

R-4: Envelope Air Leakage (R402.4)

Summary: Change the designation of envelope air leakage requirements from mandatory to prescriptive. The ability to trade off other building envelope elements against tested air leakage rates will give builders flexibility and/or allow builders to hedge against the potential for failed envelope pressure tests, which occur after construction is complete, by improving other envelope components.

DOE proposal R-4 was revised on December 18, 2015.

Stakeholder Feedback: There were 14 public comments received for proposal R-4. Comments are summarized below, followed by a DOE review:

- Six comments opposing any changes to the code that permit envelope efficiency to be traded down for improved equipment efficiency.

Review: DOE's option package proposal was designed to offer limited tradeoffs to accommodate a few of the most commonly requested envelope changes without opening the envelope to the full energy performance compliance path. However, DOE understands the reasons many oppose envelope-equipment tradeoffs, including the limited ones proposed in R-4. In light of these and other comments, DOE is modifying its proposal significantly.

- One comment suggesting that DOE be certain the option package table comply with the specific preemption requirements of the National Appliance Energy Conservation Act (NAECA).

Review: DOE believes the option package proposal to be consistent with NAECA requirements. However, as a result of the comments on this proposal DOE is modifying the proposal in a way that eliminates consideration of HVAC equipment efficiencies.

- One comment requesting that the option package table be expanded to include other kinds of HVAC equipment such as geothermal heat pumps.

Review: The request is reasonable and could readily be worked into the original proposal framework. However, as a result of the comments on this proposal DOE is modifying the proposal in a way that eliminates consideration of HVAC equipment efficiencies.

- One comment asking whether DOE considered adding an EER requirement in addition to a SEER requirement for the HVAC efficiency options.

Review: DOE did not consider EER requirements because SEER, a seasonal average, is the metric that characterizes energy consumption. EER (usually rated at an outdoor air temperature of 95 °F) may allow better characterization of peak load performance, but the relevant IECC compliance path considers only energy performance, not peak performance. Although Federal equipment efficiency regulations (CFR Title 10, Part 430) are expressed only in terms of SEER for most product classes and geographical regions, there are minimum EER requirements for split-system air conditioners in the Southwest region (AZ, CA, NV, NM), making EER potentially important to code officials in that region, even if EER is not relevant to IECC code compliance. However, in light of this and other comments, DOE is modifying its proposal in a way that eliminates this issue.

- One comment questioning why heat pump SEER values seem unreasonably high in cold climates.

Review: Heat pumps have both heating (HSPF) and cooling (SEER) efficiency metrics that are impacted by the same equipment characteristics. Consequently, it is generally not possible to purchase a high-HSPF heat pump that is not also high-SEER. It may be possible to eliminate the SEER thresholds in the coldest of climates, but even in the northern U.S. there can be significant cooling loads that impact the cost-effectiveness analysis of heat pumps.

- One comment requesting that DOE extend the option packages to include energy-neutral packages for mass walls.

Review: The proposal was designed to offer a limited set of prescriptive tradeoffs that address a few of the most commonly requested envelope changes by allowing those changes in trade for HVAC efficiency improvements or other improvements. DOE is not aware of a substantial call for trading the prescriptive insulation requirements in mass walls.

- One comment noting oddities in the option packages such as one package of envelope trades being essentially a subset of another package's envelope trade, yet both packages have the same HVAC trades.

Review: The proposal was designed to offer a limited set of prescriptive tradeoffs that address a few of the most commonly requested envelope changes by allowing those changes in trade for HVAC efficiency improvements or other improvements. The process of addressing these common trades, combined with the granularity of available HVAC and other tradeoffs, resulted in two commonly requested envelope trades (replacing 2x6 walls with 2x4 walls, revising overall envelope requirements to 2009 IECC levels) resulted in the same HVAC equipment tradeoff. The comment, however, is reasonable, and assuming final energy analyses were similar to preliminary results, DOE would eliminate one of the options. However, in light of this and other comments, DOE is modifying its proposal in a way that eliminates this issue.

