

# Residential New Construction Simulated Performance Alternative Guide

City of Fort Collins Building Services  
Fort Collins Utilities

## **What This Guide Is . . . and Is Not**

This guide provides information regarding successful use of the Simulated Performance Alternative (SPA) path to document compliance with the City of Fort Collins' residential energy code.

This guide does not include all the details you need to know to complete the SPA path, to obtain Residential Energy Services Network (RESNET) certification or to operate energy modeling software. For those details, you must consult the referenced procedures or organizations, seek specialized training and/or technical support.

This guide may periodically be updated with additional information as needed. Users are encouraged to direct questions and/or provide suggestions for improvement to:

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## **Acknowledgements**

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## **1.0 Simulated Performance Alternative Path**

Three paths are available to document compliance with the City's energy code requirements: prescriptive (2009 IRC Chapter 11 or 2009 IECC Chapter 4), Total UA Alternative (2009 IECC Section 402.1.4) or SPA (2009 IECC Section 405). Builders must declare at time of building permit application which path they plan to follow and submit supporting documentation. The SPA path offers the most flexibility in energy efficiency choices, while producing a building that performs at least as well as a comparable building built to prescriptive path specifications.

### **1.1 SPA Path**

To pass code, the "Proposed Design" must have a projected annual energy cost – for space heating, space cooling and service water heating – less than or equal to the "Standard Reference Design." The comparison is performed using approved energy modeling software (2.1 below). 2009 IECC Table 405.5.2(1) lists many of the details about how to perform the comparison. This guide clarifies SPA path specifics for City of Fort Collins.

Review Section 405 for other general requirements of the SPA path. Homes complying under ANY of the energy code paths must comply with all Mandatory code provisions.

## 1.2 Fort Collins Amendments

Effective January 1, 2012, several local amendments to the 2009 IECC affect the SPA path:

- Section 402.1.1. More stringent insulation and fenestration requirements for electric-heat homes:

| Heating system type* | Fenestration U-Factor | Ceiling R-Value | Basement + Crawl Space Wall R-Value | Slab R-Value + Depth |
|----------------------|-----------------------|-----------------|-------------------------------------|----------------------|
| Non-electric         | 0.35                  | 38              | 10/13                               | 10, 2 ft             |
| <b>Electric</b>      | <b>0.30</b>           | <b>49</b>       | <b>15/19</b>                        | <b>10, 4 ft</b>      |

\* Electric heat: all primary electric heating systems including most heat pumps.

Non-electric heat: all primary gas-fired heating systems and ground-source electric heat pumps designed by a licensed professional engineer to operate without the use of supplemental electric resistance heat.

- Section 402.2.12. Insulation installed to RESNET Grade I standards.  
EXCEPTION: Grade II is acceptable for cavity insulation in exterior walls that include continuous rigid insulating sheathing and/or insulated siding with a minimum R-value of 5; and rim joists.
- Section 402.4.2.1. Maximum whole-house air leakage requirements = 4.0 ACH50 for non-electric-heat homes, 3.0 ACH50 for electric-heat homes.
- Section 402.5. Maximum window U-factor = 0.40.
- Section 403.6. Heating and cooling systems design and testing requirements per IRC amendments.

## 1.3 Approved SPA Software and Custom Fort Collins Report

The currently approved energy modeling software for SPA compliance is the most current version of REM/Rate™ published by Architectural Energy Corporation (AEC).

Submit the custom REM/Rate report reflecting local amendments: “Fort Collins 2012 Annual Energy Cost Compliance.” Either a “Non-Electric Heat” or “Electric Heat” version is generated based on the designated heating system (as defined in the code amendments, see 1.2 above).

Those wishing to use other software must submit details to the Building Department for review.

## 1.4 Rater Credentials

SPA submittals must be prepared by individuals holding a current RESNET “Home Energy Rating System Rater” certification ([www.resnet.us/professional/energy-rater](http://www.resnet.us/professional/energy-rater)).

