BY CLAYTON DEKORNE

Air-Sealing Code Update

Early this year, in keeping with its three-year update cycle, the International Code Council published the 2021 International Energy Conservation Code (IECC), which serves as the foundation of Part 4, Chapter 11 of the International Residential Code (IRC). The new model energy code is being hailed as the most significant change in building energy-efficiency requirements since the 2012 code. (It has also been dubbed the most stringent or most progressive energy code ever, depending on your slant.) Some of the overarching provisions that caught *JLC*'s eye include:

Reflecting a warming world climate, the climate zone map has changed. Approximately 10% of U.S. counties have shifted to a warmer climate zone. The map also adds a new zone, climate zone 0, representing the hottest climates worldwide (no U.S. cities are included in this zone).

The terms "Prescriptive" and "Mandatory" have been eliminated from the section titles throughout the pages covering thermal envelope, duct installation, mechanical ventilation, and lighting measures. In addition, the word "Compliance" is replaced by "Application." These changes, while largely semantic, follow a general shift toward simplifying the code's language and emphasizing that the code offers "options" that we are being guided to "apply," rather than "mandates" we must "comply" with. (Still, the code is a collection of requirements—and the word "mandatory" has been removed only from the section titles.)

Added measures. Arguably the most radical change is that measures dubbed "additional efficiency package options" have been added on top of the base provisions, regardless of the compliance path used. Even when following the prescriptive path, you now have to add at least one package of predefined measures that upgrade insulation and glazing, heating and cooling, water heating, ducts, or air-sealing and ventilation. (We will be revisiting this change in future articles as we learn more about how it will be implemented.)

In addition to these high-level changes, a number of insulation measures also stood out as especially significant:

Insulation in the lid. In the prescriptive path, ceiling insulation levels have increased to R-49 (up from R-38) in climate zones 2 and 3 and to R-60 (up from R-49) in climate zones 4 through 8.

Continuous insulation (ci) has been added as an insulation

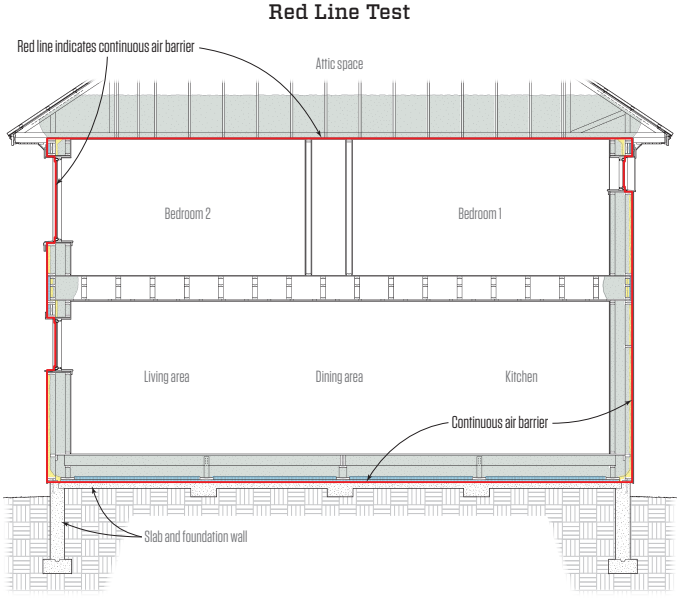


Photo: Jake Bruton

The 2021 IECC still requires blower door testing **(1)**, but when a builder follows a performance option, the building can be leakier in climates zones 3–8. The new code improves the description of the air barrier, recognizing that it is not one thing, but composed of many materials—a point architect Steve Baczek makes when urging builders to define the air barrier on plans with a "red line test" (above, right) to establish continuity and show where the transition points are that will need the most attention.

Inadequate sealing at the top and bottom of the wall continues to be a major source of building leakage in many new homes. The code doesn't specify how to air-seal the top plates, allowing builders to innovate. The method employed by Steve Baczek and builder Jake Bruton is to apply a peel-and-stick to the top of the taped exterior sheathing **(2)**, pulling it across the top plates. The inside edge **(3)** is picked up by the ceiling drywall, which serves as the air barrier on the lid. At the base of the wall, liquid flashing **(4)** or a flashing membrane **(5)** works to seal the bottom edge of the sheathing to the foundation. New language on sealing rim joists specifies that the air barrier must seal to the sill and to the subfloor. In this soon-to-be finished basement **(6)**, spray foam proved an effective seal that would meet these requirements.

