PUBLIC CODE CHANGE PROPOSAL FORM
FOR PUBLIC PROPOSALS IN THE INTERNATIONAL CODES

2007/2008 CODE DEVELOPMENT CYCLE
CLOSING DATE: All Proposals Must Be Received by August 20, 2007
The 2007/2008 Code Development Hearings are tentatively scheduled for February 18 – March 2, 2008, location TBD.

1) **Name:** Ronald Majette **Date: August 19, 2007**
Jurisdiction/Company: U.S. Department of Energy
Submitted on Behalf of: U.S. Department of Energy
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2) **Copyright Release: In accordance with Council Policy #28 Code Development, all Code Change Proposals, Floor Modifications and Public Comments are required to include a copyright release. A copy of the copyright release form is included at the end of this form. Please follow the directions on the form. This form as well as an alternative release form can also be downloaded from the ICC website at www.iccsafe.org. If you have previously executed the copyright release, please check the box below:**

☐X **2007/2008 Cycle copyright release on file**

3) Indicate appropriate International Code(s) associated with this Public Proposal – Please use Acronym:____IECC and IRC_____
If you have also submitted a separate coordination change to another I-Code, please indicate the code: _____
(See section below for list of names and acronyms for the International Codes).

4) **Be sure to format your proposal and include all information as indicated on Page 2 of this form.**

5) Proposals should be sent to the following offices via regular mail or email. An e-mail submittal is preferred, including an electronic version, in either Wordperfect or Word. The only formatting that is needed is **BOLDING**, ~~STRIKEOUT~~ AND UNDERLINING. Please do not provide additional formatting such as tabs, columns, etc., as this will be done by ICC. **REMOVE TRACKING CHANGES, AUTOMATIC NUMBERING, OR ANY OTHER ADVANCED FORMATTING TOOLS THAT ARE PROVIDED BY WORD, FROM FILES CONTAINING YOUR CODE CHANGE PROPOSAL THAT YOU SEND TO ICC.**

Please use a separate form for each proposal submitted. Note: All code changes received will receive an acknowledgment.

Please check here if separate graphic file provided. ☐

Graphic materials (Graphs, maps, drawings, charts, photographs, etc.) must be submitted as separate electronic files in .CDR,.IA,.TIF or .JPG format (300 DPI Minimum resolution; 600 DPI or more preferred) even though they may also be embedded in your Word or Wordperfect submittal.

Code
IBC - International Building Code
IEBC - International Existing Building Code
IFC - International Fire Code
IFGC - International Fuel Gas Code
IPC - International Plumbing Code
IPSDC - International Private Sewage Disposal Code
IPMC - International Property Maintenance Code
IWUIC - International Wildland-Urban Interface Code
IZC - International Zoning Code
ELECT - International Code Council Electrical Code– Administrative Provisions

Send to:
International Code Council
Chicago District Office
Attn: Diane Schoonover
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Country Club Hills, IL 60478-5795
Fax: 708/799-0320
codechanges@iccsafe.org

IECC - International Energy Conservation Code
ICC PC - ICC Performance Code
IMC - International Mechanical Code
IRC - International Residential Code

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CODE CHANGE PROPOSAL

Please provide all of the following items in your code change proposal. Your proposal may be entered on the following form, or you may attach a separate file. However, please read the instructions provided for each part of the code change proposal. The sections identified in parentheses are the applicable sections from CP #28 Code Development. The full procedures can be downloaded from www.iccsafe.org.

Code Sections/Tables/Figures Proposed for Revision (3.3.2): IECC Section 403.2.2, Table 404.5.2(1), and Table 404.5.2(2). IRC Section N1103.2.2.

Note: If the proposal is for a new section, indicate (new).

Name/Company/Representing (3.3.1):

Note: You must indicate your name and the full name of who you are representing. Do not use acronyms.

Proposal: NOTE: PLEASE READ ITEM 5) of the first page of this form for formatting instructions.

IECC:

403.2.2 Sealing. All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.1 of the *International Residential Code*. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 CFM per 100 ft^2 of conditioned floor area or a total leakage less than or equal to 12 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.10 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 6 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.10 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be 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 4 CFM per 100 ft^2 of conditioned floor area.

Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

Table 404.5.2(1)
Specifications for the Standard Reference and Proposed Designs.

Thermal Distribution Systems	A thermal distribution system efficiency (DSE) of ~~0.80~~ 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. For tested duct systems, the leakage rate shall be the applicable maximum rate from Section 403.2.2.	~~Same as standard reference design, except where~~ As tested or as specified in Table 404.5.2(2) if not tested.

(remained of Table 404.5.2(1) unchanged)

Table 404.5.2(2) Default Distribution System Efficiencies for Proposed Designs [(a)]

Distribution System Configuration and Condition:	Forced Air Systems	Hydronic Systems [(b)]
Distribution system components located in unconditioned space	~~0.80~~ --	0.95
Untested d~~D~~istribution systems entirely located in conditioned space [(c)]	0.88	1.00
~~*Proposed* "reduced leakage" with entire air distribution system located in the conditioned space [(d)]~~	~~0.96~~	~~--~~

~~*Proposed* "reduced leakage" air distribution system with components located in the unconditioned space~~	~~0.88~~	~~--~~
"Ductless" systems (~~d~~e)	1.00	--

Notes:
(a) Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
(b) Hydronic Systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced air flows to maintain space temperatures.
(c) Entire system in conditioned space shall mean that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.
~~(d) Proposed "reduced leakage" shall mean leakage to outdoors not greater than 3 cfm per 100 ft^2 of conditioned floor area and total leakage not greater than 9 cfm per 100 ft^2 of conditioned floor area at a pressure differential of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft^2 of conditioned floor area at a pressure difference of 0.02 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to outdoors. This performance shall be specified as required in the construction documents and confirmed through field-testing of installed systems as documented by an approved independent party.~~
(d~~e~~) Ductless systems may have forced airflow across a coil but shall not have any ducted airflows external to the manufacturer's air handler enclosure.