## 1.5 Inspection and Testing Responsibilities

The energy rater shall perform inspections and testing as the home is built, including:

- Foundation stage
  - Inspect: Slab edge insulation
  - Inspect: Exterior crawl space and basement insulation
- Rough framing stage
  - Inspect: conformity/changes from architectural plans
  - Inspect: framing details affecting thermal boundary location

- Rough mechanical stage
  - Optional test: total duct leakage (alternative: test at completion)
- Insulation stage
  - Inspect: R-values of all installed insulation
  - Inspect: Insulation installation per RESNET grading standards (including air barrier alignment and encapsulation)
  - Inspect: Air-sealing details
  - Inspect: NRFC U-Factor and SHGC ratings for all windows, skylights, doors
  - Inspect: Ductwork location relative to thermal boundary
- Completed home
  - Inspect: R-value and installation grade of any insulation installed since the insulation inspection
  - Inspect: Crawl space interior height
  - Inspect: Foundation height with respect to finished grade
  - Test: Whole-house air leakage
  - Test: Duct leakage to outside
  - Inspect: Mechanical equipment manufacturer and model #

## 2.0 SPA Data Requirements

### 2.1 Weather Data

Select the “Fort Collins, CO” weather file in REM/Rate.

### 2.2 Approved Utility Rates

The following approved utility rates shall be entered in the modeling software for ratings for any home for which a lot-specific permit application is submitted in 2013.

- Electricity: \$5/month + \$0.09/kWh
- Gas: \$12/month + \$0.65/therm

Utility Name:

Fuel Type:

Seasons

| Start | Through |
|-------|---------|
| Jan   | Dec     |

Add Delete

Start Month:  End Month:

Rates for Selected Season

Service Charge (\$/Month):

| Min | Max     | Rate   |
|-----|---------|--------|
| 0   | 1000000 | 0.0900 |

Add Delete

Block Range:  to

Rate (\$/kWh):

Utility Name:

Fuel Type:

Seasons

| Start | Through |
|-------|---------|
| Jan   | Dec     |

Add Delete

Start Month:  End Month:

Rates for Selected Season

Service Charge (\$/Month):

| Min | Max     | Rate   |
|-----|---------|--------|
| 0   | 1000000 | 0.6500 |

Add Delete

Block Range:  to

Rate (\$/Therms):

Approved rates will typically be annually updated on January 1. It is the energy rater’s responsibility to use approved utility rates. As noted below, the energy rater will document the utility rates used for each submitted rating.

## 2.3 Thermal Envelope

The energy rater and builder must agree on the boundary of the thermal envelope and which spaces are considered “inside” versus “outside.”

## 2.4 Conditioned Floor Area

Conditioned Floor Area (CFA) must be calculated per RESNET “Mortgage Industry National Home Energy Rating Standards.” Reminders:

- Calculate floor areas using exterior dimensions.
- Include the area of all floors within the thermal envelope. Specifically, for areas that sometimes cause confusion:
  - INclude all conditioned basement floor area, regardless of whether the basement is finished, unfinished or a combination.
  - INclude floor area of unfinished spaces within the thermal envelope, such as “bonus rooms” (Fort Collins requires bonus rooms to be insulated).
  - EXclude crawl space floor area, even for sealed, conditioned crawl spaces.
  - EXclude unconditioned basement floor area (very uncommon).
- Do not count area of an imaginary upper level floor in rooms with two-story ceilings.

## 2.5 Conditioned Volume

Conditioned volume for each portion of the building is calculated by multiplying the appropriate CFA by the corresponding average interior ceiling height. Specific details:

- Include the basement volume, regardless of whether the basement is finished, unfinished or a combination. EXCEPTION: EXclude unconditioned basement floor area (very uncommon).
- INclude the crawl space volume for typical sealed, “conditioned” crawl spaces. If the building plans do not label crawl space vertical dimensions, for “Projected” ratings calculate volume assuming 4’ interior height. For “Confirmed” ratings, update using as-built height.
- EXclude crawl space volume for:
  - Vented, unconditioned crawl spaces (very uncommon).
  - “Deep” crawl spaces under below-grade structural basement floors.
- INclude the volume of unfinished spaces within the thermal envelope, such as “bonus rooms.”
- INclude the volumes of floor joist cavities between conditioned levels, typically using a height of one foot. The volume of the floor joist cavity for conditioned space over a garage may be included or excluded at the energy rater’s discretion.

