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Air Sealing

Energy Code Requirements

The code has a list of areas that must be sealed (ECCCNYS 502.1.4.2), and gives examples of sealants to use. The leaks to be sealed include leaks between conditioned and unconditioned space, and leaks between conditioned space and outdoors. Note that fiberglass batts do not stop air and cannot be used as a sealant.

It is interesting to note the extent to which code requirements for air sealing and fireblocking overlap: “Fireblocking shall be provided to cut off all concealed draft openings (both vertical and horizontal)...” (IRC Section R602.8). Fire is much the same physically as heat loss, except it’s much faster and more destructive. Specific fireblocking requirements parallel the requirements for air sealing that are outlined in the ECCCNYS, calling for draft stops that address the following:

- Hidden leaks in walls that intersect with attics and/or basements, including the openings around and associated with chimneys, ducts, vents, furred ceiling spaces, and the like (chaseways and cavities).
- Leaks that result from a change in ceiling height (e.g. soffits, drop ceilings).
- Leakage pathways associated with stair stringers.

In general, wherever draftstopping makes sense from an energy perspective, it is probably also required by fire code. Fire code however, may call for draft stops in places that do not align with the thermal envelope (such as between two heated floors). With respect to energy efficiency, these stops are less of a concern.

Fireblocking and air sealing requirements not only overlap, but are also complementary. With fireblocking, the emphasis is placed on selecting an appropriate material to serve as a draft stop (acceptable materials include 2" of lumber, 3/4" nominal plywood or particle board, 1/2" drywall or 1/4" cement board). Energy code complements this requirement by calling for

the perimeters of these stops (or baffles) to be sealed to the surrounding surfaces. Both steps are required to achieve a complete and effective air barrier.

It is important to note that there is also one way in which these two sections of the code are *not* complementary. In addition to the items listed above, mineral and glass fiber materials are also allowed for use as fire stops. Fibrous materials however, are ineffective at stopping air. Consequently, they should not be used where air sealing is required.

The ECCCNY goes on to require sealed draft stops anywhere there are openings between conditioned and unconditioned space. The following is a list of some of the most important locations:

- **Between wall and roof or ceiling; wall and floor; between wall panels.** These are often some of the largest leaks in a house. They typically occur in places where cavities between studs or joists connect a conditioned space to an attic or basement area. “Draftstop” blocking is the simplest way to deal with these leaks. Typical examples are shown in Figures 7.11-7.18.
- **Penetrations** of utility services through walls, floors, ceiling/roofs, wall plates. Plumbing, electrical, duct and chimney chases are examples of these leaks. See Figures 6.5, 7.8, 7.11-7.12, 7.14, and 11.1-11.7.
- **Door and window frames**—Rough openings should be sealed to frames with low expansion foam, caulking, or backer rod and caulk. Be careful, even with low expansion foam; if you fill large spaces it can still push out the jambs. To control this, don’t worry about filling the entire space; just bridge the gap between the rough opening and the jamb. See Figures 8.3 and 8.4.
- **At foundation/sill**—The numerous framing members between the top of a foundation wall and the toe plate of the wall above allow significant leakage. The weight of a house is not enough to force these pieces together. Foam “sill seal” between the foundation and sill is commonly used. In addition, seal the band joist area according to Figure 7.1 or 7.2. Note: vertical “steps” in the foundation height (where the grade changes) need special attention to avoid air leakage. Sill sealer will not generally stop air leakage in these locations.
- **Around/behind tubs and showers**—These leaks cause heat loss, and are common causes of comfort complaints and freezing pipes. Bathrooms over garages are especially prone to such problems. See Figures 11.7-11.8.
- **At attic and crawlspace panels**—Attic scuttles, pull-down stairs, access doors through knee walls into unheated attic spaces, and

access from a conditioned basement space into a crawlspace all need weather-stripping as well as insulation. See Figure 11.10.

- **At recessed lights**—The requirements for recessed lights are given on page 83, and Figure 11.9.

