

# **Fort Collins Building & Zoning Dept.**

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## **2005 Fort Collins Residential Energy Code COMPLIANCE GUIDE** *Including Compliance Form & Insulation Guidelines*

Revised 10-18-2005

## **SELECT A COMPLIANCE PATH**

The home builder/designer selects one of three compliance path choices: (A) the “prescriptive” method, (B) the Total UA alternative method, or (C) the “Simulated Performance Alternative (SPA)” (energy rating) method. All paths require higher standards for electrically heated homes than for gas-heated homes. This guide is based on gas-heated homes. With the SPA rating choice, the applicant is eligible for a \$75 reduction in the building permit fee.

### **A - PRESCRIPTIVE PATH:**

This path specifies minimum insulation levels, air tightness, HVAC efficiencies and other criteria for the house.

**1. Permit Application.** Submit compliance form provided. The prescriptive form requires applicant to select of 1 of the 4 methods of compliance. Place a check next to the prescriptive box and then choose a method.

**2. Insulation Inspection** will be done by City staff based on the method chosen and the *FORT COLLINS INSULATION GUIDELINES* for general placement and quality. The compliance form must be on site at the time of inspection. Refer to the “List of prescriptive requirements” for further details.

**3. Air Tightness Requirements** are also required and can be met by either:

a) Prescriptive sealing according to the “*FORT COLLINS AIR SEALING CHECKLIST*”. It includes information on where and when to seal each building component, plus material recommendations and other suggestions; or,

b) By demonstrating that the completed building meets a specific air-tightness level via a “blower door” performance test.

**4. Disclosure Statements.** City disclosure forms signed by the insulation installer and the HVAC contractor must be received by the City prior to the Certificate of Occupancy.

### **B - TOTAL UA ALTERNATIVE PATH (REScheck):**

This path shows the total building thermal envelope UA is less than or equal to the total UA of the prescriptive U-values.

**1. Permit Application.** Applicant must submit a rating and compliance form with the building permit application. The REScheck program can be downloaded to a computer for free from [www.energycodes.gov](http://www.energycodes.gov). The user must input data about the house such as exterior wall area, roof area, insulation r-values and window u-values. When complete, **a passing score of 10% better than code** must be printed and included with the plans. For a given repeated (“stock”) plan, the rating must be based on the “worst case” configuration energy-wise.

**2. Insulation Inspection** will be done by City staff based on the rating and the *FORT COLLINS INSULATION GUIDELINES* for general placement and quality. The rating from plans must be on site at the time of inspection.

**3. Air Tightness Requirements** are also required and can be met by either:

a) Prescriptive sealing according to the “*FORT COLLINS AIR SEALING CHECKLIST*”. It includes information on where and when to seal each building component, plus material recommendations and other suggestions; or,

b) By demonstrating that the completed building meets a specific air-tightness level via a “blower door” performance test.

**4. Disclosure Statements.** City disclosure forms signed by the insulation installer and the HVAC contractor must be received by the City prior to the Certificate of Occupancy.

## **C - SIMULATED PERFORMANCE ALTERNATIVE PATH (SPA):**

The SPA or “ENERGY rating” approach offers ultimate flexibility by allowing trade-offs and variability among most energy components using a computer model. If the projected average annual energy use does not exceed that of the same house built to prescriptive path standards, the proposed house will comply. Certified private “raters” are required to verify compliance from plans and again when the building is completed. A home energy rating from a nationally accredited home energy rating program is necessary. The National Association of State Energy Officials has adopted a national accreditation standard for **Home Energy Rating Systems (HERS)**. These standards and raters are available on the RESNET web site. Three current SPA energy rating systems are E-STAR of Colorado, Builtwright, and Energysmiths. These rating systems are eligible for a \$75 REDUCTION in the building permit fee. The energy rating option provides home buyers a means to qualify for an Energy Efficient Mortgage, which typically allows an additional “stretch” in the qualifying ratios.

**1. Permit Application.** Applicant must submit a preliminary rating completed and signed by a certified SPA rater with the building permit application. This rating is also required to qualify for the fee reduction. For a given repeated (“stock”) plan, the rating must be based on the “worst case” configuration energy-wise.

