Glazing U-Factor:_____ SHGC:_____ VT:_____				
Exterior Door 1 U-Factor:_____			Exterior Door 2 U-Factor:_____	
Exposed Duct R-Value: _____				
Building Envelope Air Leakage:_____				
Duct System Leakage:_____				
Space Heat Type:_____ Fuel:_____ Efficiency:_____				
Hot Water Type:_____ Fuel:_____ Efficiency:_____				
Gas-fired unvented heater: Electric furnace: Electric baseboard:				

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R402.4

Air Leakage

- ❑ Must limit air leakage
- ❑ Best practice and appropriate material use
- ❑ Areas prone to leakage:
  - ❑ Fans
  - ❑ Doors
  - ❑ Chimney chases
  - ❑ Recessed light fixtures
  - ❑ Windows
  - ❑ Plate penetrations
  - ❑ Outlets
  - ❑ Rim joist

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Caulks

- Newer polymer caulks
- Siliconized acrylic latex
- Polyurethane

R402.4.4.1.2

Air Leakage Testing Requirement!!

For Climate Zones 6, 7, 8

≤ 3 ACH_{50}

MORE RESTRICTIVE THAN PERFORMANCE METHOD!

For Climate Zone 9?

NOT ADDRESSED

YES,
YOU HAVE TO PERFORM,
AND PASS,
A BLOWER DOOR TEST
IN THE PRESCRIPTIVE METHOD

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Air Leakage Testing Summary

- Performance Method (AA R405.3)
  - ≤ 4 ACH_{50}
- Prescriptive Method
  - ≤ 3 ACH_{50} in climate zones 6-8 (R402.4.1.2)
  - Not addressed in climate zone 9

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R402.4.1.3 AA

Crawlspace vapor retarder

- Exposed earth crawlspace
  - Covered with a continuous vapor retarder
  - Seams overlap minimum 6 inches
    - Sealed and/or taped
  - Extend 6 inches up foundation wall
- See section for further crawlspace vapor retarder details

68
68

R402.4.3

Fenestration Air Leakage

- Maximum infiltration rates:
  - 0.3 cfm per square foot for windows
  - 0.5 cfm per square foot for doors
  - Exception: site built windows, skylights and doors
  - Exception: products for which air infiltration data are not available on the manufacturer's labels or at the manufacturer's website

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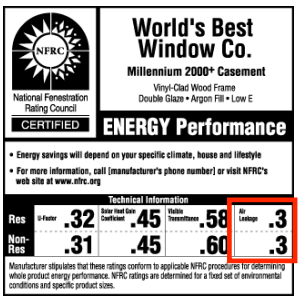
Fenestration (Windows)



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R402.4.4

Recessed Lighting

- Recessed lights sealed to minimize air leakage
  - gasket OR
  - caulking
- IC rated with sealed enclosures
- Labeled as meeting ASTM E 283
- Air leakage ≤ 2 cfm @ 75 Pa

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R403

Controls

- A thermostat must be provided for each heating and cooling system
  - Exception: Solid fuel appliances do not require thermostats
- All systems requiring a thermostat must have a programmable thermostat.
  - Exception: radiant in-floor heat and other thermal inertia systems

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R403.1.2

Heat pump supplementary heat

- Heat pumps with supplementary electronic resistance heat shall have:
  - Controls the prevent supplemental heat when heat pump can meet load

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R403.2.3 and R403.2.4 AA

Ducts

- Framing cavities NOT to used as SUPPLY ducts
  - OK for return air
- Smooth walled as much as possible
- Flex duct supported full length
- Maximum 90° bend

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R403.2.2

Duct Sealing

- Ducts, air handlers, and filter must be sealed according to IMC or IRC standards
- If duct system and air handler are entirely within thermal envelope, duct leakage test NOT required
- If portion of system is outside thermal envelope,
  - Duct leakage test IS required
    - Leakage to outside OR
    - Total leakage test
- See section for testing details and specifications

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R403.3

Mechanical Piping

- Piping carrying fluids hotter than 105° or colder than 55 ° must be insulated to at least R-3
- Unless within thermal envelope

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R403.5

Mechanical Ventilation

- Ventilation intakes and exhausts must have automatic or gravity dampers
- Minimize exterior exhaust rising into attic vents

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R403.5.1

Mechanical Ventilation

- Minimum required fan efficacy

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

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R403.6

Equipment Sizing and Installation

- Heating and cooling equipment sized in accordance with
  - ACCA Manuals S and J

OR

  - AK Warm
    - approved for heating calculations

- All equipment installed according to manufacturer's specs and this standard

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Equipment Sizing and Installation

- All heating and cooling shall be sized less than or equal to 125% of load (no over sizing)
  - According to
    - AK Warm
    - Manual J or other
  - When feasible considering equipment manufacturer's sizing options
  - Use smallest available output options to meet the load calculation

80

R403.8

Snow melt system controls

- Automatically shut off system when pavement is above 50°F and no precipitation is falling
- Automatic or manual control to allow shutoff when outdoor air temperature is above 40°F

81

R403.11

Combustion Safety

- Due to the increased risk of back-drafting and carbon monoxide poisoning that comes with increasingly air-tight homes, it is strongly recommended that all installed space and water heating equipment be sealed combustion appliances.

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403.11.1

Combustion Safety Testing (mandatory)

- A safety inspection of all combustion appliances must be completed in accordance with the Building Performance Institute standard as required in AHFC regulations.
- This inspection includes all of the following tests (using BPI* methods):

*Building Performance Institute

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403.11.1

Combustion Safety Testing (mandatory)

- Carbon monoxide measurement at each appliance

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403.11.1

Combustion Safety Testing (mandatory)

- Draft measurement

AND

- Spillage evaluation for atmospherically vented appliances

85

403.11.1

Combustion Safety Testing (mandatory)

- Worst-case negative pressure measurement for each combustion appliance zone.

