

2008 Building Energy
Efficiency Standards
Changes

Miles Hancock
Assistant Building Official
City of South San Francisco

2008 California Energy Code

Effective Date:

August 1, 2009

2008 B.E.E.S.

2008 BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS

CALIFORNIA
ENERGY
COMMISSION

REGULATIONS / STANDARDS



December 2008
CEC-400-2008-001-CMF

Arnold Schwarzenegger
Governor



Reference Appendices

REFERENCE APPENDICES

CALIFORNIA
ENERGY
COMMISSION



for the **2008 BUILDING ENERGY
EFFICIENCY STANDARDS**
FOR **RESIDENTIAL AND
NONRESIDENTIAL BUILDINGS**

JOINT APPENDICES
RESIDENTIAL APPENDICES
NONRESIDENTIAL APPENDICES

REGULATIONS / STANDARDS

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Residential Compliance Manual

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Non-Res Compliance Manual

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California Energy Commission

To order the 2008 Building Energy Efficiency Standards

- (916) 654-5200 Publications
- Download at www.energy.ca.gov

- CEC Hotline

You can reach the hotline weekdays from 8:00 a.m. to 12:00 p.m.
and 1:00 p.m. to 4:30 p.m.:

(800) 772-3300 (916) 654-5106

Blueprint

The Energy Commission publishes the Blueprint, a quarterly newsletter that answers questions and addresses issues related to enforcement and compliance. The Blueprint also provides updated information on technical assistance and computer compliance programs and lists of training opportunities offered throughout the state. The Blueprint is available online at <http://www.energy.ca.gov/title24>

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Approved Compliance Programs

- EnergyPro 5 - Residential and non-Residential
- MicroPas 8 - Residential

DEFINITIONS § 101 (Residential Space Type)

| 2005 | 2008 |
|---|---|
| Low-Rise Residential Building | |
| Is a building, other than a hotel/motel that is of Occupancy Group R, Division I, and is multi-family with three stories or less, or that is of Occupancy Group R, Division 3 | Is a building, other than a hotel/motel that is of Occupancy Group R, division I, and is multi-family with three stories or less, or a single family residence of Occupancy Group R, Division 3, or an Occupancy Group U building located on a residential site |

DEFINITIONS § 101 (Residential Space Type)

| 2005 | 2008 |
|------|--|
| | <ul style="list-style-type: none"><li data-bbox="604 430 1619 711">• Laundry is a non-habitable room or space which contains plumbing and electrical connections for a washing machine or clothes dryer. |
| | <ul style="list-style-type: none"><li data-bbox="604 755 1675 1036">• Storage Building is a non-habitable detached building used for the storage of tools, garden equipment, or miscellaneous items. |
| | <ul style="list-style-type: none"><li data-bbox="604 1079 1732 1507">• Utility Room is a non-habitable room or building which contains only HVAC, plumbing, or electrical controls or equipment; and which is not a bathroom, closet, garage, or laundry room. |

DEFINITIONS § 101 (Residential Space Type)

| 2005 | 2008 |
|--|--|
| <ul style="list-style-type: none">Bathroom is a room containing a shower, tub, toilet or sink used for personal hygiene. | <ul style="list-style-type: none">Bathroom is a room or area containing a sink used for personal hygiene, toilet, shower, or a tub. |
| | <ul style="list-style-type: none">Closet is a non-habitable room used for the storage of linens, household supplies, clothing, non-perishable food, or similar uses, and which is not a hallway or passageway. |

DEFINITIONS § 101 (Residential Space Type)

| 2005 | 2008 |
|--|---|
| | <ul style="list-style-type: none">Garage is a non-habitable building or portion of building, attached to or detached from a residential dwelling unit, in which motor vehicles are parked. |
| <ul style="list-style-type: none">Kitchen is a room or area used for cooking, food storage and preparation and washing dishes, including associated counter tops and cabinets, refrigerator, stove, ovens, and floor area. | |

Compliance Documentation

- New requirements for documentation procedure called registration.
- Required for construction of residential buildings for which HERS verification is required.



Compliance Documentation

Registration will be phased in with several steps beginning with:

Step 1: Registration will be introduced as a requirement for newly constructed low-rise residential buildings demonstrating compliance under Section 151(c)2 multiple orientation alternative for which compliance requires HERS field verification.

When documentation is prepared with the dwelling unit in cardinal orientation and there are HERS compliance measures then a transfer file will be uploaded to a HERS Provider for registration.