**2. Insulation Inspection.** During construction a City inspector performs an insulation inspection prior to wallboard installation. But, unlike the extensive list of items inspected by the City under the prescriptive compliance option, many of these items are already taken into account through the rating process. SPA rated houses do not need to adhere to the “Air Sealing Checklist” as do homes built to the Prescriptive and UA standards. The preliminary rating from plans must be on site at the time of inspection.

**3. Disclosure Statements.** City disclosure forms signed by the insulation installer and the HVAC contractor must be received by the City prior to the Certificate of Occupancy.

**4. The Final Rating.** When the home is completed, the rater does a final check to verify the energy-saving features previously agreed to are installed. A final rating completed and signed by the certified rater meeting the minimum passing score of 84 must be received by the City for the C.O. to be issued.

## 2005 Fort Collins Residential Energy Code ***LIST OF PRESCRIPTIVE REQUIREMENTS***

Revised 10-18-2005

This list represents the prescriptive requirements outlined in the 2005 Fort Collins Energy Conservation Code, and supplemented by various other documents referenced below. Contact Fort Collins Building and Zoning Department for more information at: (970 221-6760).

### ***A. INSULATION – General Requirements***

- Prescriptive insulation requirements (R-values or U-values) are spelled out for each component below -- in some cases there is more than one option.
- The *INSULATION GUIDELINES* lists detailed installation requirements, both general and for specific building components.
- An insulation disclosure form must be completed and submitted prior to a Certificate of Occupancy (C. O.), listing insulation materials that were installed and stating that installation was in accordance with the *Insulation Guidelines*.

## **B. AIR SEALING – General Requirements**

- Two options: air sealing checklist or blower door test.
- The *AIR SEALING CHECKLIST* describes prescriptive air sealing requirements.
- Blower door test performance standard: ACH50 = 5.0 on completed home.
- An Air Sealing disclosure form must be completed and submitted prior to a C.O., for either option.

## **C. SPECIFIC REQUIREMENTS BY BUILDING ELEMENT**

### **1. Basement**

- a) Wall insulation required, interior or exterior.
  - 1) Interior insulation: R-13 from top of wall to floor, must be covered with gypsumboard or approved durable material.
  - 2) Exterior insulation
    - R-10 from top of wall to at least 48" below grade.
    - Protect above grade portion from the weather (to 6" below grade).
    - Insulate full perimeter, including areas adjacent to exterior concrete slabs (patio, garage, walks).
- b) Air sealing
  - 1) Mud sill to foundation.
  - 2) Penetrations through foundation and rim joists.
  - 3) Sump

### **2. Crawl space: Two crawl space options: "warm" or "cold."**

- a) Warm crawl space.
  - 1) Insulation
    - R-19 perimeter insulation.
    - Insulate from top of foundation wall at least to interior grade (if interior grade is less than 12" below exterior grade, requirement changes).
    - Insulation full loft, in contact with wall, no gaps between batts.
    - No insulation required on ducts or pipes or floor above.
  - 2) Ventilation
    - Ventilated by Mechanical means or conditioned with heat..
    - Ducts are required to be sealed.
  - 3) Vapor Retarder on crawl space floor.
    - Membrane material of 10 mil, 6 mil Cross-linked or reinforced polyethylene.
    - Overlap seams 12".
- b) Cold crawl space
  - 1) Insulated and air sealed at floor above and any walls to conditioned space.
    - Floor above: R-30 or R-19 per compliance form.
    - Baffle vents so they don't channel air into insulation.
    - Walls to conditioned space must meet wall insulation requirements.
    - Insulate ducts (R-6) and pipes in the crawl space.
  - 2) Air sealing
    - Seal all penetrations between crawl space and conditioned space.
    - Seal ducts using mastic and mesh or other approved material.
  - 3) Ventilation
    - Provide openings to exterior of 1/1500 floor area of opening size for cross ventilation.
  - 4) Moisture barrier on crawl space floor
    - 1.0 perm rating (6 mil poly typical).
    - Overlap seams 12".

### **3. Slab-on-grade: (any slab 0-12" below grade -- including shallow portions of walkout basements)**

- a) Full perimeter edge insulation required.