Durable caulking, gaskets, tapes and/or housewraps should be used to seal these areas. The code also says to “allow for differential expansion and contraction of the construction materials,” for example where wood, metal, concrete and/or plastic join each other. If you use housewrap for an air barrier, it should be installed according to manufacturer’s instructions. These instructions generally call for careful detailing and taping of all seams, including—but not limited to—the edges around window and door openings, at the sill area, and where exterior walls meet roof lines. Also note that housewrap generally does not address many of the most significant leakage pathways in a house (which are typically found in attics and basements). See page 114 for more information about bulk water control.

ENERGY STAR

Air sealing is an important part of energy efficient construction, but does not neatly fit into any one category of subcontractor. Some air sealing is done most easily by framers as they put the pieces together. Some can be done by drywall crews. Some insulation contractors specialize in air sealing. But it is the builder who is ultimately responsible to see that adequate air sealing is done by the right people at the right times. If planned thoughtfully and done at the right stages of construction, most air sealing can be done with very little added expense. If you pay attention to the air sealing requirements of the energy code, you will already be well on the way to building an ENERGY STAR Labeled New Home.

The concept of air sealing is to provide a continuous air barrier all the way around the house. It does not mean hermetically sealing the building—there will always be leaks and cracks where air can get in and out. It does mean thinking about what material is going to stop indoor air from mixing with outdoor air. See Figure 11.1 for an example of this concept. Note that in all drawings, the dotted line (in color) represents the primary air barrier.

Testing for whole house air leakage, complying with a prescribed maximum air leakage rate, and sealing all major bypasses between conditioned and unconditioned space are all requirements associated with participating in the New York ENERGY STAR Labeled Homes program. The maximum allowable air leakage rate (as determined by a blower door test) is 0.35 natural air changes per hour (ACHnat). The HERS rater who is hired to certify the house typically performs a blower door test at one of the inspections that is performed to verify compliance with ENERGY STAR standards.

Here are some hints to help with air sealing:

- **Get the biggest leaks first.** This may seem obvious but it's not. There's little point in caulking the small cracks or sealing electrical boxes if you have a plumbing chase or floor system that leaves a hole of ten, or twenty, or forty square feet, straight into an attic. A simple rule of thumb is, first seal up the ones you can crawl through. Then seal up the ones a cat can crawl through. Then go after the details.
- **Get the least expensive ones next.** Think about ways that you can build air sealing into tasks you are doing anyway, with materials that are on hand. Some examples: specify drywall adhesive or acoustical sealant on top plates and end studs of partition walls. Specify construction adhesive on all layers of floor framing instead of just the sub-floor. Use leftover scraps of rigid insulation to block off chases or floor cavities. Then, before drywall is hung, have one person go around with a foam gun and seal up all the small wiring and plumbing penetrations in top plates or end studs, as well as the window and door frames. If you do whatever you can in two or three hours, it will make a big difference in most houses.
- **Once the drywall is up, all the leaks become invisible.** They don't go away—they just disappear so you can't see them. Walk through the house before the drywall crew shows up, imagine that only the ceiling sheetrock has been applied and ask yourself, "Can I stick my hand past the sheetrock, through the insulation and into an attic space from here?" Then imagine the sheetrock has been applied only to the walls and ask yourself a similar question: "Can I stick my hand through the insulation to the outside or to an unconditioned space (e.g., a garage) from here?" If the answer to either question is "Yes," then draft stops or blocking should be added before the drywall is hung. It will never happen later. (Of course if you are using "air tight drywall approach" then the drywall itself may be a substantial component of your air barrier. See Figures 11.1-11.3 for more information.)
- **Insulation does not necessarily make a house air tight.** There are some cases however, when it can help. Spray foam, for example, has inherent air sealing characteristics. The use of other insulation systems, such as Structural Insulated Panels (SIPs), Insulated Concrete Forms (ICFs), or (to a lesser extent) damp-spray or dense pack cellulose, can also contribute to a reduction in air leakage. Regardless of the insulation type or system being used, it is essential not to rely entirely on insulation to do the job of air sealing. None of these systems will adequately seal large chases. Care should always be taken to identify and address remaining leakage pathways.

