

**Sector:** Residential

**Category/Practice:** Energy Efficiency / HVAC Commissioning

**Proposed GB Practice**

**Description**

Add more specific language to the code to:

- Require testing of heating, cooling and ventilation systems to compare installed performance versus design specifications
- If a system is operating out of tolerance, the problems must be addressed and the system must be retested.
- Repeat this cycle until the system passes all tests.
- Document results.

Commissioning will be performed by certified contractors.

**Applicability**

New Construction: Applies in full

Existing Buildings/Additions: Applies when the addition work scope includes a new heating/cooling system.

Existing Buildings/Alterations: Applies with a more limited commissioning scope (reflecting inaccessibility of ductwork in many buildings). Likely limitations:

- No requirement to test duct leakage
- No requirement to seal ductwork
- No requirement to test and match room-by-room flows
- Greater tolerances for elevated static pressure and low air flow

**Intent**

Verify that HVAC systems perform as designed, meeting comfort needs and performing in accordance with manufacturer specifications.

**Benefits and Costs**

**Triple Bottom Line Benefits**

People:

- Improved thermal comfort
- Improved sense of control over heating and cooling
- Healthier indoor air

Economic:

- Energy savings due to improved installed efficiency of heating and cooling equipment operating correctly in conjunction with distribution system.  
Savings estimate for the combination of more careful design and commissioning (i.e. this amendment + HVAC Commissioning amendment): 5% to 10% reduction in heating + cooling energy use, ~\$30-60 per year.
- Enhanced durability of HVAC equipment operating within manufacturer specifications.

Environment: Environmental benefits associated with reduced energy use.

#### **Costs Passed to Owner**

“Medium” cost (\$200 to \$300). Full-service HVAC contractors already provide these services. Contractors installing low-bid HVAC systems probably are not. They will need to attend training, purchase equipment and spend more time performance-testing the installed systems.

No additional time is assumed for addressing problems identified with the testing. Experience with other quality assurance processes suggest short learning curves when contractors begin receiving quantitative feedback on their work.

#### **Lost Opportunity**

Access to address ductwork problems is typically very limited after initial construction.

## **Implementation**

#### **Availability of Products and/or Services**

Some local HVAC contractors are already offering these services. Others do not have the equipment or experience. A contractor certification process must be formalized to implement this proposed requirement.

#### **Practicality**

The proposed requirements are a small adjustment to existing code requirements; see “Context” below. Tolerances for passing specific testing requirements in the proposed approach are generous, providing a good step toward better performance while not setting an unreasonably high hurdle. The City may choose to more tightly define allowed testing procedures.

A practical challenge to be addressed is that the test for air conditioner refrigerant charge typically may only be performed when outdoor temperature is 55°F or above. This limits testing of one parameter during colder months.

#### **Certification Issues**

Contractor certification requirements must be established; i.e. who will be allowed to perform or oversee the testing and sign off on the commissioning form. This could be based on approaches developed for the City’s [Home Efficiency Program](#) or, more likely, a newly developed credential from the Air Conditioning Contractors Association in support of the ANSI/ACCA *HVAC Quality Installation Specification* (see “Context” below).

Testing may be performed by the same company that installed the HVAC system; i.e. third-party testing is allowed but not required.

#### **Enforcement Procedures**

Permit application/plan review: N/A

Field inspection: N/A

Certificate of Occupancy: Applicant will submit completed, signed commissioning form documenting compliance with requirements. The document will include the testing contractor's certification number and expiration date.

**Challenge**: Air conditioner refrigerant charge generally cannot be tested when outdoor temperature is below 60 F. This may be addressed through temporary Certificate of Occupancy or by allowing this test to be bypassed if the AC equipment includes a Thermal Expansion Valve (which compensates to some degree for improperly charged equipment).

#### **Support Materials Needs**

Commissioning documentation form

#### **Training Needs – Industry**

Some local contractors are already familiar with all of the procedures embodied in this proposed requirement, through industry training, training offered recently through the City's [Home Efficiency Program](#) or the regional Select HVAC program. Comprehensive training will be needed by some contractors on HVAC system design, installation and commissioning. All contractors wishing to become certified will need some training.

