Building Division **Department of Community Development**

One DesCombes Drive
Broomfield, CO 80020

303.438.6370 VOICE
303.438.6207 FAX

www.broomfield.org

Residential Energy Conservation Submittal, Inspection and Compliance

2012 International Energy Conservation Code®

The City and County of Broomfield Building Division has adopted the 2012 *International Energy Conservation Code®*, effective March 15, 2014. Chapter 11 has been amended out of the IRC and the 2012 IECC Residential Provisions will be enforced for detached one and two family dwellings, townhomes, and multifamily projects. This handout summarizes energy code compliance methods and submittal and inspection requirements.

Residential energy efficiency covers the thermal envelope of the building, the mechanical systems, and the lighting systems. Provisions are either mandatory for all conditions, or apply to one of the two design paths available to show compliance with the code: prescriptive or performance approach per IECC Section R401.2.

CITY AND COUNTY OF BROOMFIELD DESIGN PARAMETERS	
Broomfield is in Climate Zone 5B	
Outdoor Design Conditions per Table 1A ACCA Manual J Eighth Edition	
Elevation:	5344 feet
Latitude:	40° North
Winter heating 99% Dry Bulb:	1° F
Summer Cooling 1% Dry Bulb:	91° F
Coincident Wet Bulb:	59°F
Design Grains Difference at 50% RH:	-41
Daily Range:	High (H)
Relative Humidity:	50% winter and summer
Indoor Design Temperature for Heating:	70° F
Indoor Design Temperature for Cooling:	75° F
Heating Temperature Difference (HTD):	69° F
Cooling Temperature Difference (CTD):	16° F
Cooling Load Temperature Difference (CLTD):	21.0° F
SHGC:	SHGC taken directly from sticker on glass.
While not required per IECC Table R402.1.1, the SHGC is still required data for Manual J.	*If not known, either use default per 2012 IECC Tables R303.1.3 (1, 2, or 3)*
Altitude Correction Factor (ACF):	0.84
Moisture Content:	68.2
Air Density:	0.063
Wind Velocity Value:	15 mph for heating
Wind Velocity Value:	7.5 mph for cooling

2012 IECC Section R401.2 requires all projects to comply with Sections identified as "mandatory" and with either Sections identified as "prescriptive" or the "performance" approach in IECC Section R405.

IECC MANDATORY REQUIREMENTS

1. **HVAC Equipment Sizing**. ACCA Manual J 8th edition calculation package shall be submitted for review. Total heat loss and gain shall be calculated based on the design parameters shown above, using the Bin data for Fort Collins or Stapleton/Denver. These design parameters shall not be changed for any reason. Currently there are only two approved software choices: Wrightsoft, and Elite. The builder may submit calculations based on worst case orientation of the home on the building lot for master plans; custom homes shall use the actual orientation of the home on the building lot.

2. **Equipment selection.** ACCA Manual J requires that ACCA Manual S be used for the equipment selection; submittals shall show complete details of all HVAC equipment including the make and model, performance data, and Btu input, output and efficiency.

3. **Duct Sizing.** ACCA Manual D calculations are required for each house and shall be submitted with the duct layout plans. The duct layouts are allowed to be a deferred submittal after ductwork has been installed, and shall be approved by the plans examiner for the field before calling for inspection. The approved jobsite set of plans and summary sheets shall be on site at time of mechanical rough inspection. The duct layout plans shall show all take-off locations and sizes, register sizes, return air opening sizes, duct run length, and duct size. See comments at end of handout for duct leakage testing at time of rough inspections. Note that ACCA Manual D recommends that ductwork NOT be located within any exterior walls of the building envelope.\

4. **Thermal Envelope**. The building thermal envelope shall be sealed to limit air leakage to 3 air changes per hour; and shall be tested and verified by blower door with pressure of 50 Pascals in accordance with IECC Section R402.1. Approved third party testers shall submit a written report to the building official. If no approved third party energy rater is used for inspection and testing, the blower door test shall be set up and running when the City and County of Broomfield inspection is called.

5. **Air Barriers.** Air barriers and insulation shall be installed in accordance with IECC Section 402.4.1.1 and Table R402.4.1.1. The air barrier shall be continuous and sealed at all penetrations and joints. Special attention may be needed behind bathtubs, at dropped ceilings, in cantilevered floors, and at the garage separation from the dwelling.

6. **Air Infiltration.** All windows, skylights and sliding glass doors shall be listed and labeled to meet NFRC 400 or AAMA 101 - air infiltration rate of not more than 0.3 cfm per square foot. Swinging doors shall be listed and labeled to meet NFRC 400 or AAMA 101 - air infiltration rate of not more than 0.5 cfm per square foot. Labels shall be visible at the time of inspection to verify compliance with IECC Section R402.4.3.