- b) Including thermal breaks between conditioned and unconditioned slabs (interior slab to garage slab).
- c) Interior or exterior insulation permitted.
- d) Insulation R-value and depth requirements -- several options:

SLAB HEATING	R-VALUE	DEPTH BELOW GRADE
NO	R-10	24"
YES	R-15	24"
NO	R-10	48"
YES	R-15	48"

- e) Interior insulation
  - 1) Insulate in any horizontal or vertical combination, provided slab edge has thermal break.
  - 2) Pressure treated 2x nailer is permitted at slab surface to attach floor covering.
- f) Exterior insulation
  - 1) Insulate in any horizontal or vertical combination, provided slab edge has thermal break.
  - 2) Securely fasten insulation to prevent it from moving over time.
  - 3) Protect above grade portion from the weather.
  - 4) Frost-protected shallow foundation permitted.

#### 4. *Frame floors*

- a) Insulation
  - 1) R-30 or R-19, per compliance form.
- b) 2. Installation requirements
  - 1) Insulation in contact with floor above.
  - 2) Adequate, permanent support using approved methods.
  - 3) Pipes: 2/3 of insulation below.
  - 4) Ducts: seal and insulate (R-6).
- c) Air sealing
  - 1) Cantilevers and floors over garages
  - 2) Block and seal joist cavities, with air-seal material at interior edge of supporting plate.
  - 3) Seal penetrations through subfloor and blocking.
  - 4) Insulate ducts and pipes.
  - 5) Air seal ducts using mastic or other approved materials.
- d) Tubs over unconditioned space
  - 1) Air seal plumbing penetrations through floor.

#### 5. *Walls*

- a) Insulation
  - 1) R-value requirements based on method per compliance form.
- b) Installation requirements
  - 1) Guidelines apply to all walls, including walls to garage, skylight wells, knee walls, etc.
  - 2) Care required in filling cavities completely, including in non-standard width cavities, where obstructions are present, and cavities that will be inaccessible from the interior after exterior sheathing is installed.
  - 3) Insulation on unsheathed walls must have adequate, permanent support.
  - 4) Full R-value behind all building cavities on insulated walls (tub and shower enclosures, fireplaces, soffits, chases, etc.).
- c) Air sealing -- checklist includes requirements for
  - 1) Subfloor to top of rim joist.
  - 2) Bottom plate to subfloor.
  - 3) Plate penetrations between conditioned and unconditioned spaces.
  - 4) All rim joists: seal subfloor to rim joist.
  - 5) Floor cavity used for HVAC return: seal perimeter to reduce connection to outside.
  - 6) Windows and doors.
  - 7) Knee walls, split levels, partition wall intersections.
  - 8) Tub and shower enclosures, and fireplaces.

#### 6. *Windows, doors, skylights*

- a) U-value
  - 1) Windows: U-.35 or better.
  - 2) Exterior Doors: foam core required.
  - 3) Skylights: U-.60 or better.
- b) Air sealing: Seal opening frames effectively to framing and drywall.

## 7. Ceilings/roofs

- a) Insulation
  - 1) Ceilings with attics: R-38 (Flat and scissor truss).
  - 2) Rafter cavity (no attic): R-30.
  - 3) Installation and venting requirements
    - Eaves: R-18 above outer edge of exterior wall top plate.
      - 1" vent space and baffle requirements.
    - Recessed lighting: full insulation (exception: R10 if < 1% of ceiling area).
    - Attic hatch: R-38 insulation, 16" curb.
    - Whole house fan: insulating cover, R-4 minimum, provided to homeowner with instructions.
- b) Air sealing
  - 1) Recessed lights: must be airtight units or boxed in and air-sealed.
  - 2) Attic hatch: weather-stripped.
  - 3) Whole house fan: air sealing cover provided to homeowner with instructions.
  - 4) Soffits, chases, dropped ceilings air sealed at insulation boundary.
  - 5) Flue and plumbing penetrations sealed.

## 8. Mechanical equipment

- a) Equipment: AFUE 80% or 90% per form.
  - 1) All equipment installed in accordance with manufacturer's instructions.
  - 2) Water heater piping heat loss prevention: Install Heat trap or 1" pipe insulation on first 8' of piping.
- b) Ductwork
  - 1) Ducts meet 2003 IMC requirements.
  - 2) Ducts: Insulated R-6/R-8 in unconditioned spaces sealed with mastic or other approved materials.
  - 3) Seal rim joists where floor cavities used as return ducts.
  - 4) Seal wall cavities used as return ducts.
- c) Boiler piping in unconditioned space insulated with 1" of insulation.
- d) Mechanical systems disclosure form must be completed and submitted prior to a C.O.. It lists installed equipment and states that installation was in accordance with code requirements.