Other Techniques

Much of the focus on building very tight buildings has historically concentrated on interior air barriers, particularly sealing and detailing of polyethylene vapor retarders as the primary air barrier. This should not be done in any house that has air conditioning. Use a material that's already there, such as the drywall or exterior sheathing, as the primary air barrier. The use of "airtight drywall," for example, can significantly enhance the air tightness of a home at little extra cost (see page 109).

What If I Build the House Too Tight?

There is no way to build a house "too tight." Tight is good. You *can* build an underventilated house (see pages 71-74), but not if you put in a ventilation system. Tight houses save the customer money and reduce callbacks, *but you must* install ventilation. Mechanical ventilation is strongly recommended for all new homes because it's the only way to ensure background air change rates, regardless of how tight the house is. And the ventilation air will cost *less to heat than a leaky house*, every time.

Going Further

In addition to energy savings, you get other important advantages by building a tighter house. Tight construction can help reduce:

- **Ice dams**—Most discussion of ice dam prevention concentrates on passive ventilation of the roof sheathing, such as continuous soffit and ridge vents. Ice dams are caused by heat in the attic melting snow from the bottom. Although ventilation does dilute heat that gets into the attic, reducing the *flow* of heat is more important. Sealing up air leaks into the attic is the most important factor in reducing ice dams, followed by keeping HVAC out of the attic, and proper insulation.
- **Moisture in building frame**—Most of the focus on preventing water vapor from getting to cold surfaces (wall sheathing, attic structures, etc.) has traditionally centered on vapor retarders. Vapor retarders are important; but it has been shown that over 100 times more water vapor is carried into these spaces by leaking warm, moist air, than by diffusion. Seal up the air leaks (and install mechanical ventilation) to reduce moisture that causes structural damage and health risks. See EEBA for more on the relationship between vapor diffusion retarders and air flow retarders, and the mechanisms of vapor diffusion.
- **Freezing pipe problems**—Most pipe freeze-ups are a result of moving cold air, not just cold temperatures. Of course it is important to keep pipes on the warm side of insulated assemblies. However, it is

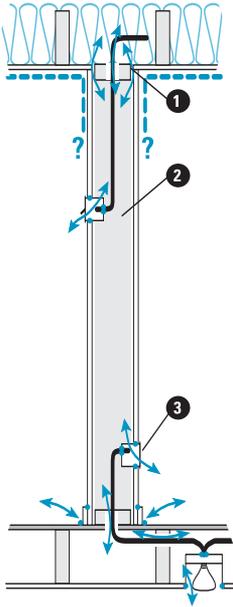
also critical to define a good air barrier and keep the pipes on the “inside.” Many pipe freezes occur in areas such as garage ceilings, kneewall floors, and other places where the air barrier is typically not well defined. See Figures 7.12 and 7.15.

- **Insects and rodents**—Of course air sealing alone won’t keep vermin outside the building, but it will greatly reduce their access to the living space. Be careful about exterior rigid insulation on foundations, which can provide invisible insect access into the house. See page 33.

FIGURE 11.1

Strategic sealing: interior partition wall intersection with attic

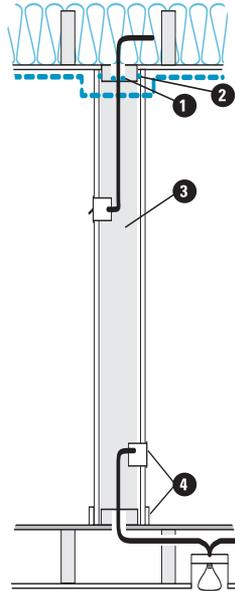
Poorly defined air barrier



A lot of material and effort may be needed with no guarantee that leakage will be stopped.