- One comment offering general support for the addition of prescriptive options to the code, but suggesting that those options should be offered via changes to the primary prescriptive path of the code, not a new section.

Review: Because DOE's purpose in developing this proposal was to address a few specific and frequently requested envelope trades, reformatting the primary prescriptive manifestation of the code was not considered.

In response to these comments, DOE has significantly revised the proposal. In deference to the several comments suggesting DOE not introduce an equipment-envelope tradeoff mechanism to the code, the original proposal will not be put forward. However, because the original proposal was designed to address a limited number of frequently requested envelope changes, DOE will put forward a single proposal that adds flexibility to one envelope property—envelope air leakage. The revised proposal would make envelope air leakage a "prescriptive" requirement rather than a "mandatory" one, which will allow the air leakage thresholds to be traded off through the Simulated Performance Alternative compliance path.

== IECC PROPOSAL:

Modify section R402 as follows:

R402.4 Air leakage (Mandatory). The *building thermal envelope* shall be constructed to limit air leakage in accordance with the requirements of Sections R402.4.1 through R402.4.4.

R402.4.1 Building thermal envelope. The *building thermal envelope* shall comply with Sections R402.4.1.1, ~~and R402.4.1.2, and R402.1.3.~~ The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

R402.4.1.1 Installation (Mandatory). The components of the *building thermal envelope* as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction. Where required by the *code official*, an *approved* third party shall inspect all components and verify compliance.

R402.4.1.2 Testing (Mandatory). The building or dwelling unit shall be tested to determine envelope air leakage, ~~and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8.~~ Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 and

reported at a pressure of 0.2 inch w.g. (50 Pascals). Where required by the *code official*, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the *code official*. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures.
2. Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures.
3. Interior doors, if installed at the time of the test, shall be open.
4. Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems, if installed at the time of the test, shall be turned off.
6. Supply and return registers, if installed at the time of the test, shall be fully open.

R402.4.1.3 Envelope Air Leakage (Prescriptive). Envelope air leakage, when tested in accordance with Section R402.4.1.2, shall not exceed 5.0 air changes per hour in Climate Zones 1 and 2, and 3.0 air changes per hour in Climate Zones 3 through 8.

R402.4.2 Fireplaces (Mandatory). New wood-burning fireplaces shall have tight-fitting flue dampers or doors, and outdoor combustion air. Where using tight-fitting doors on factory-built fireplaces listed and labeled in accordance with UL 127, the doors shall be tested and listed for the fireplace. Where using tight-fitting doors on masonry fireplaces, the doors shall be listed and labeled in accordance with UL 907.

R402.4.3 Fenestration air leakage (Mandatory). Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/m²), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/m²), when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and *listed* and *labeled* by the manufacturer.

Exception: Site-built windows, skylights and doors.

R402.4.4 Rooms containing fuel-burning appliances (Mandatory). In Climate Zones 3 through 8, where open combustion air ducts provide combustion air to open combustion fuel burning appliances, the appliances and combustion air opening shall be located outside the building thermal envelope or enclosed in a room, isolated from inside the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall *R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

Exceptions:

1. Direct vent appliances with both intake and exhaust pipes installed continuous to the outside.
2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the *International Residential Code*.

R402.4.5 Recessed lighting (Mandatory). Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

Reason: This proposal increases flexibility by giving builders compliance options for homes with higher envelope air leakage. Because the existing air leakage requirements are *mandatory*, builders have limited recourse if a finished home fails to meet the required leakage level. By allowing air leakage to be traded off through the performance path, builders have the option of improving other envelope elements to offset higher air leakage, or simply hedging against failed leakage tests by implementing modest improvements elsewhere in the home.

Energy Savings: The proposal is designed to be energy neutral.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at:

<https://www.energycodes.gov/development/2018IECC>.

Cost impact: Because tradeoffs with air leakage are optional, there is no direct cost impact.

Cost-effectiveness: This change is cost-effective in that it is expected to provide neutral energy impact, and is optional.