# 2005 Fort Collins Residential Energy Code Insulation Guidelines

Revised 10-18-2005

## 1.0 Introduction

These guidelines are the "how-to" part to the insulation requirements in the energy code. They contain details about specific applications and installation methods for achieving compliance. The goal is to improve housing quality by ensuring that the insulation will perform as closely as possible to its rated R-value through better attention to detail. Small defects in insulation can significantly degrade overall home energy efficiency. The result is increased utility costs and comfort and moisture problems throughout the life of a home. When building a home that will last for 50 or more years, it simply makes economic sense for everyone to ensure the insulation is properly installed -- during construction. Correcting mistakes after the fact is seldom feasible.

## 2.0 General requirements

2.1 All insulation materials must be installed to achieve proper densities, to avoid compression and voids, and to attain and maintain specified R-values.

2.2 Insulation must extend over the full component area to the intended R-value.

2.3 Insulation must be in substantial contact with the warm surface across the entire area being insulated.

2.4 Batt and blanket insulation must:

- a. Attain specified loft across the entire batt.
- b. Have no voids, including at edges or around obstructions such as electrical, plumbing, ductwork, etc.
- c. Be cut to fit, without compression, around plumbing, electrical, ductwork and other obstructions located in the insulated bay.
- d. Be installed in a manner which will permit inspection of the manufacturer's R-value identification mark.

2.5 Blown or sprayed insulation must:

- a. Be installed in accordance with manufacturer's instructions (density, moisture content, adhesive content, settling allowance, etc.).
- b. Have no voids, including at edges or around obstructions such as electrical, plumbing, ductwork, etc.

### 3.0 Frame walls

3.1 All walls to exterior and unconditioned space must be insulated to meet the R-values specified on the plan, including:

- a. Walls to the exterior.
- b. Walls to attic space (split level, knee walls in 1-1/2 story construction, walls to intermediate roofs, knee walls where vaulted space adjoins flat ceiling space, etc.).
- c. Walls to garage.
- d. Walls to vented ("cold") crawl spaces that have no perimeter wall insulation.
- e. Walls of skylight wells.
- f. Wall for dormers.
- g. Walls with non-standard width stud cavities.
- h. Wall cavities formed by corner framing.
- i. Wall cavities formed by framing where partition walls intersect exterior walls.
- j. Walls forming bay / bow windows, window seats, "garden" windows.

3.2 Prior to exterior sheathing being installed, all wall cavities that will be inaccessible for insulation from the interior must be insulated.

3.3 Insulation on unsheathed walls must be adequately and permanently supported.

3.4 Batt and blanket insulation must fill wall cavities completely, with attention to the following:

- a. Must be installed to full loft with no compression. (Exception: If faced-batts are inset stapled, compression of the batt shall be limited to a vertical channel immediately adjacent to the studs.)
- b. Must be cut to correct length and installed with no voids at top, bottom, sides.
- c. Must be carefully cut or split to fit snugly, without compression or voids, around obstructions such as wiring, plumbing, and outlet boxes.
- d. Must contact sheathing and drywall uniformly.
- e. Unfaced batts must protrude slightly from the stud bay prior to drywall installation -- across the entire batt including all edges.

3.5 Blown or sprayed insulation must:

- a. Must be installed so that all cavities are completely filled with no voids.
- b. Must be installed following manufacturer's instructions (density, moisture content, etc.).

3.6 Where obstructions are present:

- a. Full insulation value must be provided behind electrical boxes and other recessed fixtures, using rigid foam insulation if necessary.
- b. Full insulation value must be provided on the exterior of HVAC ducts located in insulated walls.
- c. Full R-value must be provided behind all building cavities on insulated walls (bathtubs, shower enclosures, fireplaces, drop ceilings and soffits, etc.).

3.7 Attic and crawl space access doors must be insulated to the required R-value of the wall in which they located with the insulation permanently attached to the door or cover.