Compliance Documentation

Step 2

- Effective **October 1, 2010**
 - All low rise residential buildings for which compliance requires HERS field verification:
 - Compliance documentation shall be submitted to a HERS provider registry. (CalCerts, CBPCA, CHEERS)
 - When applying for permit, the CF-1R submitted to the AHJ shall be a copy of the registered CF-1R from the HERS provider registry.

Compliance Documentation

EnergyPro CA Climate Zone 04 Field Check/Date
 Compliance Method Climate Zone

| TDV (kBtu/sf-yr) | Standard Design | Proposed Design | Compliance Margin |
|---------------------|--------------------|--------------------|----------------------|
| Space Heating | 42.12 | 28.13 | 13.98 |
| Space Cooling | 18.41 | 15.63 | 2.78 |
| Fans | 5.14 | 4.01 | 1.13 |
| Domestic Hot Water | 13.80 | 8.82 | 4.98 |
| Pumps | 0.00 | 0.00 | 0.00 |
| Totals | 79.46 | 56.59 | 22.87 |

Percent better than Standard: 28.8%

BUILDING COMPLIES - HERS VERIFICATION REQUIRED

Building Type: Single Family Addition Total Conditioned Floor Area: 1,616 ft²

Compliance Documentation

When registration is required, the Certificate of Compliance (CF-1R), Installation Certificate (CF-6R), and the Certificate of Field Verification and Diagnostic Testing (CF-4R) are required to be submitted to a HERS Provider data registry for retention.

Field Verification and/or Diagnostic Testing

Examples of measures requiring HERS verification are;

- Refrigerant Charge Measurement (RCM) and Duct Sealing.


Verification of the installation of a Refrigerant Charge Indicator Display (CID) as an alternative method for compliance with the prescriptive Refrigerant Charge Verification requirement.

NO MORE TXV Compliance Measure

Field Verification and/or Diagnostic Testing

Additionally, 2008 Standards require installation of Saturation Temperature Measurement Sensors (STMS) if a CID is not installed in the air conditioning system.

STMS make it possible to perform the refrigerant charge verification procedure without the use of pressure gauges.

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decompressor
are needed to see this picture.

Compliance Documentation

- New Compliance Option for Performance
 - New Solar Home Partnership *NSHP*
 - Allows for the installation of photovoltaic modules as compliance credit for energy efficiency over and above the energy standards.
 - This option requires a minimum of 15% compliance margin as shown on CF-1R.

Compliance Documentation

| | | | | |
|---|---|-----------------------------------|-------------------------------|-----------------------|
| EnergyPro | | CA Climate Zone 04 | | Field Check/Date |
| Compliance Method | | Climate Zone | | |
| <u>TDV (kBtu/sf-yr)</u> | <u>Standard Design</u> | <u>Proposed Design</u> | <u>Compliance Margin</u> | |
| Space Heating | 42.12 | 28.13 | 13.98 | |
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| Totals | 79.46 | 56.59 | 22.87 | |
| Percent better than Standard: | | | 28.8% | |
| BUILDING COMPLIES - HERS VERIFICATION REQUIRED | | | | |
| Building Type: | <input checked="" type="checkbox"/> Single Family | <input type="checkbox"/> Addition | Total Conditioned Floor Area: | 1,616 ft ² |

Measures requiring HERS Field Verification and/or Diagnostic Testing

The following features require field verification and/or diagnostic testing:

- Duct Sealing
- Supply Duct Location, Surface Area and R-Value
- Low Leakage Ducts in Conditioned Space
- Low Leakage Air Handlers
- Refrigerant Charge in Split System Air Conditioners and Heat Pumps
- Refrigerant Charge Indicator Display (CID)
- Verified Cooling Coil Airflow
- Air Handler Fan Watt Draw
- High Energy Efficiency Ratio (EER)
- Maximum Rated Total Cooling Capacity

Measures requiring HERS Field Verification and/or Diagnostic Testing

- Evaporatively Cooled Condensers
- Ice Storage Air Conditioners
- Building Envelope Sealing
- High Quality Insulation Installation (QII)
- Quality Insulation Installation for Spray Polyurethane Foam
- PV Field Verification

HERS Providers

Three HERS Providers in California

1. CalCERTS

www.calcerts.com

2. CBPCA

www.cbpca.org

3. CHEERS

www.cheers.org

Approval for Occupancy

Only registered CF-4R documents are allowed for these document submittals. Handwritten, field versions of the CF-4R are not allowed for document submittals for meeting compliance with the 2008 Standards.

The HERS rater must also provide a copy of the registered CF-4R to the builder, and a copy must be left in the building for the building owner at occupancy.