IRC:

N1103.2.2 Sealing. Ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.1. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 CFM per 100 ft^2 of conditioned floor area or a total leakage less than or equal to 12 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.10 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
2. Rough-in test: Total leakage shall be less than or equal to 6 CFM per 100 ft^2 of conditioned floor area when tested at a pressure differential of 0.10 inches w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be 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 4 CFM per 100 ft^2 of conditioned floor area.

Exceptions: Duct tightness test is not required if the air handler and all ducts are located within conditioned space.

Supporting Information (3.3.4 & 3.4):

The purpose of this proposal is to reduce energy losses in air-ducted distribution systems.

Is the IECC/IRC requirement for duct sealing working? Despite good intentions, the answer is a convincing "no". Visual inspection of ducts is not adequate. Ducts are often located in difficult to access areas such as attics and crawl spaces. Cracks and other leakage points in ducts may not be visible because they are covered by insulation, hidden from view, or simply too small to be readily apparent to the human eye. Testing of completed homes in Washington state where prescriptive code requirements for duct sealing apply "showed no significant improvement" over non-code homes (Washington State University 2001). Another study from Washington State concluded: "Comparisons to air leakage rates reported elsewhere for homes built before the implementation of the 1991 WSEC show no significant improvement by the general population" despite years of training emphasizing duct sealing (Hales et al. 2003).

Numerous other studies around the nation show substantial duct leakage in new homes, including those in states with codes requiring duct sealing. For example, a 2001 study of 186 houses built under the Model Energy Code in Massachusetts reported "serious problems were found in the quality of duct sealing in about 80% of these houses" (Xenergy 2001). Pressurization tests in 22 of these houses found an average leakage to the outside of the house of 183 cfm, or 21.6% of the system flow, at a pressure of 25 Pascals.

The energy savings of improved duct sealing are very substantial. A California study estimated a sales-weighted state annual average savings from duct sealing of 38 therms and 239 kWh for a 1761 ft^2 house (Hammon and Modera 1999). This is based on an estimated 12% improvement in duct efficiency based on previous studies indicating a 12-15% improvement potential. Assuming $1.20/therm gas and 9 cents/kWh electricity, this is a savings of $67/year. As much of California's population is in mild climates savings should be considerably higher on a national average.

Hammon and Modera (1999) estimate a cost of $214 for materials and labor plus $131 to $163 for testing and suggest costs will be even lower in a mature market. This does not account for possible cost savings from downsizing HVAC systems because of decreased design loads. Even with the conservatively low California energy savings estimate, this is a simple payback of 5.1 to 5.6 years. The Journal of Light Construction (2003) quotes an even lower cost of $220, which indicates a simple payback of under 4 years. Duct pressurization testing equipment commonly known as "duct blasters" cost about $1500-2000 (Sherman, 2004, PDF page 171). Presumably, this equipment would come down in price as the market for this equipment grows.

The proposed leakage limits from duct testing sets a modest target that is reasonable for a mandatory minimum code. For example, Energy Star Qualified Homes must have a leakage of 6 CFM per 100 ft^2 of conditioned floor area (or 4 CFM if the "builder option packages" are used) compared to the 8 cfm per 100 ft^2 proposed here. The proposal allows a variety of compliance methods. Notably, the testing can be done at rough-in stage immediately after the ducts are installed. This allows potentially costly call backs to be avoided if the tested leakage rate exceeds code requirements. Testing is not required if the air handler and ducts are inside the conditioned space.

The residential building energy efficiency requirements in ICC codes have not had a substantial national improvement in 14 years, since 1993. The most notable improvement since 1993 was the addition of the 0.40 SHGC requirement for glazing, and that applies to only the southern third of the nation and occurred 10 years ago. During that time, fuel prices have increased dramatically and environmental concerns from energy usage (notably global warming) have come to the forefront. It's time for the ICC to take serious action to improve energy efficiency in buildings and the Department of Energy believes improved duct systems are the place to start. Poor duct sealing is a widespread problem that will result in senseless energy loss for many decades after a new building is occupied. This proposal represents a reasonable and cost effective improvement that is badly needed.

References:

Washington State University. 2001. *Washington State Energy Code Duct Leakage Study Report.* WSUCEEP01105. Washington State University Cooperative Extension Energy Program, Olympia, Washington.

Hales, D., A. Gordon, and M. Lubliner. 2003. 2003. *Duct Leakage in New Washington State Residences: Findings and Conclusions.* ASHRAE transactions. KC-2003-1-3.

Hammon, R. W., and M. P. Modera. 1999. "Improving the Efficiency of Air Distribution Systems in New California Homes-Updated Report." Consol. Stockton, California. http://www.energy.ca.gov/title24/ducttape/documents/IMPROVE_EFFICIENCY_RES.PDF

Journal of Light Contuction. April 2003. "Pressure-Testing Ductwork." Michael Uniacke.

Sherman et al. 2004. Instrumented HERS and Commissioning.
http://www.energy.ca.gov/pier/final_project_reports/500-04-012.html

Xenergy. 2001. Impact Analysis Of The Massachusetts 1998 Residential Energy Code Revisions.
http://www.mass.gov/Eeops/docs/dps/inf/inf_bbrs_impact_analysis_final.pdf

Referenced Standards (3.4 & 3.6):

Cost Impact (3.3.4.6):

The code change proposal will increase the cost of construction.