86

Combustion Safety Test Results

- Must be recorded in AKWarm
- Passing is not required!

Subject to change?

87

R404

Electrical Power and Lighting

- 75% of lamps and/or lighting fixtures must be high efficacy.
- Exception: Low voltage lighting

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Electrical Power and Lighting

- Definition of high efficacy:
  - 60 lumens per watt for lamps (bulbs) over 40 watts
  - 50 lumens per watt for lamps (bulbs) between 15 and 40 watts
  - 40 lumens per watt for lamps (bulbs) under 15 watts

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R403.5

Mechanical Ventilation (Mandatory)

90

Ventilation

- Ventilation must meet ANSI/ASHRAE Standard 62.2-2010

Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

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92

93

94

95

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Mandatory Measures for the Prescriptive Method Only

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Prescriptive Builders

- ❑ Obtain PUR 101 from ARIS
- ❑ Contact AHFC Energy Programs Department for ARIS access

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Prescriptive Measures

- ❑ R402.1* General
- ❑ R402.2 Specific Ins. Requirements
- ❑ R402.3 Fenestration
- ❑ R403.2.1 Insulation (Ducts)
- ❑ R403.4.2 Hot Water Pipe Insulation

*All of Section R402 is required. 402 Sections not listed here are Mandatory Measures

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R402

Building Thermal Envelope

- ❑ Prescriptive Method
  - ❑ Prescriptive measures + Mandatory Measures
- ❑ See Alaska Amendments for
  - ❑ Additions
  - ❑ Deletions
  - ❑ Exceptions
- ❑ Insulation requirements in Tables R-A402.1.1 and R-A402.1.3

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Table R-A402.1.1 & A402.1.3

- ❑ Establish minimum R and U values for components
- ❑ Updated tables

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Table R-A402.1.1 Nominal Insulation and Glazing Minimum R-values by Component

Climate Zone	Windows, Doors & Skylights	Ceiling[a]	Exterior Wood Frame Wall	Floor	Below Grade Wall[b]	Slab[c] & Depth	Crawl Space Wall[b]
6	3.33	54 or 43	25	38	15/19	15, 4ft	15/19
7	3.33	54 or 43	25	38	15/19	15, 4ft	15/19
8	4.5	59 or 48	30	38	15/19	15, 4ft	15/19
9	5	65 or 52	35	43	NR	NR	NR

a. The smaller value may be used with a properly sized, energy-heel truss. Zones 6 and 7 may use a 13" energy heel truss.
b. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home.
c. R-5 shall be added to the required slab edge R-values for heated slabs.
d. A vapor retarder may be installed within the thermal insulation so long as the R-value of the thermal insulation on the warm side of the vapor retarder does not exceed one third of the total R-value. [Note that "one third" is a general statewide maximum and more restrictive values may be needed in the colder climate zones.

Table R-A402.1.3 Asssembly Insulation and Glazing Maximum U-factors[a]

Climate Zone	Windows, Doors & Skylights	Ceiling	Exterior Wood Frame Wall	Floor	Below Grade Wall	Slab	Crawl Space Wall
6	0.30	0.023	0.048	0.028	0.050	0.067	0.050
7	0.30	0.023	0.048	0.028	0.050	0.067	0.050
8	0.22	0.021	0.042	0.028	0.050	0.067	0.050
9	0.20	0.020	0.036	0.026	NR	NR	NR

a. Nonglazing U-factors shall be obtained from measurement, calculation or an approved source.

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R402.1.4

Total UA Alternative

- Can use this to meet thermal envelope requirements

IF:

combined U-factors of entire structure
(sum of: U-factors X assembly area) ≤
result using values from Table A402.1.3,

THEN:

the structure meets IECC requirements

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R402.2.1 AA

Ceilings with attic spaces

- R-A402.1.1 insulation values
- Where full height of uncompressed insulation can extend over the wall top plate, the smaller R-value from Table R-A402.1.1 can be used

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R402.2.2 AA

Ceilings without attic spaces

- Cathedral ceilings:
  - 450 ft² (or 15% of area)* can be below minimum insulation level determined from Table R-A402.1.1

BUT

Must be at least R-30!

*Whichever is less

106

R402.2.3

Baffles

- Air permeable insulations require eave baffles
- Includes loose fill cellulose, fiberglass etc.

107

R402.2.5 AA

Mass Walls

- Delete this subsection

108

R402.2.7 AA

Floors

- Floor insulation must be tight to the subfloor
- Exception:
  Floor systems that require space for radiant tubing, plumbing ducting, and/or wiring. These floors must
  - meet R-value requirement
  - be sealed to prevent air infiltration

109

R402.2.8

Basement Walls

- Insulated from top of wall to floor
- Not required more than 10' below grade

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402.2.9

Slab-on-Grade Floors

- Required slab insulation may be satisfied vertically or horizontally
- If extending outward, perimeter insulation covered by pavement or at least 10" of soil

111

R402.2.10 AA

Crawlspace Walls

- Crawlspace walls can be insulated if
  - The only venting in the crawlspace is mechanical

    OR
  - The crawlspace is not vented to the outside

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R402.2.10 AA

Crawlspace Walls

- Permanently fastened crawlspace insulation must
  - extend from top of wall to footer on the inside

    OR
  - vertically and/or horizontally for at least 36 inches on the outside
- Vapor retarder must extend 6" up foundation wall

113

R402.3 AA

Fenestration (Prescriptive)

114

R402.3.7 AA

Fenestration Exemptions

- 15 ft² of glazing exempt
- One door exempt
- The total glazing area cannot exceed 18% of the floor area by the prescriptive method

115

R402.3.7 AA

Skylights

- Skylights are strongly discouraged
- Skylight area may not exceed 1% of the ceiling thermal envelope area
- Skylight sidewalls insulated to the same R-value as the ceiling.

116

R403.2.1 AA

Insulation (Ducts)

- Supply and return ducts in unconditioned space discouraged
- If outside thermal envelope then insulate to same level as wood-framed wall*

.

117

Example

- What is the R-value required for ventilation ductwork extending through an attic in Fairbanks (Climate Zone 8) when using the prescriptive method?

118
118

Answer:

- Must be insulated to the same level as a wood-frame wall in Climate Zone 8; R-value = 30.

Table A402.1.1 Insulation and Glazing Minimum R-values by Component

Climate Zone	Windows, Doors, & Skylights	Ceiling[a]	Exterior Wood Frame Wall	Floor	Below Grade Wall[b]	Slab and Depth[c]	Crawl space Wall[b]
6	3.33	54 or 43	25	38	15/19	15, 4ft	15/19
7	3.33	54 or 43	25	38	15/19	15, 4ft	15/19
8	4.5	59 or 48	30	38	15/19	15, 4ft	15/19
9	5	65 or 52	35	43	NR	NR	NR

119
119

A peculiar note about the Standard

- The level of insulation required for ducts outside the thermal envelope depends on whether the prescriptive or performance method is chosen.
- Prescriptive = same as for wood-frame wall AA R403.2.1
- Performance = same as for envelope assembly duct penetrates AA R405.2

Such intrigue……..

120
120

Mandatory Measures for the Performance Method Only

121

Performance Builders

- PUR 101 from AKWarm©
- AHFC Certified Energy Rater

122

Performance Measures

- R405.1 Scope
- R405.2 Mandatory Requirements
- R405.3 Performance-based compliance

Must also meet Mandatory Measures

123

R405.1

Scope

- Energy performance analysis - AKWarm©
- Heating, cooling, and service water heating energy

124

R405.2 AA

Mandatory Requirements

- Meet provisions in R401.2
- Ducts not within the thermal envelope must be insulated to at least the level of the envelope assembly through which it penetrates. (Table R-A402.1.1)

125

R405.3 AA

Performance-based compliance

- AkWarm© rating ≥ 89 (5-star) by AHFC certified energy rater
- Air-tightness ≤ 4 ACH_{50}
- Delete sections R405.4 – R405.6.3

126

Whole Building Ventilation

127

ASHRAE Scope

- Following this standard does not guarantee healthy indoor air
- Many contaminant sources
- Outside air polluted
- System not operated and maintained
- This is a minimum standard only

128

4.1

Ventilation Rate

- Mechanical
  exhaust OR
  supply and exhaust
- MUST be supplied in each dwelling
- Whole building ventilation with outdoor air
- Must meet minimum rates

129

Ventilation Rate

- To determine ventilation rate use **EITHER**
  - Equation R-A4.1a
    OR
  - Table R-A4.1a
- Either one is OK
  - Slightly different rates between the 2
    - Table usually higher

130

Ventilation Equation R-A4.1a

- $Q_{fan} = 0.01A_{floor} + 10(N_{br} + 1)$

  Q_{fan} = fan flow rate in cubic feet per minute

  A_{floor} = floor area in square feet

  N_{br} = number of bedrooms

131

A note about the equation

$10(N_{br} + 1)$

- 10 = cfm per occupant
- $(N_{br} + 1)$ = Number of bedrooms + 1 really means that you assume each bedroom has 1 occupant AND the master bedroom has 2 occupants

132

Ventilation Equation R-A4.1a - Example 1

- 1200 square foot home with 3 bedrooms, how much ventilation (using equation R-A4.1a)?

Recall the equation

$Q_{fan} = 0.01A_{floor} + 10(N_{br} + 1)$

133

Ventilation Equation R-A4.1a - Example 1

- 1200 square foot home with 3 bedrooms, how much ventilation (using equation R-A4.1a)?

Substitute the known values

$Q_{fan} = 0.01*(1200) + 10(3 + 1)$

134

Ventilation Equation R-A4.1a - Example 1

- 1200 square foot home with 3 bedrooms, how much ventilation (using equation R-A4.1a)?

$Q_{fan} = 0.01*(1200) + 10(4)$

$Q_{fan} = 12 + 40$

135

Ventilation Equation R-A4.1a - Example 1

- 1200 square foot home with 3 bedrooms, how much ventilation (using equation R-A4.1a)?

Calculate

$Q_{fan} = 12 + 40$

Result

$Q_{fan} = 52$ cfm

136

Ventilation Equation R-A4.1a - Example 2

- 5000 square foot home with 6 bedrooms, how much ventilation?

$Q_{fan} = 0.01A_{floor} + 10(N_{br} + 1)$

137

Ventilation Equation R-A4.1a - Example 2

- 5000 square foot home with 6 bedrooms, how much continuous ventilation?

$Q_{fan} = 0.01A_{floor} + 10(N_{br} + 1)$

$Q_{fan} = 0.01*(5000) + 10(6+1)$

$Q_{fan} = 50 + 70$

$Q_{fan} = 120$ cfm

138

Ventilation Equation R-A4.1a - Exercise 1

- According to equation R-A4.1a, how much continuous ventilation is required for a 1700 square foot home with 2 bedrooms?

139

Ventilation Equation R-A4.1a - Exercise 1

1700 * .01 = 17

2 bedrooms plus 1 = 3; 3x10 cfm = 30

17 + 30 = 47 cfm

Answer: 47 cfm

140

Ventilation Table R-A4.1a

- Table R-A4.1a may also be used to determine ventilation rate
- No calculations required
- May result in slightly higher ventilation rates

141

Ventilation Table R-A4.1a - Exercise 1

- According to table R-A4.1a, what is the required ventilation rate for a 2250 square foot home with 3 bedrooms?

Table R-A4.1a, Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500	110	130	150	170	190

142

Ventilation Table R-A4.1a - Exercise 1

- Answer: 70 cfm

Table R-A4.1a, Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500	110	130	150	170	190

143

Ventilation Table R-A4.1a - Exercise 2

- According to table R-A4.1a, what is the required ventilation rate for a 5500 square foot home with 6 bedrooms?

Table R-A4.1a, Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500	110	130	150	170	190

144

Ventilation Table R-A4.1a - Exercise 2

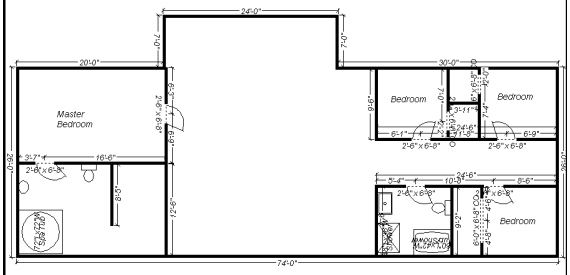
- Answer: 140 cfm

Table R-A4.1a, Ventilation Air Requirements, cfm

Floor Area (ft^2)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1500	35	55	75	95	115
1501-3000	50	70	90	110	125
3001-4500	65	85	105	125	145
4501-6000	80	100	120	140	160
6001-7500	95	115	135	155	175
>7500	110	130	150	170	190

145

Plan Exercise 1 Determine ventilation rate using the table and the equation



146

Plan Exercise 1

- Equation Answer: 70.92 CFM
- Table Answer: 90 CFM

147

4.1.1 AA

Occupant Density

- Assume
  - 2 people for first bedroom
  - one person for each additional bedroom
- Higher occupant densities?
  - 10 cfm per person - Alaska Amendment
- Other approved methods by a licensed design professional

148

4.1.3

Infiltration Credit

- No additional credit given for natural air infiltration on new homes
- Minimum ventilation rates in tables and equations must be met with mechanical ventilation
- 2 cfm per 100 ft^2 already included in tables and equation

149

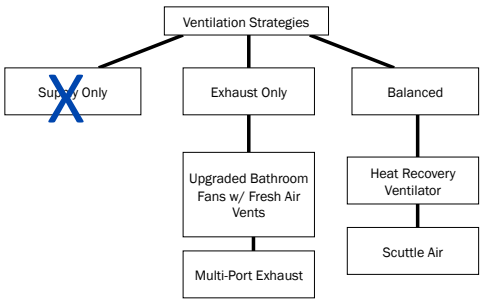
4.2 AA

System Types

- One or more supply and/or exhaust fans
- Local exhaust fans may be part of the system
- Scuttle air system approved if minimum return air temperatures met.
- Supply only systems not allowed
- Balanced HRV system recommended

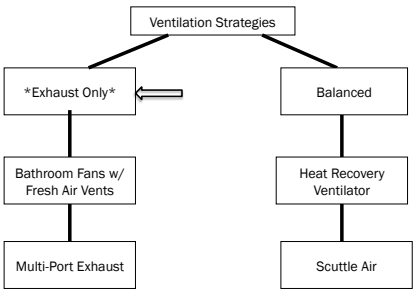
150

System Types



151

System Types



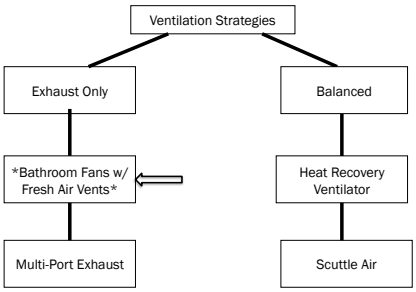
152

Ventilation Strategies

- Exhaust Only:
  - May create negative pressure problems
  - No heat recovery
  - Fresh air may not be evenly distributed

153

System Types



154

Ventilation Strategies

- Exhaust Only with Fresh Air Vents:
  - Can have more evenly distributed air than without fresh air vents
  - Control negative pressures

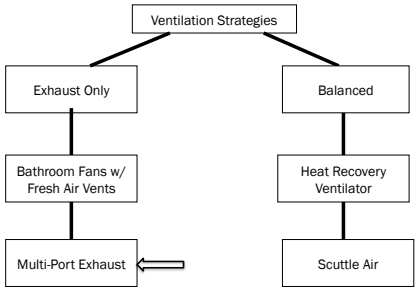
155

Ventilation Strategies

- Exhaust Only with Fresh Air Vents:
  - Recommend undercut interior doors and/or wall louvers for circulation
  - May be unsightly
  - Cold incoming air may be uncomfortable
    - Disable by occupants possible
  - No heat recovery

156

System Types



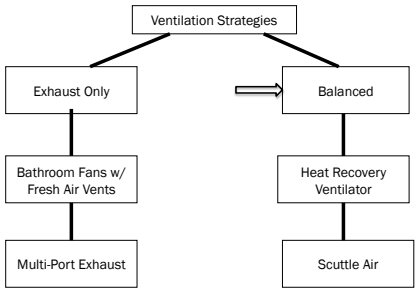
157

Ventilation Strategies

- Multi-point exhaust:
  - A fan with multiple connections that draw from 2 or more locations
  - Potentially better distribution than single point system
  - Needs fresh air intakes

158

System Types



159

Ventilation Strategies

- Balanced System:
  - A balanced ventilation system supplies and exhausts equal amounts of air

160

Ventilation Strategies

- Advantages of a balanced system:
  - Heat recovery possible
  - Custom air flow planning
  - House can be maintained at neutral pressure

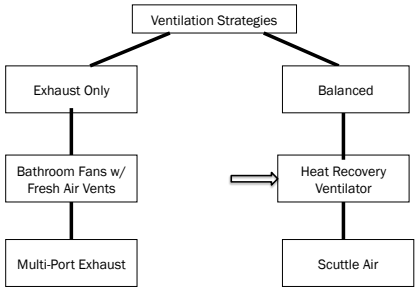
161

Ventilation Strategies

- Disadvantages of a balanced system:
  - Higher installation cost
  - Can be complex
  - More maintenance than exhaust only systems

162

System Types



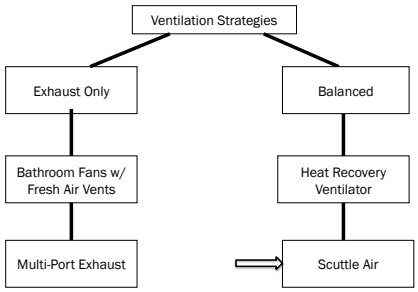
163

Ventilation Strategies

- Heat Recovery Ventilator:
  - Transfers energy from the outgoing exhaust air to the incoming fresh air
  - Often lower operating expenses in harsh climates

164

System Types



165

Ventilation Strategies

- Scuttle Air:
  - Duct connects furnace return to outside
  - Fresh air drawn into furnace return
  - Motorized damper is opened when fresh air is desired
  - Interlock requires exhaust fan in house to run when scuttle is open

166

4.3

Airflow Measurement

- Quantity of outdoor air supplied and/or quantity of indoor air exhausted
- Must be measured
  - Flow hood
  - Flow grid
  - Other device
- Test in all modes designed to meet whole-house ventilation requirement

167

4.4

Control and Operation

- "Fan on" switch for furnace acceptable control for scuttle systems
- All systems must have occupant override capabilities
- All controls MUST be labeled

168

4.4

Control and Operation

- Intermittent whole-house ventilation system allowed
  - Must meet Section 4.5 requirements
  - Must operate automatically on a timer
  - Must operate at least 1x each day
  - Must operate at least 10% of the time

169

4.6.2 AA

Very Cold Climates

In Alaska, supply-only ventilation during the heating season is not allowed.

170

4.5

Delivered Ventilation

171

4.5 AA

Delivered Ventilation

- Delivered ventilation from the Table and Formula R-A4.1a counted as larger of supply or exhaust, *continuous to the home (24/7)*
- Exception:
  - Effective ventilation rate formula may be used if ventilation system is designed to operate *intermittently*

172

Effective Ventilation Rate

- Determined from

$$Q_f = Q_r / (\varepsilon * f)$$

- Where
  - Q_f = fan flow rate
  - Q_r = ventilation air requirement
  - ε = ventilation effectiveness, Table 4.2
  - f = fractional ON-time

173

174

5.1

Local Exhaust

175

5.1

Operable windows do not meet the ventilation requirements!

176

5.1

Local Exhaust

- Local mechanical exhaust required in
  - Kitchen
  - bathroom
- Can be
  - Intermittent OR
  - Continuous
- Custom ventilation strategies OK if approved by licensed design professional

177

5.2 – 5.2.1

Local Exhaust - Intermittent

- Must ALLOW occupant control
- All control types allowed
  - IAQ, timers, occupancy sensors, etc.

178

5.2.2

Local Intermittent Ventilation Rate

- At least flow rate in Table 5.1

TABLE 5.1
Intermittent Local Ventilation Exhaust Airflow Rates

Application	Airflow	Notes
Kitchen	100 cfm	Vented range hood (including appliance-range hood combinations) required if exhaust fan flow rate is less than 5 kitchen air changes per hour
Bathroom	50 cfm	

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Kitchen Intermittent Ventilation Rates

- Minimum kitchen exhaust airflow is 100 cfm
- Vented range hood required if exhaust fan flow rate is less than 5 kitchen air changes per hour

180

5.3

Local Exhaust - Continuous

- Operates without occupant intervention
- May be part of a balanced mechanical system

181

5.3.1

Local Exhaust – Continuous: Control and Operation

- Operates during all occupiable hours
- Override must be readily accessible

182

5.3.2

Local Exhaust – Continuous: Ventilation Rate

- At least flow rate in Table 5.2

TABLE 5.2
Continuous Local Ventilation Exhaust Airflow Rates

Application	Airflow	Notes
Kitchen	5 Air Changes per Hour	Based on kitchen volume
Bathroom	20 cfm	

183

Kitchen Continuous Ventilation Rates

- Continuous kitchen exhaust must be 5 air changes per hour, based on kitchen volume

184

Determining Continuous Ventilation Rates

- 3 steps:
  1. Determine kitchen volume
  2. Determine volume of air in 5 air changes per hour
  3. Determine fan flow requirement

185

Kitchen Fan Example

- Kitchen = 14 ft X 8 ft X 8 ft
- What size fan is required if ventilation is continuous?
  - Determine kitchen volume:

    14 ft X 8 ft X 8 ft = 896 ft^3
  - Volume of air in 5 air changes/hour:

    896 ft^3 X 5 = 4480 ft^3 of air

186

Kitchen Fan Example

- 5 air changes/hour:

  896 ft^3 X 5 = 4480 ft^3 of air

- Fan flow required (ft^3/min or cfm):

  ft^3/min = (4480 ft^3/hr) **/** (60 min/hr)

  = 75 ft^3/min (cfm)

187

Kitchen Fan Exercise

- Determine the continues ventilation rate to meet BEES 2012 for a 20' X 12' X 10' kitchen?

- The presentation will resume in about 3 minutes…

188

Kitchen Fan Exercise

- Determine the continues ventilation rate to meet BEES 2012 for a 20' X 12' X 10' kitchen?

- First, determine kitchen volume:

  20' X 12' X 10' = 2400ft^3

- Second, determine the volume of air in 5 air changes:
  - Kitchen volume is 2400ft^3 as calculated above
  - For 5 air changes, multiply kitchen volume by 5

  2400ft^3 X 5 = 12,000ft^3

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Kitchen Fan Exercise

- Determine the continues ventilation rate to meet BEES 2012 for a 20' X 12' X 10' kitchen?

- For this kitchen, 12,000ft^3 of air must be exchanged each hour

- For ventilation rate, divide the total volume of air to be exchanged each hour by 60 min to get continuous flow in cfm:

  12,000ft^3 **/** 60min = **200 cfm**

190

5.4

Airflow Measurement

- For local exhaust:
  Indoor air exhausted by the ventilation as installed

- MEASURE with:
  - Flow hood
  - Flow grid
  - Other devices

191

5.4

Airflow Measurement - EXCEPTION

- Can use airflow rating in Section 7.1*
  - at a pressure of 0.25 in. water column (62.5 Pa)
  - Duct sizing must meet requirements of Table 5.3 or manufacturer's design criteria

*Section 7.1 identifies 3rd party airflow and sound ratings for fans

192

Airflow Rating – Example 1

- For a fan rated for 50 cfm @ .25" w.c., what is the max length of 5" smooth duct?

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size.
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

193

Airflow Rating – Example 1

- For a fan rated for 50 cfm @ .25" w.c., what is the max length of 5" smooth duct? NO LIMIT

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size.
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

194

Airflow Rating – Example 2

- If you include 2 elbows in 4" duct for a fan rated for 80 cfm @ 0.25" w.c., how much straight ducting is left?

195

Airflow Rating – Example 2

- 35' max length – 30' (2 elbows account for 30') = 5' of straight ducting left

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size.
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

196

197

198

Other Requirements – Section 6

199

Transfer Air

- Air that moves from one space to another within a dwelling
  - Garage to home
  - Crawlspace to home
  - Attic to home
- Also includes movement between adjacent dwellings

200

Controlling Transfer Air

- Seal
  - Joints
  - Seams
  - Penetrations
  - Openings
- With
  - Caulk
  - Gaskets
  - Weather stripping
  - Wraps

201

6.1

Adjacent Spaces

- Transfer air MUST be minimized
  - Sealing
  - Pressure management
  - Airtight fixtures, etc.
- Ventilation air MUST come from outside

202

6.1.1

Multifamily Buildings

- Use gasketing or weather stripping on doors between units and common hallways
  - Unless ventilation system is designed for transfer air between units and hallways

203

6.2

Instructions and Labeling

204

System Instructions

- Identify system design and installed equipment
- Written instructions for homeowner
  - Operation
  - Maintenance
- Ventilation controls labeled
- Chapter 13 of ASHRAE Guideline 24 outlines required information

205

System Instructions - Required Information

- Contractor's name and contact info
- Ventilation calculations
- Combustion safety calculation
- Clear statement of ventilation approach
- Operating schedule
- All manufacturer's installation manuals
- Control strategy and description
- Maintenance information

206

6.3

Clothes Dryers

- Dryers must be vented to the outdoors
- Exception:
  - Condensing dryers
    - Plumbed to a drain

207

6.4

Combustion and Solid Fuel Burning Appliances

208

Atmospherically Vented Appliances

- Where atmospherically vented combustion or solid fuel burning appliances are present inside pressure boundary:
- Total net exhaust flow of two largest fans exceeds 15 cfm per 100² ft., flow reduced flow or relief air provided

209

Example 1

- If an atmospherically vented or solid fuel burning appliance is present, what would the maximum net exhaust flow of the two largest fans in a 2000² ft. house be?
- 2000² ft./ 100² ft. = 20
- 20 * 15 cfm = 300 cfm
- 300 cfm is the maximum net exhaust flow of two largest fans before flow must be reduced, or relief air provided

210

Example 2

- If an atmospherically vented or solid fuel burning appliance is present, what would the maximum net exhaust flow of the two largest fans in a 1100² ft. house be?
- 1100² ft./ 100² ft. = 11
- 11 * 15 cfm = 165 cfm
- 165 cfm is the maximum net exhaust flow of two largest fans before flow must be reduced, or relief air provided

211

Example 3

- If an atmospherically vented or solid fuel burning appliance is present, what is the smallest house a 100 cfm range hood and a 150 cfm clothes dryer may be installed in without reducing the flow or providing relief air?
- 250 cfm / 15 cfm = 16.67
- 16.67 * 100 = 1667² ft.

212

Exercise 1

- If an atmospherically vented or solid fuel burning appliance is present, what would the maximum net exhaust flow of the two largest fans in a 3250 square foot house be?

213

Exercise 1

- 3250² ft./ 100² ft. = 32.5
- 32.5 * 15 cfm = 487.5 cfm
- 487.5 cfm is the maximum net exhaust flow of two largest fans before flow must be reduced, or relief air provided

214

Exercise 2

- If an atmospherically vented or solid fuel burning appliance is present, what is the smallest house a 250 cfm range hood and a 200 cfm clothes dryer can be installed in without reducing the flow or providing relief air?

215

Exercise 2

- 450 cfm / 15 cfm = 30
- 30 * 100 = 3000² ft.

216

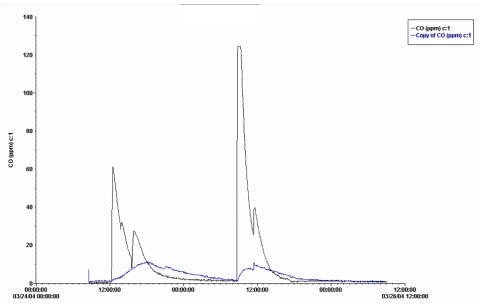
6.5.1

Garages

- ❑ Source of a variety of contaminants
- ❑ Must minimize air transfer from garage to the house
  - ❑Garage – house communication
- ❑ Garage/house man door must be gasketed or weather stripped
- ❑ Air seal walls, ceilings, and floors that separate garage from occupiable space

217

Garage Communication



218

6.5.1

Garages

- ❑ Seal
  - ❑Joints
  - ❑Seams
  - ❑Penetrations
  - ❑Openings
- ❑ With
  - ❑Caulk
  - ❑Gaskets
  - ❑Weather stripping
  - ❑Wraps

219

Garages

- ❑ Air handlers in garages not recommended
- ❑ Maximum total air leakage 6% fan flow @ 25 Pa

220

6.5.2

Space-Conditioning System Ducts

- ❑ Duct joints outside pressure boundary sealed
  - ❑Best practice = seal all joints!
- ❑ No duct connections between garage and occupiable space - supply or return
- ❑ If air handler or ducts outside pressure boundary
  - ❑No more than 6% system leakage (25 Pa)
  - ❑See testing requirements

221

6.6 AA

Ventilation Opening Area

222

6.6 AA

Ventilation Air Openings

- Ventilation air through an exterior door or operable window shall not be considered as part of a mechanical ventilation system design and shall not be included in a calculation showing compliance with the required minimum ventilation rate
- Windows and doors are not classified as ventilation system components

223

Appendix C1.0 AA

Exhaust Ventilation

- Informative appendix:
- For exhaust only systems, passive intake vents should be provided where the sum of the intake capacity is at least equal to the exhaust rate and no single intake vent is rated at more than 25 cfm

224

6.7

Filtration

- Outdoor air ducts > 10 feet before furnace must be filtered
  - Scuttle air
  - HRV duct connected to forced air distribution

Filter must meet

- MERV 6 filter rating
  (Minimum Efficiency Reporting Value)
- Filter must be accessible for maintenance

225

6.8 AA

Air Inlet

- Fresh 80's, 100's
- Aldes Airlets
- Other brands & types available.

226

6.8 AA

Air Inlet – Opening Locations

- Outdoor air intakes NOT located within 10 feet of a pollutant source
  - Chimneys, vents, exhausts, etc.

227

6.8 AA

Air Inlet – Opening Locations

- Cannot be obstructed by snow or landscaping
- Forced air inlets screened with mesh ≤ 1/2"

228

6.8 AA

Opening Location - Exceptions

- Stretch string distance of 3' from
  - pollution sources on roof
  - dryer exhausts
- No minimum distance between windows and local exhaust outlets for
  - Bathrooms
  - kitchens
- Vent terminations meeting National Fuel Gas Code

229

6.8 AA

Opening Location – Exceptions Cont'd

- "The intake shall be placed so that entering air is not obstructed by snow, plantings, or other material, and shall be located at least 18 inches above an adjacent finished grade"

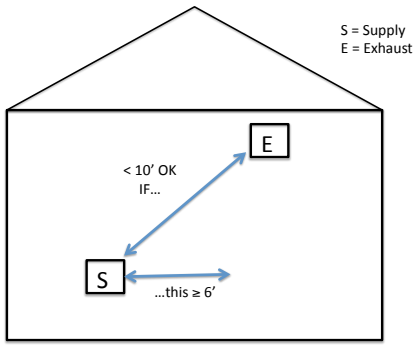
230 230

6.8 AA

Opening Location – Exceptions Cont'd

- A ventilation system's supply and exhaust vents on the exterior of a building may be separated less than 10 feet as long as they are separated a minimum of 6 feet horizontally. They may be separated less than this if they are part of a system engineered to prevent entrainment of the exhaust air. Care should be taken to locate an intake vent where it can be easily cleaned at regular intervals.

231



7.0

Air Moving Equipment

235

7.1 AA

Air Moving Equipment

- A ventilation appliance shall be located in a place that is accessible and convenient to access for annual or more frequent maintenance (changing of filters, oiling, cleaning, etc.)

236

Appliance Access

- Appliances in underfloor areas:
  - Path minimum 22" wide, and not less than width of appliance
  - Path minimum 30" high, and not less than appliance height
  - Maximum 20' from access to appliance.

  There's more…

237

Appliance Access

- Minimum 30" by 30" level service area
- Minimum 22" by 30" access, but no less than appliance dimensions
- Light fixture and outlet near appliance required
- Exception present

238

7.2

Air Moving Equipment

- Continuous fans maximum 1 sone
- Intermittent fans maximum 3 sones, unless 400 cfm or greater
- *Includes range hoods and bath fans*

239

Air Moving Equipment

Specifications:		
Static Pressure in inches w.g.	0.1	0.25
Air Volume (CFM)	290	257
Noise (sones)	2.0	NA
Power Consumption (watts)	64	62
Energy Efficiency: CFM's / Watt	4.5	4.1
Speed (RPM)	877	990
Washington State VIAQ Code	Yes	

Specifications:		
Static Pressure in inches w.g.	0.1"	0.25
Air Volume (CFM)	380	348
Noise (sones)	3.0	NA
Power Consumption (watts)	112	110
Energy Efficiency: CFM's / Watt	3.4	3.1
Speed (RPM)	736	823
Washington State VIAQ Code	Yes	

240

Air Moving Equipment

- Sone rating exception:
  - Remote mounted fans more than 4' from the grille
  - Furnace air handlers

241

Airflow Rating

- Air flow measured by flow hood, pressure pan, flow stations, etc.
- Or follow prescriptive method - Table 5.3

242

Airflow Rating

- Table 5.3 – based on 0.25" w.c. pressure

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	**Flex Duct**				**Smooth Duct**			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

243

Equipment - Distribution Materials

- Ducting type affects resistance a fan encounters
- Flexible ducting can have 2 to 10 times the resistance of a smooth walled pipe.

Airflow Rating

Specifications:		
Static Pressure in inches w.g.	0.1	0.25
Air Volume (CFM)	290	257
Noise (sones)	2.0	NA
Power Consumption (watts)	64	62
Energy Efficiency: CFM's / Watt	4.5	4.1
Speed (RPM)	877	990
Washington State VIAQ Code	Yes	

Specifications:		
Static Pressure in inches w.g.	0.1"	0.25
Air Volume (CFM)	380	348
Noise (sones)	3.0	NA
Power Consumption (watts)	112	110
Energy Efficiency: CFM's / Watt	3.4	3.1
Speed (RPM)	736	823
Washington State VIAQ Code	Yes	

245

Airflow Rating – Example 1

- For a fan rated for 50 cfm @ .25" w.c., what is the max length of 5" smooth duct?

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	**Flex Duct**				**Smooth Duct**			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

246

Airflow Rating – Example 1

- For a fan rated for 50 cfm @ .25" w.c., what is the max length of 5" smooth duct? NO LIMIT

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

247

Airflow Rating – Example 2

- If you include 2 elbows in 4" duct for a fan rated for 80 cfm @ 0.25" w.c., how much straight ducting is left?

248

Airflow Rating – Example 2

- 35' max length – 30' (2 elbows account for 30') = 5' of straight ducting left

TABLE 5.3 Prescriptive Duct Sizing

Duct Type	Flex Duct				Smooth Duct			
Fan Rating CFM @ 0.25 in. wg (L/s @ 62.5 Pa)	50 (25)	80 (40)	100 (50)	125 (65)	50 (25)	80 (40)	100 (50)	125 (65)
Diameter in. (mm)	**Maximum Length** ft. (m)							
3 (75)	X	X	X	X	5(2)	X	X	X
4 (100)	70(27)	3(1)	X	X	105(35)	35(12)	5(2)	X
5 (125)	NL	70(27)	35(12)	20(7)	NL	135(45)	85(28)	55(18)
6 (150)	NL	NL	125(42)	95(32)	NL	NL	NL	145(48)
7 (175) and above	NL	NL	NL	NL	NL	NL	NL	NL

This table assumes no elbows. Deduct 15 feet (5 m) of allowable duct length for each elbow.
NL = no limit on duct length of this size
X = not allowed, any length of duct of this size with assumed turns and fitting will exceed the rated pressure drop.

249

7.3

Multi-Branch Exhaust Ducting

- Common exhaust ducts fitted with backdraft dampers
- Common exhaust ducts across dwelling units not allowed, unless:
- Single fan downstream of all exhaust points, fan runs continuously or backdraft dampers installed

250

7.3

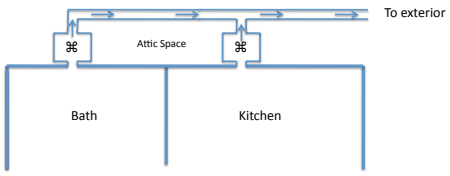
Common Exhaust Duct

Within a dwelling

251

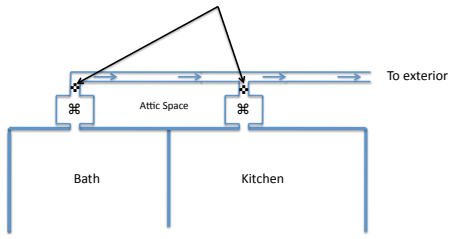
Multiple exhaust fans IN SAME UNIT sharing a common duct

NOT PERMITTED, unless…



252

All fans have backdraft dampers!



253

7.3

Common Exhaust Duct

Different dwellings

254

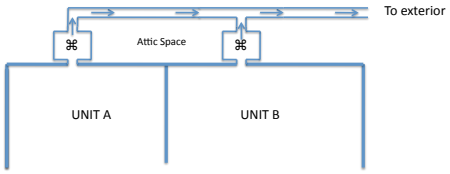
7.3

DON'T EVEN DARE!

255

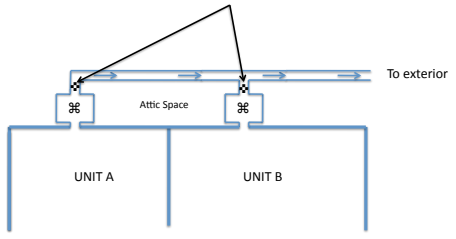
Exhaust fans in DIFFERENT UNITS CANNOT share a common duct

Never, ever…



256

NOT EVEN IF BACKDAMPERS ARE INSTALLED!!



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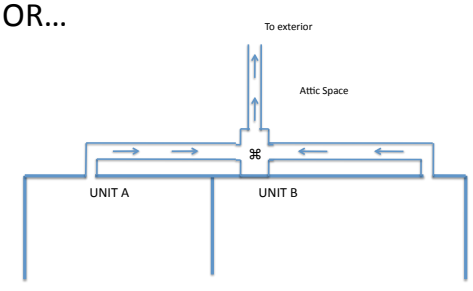
Common fan for multiple units – FAN MUST RUN CONTINUOUSLY

OR…



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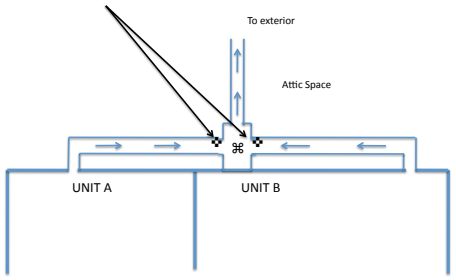
…MUST HAVE BACKDRAFT DAMPERS



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