The background features a gradient from light blue to white, overlaid with several diagonal, semi-transparent blue bands that create a sense of depth and movement.

Residential

Envelope

Roofing Products

All roofing products must meet the mandatory requirements of 10-113 and 118(i), and prescriptive requirements of 151(f)12. Roofing products with high solar reflectance and thermal emittance are referred to as “cool roof”, which refers to an outer layer or exterior surface of a roof.

- High reflectance
- High Emittance

Cool Roofing

High reflectance: While dark surfaces absorb the sun's energy, light colored surfaces reflect solar energy and stay cooler.

High emittance: Refers to the ability of heat to escape from a surface once it is absorbed. Surfaces with low emittance (usually shiny metallic surfaces) contribute to the transmission of heat into the roof components under the roof surface. The heat can increase the building's air conditioning load resulting in increased air conditioning load and less comfort for the occupants. High emitting roof surfaces give off absorbed heat relatively quickly through the path of least resistance.

Cool Roofing

Emittance:

The emittance of a material refers to its ability to release absorbed heat. Scientists use a number between 0 and 1, or 0% and 100%, to express emittance. With the exception of metals, most construction materials have emittances above 0.85 (85%).

EPA Glossary

Cool Roofing

Roofing products that are used for compliance with the standards (prescriptive and performance approaches) are required to be tested and labeled by the Cool Roof Rating Council (CRRC) per 10-113 and that liquid applied products meet minimum standards for performance and durability per 118(I)4. The CRRC is the supervisory entity responsible for certifying cool roof products.

www.coolroofs.org

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Cool Roofing

- Roof Coverings (Prescriptive – Package D)
 - Roofing material, on a steep sloped roof ($> 2:12$), weighing $5\text{lb}/\text{ft}^2$ or more required to be CRRC certified. (Cool Roof Rating Council) All CZ's
 - Minimum aged solar reflectance of 0.15
 - Minimum thermal emittance of 0.75.
- Concrete Tile
- Clay Tile
- Slate

Cool Roofing

There are two exceptions to meeting the roofing products requirements in the prescriptive package:

1. The roof area with building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for aged solar reflectance and thermal emittance per exception 1 of 151(f)12.
2. If roof construction has a thermal mass over the roof membrane with a weight of at least 25 lb/ft are exempt from the minimum requirements for cool roof.

Cool Roofing

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Envelope



Envelope

- Roof Coverings (Alteration – Re Roof)
 - Roofing material, on a steep sloped roof ($> 2:12$), weighing $5\text{lb}/\text{ft}^2$ or more required to be CRRC certified. (Cool Roof Rating Council) Where replacement is $>50\%$, or more than 1,000 square feet, whichever is less.
 - Exceptions
 - Existing ducts in the attic are insulated and sealed according to § 151(f) 10. (HERS Rated); or
 - Building with at least R-30 ceiling insulation; or
 - Buildings with a radiant barrier in the attic; or
 - Building that have no ducts in the attic

Prescriptive Changes

- Package D
2005

| Climate Zone | 1 | 2 | 3 | 4 |
|-------------------------------------|------------------|------------------|-------------------|-------------------|
| BUILDING ENVELOPE | | | | |
| Insulation minimums ¹ | | | | |
| Ceiling | R38 | R30 | R30 | R30 |
| Wood-frame walls | R21 | R13 | R13 | R13 |
| “Heavy mass” walls | (R4.76) | (R2.44) | (R2.44) | (R2.44) |
| “Light mass” walls | NA | NA | NA | NA |
| Below-grade walls | R0 | R0 | R0 | R0 |
| Slab floor perimeter | NR | NR | NR | NR |
| Raised floors | R19 | R19 | R19 | R19 |
| Concrete raised floors | R8 | R8 | R0 | R0 |
| Radiant Barrier | NR | REQ | NR | REQ |
| FENESTRATION | | | | |
| Maximum U-factor ² | 0.57 | 0.57 | 0.67 | 0.67 |
| Maximum Solar Heat Gain Coefficient | NR | 0.40 | NR | 0.40 |
| DUCTS | | | | |
| Duct sealing | REQ ⁸ | REQ ⁹ | REQ ¹⁰ | REQ ¹¹ |
| Duct Insulation | R-6 | R-6 | R-6 | R-6 |