- ❶ Air barrier is broken at attic/wall intersection. Top plate shrinks away from drywall when wood dries
- ❷ Wall cavity serves as duct linking unconditioned attic to rest of house
- ❸ Many potential air leakage paths. Sealing one may simply shift leakage to another.

Well-defined air barrier



Sealing the top plate, before the drywall is hung, requires little effort and completes the air barrier at the insulated ceiling.

- ❶ Seal top plate penetrations
- ❷ Seal drywall to framing—"airtight drywall approach"
- ❸ "Inside air"
- ❹ No need to seal drywall penetrations in interior wall

FIGURE 11.2

Sealing intersections at the ceiling

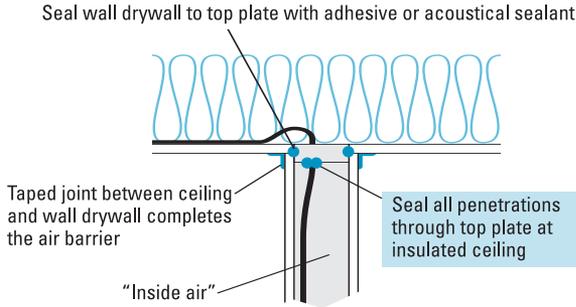
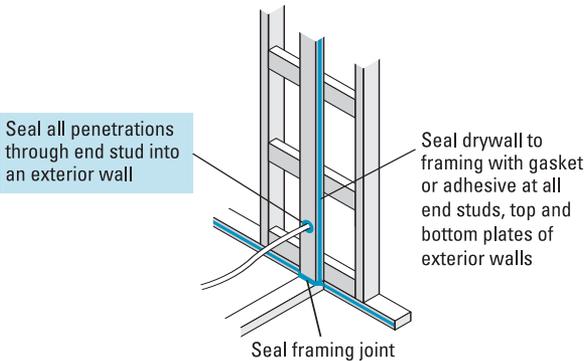


FIGURE 11.3

Sealing intersections at exterior walls



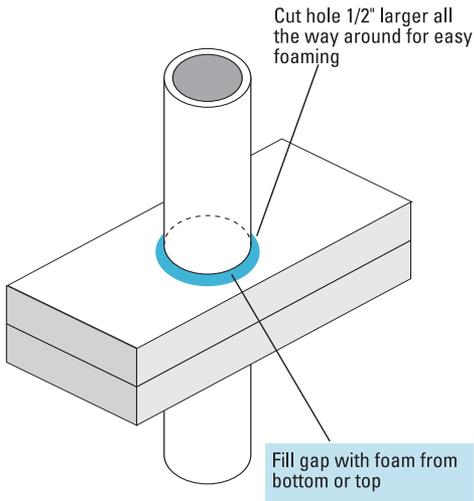
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The sealing techniques shown in Figures 11.1 to 11.3 are the fundamental components of “airtight drywall approach” (which includes airtight or sealed electrical boxes, and carefully sealed band joists as well). Even if you are not using a complete “airtight drywall” system, specifying adhesives at top plates and end studs will significantly reduce air leakage. Be especially careful at the intersections where multiple partition walls meet each other at insulated ceilings.

FIGURE 11.4

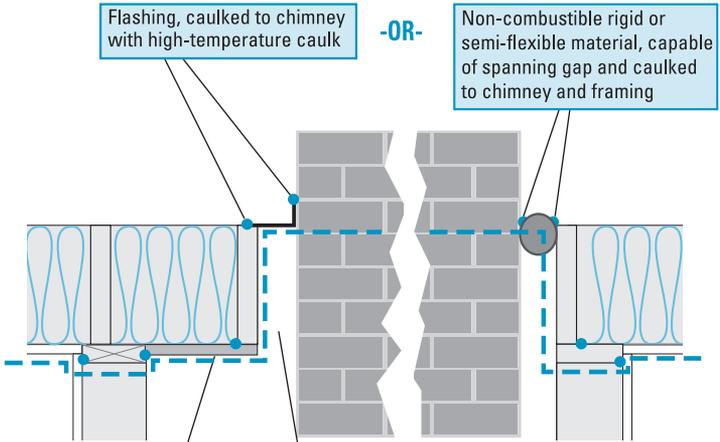
Sealing plumbing vent pipes



Plumbing vent pipes can be sealed with foam from above or below. Long, straight pipe runs may be sealed using a rubber boot or roof boot to address the movement of pipes relative to the framing. This requires coordination with the plumber, to install it as the pipe goes in.