Photos: 2–4, Jake Bruton; 5, Matt Risinger; 6, Steve Easley

The new code provides added detail on how to seal mechanical penetrations in "shafts" (or chases), with an emphasis on creating a seal that will allow for expansion and contraction as well as vibration. Fire-rated caulk around flues **(7)**, or fire-rated foam (as this doubles as a fire stop) around insulated ducts **(8)** should meet the new requirements.

option in all climate zones, and fat wall insulation without continuous insulation (R-30) has been added as an option in climate zones 6 through 8, where previously only continuous insulation options were available.

Slab insulation. The new code requires R-10 (now specified as continuous insulation) to a depth of 2 feet in climate zone 3 and to a depth of 4 feet in climate zones 4 and 5. Previously, slab R-value requirements had not been increased in any climate zone since 2006.

To be clear, no state has yet adopted the 2021 version, but all the states that have adopted the IECC are actively considering it, and some municipalities are also taking up the discussion of adopting the new provisions this summer. To get out in front of any pending action, *JLC* wanted to begin exploring the changes before they hit the street, focusing first on air-sealing.

AIR-SEALING LIMITS

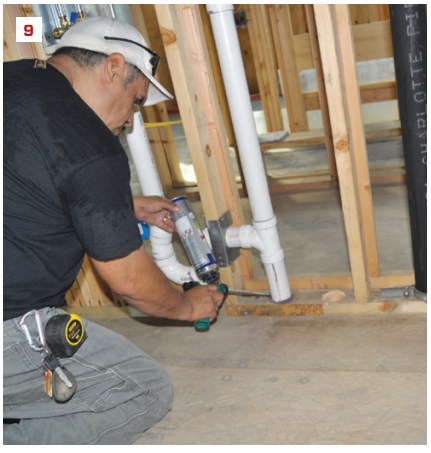
This exploration began while I was participating in an UnBuildIt podcast with Jake Bruton, owner of Aarow Building in Columbia, Mo., and architect Steve Baczek, who is based in the Boston area. Bruton had learned about the pending regulations from a summary of the code changes sent to him by HERS-rater Blake McClallen of Econsultants, based in Columbia, Mo. What caught Bruton's eye was the air-sealing limits, which are no longer labeled "mandatory" and, most surprisingly, seem to have been downgraded. Previous limits set in the 2012 version of the IECC and continued in the 2015 and 2018 editions required 3 ACH in climate zones 3 through 8, and 5 ACH in climate zones 1 and 2. The 2021 energy code now states, "The maximum air leakage rate for any building or dwelling unit under *any compliance path* shall not exceed 5.0 air changes per hour … ." It was "under any compliance path" that tripped us up on a first reading. It's not clear why that is included, as further on, the code clarifies that when complying with Section N1101.13.1 (the prescriptive option), the previous limits of 3 ACH for climate zones 3 to 8 still apply. But even with the prescriptive requirements remaining, a significant number of homes will be built leakier.

According to McClallen, in central Missouri and throughout the entire Midwestern region where Econsultants does business, fewer and fewer builders are following a prescriptive path. The majority are following the total building performance path, and a few others the Energy Rating Index (ERI) performance option, because these give them the most freedom in how they build. This is especially true with lumber prices exceedingly high and many builders seeking to show compliance with 2x4 walls.

Econsultants certifies compliance with property standards set by a number of state and local affordable housing or low-income tax credit programs, as well as certification for Energy Star, National Green Building Standards, and building code compliance. The majority of builders it is working with are *not* selling high-performance buildings. Instead, many are seeking to shave costs wherever they can to keep the building as affordable as possible. The performance path allows them to make trade-offs, usually identifying these by modeling home performance in a program like the Department of Energy's REM/Rate that has the IECC provisions programmed in. So, for example, as you reduce wall thickness (and with it, insulation values), you need to increase other measures, like duct sealing (one of the easiest measures because it involves a limited area and it's straightforward and inexpensive to apply mastic), or increase HVAC or water-heating efficiencies or lighting controls, or decrease window U-factors. None of these last measures, however, involves products that are much cheaper or easier to source right now.