Duct Sealing

- HERS Rater
- CF-6R
- CF-4R



Prescriptive Changes 2008

2008 Building Energy Efficiency Standards

TABLE 151-C COMPONENT PACKAGE D

| | | | | | | |
|-----------------------------|---|------------------------|------|------|------------------|------|
| Roofing Products | Low-sloped | Aged Solar Reflectance | NR | NR | NR | NR |
| | | Thermal Emittance | NR | NR | NR | NR |
| | Steep Sloped (less than 5 lb/ft ²) | Aged Solar Reflectance | NR | NR | NR | NR |
| | | Thermal Emittance | NR | NR | NR | NR |
| | Steep Sloped (5 lb/ft ² or more) | Aged Solar Reflectance | 0.15 | 0.15 | 0.15 | 0.15 |
| | | Thermal Emittance | 0.75 | 0.75 | 0.75 | 0.75 |
| Fenestration | Maximum U-factor ² | | 0.40 | 0.40 | 0.40 | 0.40 |
| | Maximum Solar Heat Gain Coefficient (SHGC) ² | | NR | 0.40 | NR | 0.40 |
| | Maximum Total Area | | 20% | 20% | 20% | 20% |
| | Maximum West Facing Area | | NR | 5% | NR | 5% |
| Central Forced Air Handlers | Cooling Airflow and Watt Draw | | NR | NR | NR | NR |
| | Central Fan Integrated Ventilation System Watt Draw | | REQ | REQ | REQ ² | REQ |
| DUCTS | Duct sealing | | REQ | REQ | REQ | REQ |

- Alternative to Package D has been eliminated

Prescriptive Changes

TABLE 151-D COMPONENT **PACKAGE E**

| | | 1 | 2 | 3 | 4 | |
|----------------------------------|---|-------------------------------|------------------|------------------|------------------|---------|
| Insulation minimums ¹ | Ceilings | R38 | R30 | R38 | R30 | |
| | Walls | Wood-frame walls | R21 | R19 | R19 | R19 |
| | | Heavy mass walls | (R4.76) | (R2.44) | (R2.44) | (R2.44) |
| | | Light mass walls | NA | NA | NA | NA |
| | | Below-grade walls | R0 | R0 | R0 | R0 |
| | Floors | Slab floor perim. | NR | NR | NR | NR |
| | | Raised floors | R19 | R19 | R19 | R19 |
| Concrete raised floors | | R8 | R8 | R0 | R0 | |
| Radiant Barrier | | NR | REQ | NR | REQ | |
| Roofing Products | Low-sloped | Aged <u>Solar Reflectance</u> | NR | NR | NR | NR |
| | | <u>Thermal Emittance</u> | NR | NR | NR | NR |
| | Steep Sloped (less than 5 lb/ft ²) | Aged <u>Solar Reflectance</u> | NR | NR | NR | NR |
| | | <u>Thermal Emittance</u> | NR | NR | NR | NR |
| | Steep Sloped (5 lb/ft ² or more) | Aged <u>Solar Reflectance</u> | 0.15 | 0.15 | 0.15 | 0.15 |
| | | <u>Thermal Emittance</u> | 0.75 | 0.75 | 0.75 | 0.75 |
| Fenestration | Maximum U-factor ² | 0.50 ⁵ | 0.57 | 0.57 | 0.57 | |
| | Maximum Solar Heat Gain Coefficient (SHGC) ³ | NR | 0.40 | 0.40 | 0.25 | |
| | Maximum Total Area | 20% | 20% | 20% | 20% | |
| | Maximum West Facing Area | NR | 5% | NR | 5% | |
| THERMAL MASS ⁴ | | NR | NR | NR | NR | |
| SPACE-HEATING ^{5, 10} | Electric-resistant allowed | No | No | No | No | |
| | If gas, AFUE = | MIN ⁵ | MIN | MIN | MIN | |
| | If heat pump, HSPF ⁶ = | MIN ⁵ | MIN | MIN | MIN | |
| SPACE-COOLING | SEER = | MIN | MIN | MIN | MIN | |
| | If split system, Refrigerant charge measurement or charge indicator display ⁷ | NR | REQ | NR | NR | |
| Central Forced Air Handlers | Cooling Airflow and Watt Draw | NR | NR | NR | NR | |
| | Air Distribution System <u>Central Fan Integrated Ventilation System</u> Watt Draw | REQ ⁸ | REQ ⁸ | REQ ⁸ | REQ ⁸ | |
| DUCTS | Duct sealing | REQ | REQ | REQ | REQ | |
| | Duct Insulation | R-8 | R-6 | R-8 | R-6 | |
| WATER-HEATING | | | | | | |

Package E

Package E energy budget is equivalent to Package D; however, under this package it offers an energy equivalent prescriptive compliance method for metal frame fenestration products. It offsets the allowance of higher fenestration U-factors with other upgraded conservation features and compels the use of products with a structural rating not required by other compliance measures. The maximum fenestration U-factors of up to 0.57 are allowed in exchange for lower SHGC, higher duct insulation R-values, and higher AFUE or HSPF.