One particular area in which training will be needed is accurate measurement of air flow through registers.

#### **Training Needs – Staff**

Building Department needs additional expertise to review submittals.

## **Background**

#### **Current Practice**

With some exceptions, there is little evidence that most HVAC systems receive more than a cursory start-up test after installation. Many systems operate outside of manufacturer specifications. Many residents complain that their HVAC systems don't meet comfort needs and that they feel they have little control over them.

#### **Context**

According to the [Building Commissioning Association](#), commissioning is defined as documented confirmation that building systems function in compliance with criteria set forth in the project documents to satisfy the owner's operational needs.

In the past, heating and cooling system design and installation was largely based on rules-of-thumb that have proven to be unacceptable. Ductwork was often laid out on the job site rather than following a carefully planned design. Little performance testing was conducted after systems were installed. Results have included oversized equipment, poor matches between equipment and distribution systems, equipment that doesn't operate within manufacturer specifications, poor thermal comfort and, among many occupants, a sense that they have little control over their heating and cooling systems. These observations were documented in a [survey](#)

[of Fort Collins homes built in the mid- to late-1990s](#). They are not exclusive to Fort Collins; similar issues have been observed nationally.

The City has provided contractor training on these issues since the early 1990s. Awareness of these issues has markedly increased in the past decade with information and training. Code revisions have gradually tightened requirements for heating/cooling system design, installation and testing. The 2005 City code required that:

- Heating + cooling equipment is sized in accordance with the building load calculated with ACCA Manual J and that ductwork be designed in accordance with ACCA Manual D. ACCA is the Air Conditioning Contractors of America, a national trade association of HVAC contractors.
- “All heating and cooling equipment shall be tested to ensure such equipment is operating within the manufacturer’s recommended operating parameters and standards, including within such parameters and standards for sufficient combustion, according to the applicable protocols established by the building official and in accordance with the mechanical code adopted by the City.”
- Prior to receiving a Certificate of Occupancy, HVAC contractors submit signed mechanical systems disclosure forms listing installed equipment and stating that the installations were in compliance with code.

Though a large amount of local progress has been made in HVAC system design and installation, there is still little evidence that most systems are performance tested after installation. A 2007 survey of new Fort Collins homes documented wide ranges for HVAC performance parameters and systems operating out of specification for static pressure and air flow.

The 2009 IRC adds requirements that:

- Equipment be sized in accordance with ACCA Manual S procedures
- Duct systems in which any portion is located in unconditioned space must be leak-tested and meet maximum leakage requirements.

The disclosure requirement from past Fort Collins codes was not carried over to the recently adopted building code.

The proposed requirement provides a more comprehensive and specific framework addressing system installation and testing, tied back to documented design parameters. The intent is to base the details on the [HVAC Quality Installation Specification](#), ANSI/ACCA 5 QI-2007, developed by the Consortium for Energy Efficiency and ACCA. This standard takes a systems approach, from design through installation, performance testing, documentation and owner education. This approach provides the HVAC contractor invaluable feedback about how well the installed system operates. A manual, *Technician’s Guide for Quality Installations*, is also available from ACCA to support the standard. [Updates to the quality installation standard](#) have recently been issued for public review; the updated standard should be available by first quarter 2011.

ENERGY STAR New Homes Version 3 guidelines (which will be fully effective by January 2012), include an approach aligned with the ACCA quality installation standard. It extends the ACCA 5 approach to ventilation systems. ENERGY STAR’s new checklists for HVAC contractors and energy raters provide a practical, organized framework for fulfilling the standard’s requirements. The contractor checklist documents design parameters on one side of a page. The other side documents performance measurements and pass/fail questions about

meeting the standard, and includes a contractor signature block. This is a model the City could choose to use or adapt.

Other voluntary green building rating systems, such as LEED/Homes and NGBS, include subsets or variations of these requirements.

**Related Green Building Practice**

This proposed amendment ties closely to:

- Heating and cooling system design
- Whole-building ventilation

**Known Objections**

Higher first cost