7. **Air Leakage.** Recessed lighting through or into the building thermal envelope shall be sealed by gasket or caulk to limit air leakage; and shall be IC rated and labeled as having an air leakage rate not more than 2.0 cfm at 75 Pascals, ASTM E283 per IECC Section R402.4.4.

8. **Controls.** HVAC systems shall be provided with at least one thermostat in accordance with IECC Section R403.1. For forced air furnaces, the thermostat shall be programmable to control the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F or up to 85°F. The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F and a cooling temperature set point no lower than 78°F.

9. **Duct Sealing.** Ducts, air handlers, and filter boxes shall be sealed per IECC Section R403.2.2. Joints and seams shall comply with Section M1601.4.1 of the 2012 IRC. Ducts and air handlers outside the thermal envelope shall be tested for tightness by either:
    1. Post-construction test verifying total leakage less than or equal to 4 cfm per 100 square feet of conditioned floor area at a pressure differential of 25 Pascals across the entire system including the air handler enclosure, with all register boots taped or otherwise sealed during the test; or
    2. Rough-in test verifying total leakage less than or equal to 4 cfm per 100 square feet of conditioned floor area tested at a pressure differential of 25 Pascals across the system including the air handler enclosure, with all registers taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3 cfm per 100 square feet of conditioned floor area.

    Air handlers shall indicate air leakage not more than 2 percent of the design air flow rate. Building framing cavities shall not be used as ducts or plenums.

10. **Piping Insulation.** Mechanical system piping (from boilers or chillers) capable of carrying fluids above 105°F or below 55°F shall be insulated to minimum R-3. Circulating hot water systems shall be provided with an automatic or readily accessible manual switch that can turn off the hot-water circulating pump when the system is not in use. See IECC Sections R403.3 and R403.4. IECC Section R403.4.2 requiring insulation on hot water piping has been deleted by policy.

11. **Lighting.** At least 75% of all light fixtures shall have approved high efficacy lamps in accordance with Section R404, 2012 IECC.

12. **Certificate.** The builder shall post a permanent certificate in an approved location in the house in accordance with IECC Section R401.3. The approved location is on a wall nearest the furnace. This certificate shall list the predominant R-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor), ducts outside conditioned spaces and U factors and solar heat gain coefficients (SHGC) for fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.

IECC PRESCRIPTIVE REQUIREMENTS

All mandatory requirements above apply. IECC Section R402 lists the minimum requirements for the building thermal envelope. The building thermal envelope includes insulation, fenestration, and air leakage. All tables in IECC Section R402 shall use zone 5B. The plans shall show the following information.

1. **Thermal envelope.** The exact location of the building thermal envelope and air barrier shall be delineated on the plans, details, and section views.

2. **Insulation.** Provide all insulation "R" values, materials, and locations to be installed (walls, ceilings, cantilever floors, floors over garage, crawl space, basement walls, etc.) per IECC Sections R402.1 and R402.2 and Table R402.1.1. Please note that the cavity insulation shall be completely in direct contact with the floor sheathing at cantilevers or in floors located above garages. If the R-factor for any specific location does not meet the prescriptive tables, calculations for **total UA alternative** shall be submitted to verify compliance per IECC Section R402.1.4. See item 4 below.

3. **Fenestration.** Provide all fenestration U-factors and glazed fenestration SHGC per IECC Section R402.3 and Table R402.1.1 and opening sizes in a window schedule. Fenestration includes all windows, glass block, skylights, and all doors with or without glazing.

   If the U-factor for any individual unit does not meet the prescriptive tables, calculations for an area weighted average of all fenestration units shall be submitted to verify compliance in accordance with IECC Section R402.3.1.

   If the SHGC for any individual unit does not meet the prescriptive tables, calculations for an area weighted average of all glazed fenestration units shall be submitted to verify compliance in accordance with IECC Section R402.3.2.

   Certain individual fenestration units may be exempted per IECC Sections R402.3.3 and R402.3.4.

4. **Total UA Alternative.** This is the "trade-off" approach for the thermal envelope when the prescriptive requirements cannot be met exactly. Calculations shall show that the total proposed building thermal envelope UA is less than or equal to the total prescriptive building thermal envelope UA per IECC Section R402.1.4. The UA is the sum of the U-factors multiplied by each respective actual construction assembly area for the entire house - essentially an area weighted average of heat transmission ability. These calculations shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance. RES*check* is free approved software for performing these calculations. The submitted RES*check* printout shall show all of the following specific information:
   a. 2012 IECC compliance;
   b. orientation of each individual wall;
   c. insulation types, R-values, and whether continuous or cavity;
   d. accurate square footage;
   e. accurate window and door sizes and the specific wall in which they are located;
   f. U-factor for all fenestration; and
   g. SHGC (solar heat gain) for all glazed fenestration.