## 2.6 Insulation Grade

For all insulation specifications, enter installation grade based on local amendment 2009 IECC Section 402.2.12 (see 2.1 above) and site inspections.

## 2.7 Crawl Spaces

- For the typical sealed, “conditioned” crawl space, enter a “slab floor” to account for heat loss through the crawl space floor.
- If the building plans do not label crawl space vertical dimensions:
  - For “Projected” ratings, enter crawl space walls and floor depth below grade assuming 4’ interior height and 0.5’ wall exposure above grade.
  - For “Confirmed” ratings, update data for these components to as-built dimensions.

## 2.8 Rim Joist Area

Follow REM/Rate Help screen instructions regarding which rim joists to include in your inputs.

## 2.9 Window Shading

- Window shading by exterior overhangs must be modeled.
- Adjacent shading
  - Choose “Most” for winter and summer shading for basement windows set in typical, code-minimum window wells.
  - Base decisions about other adjacent shading on the building plan.

## 2.10 Attic Insulation

Attic insulation is typically blown on the attic floor, with a layer between 2x4 truss bottom chords and the remainder covering the bottom chords. Model specifications should reflect this as a combination of cavity insulation and continuous insulation. Insulation R-value may be reduced for eave areas at the rater’s discretion.

## 2.11 Ductwork

- Ductwork location. With respect to the thermal boundary, ducts can be located inside, outside or a combination. Sometimes the location is obvious, in others it is not. Fort Collins Building Services has published details that, when followed, will classify ductwork in several of these less-obvious cases – exterior walls, floors over garages, soffits adjacent to garages, cantilevers – as inside the thermal boundary. For “Projected” ratings, energy raters should model ductwork in accordance with builder specifications. For “Confirmed” ratings, model as-built duct locations.
- Duct leakage. The testing requirements and REM/Rate specification of duct leakage depends upon the ductwork location. Duct leakage only affects the energy rating results and code compliance PASS/FAIL decision when leakage to outside is specified.
  - For ductwork clearly 100% within the thermal boundary, the code does not require duct leakage measurement. Duct leakage to outside can be assumed to be zero and entered as zero in a “Projected” rating (Option: check the “Exemption – No Test Required” box). In the absence of testing, the energy rater may also enter zero leakage to outside in a “Confirmed” rating.
  - If any ductwork is located outside the thermal boundary, for a “Projected” rating the energy rater must enter an estimate of duct leakage to outside. By default, enter the code-maximum duct leakage to outside = 8 cfm per 100 sf of conditioned floor area. If the builder has data that suggests a significantly lower leakage rate is liable to be achieved in the completed home, the builder can direct the rater to enter a lower leakage rate. Duct leakage to outside must be measured in the completed building and the result reflected in the “Confirmed” rating.
  - (Note: some additional details may come into play when duct leakage in individual multifamily dwelling units is tested; refer to Chapter 8 of the RESNET standard and discuss with the contacts listed in the beginning of this guide.)
- Ductwork conductive losses. When any ductwork is outside the thermal boundary:
  - Choose corresponding inputs in REM/Rate’s “Duct Locations” section (percentage in different types of thermal locations and corresponding duct insulation R-values).
  - Enter Duct Surface Area. Unless more detailed data is available, enter the area served (for one-system houses, typically the Conditioned Floor Area), the number of return grilles (for “Projected” ratings, estimate based on builder typical practice; for “Confirmed” ratings, update to as-built) and use REM/Rate’s “Estimate Surface Area” button.

## **2.12 Whole-House Infiltration**

- For “Projected” ratings, by default enter the maximum allowable air leakage rate based on heating system type (see 1.2 above). A lower rate may be entered if the builder has data suggesting it is liable to be achieved in the completed home
- For “Confirmed” ratings, the measured CFM50 must be entered.

## **2.13 Whole-House Mechanical Ventilation**

- For “Projected” ratings, enter:
  - The design whole-house ventilation rate as documented by the system designer. Note: the code-minimum airflow rate is  $0.01 \times \text{CFA} + 7.5 \times (\# \text{ of bedrooms} + 1)$ . The design value may be higher.
  - The remaining data in accordance with the system design.
- For “Confirmed” ratings, enter the measured ventilation flow rate and update other parameters to reflect as-built conditions. There is no requirement to measure fan wattage.

## **3.0 SPA Submittal Requirements**

SPA submittals are required at two stages in the compliance process:

- A passing “Projected” energy rating report is required at time of permit application. This reflects the proposed architecture and energy specifications. For stock plans, it reflects the “worst-case” combination of options and orientation.
- A passing “Confirmed” energy rating report, reflecting as-built data, is required to receive a Certificate of Occupancy for final approval of a completed home.

The “Projected” rating is based on the best available data at plans stage and includes some assumptions. The “Confirmed” rating, reflecting the as-built product, is what really “counts.” If the home fails at this stage, a C.O. will not be issued until the builder can demonstrate energy code compliance. Builders are encouraged to specify energy features at permit stage that provide a comfortable passing margin in the “Projected” rating.

Builders using stock plans are encouraged, at lot-specific permit stage, to have their energy raters update the stock plan worst-case energy rating to a “Projected” rating for each building address. At minimum, builders should be aware that SPA PASS or FAIL results may change as the approved utility rates are annually updated. The approved utility rates at time of lot-specific permit application will be used to determine PASS or FAIL at permit and completion stages.

General SPA requirements are listed in Section 2 above. Details for each type of submittal are itemized in the following subsections. A “SPA Cover Sheet” must be included with all submittals.

### **3.1 Building Permit Submittal – Stock Plans**

- SPA data requirements apply; see Section 2 above.
- “Projected” rating
  - The rating must reflect the “worst-case” combination of options and orientation, based on the results reported in the custom Fort Collins compliance report. This typically means:
    - Check each foundation type.
    - Include all options that add thermal envelope area and/or glazing area.
    - Treat all “unfinished” areas within the thermal boundary as conditioned space.
    - Use REM/Rate’s worst-case orientation analysis tool and submit results for the orientation in which the energy cost of the Proposed Design is greatest.
  - Follow instructions in 2.11, 2.12 and 2.13 above regarding ductwork, infiltration and whole-house ventilation entries.
  - Enter the utility rates approved at time of submittal. (Note that different utility rates may apply for the “Confirmed Rating;” see 3.3 below.)
- Complete and submit the SPA Cover Sheet with required attachments.

Note: if builder updates the energy specifications for the stock plan, the “Projected” rating must also be updated.

### **3.2 Building Permit Submittal – Lot-Specific Plans**

- SPA data requirements apply; see Section 2 above.
- “Projected” rating
  - Reflect the building orientation shown on the plot plan.
  - Reflect the architectural plans and energy specifications for this address.
  - Treat all “unfinished” areas within the thermal boundary as conditioned space.
  - Follow instructions in 2.11, 2.12 and 2.13 above regarding ductwork, infiltration and whole-house ventilation entries.
  - Enter the utility rates approved at time of submittal.
- Complete and submit the SPA Cover Sheet with required attachments.

### **3.3 Completed Home Submittal**

- SPA data requirements apply; see Section 2 above.
- “Confirmed” rating
  - Reflect as-built orientation.
  - Reflect as-built dimensions and specifications for the completed building.
  - Treat all “unfinished” areas within the thermal boundary as conditioned space.
  - Enter measured data for whole-house infiltration and whole-house ventilation.
  - Follow instructions in 2.11 above regarding ductwork entries.
  - Use the utility rates approved at time of lot-specific permit submittal.
- Complete and submit the SPA Cover Sheet with required attachments.