In the end, McClallen says, it's often easier to stick with a 2x6 wall or switch to a taped sheathing product like Zip System, which he argues is one of the easiest ways to improve airtightness, though it's not a particularly low-cost item now either. But if by using that

Photos: Steve Easley



Plumbing penetrations to the exterior, such as drainpipes leading into an unsealed crawlspace **(9)** or through slabs must now be air-sealed. All electrical penetrations to the exterior must also be sealed **(10)**. Note that an air-seal at fireblocking height doubles as a fire stop and requires a fire-rated sealant. Electrical boxes in exterior walls must also be air-sealed. In this garage wall **(11)**, foam is used to seal up the boxes facing the garage; note the flanged OS-4 box (center, in photo) for the kitchen-facing wall.

approach, a builder is able to go with 2x4s and less-expensive windows, tightening to a lower limit than required may still be a viable option. "We'll see how things go," says McClallen, who has yet to be able to play with REM/Rate with the new 2021 programming, though he's expecting it to come out any day now.

IMPROVED BUILDING STANDARDS

If the lower airtightness limits are a small step backward, the IECC takes two steps forward with improvements to Table R402.4.1.1 (Table N1102.4.1.1 in the IRC). In particular, added to the general requirements is the statement: "Breaks or joints in the air barrier shall be sealed." This is key, notes Steve Baczek, because it nods to the fact that the air barrier isn't one material—a point that trips up many in the trades. Steve always urges builders to do a "red line test" by drawing a continuous red line on building sections in the plans to define the air barrier (see "Red Line Test," page 15). This immediately shows that the air barrier can cross sheathing, framing, glass, drywall, and concrete and helps builders focus on the transitions between those materials.

Other air-sealing amendments to the table include:

Rim joists. The air-barrier installation requirements now specifically address sealing "the junctions of the rim board to the sill plate and the rim board to the subfloor." Note that this language is specific to rim joists for first-floor wood framing over the foundation, not rim joists between floors, and not first-floor walls on slabs. Coverage of the latter is addressed in the table section on sealing walls, which continues to be worded: "The junction of the foundation and sill plate shall be sealed." That wording remains a point of controversy because most builders frame walls on the deck and stand them up with the sheathing hanging below the bottom plate to catch the sill. To save steps, even the best builders air-seal the foundation to the sheathing, not to the sill plate.

Shafts and penetrations includes new language for sealing utility penetrations that run through a shaft or chase. The new code specifies that these now need to be "caulked, gasketed or otherwise sealed" to allow for "expansion and contraction of materials and mechanical vibration." This new language seems to favor flexible boots (made of fire-rated silicone if it's a flue), though it does also allow caulk or foam. It clearly disallows unsealed metal escutcheons.

Plumbing and electrical penetrations. Previous versions of Table R402.4.1.1 had a blank cell in the air-barrier column for plumbing and electrical. The new code specifies that all holes created by "plumbing, wiring or other *obstructions* through the air barrier shall be air sealed." The use of the word "obstructions" instead of "penetrations" is confusing. You want the air barrier to be an obstruction to airflow. What is a plumbing pipe or wire obstructing?

In addition to the updates to Table R402.4.1.1, the 2021 IECC adds a new section titled "Air-Sealed Electrical Boxes," which requires sealing electrical and communication boxes in walls "between conditioned and unconditioned spaces." This section specifies the air leakage limit for these boxes and names NEMA OS 4-rated (gasketed and grommeted) boxes as an alternative. Here again, there remains some gray area: If an official takes a strict interpretation of "unconditioned space," that can draw a sharp focus on separation walls between attached garages, sheds, and other parts of the building. Or the code official could take a broad interpretation that includes the outside as "unconditioned space," and require you to air-seal every box in an exterior wall. If so, there could be friction if your exterior-wall air barrier is at the sheathing, and you don't want to spend the money on OS-4 boxes or the painstaking work of caulking around every box. You may need to be able to convince the official there is already an air barrier behind the electrical box. We shall see.

Photos: 9, 11, Matt Risinger; 10, Roe Osborn