FIGURE 11.5

Chimney Chases



Be careful about sealing joist spaces. If chase goes past first joist, use plywood, drywall, or thin profile structural sheathing to bridge the space between the top plate and the chimney rough opening

2" air space required between chimney and combustible materials

NOTE: Duct chases can be just as large a leak, but ducts can be sealed directly to framing with spray foam.

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Unsealed chimney chases are often one of the largest leaks in a house. Be careful to keep combustible materials at least 2" from the chimney, and use high-temperature silicone caulking or firestop caulk. Many prefabricated chimneys have draft blocking and/or insulation guard kits available to fit them; follow the manufacturer's instructions.

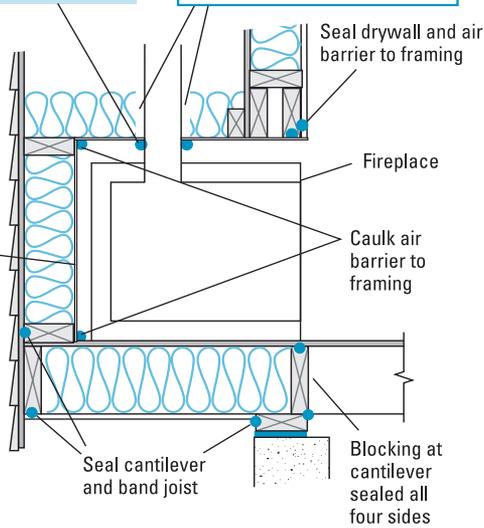
FIGURE 11.6

Air sealing fireplace enclosures

Seal chimney where it penetrates top of enclosure. Use factory-supplied chimney flashing if available.

Allow for required clearance to insulation and combustible materials.

Air barrier (thin profile structural sheathing, plywood, OSB, drywall, sheet metal) installed before fireplace



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TIP: In some instances with complex framing, such as a home entertainment center recessed above the fireplace cavity, it may be simpler to use the exterior sheathing as the air barrier. However, it is still necessary to seal the top of the chase as shown in Figure 11.5.

Be sure to install the air barriers and do the sealing before the fireplace is set in place.

FIGURE 11.7

Boxed-in tub in insulated floor

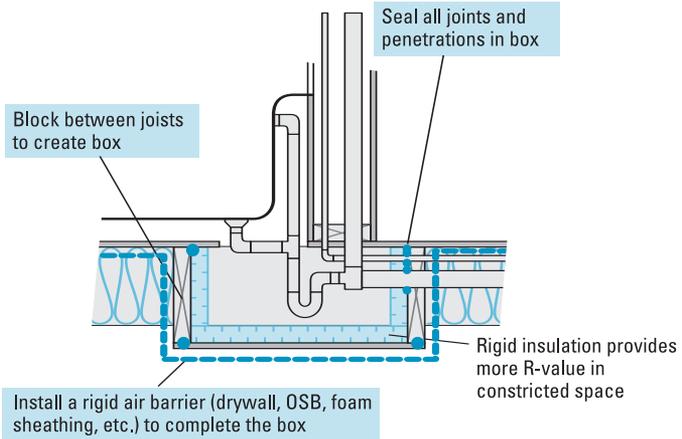
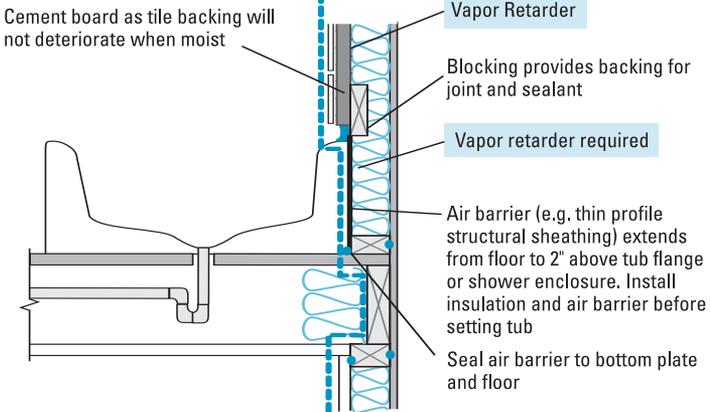


FIGURE 11.8

Sealing tub and shower enclosure



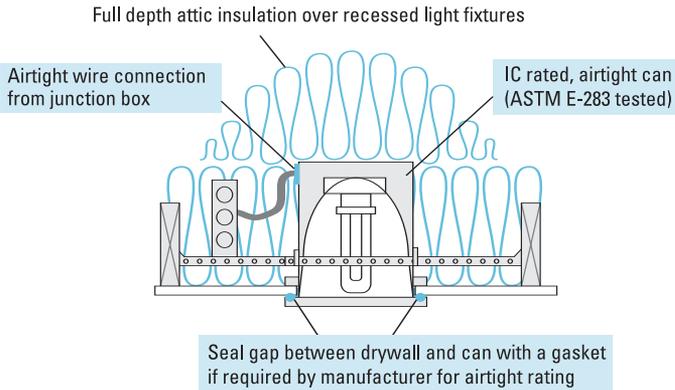
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⚠ CAUTION: Do not use standard or moisture resistant drywall as a tile backing material in this application. They deteriorate when they get wet.

FIGURE 11.9

Recessed lights



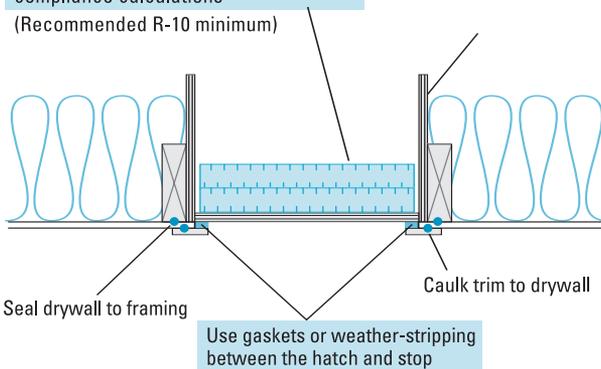
⚠ CAUTION: Recessed lights must be specifically designed for air tightness and for insulation contact. Do not attempt to seal or insulate recessed lights that are not designed for this purpose.

FIGURE 11.10

Attic hatch

Insulate to same R-value as surrounding area, or include actual R-value in compliance calculations
(Recommended R-10 minimum)

Rigid curbs allow full depth insulation up to the hatch



TIP: If the attic is accessed from an unheated space, like a garage, hatch air sealing and insulation are not required.

FIGURE 11.11

Bulkhead door detail

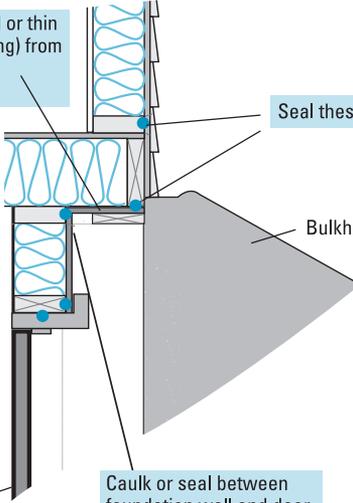
Install draftstop (plywood or thin profile structural sheathing) from top plate of frame wall to exterior sheathing

Seal these points

Bulkhead door

Exterior rated, insulated door

Caulk or seal between foundation wall and door rough opening



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CAUTION: This area may contribute to air leakage even in an uninsulated basement.