The background of the slide is an abstract composition of diagonal lines in various shades of blue, ranging from a deep navy blue on the left to a very light, almost white blue on the right. The lines are slightly blurred and overlap, creating a sense of depth and movement. The overall effect is clean and modern.

Mechanical

Mechanical

- Heating and cooling still to be determined using;
 - ASHRAE
 - SMACNA
 - ACCA Manual J
- Heating systems shall be equipped with thermostats capable of **four** setback time periods within 24 hours.

Mechanical

- **New mandatory feature Section 150 (o)**
 - Ventilation for Indoor Air Quality
 - ASHRAE Standard 62.2

- All dwelling units shall meet the requirements of ASHRAE 62.2.

Mechanical

- Requirements of 150 (o)
 - A whole building mechanical ventilation system.
 - Exception: Alterations and Additions 1,000 ft² or less.
 - Additions larger than 1,000 ft², application of 150 (o) shall be based on the conditioned floor area of the entire dwelling unit.
 - Kitchens and bathrooms shall have local (spot) exhaust systems vented to the outdoors.
- Ventilation air shall come from the outdoors.
- Wall and openings between the house and the garage shall be sealed.
- Mechanical systems for heating and cooling that supply air to habitable spaces shall have MERV 6 filters or better.

Mechanical

- MERV 6 (Minimum Efficiency Reporting Value)
- Range from 1 to 16
- High values can affect airflow
- Mandated for any HVAC system having >10' ductwork



Mechanical

- Kitchen Ventilation
 - Minimum 100 cfm range hood; or
 - Ceiling or wall mounted continuous or intermittent exhaust fan providing at least 5 air changes per hour.



300 CFM



160 CFM

Mechanical

Example for kitchen ceiling or wall fan:

A 12' x 18' kitchen with a ceiling height of 9' requires a continuous or intermittent fan capable of 162 CFM.

$$12 \times 18 \times 9 = 1,944\text{cu/ft} \times 5\text{ach} = 9720/60\text{min} = 162\text{cfm}$$

Mechanical



Panasonic In Line 240 CFM 1.4 Sone



Broan Ceiling 50 CFM <0.3 Sone



Panasonic Ceiling 190 CFM 1.3 Sone

Mechanical

- Bathroom Exhaust
 - Bathroom contains a tub, shower or similar source of moisture to be considered for local ventilation requirements. Powder room is not covered by these requirements, lighting requirements are still in effect.
 - Minimum ventilation rate of 50cfm.