5. **Duct Insulation.** Indicate duct insulation: minimum R-8 for supply and return ducts in attics and minimum R-6 for ducts in floor systems in accordance with IECC Section R403.2.1.

SIMULATED PERFORMANCE ALTERNATIVE REQUIREMENTS

All mandatory requirements above apply. The IECC Section R405 option allows design flexibility by showing that the annual energy cost of the proposed home design is less than or equal to the annual energy cost of the standard reference design. Compliance is determined by documentation submitted from approved software. Software tools shall have RESNET (Residential Energy Services Network) accreditation to perform the simulated energy performance calculation required by IECC Section R405.3. The most current software edition available shall be used and indicated on the printouts. A building plans rating completed by an accredited RESNET rater that includes the Building File, the Building Reference File, and the Code Compliance sheets shall be submitted at time of permit application. This document

shall be site specific for custom homes. Subdivision master plans may submit one for each model (with all various options at worst case orientation) for initial review. The builder shall submit a copy of this approved building plans rating with each new permit application.

Every house will be required to furnish a final report and compliance certificate which will be compared to the initially approved master Plan Rating. This simulated performance alternative requires the builder to provide on-site third party inspections by an accredited RESNET rater.

1. **The building plans rating document shall include the following:**
   a. Inspection checklist of building component characteristics of the proposed design.
   b. Accurate square footage.
   c. Mechanical system details.
   d. Name of individual completing report.
   e. Name and version of the compliance software tool.
   f. Name of individual who will do the field inspections and issue the final rating.

2. **The architectural plans shall show** the location of the building thermal envelope and air barrier in plans, details, and section views.

3. **Additional information shall be submitted to verify compliance with all mandatory requirements above.**

At time of final inspection, the compliance certificate shall certify that the house complies with IECC Section R405.3 and the minimum requirements of the 2012 IECC. Please note that an insulation inspection by the Broomfield Building Division is required for the simulated performance alternative unless the approved third party RESNET rater has agreed to verify insulation installation meeting Grade 1 installation quality.

INSPECTION AND SUBMITTAL REQUIREMENTS FOR PRESCRIPTIVE COMPLIANCE

1. The builder shall call for an insulation inspection, an air barrier inspection, and blower door test verification for air leakage requirements.

2. The builder shall perform a “duct blaster” test for duct leakage either at rough or final stages in accordance with IECC Section R403.2.2. This test is to be performed by the contractor and a written report of the results shall be provided to the Building Division before C.O.

3. The builder shall provide a window and door schedule showing U-factors and SHGC for each opening and a copy of the RES*check* if using the total UA alternative on site for inspector doing rough inspection and insulation inspections. The builder shall leave the National Fenestration Rating Council (NFRC) labels on all windows and doors at time of rough inspections so inspectors can verify compliance.

4. The builder shall provide a Balance Report at time of final inspection that verifies that the air flow meets the calculations submitted at time of permit issuance. This report shall show the following: static pressure at final (total static shall not be more than the manufacturers’ listing and add supply, return, AC coil and filter for total static pressure; total flow and room to room flows. Room to room pressures are not to exceed 3 pa (Pascal) which is the industry standard. If outside air is introduced into the system or if the whole house ventilation is accomplished by use of exhaust only fans, these flows shall be measured to determine if they are performing as designed. When a builder is working from approved master plans, a balance report is required only the first time each model is built.

HVAC System Verification with Testing

Contractor		Date
Subdivision		
Address	Lot	

Rough Duct Leakage			
Duct Leakage		Pass	Fail
Leakage Maximum			

Rough Pressures & Flows				
Static Pressure	yes	no		
Coil Present				
Filter Removed				
Cooling Speed		-		
Return Pressure				
Supply Pressure				
Total Static Pressure		Pa.	Pass	Fail
Maximum Static Pressure				
Air Cycler	low	high		
Measured Flow			Pass	Fail
Design Air Flow				
Air Flow For Cooling	low	high		
Design Air Flow			Pass	Fail
Total Supply Measured Air Flow				

Final Commissioning				
Air Flow			Pass	Fail
All Rooms +-20% of Design				
All Rooms <3Pa.				
Heating		- - -		
Return Air Temp	-			
Supply Air Temp				
Furnace Heatrise			Pass	Fail
Furnace Heatrise Range				
Air Conditioning				
Condenser Air Entering Temp				
Target Subcooling from Mfg.		<12 SEER=10		
Liquid Line Temp		12SEER =15		
High Side Temp (from gauge chart)			Pass	Fail
Actual Subcooling		3 degrees from target?		
Structural Floor Exhaust Fan	low	high		
Measured Flow			Pass	Fail
Design Air Flow				