#### 4.0 Rim and band joists

##### 4.1 Batts:

- a. Insulation must be cut to fit snugly against all edges.
- b. Insulation must be installed to achieve uniform, full loft.
- c. Insulation must not be stapled directly through the insulation, causing compression.

##### 4.2 Blown or sprayed insulation must:

- a. Be installed so that all cavities are completely filled with no voids.
- b. Be installed following manufacturer's instructions (density, moisture content, etc.).

##### 4.3 In a "cold" crawl space with vents installed in the rim joist, permanent baffles must be installed to direct airflow into the crawl space and not into the insulation.

#### 5.0 Ceilings / roofs

##### 5.1 Insulation must be installed to manufacturer's specified density and thickness to attain required R-values.

##### 5.2 Insulation must be distributed evenly across the entire ceiling, with the following exceptions:

- a. For attic space in which the insulatable space at the edge of the ceiling/roof is restricted, ceiling/roof insulation R-value may be reduced to the extent necessary due to roof slope and ventilation clearances; provided that the R-value installed directly above the outer surface of the exterior wall must be no less than **R-15**.
- b. Whole house fans must be provided with a sealed, insulated cover for winter use that achieves a minimum **R-4** rating and is accompanied with instructions for the user.

##### 5.3 Attic access openings must be provided with the following:

- a. An attic hatch with permanently attached insulation rated at **R-38** or higher.
- b. A curb of a rigid, durable material (not cardboard), with a minimum height of 16 inches and not less than the insulation depth located at the attic access to accommodate full depth attic insulation adjacent to the opening..

##### 5.4 Full insulation must be installed over recessed lighting. Exception: When such lighting comprises less than 1% of the total roof area, a minimum of **R-10** insulation must be over the fixtures. Where "I. C." rated fixtures are not used, covers shall be used to support insulation over such fixtures in accordance with their listings.

##### 5.5 Insulation must be installed around chimneys and flues as required by the Building Code for clearances.

##### 5.6 Where soffit vents are used for attic ventilation, the following conditions must be met:

- a. Insulation baffles must be installed next to all soffit vents to maintain a 1" ventilation path between the baffle and the roof sheathing and to prevent blowing of insulation or air intrusion underneath the insulation.
- b. Baffles must be installed so that insulation requirements are met over the exterior wall.
- c. Baffles must extend parallel to the roof sheathing to at least to a point 6" vertically above non-compressed batt insulation, or 12" vertically above full depth blown insulation.
- d. Baffles shall be of weather resistant materials.

##### 5.7 For blown or sprayed insulation, thickness markers, labeled in inches, shall be installed at least one for every 300 square feet through the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness and minimum settled thickness of the insulation. Each marker shall face the attic access with numbers a minimum of 1" in height.

#### 6.0 Frame Floors

##### 6.1 Insulation must be in substantial contact with the floor surface above, with no air space between insulation and floor.

##### 6.2 Insulation must be permanently supported to attain full loft without compression, using one of the following acceptable means of support, spaced no more than 24" apart: polyethylene twine, lath, chicken wire, other approved methods (lightning arrestors are not approved).

##### 6.3 Batt insulation must:

- a. Be cut to fit snugly, without compression, around obstructions such as wiring, plumbing, and duct runs.
- b. Be installed with no voids at sides or ends.

##### 6.4 Duct runs through insulated joist cavities must be insulated to a minimum of **R-6** on the cold side.

##### 6.5 Pipe runs through insulated joist cavities must be insulated by at least 2/3 of the required floor R-value on the cold side.

##### 6.6 In cantilever floors and floors extending over unconditioned spaces, insulation must extend from the outer edge of the floor to blocking on the inside edge of the supporting wall top plate.

6.7 In an insulated floor over a vented crawl space, insulation must be installed so as to not block crawl space vents. Where vents are installed in the rim joist, permanent baffles must be installed to direct airflow into the crawl space and not into the insulation.

### **7.0 Slab floors**

7.1 The insulation requirement applies to:

- a. Slabs that are on-grade or less than 12" below grade.
- b. Shallow portions of slabs for which the depth below grade varies (daylight portion of a walkout basement).
- c. The interface between a slab under conditioned space and an adjoining "cold" slabs (garage, patio, etc.)