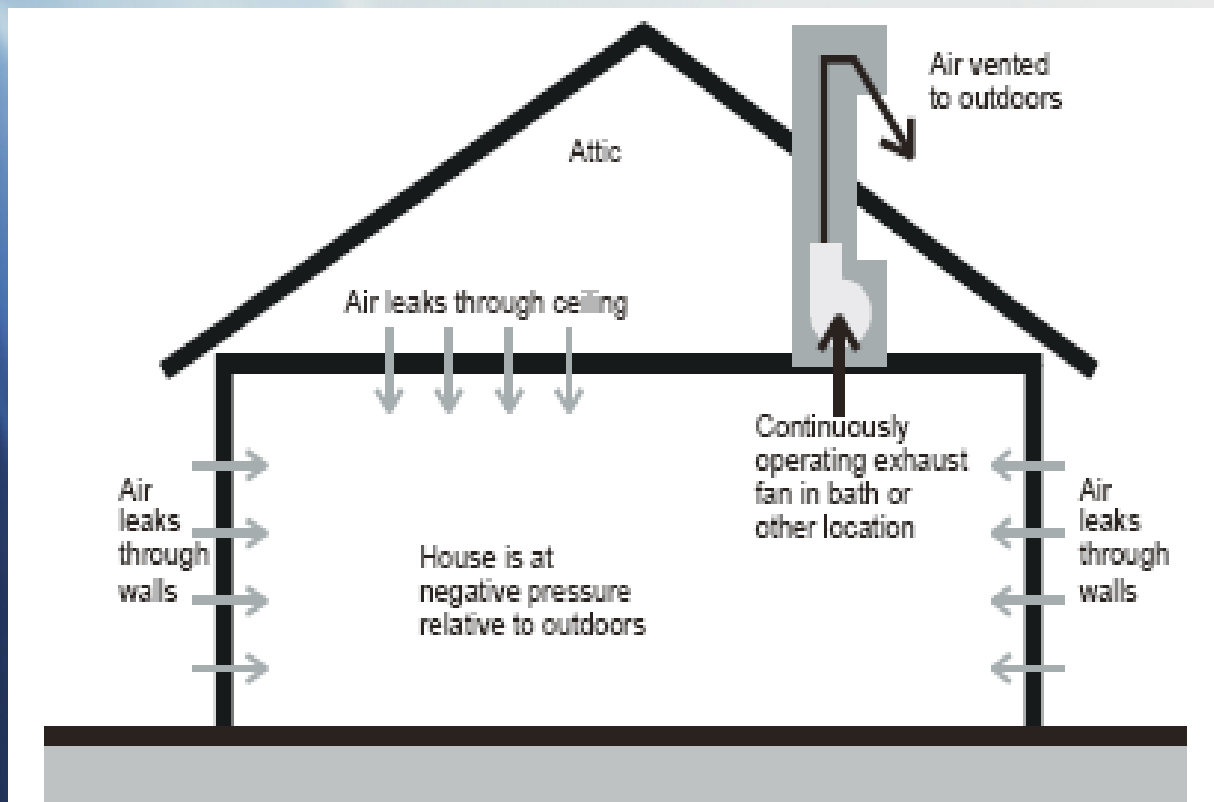


Mechanical

- Typical solutions for Whole Building Ventilation
 - Three generic solutions to meeting outside air requirement:
 - Exhaust ventilation,
 - Supply ventilation, or a
 - Combination of supply and exhaust ventilation.
- Whole building ventilation may be achieved through a single fan or a system of fans that are dedicated to this ventilation only. Or it may be carried out by fans that also provide local exhaust or distribute heating and cooling.

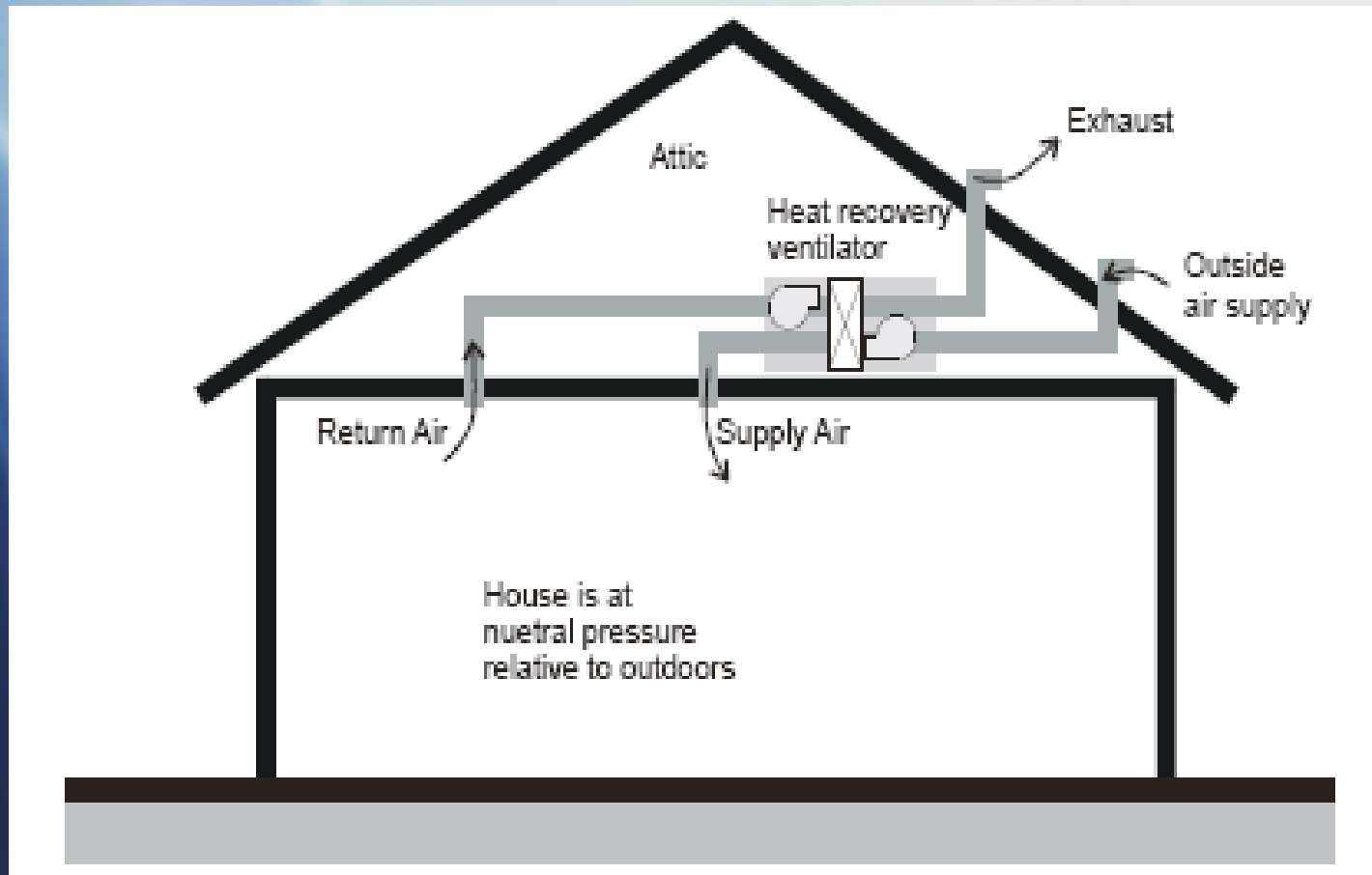
Mechanical

- Exhaust ventilation typically the most common.
- Ceiling mounted fan or inline fan.



Mechanical

- Combination ventilation



Mechanical

- Ventilation Flow Rate
 - Continuous Ventilation
 - **Ventilation rate (cfm) = CFA/100 + 7.5 x (number bedrooms + 1)**
 - **Example; 2,000 square foot 3 bedroom home.**
 $2000/100 = 20 + (7.5 \times 4) = 50$ cfm

or

| Floor Area (ft ²) | Bedrooms | | | | |
|-------------------------------|----------|-----|-----|-----|-----|
| | 0-1 | 2-3 | 4-5 | 6-7 | >7 |
| ≤1500 | 30 | 45 | 60 | 75 | 90 |
| 1501-3000 | 45 | 60 | 75 | 90 | 105 |
| 3001-4500 | 60 | 75 | 90 | 105 | 120 |
| 4501-6000 | 75 | 90 | 105 | 120 | 135 |
| 6001-7500 | 90 | 105 | 120 | 135 | 150 |
| >7500 | 105 | 120 | 135 | 150 | 165 |

Mechanical

- Intermittent Ventilation

- Most common example is when outside air is ducted to the return plenum and the central HVAC fan is used to provide ventilation.
- This is permitted as long as the ventilation air flow is increased to respond to the fewer hours of fan operation.
- Equation is $Q_f = Q_r / (ef)$
- Where
 - Q_f = fan flow rate
 - Q_r = ventilation air requirement (continuous)
 - e = ventilation effectiveness
 - f = fractional on - time

Mechanical

- Ventilation Effectiveness for Intermittent Fans

Table 4-8 – Ventilation Effectiveness for Intermittent Fans

| Daily Fractional Ontime, f | Ventilation Effectiveness, e |
|--|--------------------------------|
| $f \leq 35\%$ | 0.33 |
| $35\% \leq f < 60\%$ | 0.50 |
| $60\% \leq f < 80\%$ | 0.75 |
| $80\% \leq f$ | 1.0 |
| Fan runs at least once every three hours | 1.0 |

Mechanical

- Example of flow rate for Intermittent Fan
 - If the required ventilation rate is 50 cfm and the ventilation fan runs once every 3 hours for a total of 12 hours the flow rate would be –
 - Fractional on time is 50% and the effectiveness is 1.0
 - The fan size would be, $Q_f = 50 / (0.50 \times 1.0) = 100$ cfm

Mechanical

- Control Options
 - If a bathroom exhaust fan is used to provide the ventilation for a house, it may be controlled by a typical wall switch but the switch must be labeled to inform the occupant that it controls the whole house ventilation.
 - If the HVAC system provides intermittent ventilation it must be controlled by a timer in order to assure that adequate ventilation is provided.

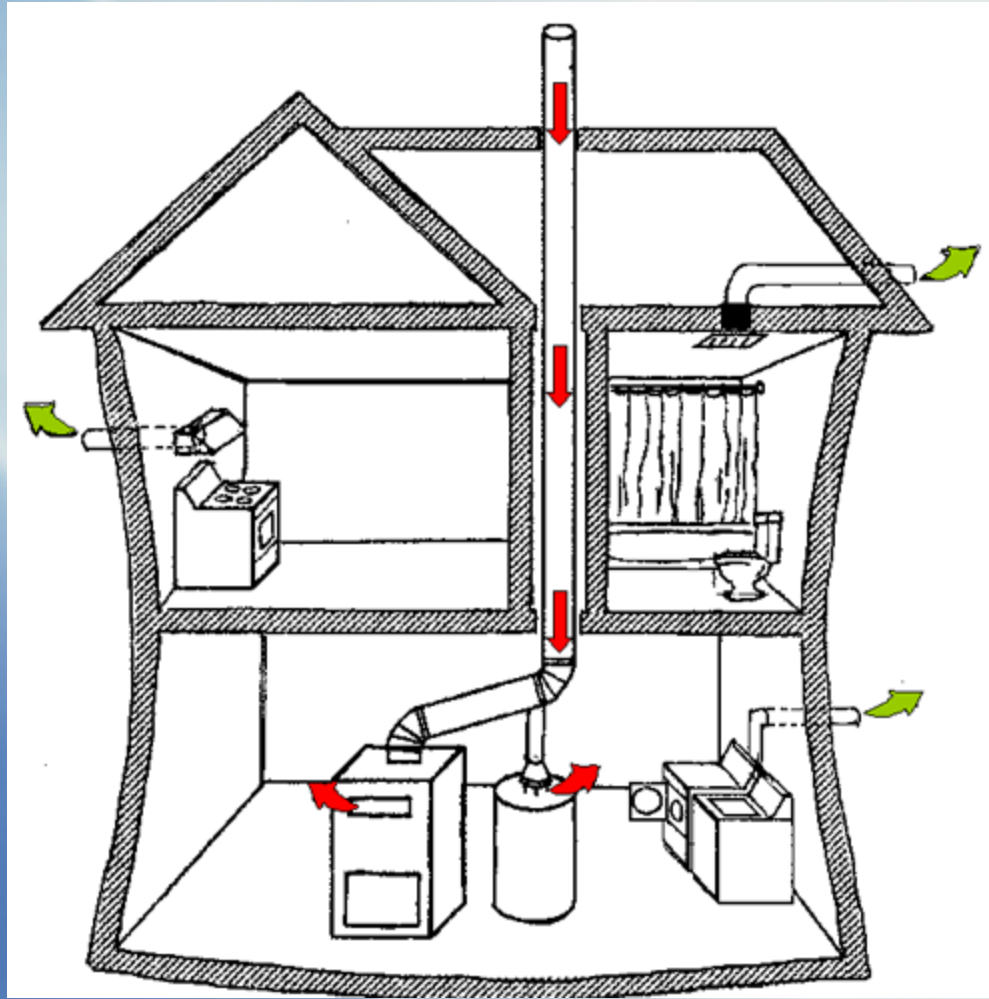
Mechanical

- Sound Ratings
 - Continuous Ventilation Fans – 1.0 Sone maximum
 - Intermittent Ventilation Fans – 3.0 Sone maximum
 - Unless the maximum rated airflow is greater than 400 cfm.
 - HVAC air handlers and remote mounted fans need not meet sound requirements. To be considered for this exception, a remote mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways, and there must be at least 4ft of ductwork between the fan and the intake grille.

Mechanical

- Attached Garages
 - The wall and or ceiling between the living space and garage shall be constructed to avoid air migration. (Sealed penetrations, caulked drywall to mudsill)
 - If an air handling unit (furnace) is located in the garage, or return ducts are located in the garage (regardless of the air handler location) the entire duct system must meet the sealed and tested ducts criteria. (6% Maximum leakage, HERS Rater)

Mechanical



Mechanical

- Backdrafting danger
 - If there are atmospherically vented combustion appliances in the conditioned space and the two largest exhaust fans have a combined capacity that exceeds 15cfm/100 ft² of floor area then an electrically interlocked makeup air fan must be installed so that the net exhaust is less than 15cfm/100 ft².
 - The two largest exhaust fans are normally the range hood and the clothes dryer (if located in the conditioned space).

Mechanical



GE Monogram



Maytag

Mechanical

- Backdrafting Example
 - 1,001 ft² addition making a 2,500 ft² home
 - Standard 75 gallon water heater and 80% efficient furnace located in hallway.
 - Range hood with 3 cfm levels (speeds) 1,200, 1,400, 1,600
 - Dryer with 150 cfm

$$2,500/100 = 25 \times 15 = 375\text{cfm max}$$

1,600 + 150 = 1,750 > 375 – Reduce exhaust cfm to level below 375 or add interconnected makeup air fan which in this case would be sized at 1,375. (1,750 – 375)