7.2 Insulation must extend from the surface of the slab to the required depth vertically or in an equivalent vertical and horizontal combination.

7.3 Insulation materials suitable for long term exposure to soil/moisture without degradation of thermal properties.

7.4 The insulation material must be permanently protected from degradation by the sun and weather in accordance with manufacturer's instructions.

### **8.0 Crawl space perimeter walls**

8.1 Batt insulation must be installed to attain full loft everywhere (including at the rim joist).

8.2 There must be no voids between adjoining pieces of insulation.

8.3 Insulation must be in substantial contact with wall surface, with no air space between the insulation and wall.

8.4 Insulation shall be permanently attached.

8.5 Insulation shall extend from the top of the foundation wall to at least the interior grade. If the interior grade is less than 12" below the exterior finished grade, the insulation shall continue out onto the crawl space floor so that the total vertical and horizontal distance from exterior finished grade is a minimum of 24".

### **9.0 Basement walls**

9.1 Interior insulation must extend from the top of the foundation wall to the basement floor and be covered with ½" gypsum board or similar approved durable fire-rated material. Acceptable methods include:

- a. Stud wall, cavity insulation, vapor barrier, drywall (taping/finishing not required if basement is not being finished as living space).
- b. R-10 rigid insulation covered with ½" gypsum board or similar approved durable fire-rated material.
- c. Other approved methods.

Note: Insulation installed in a stud wall must meet all requirements for insulating frame walls.

9.2 Exterior insulation must:

- a. Extend from the top of the foundation wall to total a minimum of 48" vertically or in an equivalent vertical and horizontal combination. The below grade extent shall not be less than 42".
- b. Be installed between the basement wall and adjoining slabs (garage, patio, etc.)
- c. Be firmly and permanently attached to the foundation such that it will not be moved by later back-filling or soil settling.
- d. Be suitable for long term exposure to soil and moisture without degradation of thermal properties.
- e. Insulation above grade shall be protected from exposure to physical damage and from deterioration by the sun and the elements in accordance with manufacturer's instructions.

# 2005 FORT COLLINS RESIDENTIAL ENERGY CODE COMPLIANCE FORM

updated 3-18-05

Permit Number:
Address:

**DIRECTIONS:** Place a check next to Prescriptive, UA, or SPA indicating the path chosen. Next, circle the method within that path you intend to follow. If choosing prescriptive or UA, the applicant must also choose between an Air sealing checklist or Blower Door Test.

<b>(A)PRESCRIPTIVE</b> compliance for house with natural gas heating and wood framing, N1111.1				
	<b>Insulation R-value</b>			
	Standard HVAC equipment, (80% AFUE)		High efficiency HVAC equipment (90% AFUE)	
	<b>Method 1</b> 2x6 Walls	<b>Method 2</b> 2x4 Walls	<b>Method 3</b> 2x6 Walls	<b>Method 4</b> 2x4 Walls
Exterior walls above grade (frame)	18	15	18	15
Exterior insulated sheathing	-	3	-	-
Ceiling/attic	38	38	38	38
Crawl space walls	19	19	19	19
Basement walls (frame/continuous)	13/10	13/10	-	13/10
Floor over un-cond space	30	30	19	19

<b>(B)TOTAL UA ALTERNATIVE, (REScheck) SECTION N1111.5</b>
REScheck must show a passing score of 10% better than code minimum. Submit calculations demonstrating equivalency to one of the prescriptive methods above. The rating must be submitted at time of application and must include Address of residence; Name of individual completing the rating form; Name & version of software tool. Air Sealing Checklist or Blower Door Test is required.

**Circle one:      Air Sealing Checklist      Blower Door Test**

<b>(C)SIMULATED PERFORMANCE ALTERNATIVE, SECTION N1113</b>
<b>Current accredited programs: E-star of Colorado, Energy Smiths, Builtwright</b>
HERS accredited energy rating system. List company/program. Must submit score of 84 minimum. A preliminary rating must be submitted at time of application and must include Address of residence; Name of individual completing the rating/compliance form; Name & version of software tool. Final rating requires a blower door test.

SIGN:	DATE:
CONTRACTOR:	PHONE: