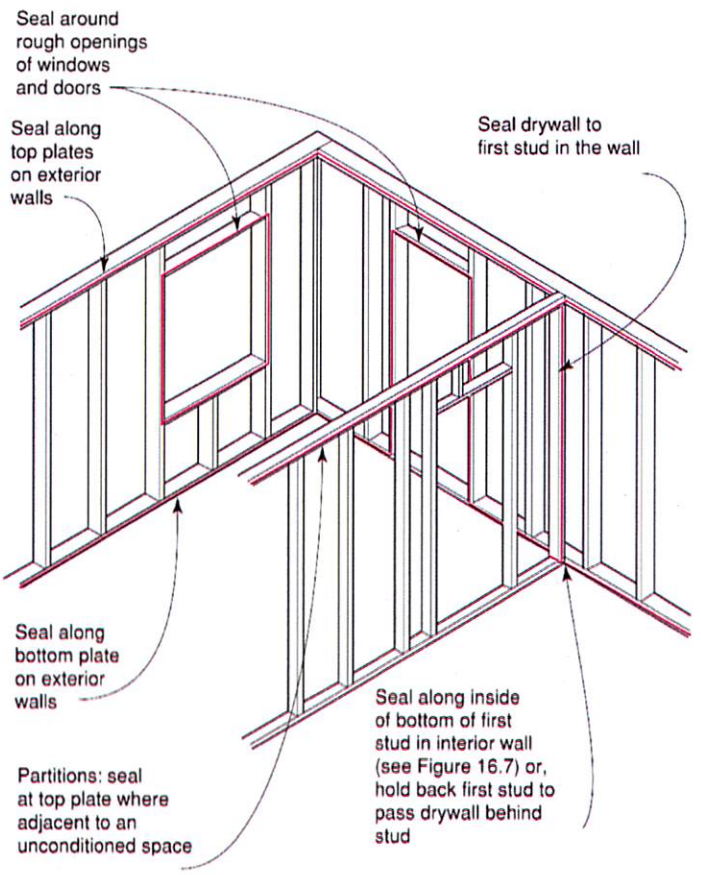
BSC Information Sheet 401

Air Barriers–Airtight Drywall Approach

for All Climates

Sealing Perimeter of Drywall Assemblies



Air Barriers—Airtight Drywall Approach

Gypsum board drywall is, itself, a suitable air barrier material. The taping of drywall seams results in a plane of airtightness at the field of the wall. However, several steps must be taken to use this material property to create a continuous and complete air barrier system. To do this, it is important to create air barrier continuity at the perimeter of drywall assemblies, at all penetrations through the drywall, and, finally, in areas of the enclosure without interior drywall.

Drywall Assembly Perimeter

Air barrier continuity at the perimeter of drywall assemblies is achieved by sealing the edges of the drywall to solid framing materials. This requires a continuous bead of sealant along:

- all exterior wall bottom and top plates,
- all top plates at insulated ceilings,
- rough opening perimeters, and
- both sides of the first interior stud of partition walls.

The air seal at the partition wall intersection is shown in greater detail below.

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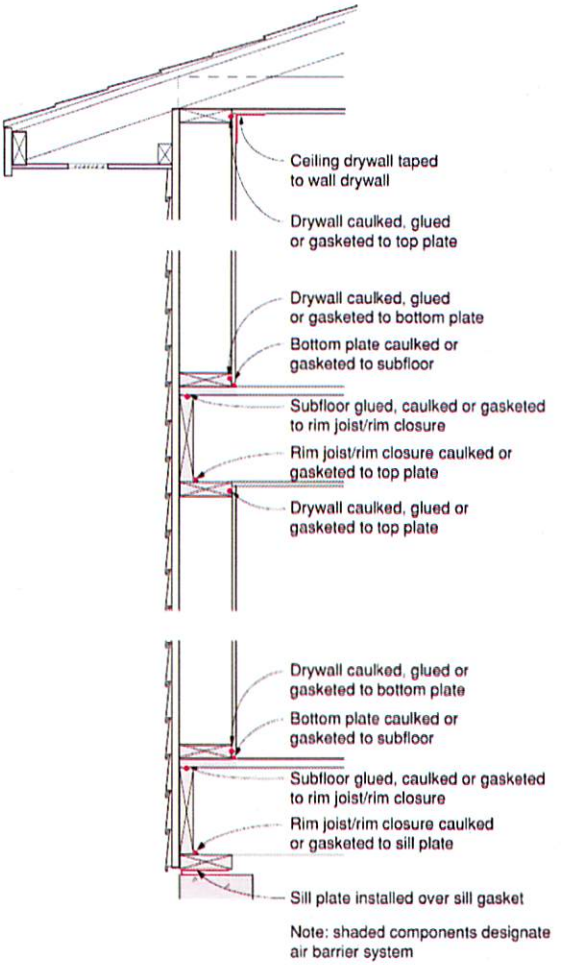
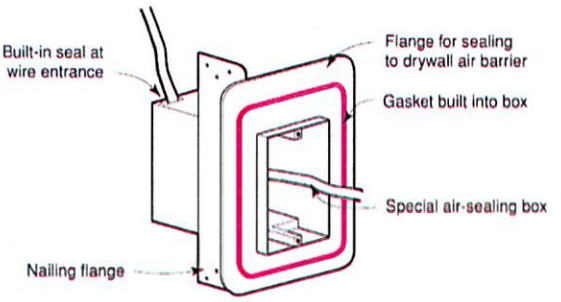
Airtight Drywall Approach – Interior Air Barrier Using Drywall and Framing

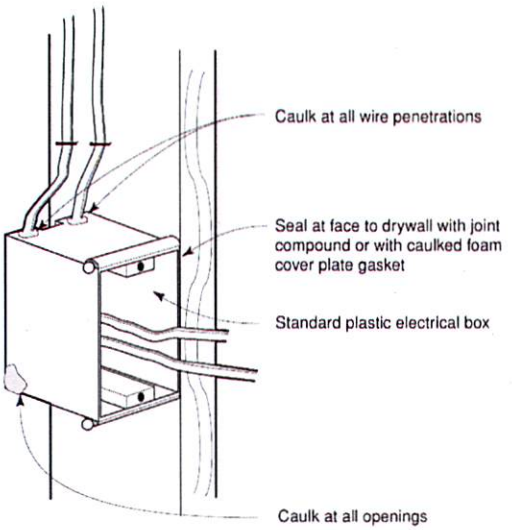


Penetrations of Drywall Assemblies

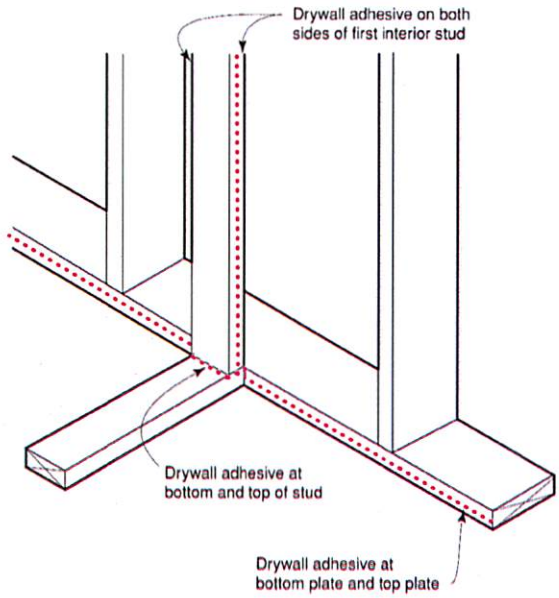
Typical penetrations in exterior wall and ceiling drywall assemblies include electric penetrations – electric boxes and recessed fixtures. Electric boxes can be made air tight by caulking or sealing all openings in the box (including around wire penetrations) and by sealing the face of the box to the drywall. Specially designed airtight electric boxes with flexible boot seals at wire penetrations and a gasketed flange at the face can also provide air barrier continuity.

Electric Box Penetrations



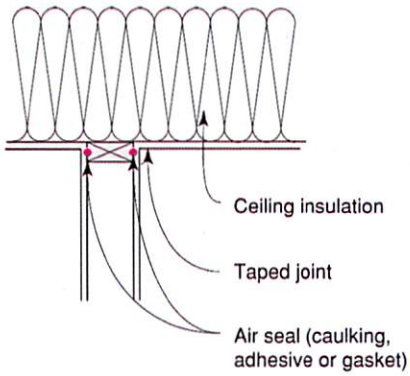


Air Sealing at Partition



- Adhesive at bottom and top of partition stud allows air barrier to transition uninterrupted to other side of partition
- Penetrations through first partition stud must also be sealed

Top Plate with Unconditioned Space Above

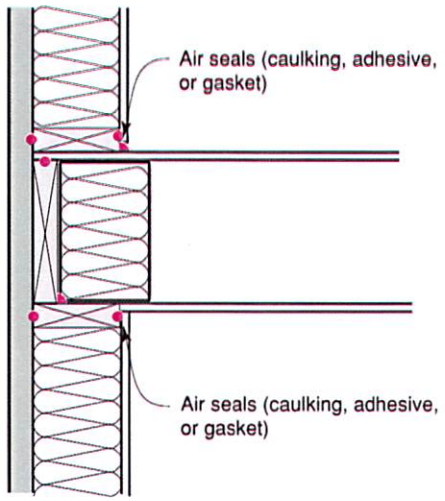


- Penetrations through top plate must also be sealed

Recessed ceiling fixtures in insulated ceiling should be both insulation contact ("IC")- and air tight rated. The housing of the recessed fixture should also be sealed (with caulk or an effective gasket) to the ceiling gypsum board.

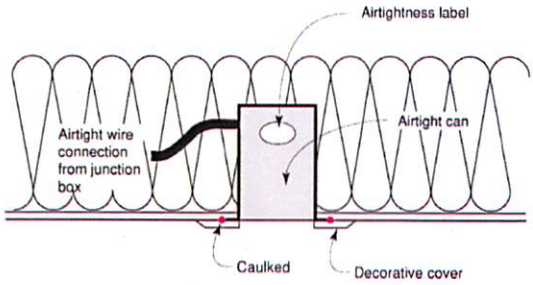
Structural Framing Air Barrier Transitions
Obviously, drywall cannot provide an air barrier where it is absent. The diagrams below and to the right show how the air barrier continuity is maintained through the framing at rim joist/band joist areas. These measures form a necessary complement to drywall sealing in the airtight drywall approach. Refer to other Information Sheets for air sealing details at other common conditions. The resources listed below also illustrate air sealing details and provide further discussion.

Intersection of Floor Joists and Exterior Wall



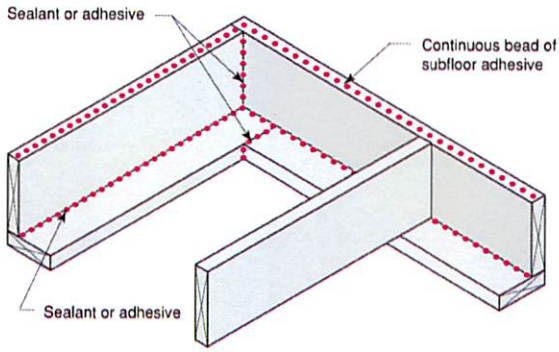
- Drywall sealed to top and bottom plates
- Bottom plate sealed to subfloor
- Subfloor sealed to rim closure board
- Rim closure board sealed to top plate

Recessed Fixture in Insulated Ceiling



- Fixture labeled IC-rated and airtight as determined by ASTM E-283 air leakage test
- Housing (not decorative trim piece) sealed to ceiling with caulk or gasket

Air Barrier Continuity at Rim Joist/Band Joist



- Continuous fillet bead applied at bottom of rim closure board
- Continuous bead of adhesive applied to top of rim closure board
- Sealant applied at all butt joints in rim closure board and sill plate/top plate
- Spray foam may also be used to seal between the sill/top plate, rim/band joist, and floor deck. Note that joints in the sill/top plate may not be sealed by the foam application.

Suggestions for Further Research:

"Understanding Air Barriers", Building Science Digest-104, www.buildingscience.com.

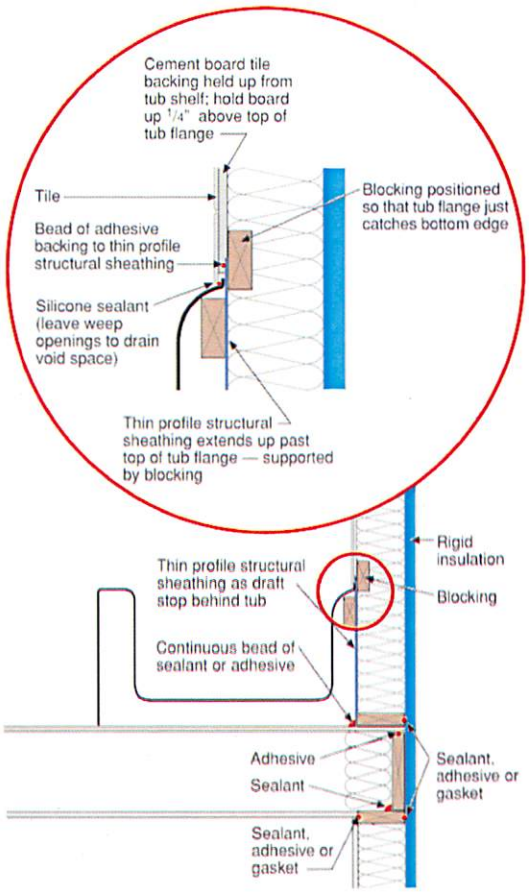
"READ THIS: Before You Design, Build, or Renovate," Building Science Primer-040, www.buildingscience.com.

Lstiburek, Joseph W.; *Builder's Guide Series*, Building Science Press, 2006.

BSC Information Sheet 407

Air Barriers–Tub, Shower and Fireplace Enclosures for All Climates

Draft Stopping and Air Barrier at Tub Enclosure - Section



- Entire perimeter of draft stop material sealed to framing and subfloor with adhesive or sealant
- Seams in draft stop material sealed
- Bottom plate sealed to subfloor
- Flat blocking for draft stop and tub flange support allows cavity insulation to be installed behind draft stop
- Cement board, fiber cement board or paperless gypsum board tile backing is recommended in place of moisture-resistant gypsum board ("green board")
- Note: cement board is not waterproof: it must be coated with a fluid applied waterproofing, or a water resistive barrier applied behind it and drained

Air Barriers—Tub, Shower and Fireplace Enclosures

To create an effective air barrier in a building, it is first necessary to cover the big holes. Some common locations for large holes in the air barrier include bathtubs, showers, fireplace enclosures, and chimneys. Holes behind tub and shower enclosures are common, as these enclosures are often installed before the interior-side air barrier of the exterior wall. Similarly, the enclosure behind a prefabricated fireplace is often left incomplete. Where the chimney flue penetrates through an insulated assembly, it is critical to maintain clearances to combustibles materials. But a non-combustible, airtight closure around this penetration is also important.

Bathtub and Shower Enclosures

The diagrams below and to the right provide an example of draft stopping using thin profile sheathing that is installed before the tub enclosure.

Other air barrier sheathings or membranes may also be used to create an airtight draft stop behind tub and shower enclosures. If spray foam insulation is used to create an air barrier in the framing cavities, the bottom plate must still be sealed to the subfloor.

Fireplace Enclosures

Ideally, chimneys for natural draft fireplaces are located within the interior of the building enclosure. Alternatively, chimney enclosures attached to exterior walls should be insulated full height to keep the chimney flue pipes warm to support sufficient draft.[1] If air barrier continuity is not maintained in the chimney enclosure the chimney could create a serious hole in the building enclosure.

Because finishes are generally brought to the face of prefabricated fireplace units, providing an air barrier in the enclosure behind the

[1] Note: use of sealed combustion, direct vent gas fireplaces eliminates the need for chimneys.

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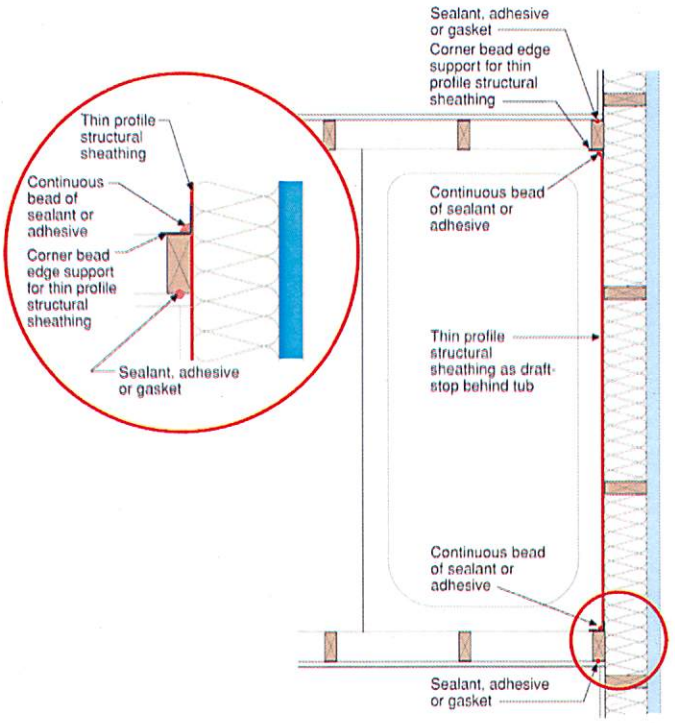
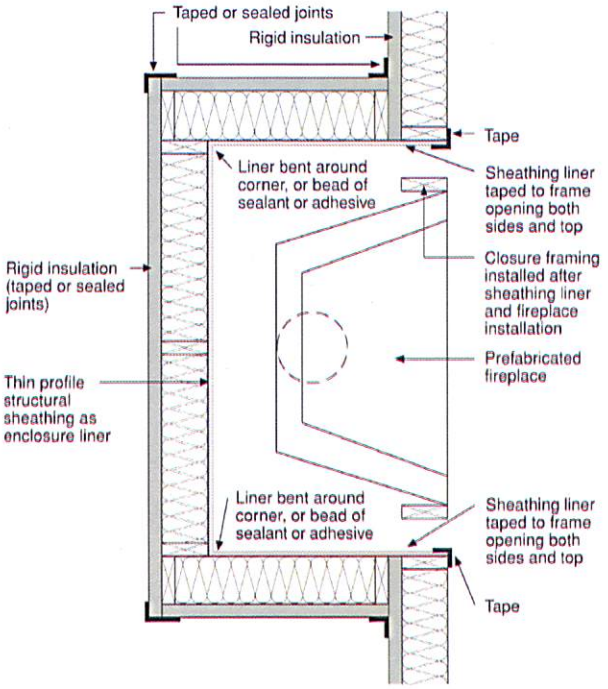
fireplace unit can create a sequencing challenge. The diagrams to the right and on the following page demonstrate one method of maintaining air barrier continuity by installing airtight draft stopping on the inside of the chimney enclosure and by installing an airtight flue closure.

Draft Stopping and Air Barrier at Tub Enclosure - Plan

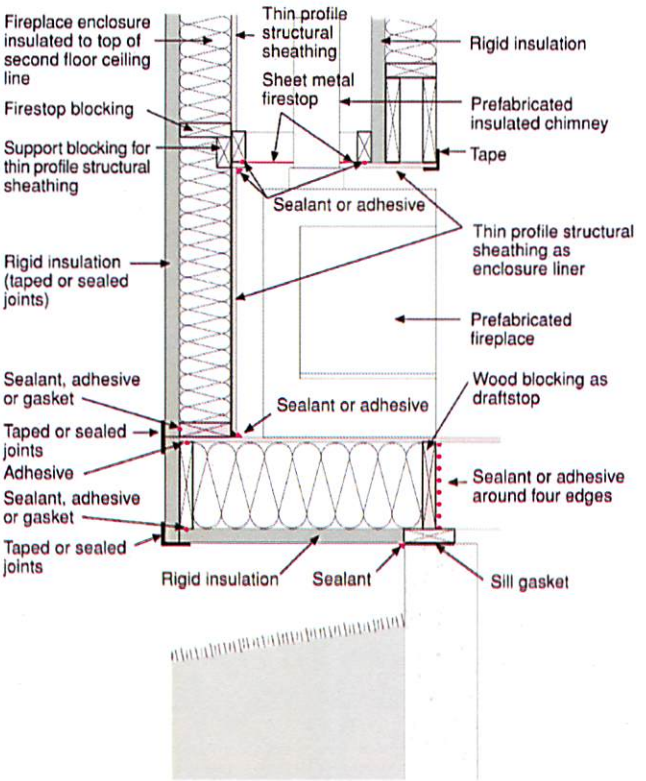


Fireplace Enclosure – Plan



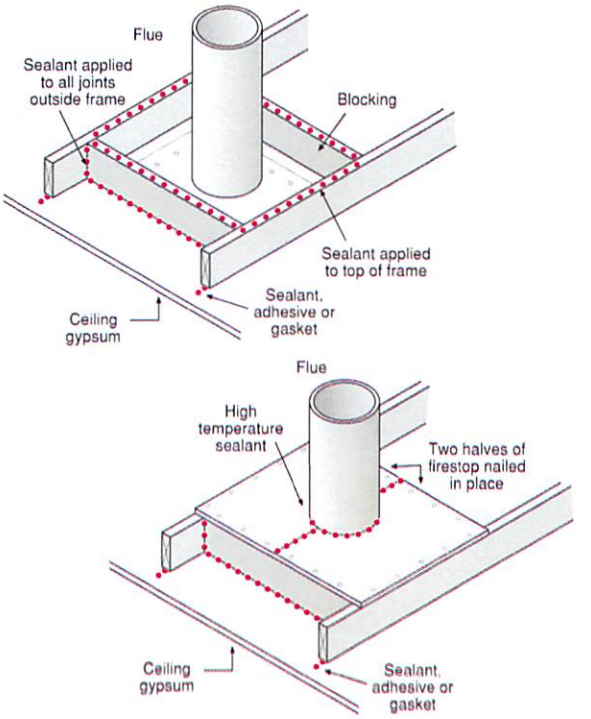
- Clearances around chimney and fireplace unit to be determined by manufacturer's recommendations and local codes
- Exterior combustion air with a damper should be provided to all fireboxes
- Draft stopping material is sealed at perimeter to framing or subfloor
- Seams in draft stopping material sealed

Fireplace Enclosure - Section



- Flue closure needed at top of insulated assembly
- Draft stopping material is sealed at perimeter to framing or subfloor
- Seams in draft stopping material sealed

Flue Closure



- Only approved high temperature sealants to be used at firestopping
- Flue closure also needed at the insulated ceiling for chimneys within the interior of the building enclosure

Suggestions for Further Research:

"Understanding Air Barriers", Building Science Digest-104, www.buildingscience.com.

"READ THIS: Before You Design, Build, or Renovate," Building Science Primer-040, www.buildingscience.com.

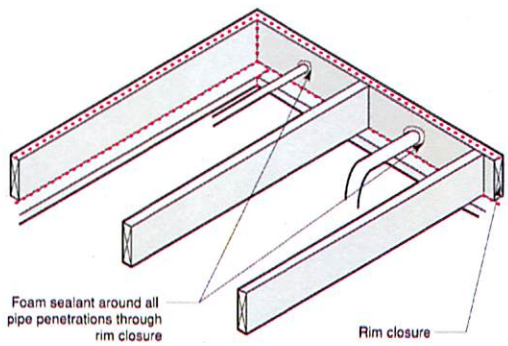
Lstiburek, Joseph W.; *Builder's Guide Series*, Building Science Press, 2006.

BSC Information Sheet 405

Sealing Air Barrier Penetrations

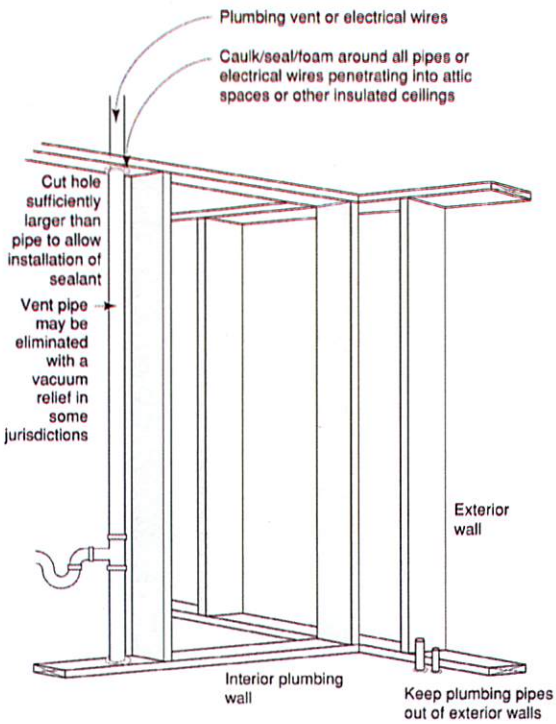
for All Climates

Air Sealing Rim Closure Penetrations



- Penetrating pipes, conduits, ducts, projecting beams etc, are sealed to the air barrier element that they penetrate.

Air Sealing at Vertical Plumbing Penetrations



- Plumbing penetrations through the floor plane are sealed either to the subfloor or to the bottom plate.
- Penetrations through the top plate must also be sealed if the top plate is in the plane of an intended air, smoke or fire separation

Sealing Air Barrier Penetrations

Most air barrier systems will require supplemental air sealing to seal around penetrations. Typical penetrations through the primary components of the air barrier system include plumbing pipes and vents, electrical wires and conduits, electrical fixtures, other mechanical services, and, in some cases, structural members.

Penetrations through Rain Shedding Assemblies

Penetrations through building enclosure elements that also perform rain water management functions must be properly flashed. It is critical that air sealing not interfere with drainage (see Information Sheet 302, and 303).

Typical Plumbing Penetrations within the Building Enclosure

Vertical plumbing runs are typically sealed at the floor plane or bottom plate for floors over unconditioned space or over a separate dwelling unit. While holes to accommodate pipes, conduits and wires represent potential breaches in the air barrier, serious lapses can result from utility chases. Utility chases must be draftstopped wherever these intersect an intended air barrier plane. In colder climates this is also an important freeze-protection measure. Diagrams on the following page illustrate measures to draftstop the utility chase.

While plumbing should not be located in exterior walls, demising walls (or party walls) represent a situation where plumbing may penetration an air barrier assembly laterally. Demising walls should be constructed as airtight assemblies for reasons of sound, smoke, fire and air quality control. Therefore, any penetrations through the drywall surface of demising walls should be sealed air tight. Ensure that the sealant material used complies with any required fire resistance rating and that it is compatible with the pipe, conduit or wire materials.

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Sealing penetrations for sprinkler heads requires special attention as the air sealing must not interfere in anyway with operation of the fire suppression system. The air seal should be between the pipe and the air barrier, not between the sprinkler head itself and the air barrier.

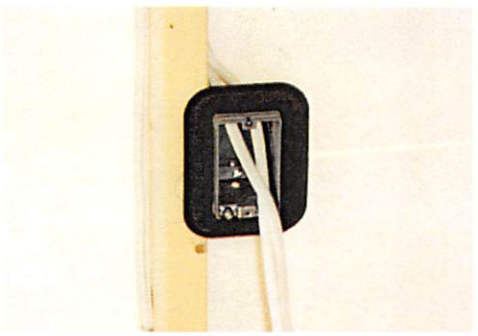
Typical Electrical Penetrations within the Building Enclosure

Vertical wiring or conduit runs are typically sealed at the floor plane or bottom plate for floors over unconditioned space or over a separate dwelling unit (i.e., similar to vertical plumbing runs described above). Holes to accommodate electrical services must also be sealed where interior partitions intersect an exterior wall or demising wall.

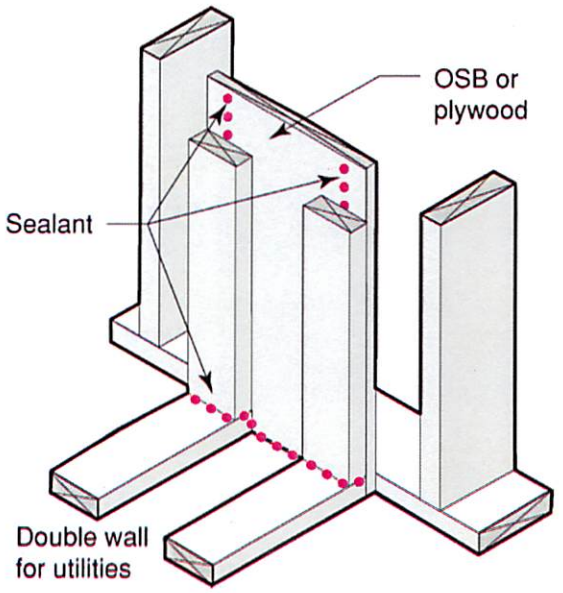
Typical penetrations in exterior wall, demising wall and ceiling drywall assemblies include electric penetrations – electric boxes and recessed fixtures.

Electric boxes can be made air tight by caulking or sealing all openings in the box (including around wire penetrations) and by sealing the face of the box to the drywall. Specially designed airtight electric boxes with flexible boot seals at wire penetrations and a gasketed flange at the face can also provide air barrier continuity.

Gasketed Electric Box

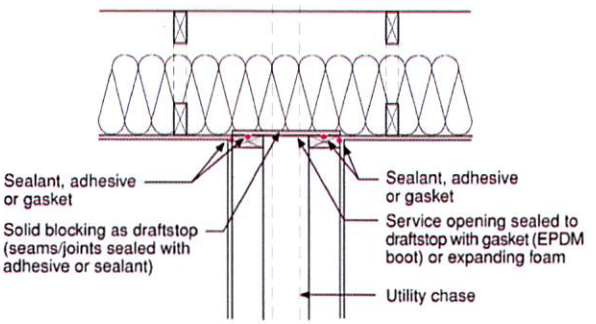


Draftstop of Utility Chase at Exterior Wall or Demising Wall



- Solid draftstop material sealed to framing to isolate utility chase cavity

Utility Chase at Insulated Ceiling

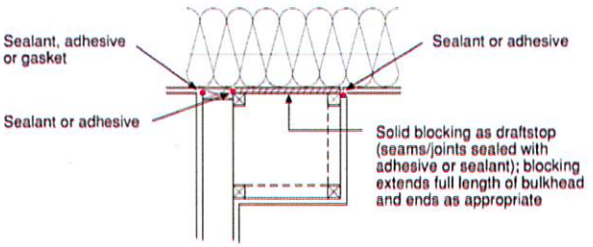


- Flexible gasket sealed to top plate or other solid blocking allows movement of penetrating element without loosing the air seal

Recessed ceiling fixtures in insulated ceiling should be both insulation contact ("IC")- and air tight rated. The housing of the recessed fixture should also be sealed (with caulk or an effective gasket) to the ceiling gypsum board.

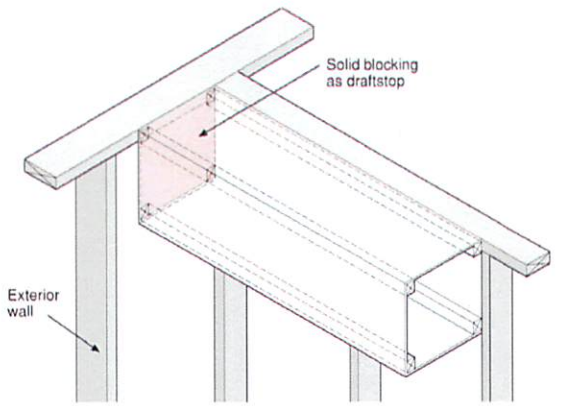
Interior soffits that are not constructed entirely inside of the air barrier may result in lapses in the air barrier if not treated properly. In terms of air barrier performance, such soffits are similar to utility chases: they must be thoroughly draftstopped wherever these intersect an intended air barrier plane.

Interior Soffit at Ceiling Air Barrier



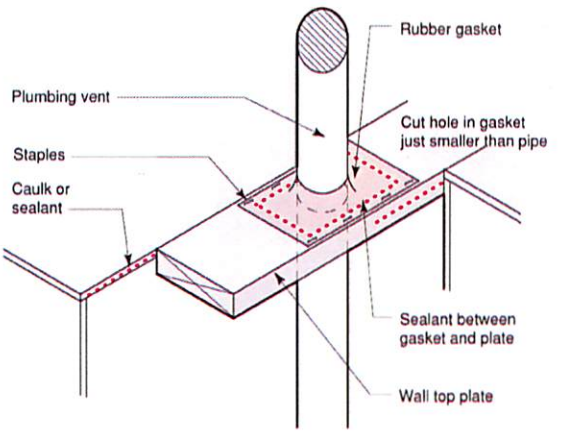
- Solid draftstop material is sealed to framing and surrounding air barrier material.
- Alternatively, the soffit may be constructed after the sealing gypsum board is installed and sealed

Interior Soffit at Exterior or Demising Wall



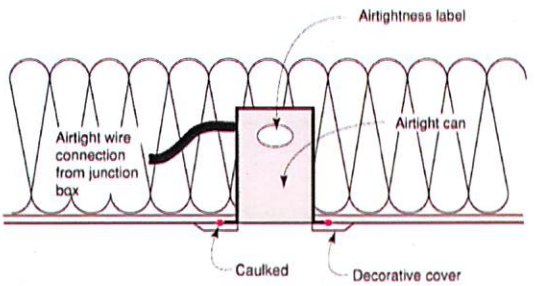
- Solid draftstop material is sealed to framing and surrounding air barrier material.
- Alternatively, the soffit may be constructed after the sealing gypsum board is installed and sealed

Plumbing Penetration through Top Plate with Unconditioned Space Above



- Flexible gasket sealed to top plate or other solid blocking allows movement of penetrating element without loosing the air seal

Recessed Fixture in Insulated Ceiling



- Fixture labeled IC-rated and airtight as determined by ASTM E-283 air leakage test
- Housing (not decorative trim piece) sealed to ceiling with caulk or gasket

Suggestions for Further Research:

"Understanding Air Barriers", Building Science Digest-104, www.buildingscience.com.

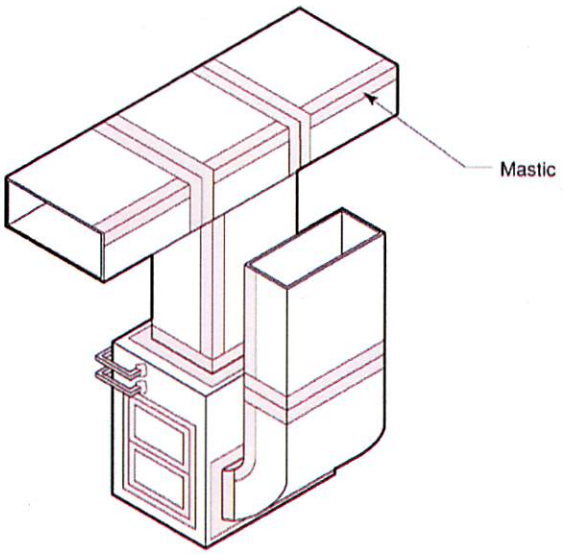
"READ THIS: Before You Design, Build, or Renovate," Building Science Primer-040, www.buildingscience.com.

Lstiburek, Joseph W.; *Builder's Guide Series*, Building Science Press, 2006.

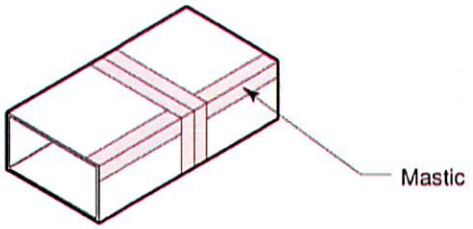
BSC Information Sheet 603

Duct Sealing
for All Climates

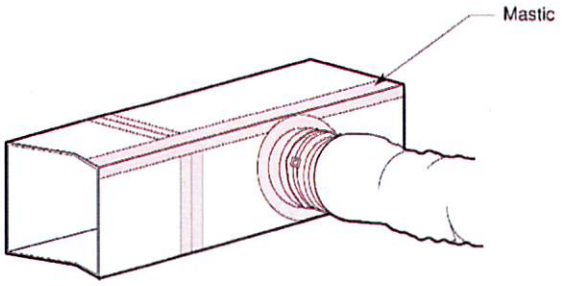
Air Handler Air Sealing



Rigid Duct Air Sealing



Flex Take-off from Rigid Air Sealing



Duct Sealing

Ductwork, furnaces and air handlers should be sealed against air leakage. The only place air should be able to leave the supply duct system and the furnace or air handling unit is at the supply registers. The only place air should be able to enter the return duct system and the furnace or air handling unit is at the return grilles. A forced air system should be able to be pressure tested the way a plumber pressure tests a plumbing system for leaks. Builders don't accept leaky plumbing systems, so they should not accept leaky duct systems.

Supply systems should be sealed with mastic in order to be airtight. All openings (except supply registers), penetrations, holes and cracks should be sealed with mastic or fiberglass mesh and mastic. Fabric/rubber duct tape (common duck tape developed for temporary repair of cotton duck tarps and raingear has thousands of uses. Sealing ducts is not one of them) should not be used: after hot and cold cycling, the adhesive dries out and fails. Tapes meeting UL 181A or 181B may provide reasonable performance. These must be applied only to clean, dry, and dust-free surfaces. Sealing of the supply system includes sealing the supply plenum, its attachment to the air handler or furnace, and the air handler or furnace itself. Joints, seams and openings on the air handler, furnace or ductwork near the air handler or furnace should be sealed with both fiberglass mesh and mastic due to greater local vibration and flexure.

Return systems should be "hard" ducted and sealed with mastic in order to be airtight. Building cavities should never be used as return ducts. Stud bays or cavities should not be used for returns. Panned floor joists should not be used. Panning floor joists and using stud cavities as returns leads to leaky returns and the creation of negative pressure fields within interstitial spaces. Carpet dustmarking at baseboards, odor problems, mold problems and pollutant transport problems typically occur when building cavities are used as return ducts.

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The longitudinal seams and transverse joints in sheet metal ducts should be sealed. The inner liner of insulated plastic flex duct should be sealed where flex ducts are connected to other ducts, plenums, junction boxes and boots/registers.

The recommended procedure to connect insulated flex duct to a metal collar is as follows:

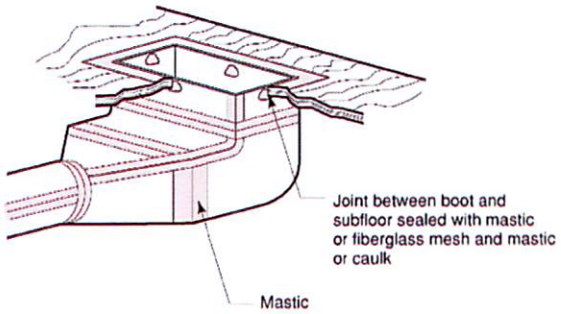
1. brush a thick coat of mastic around the collar;
2. slide the inner liner over the collar;
3. tie wrap the collar with a tensioning tool (not just by hand);
4. pull the outside liner over the boot;
5. tape the outside liner to the boot with appropriate tape;
6. brush mastic over the tape bridging from the outside liner vapor barrier to the vapor barrier of the boot.

When flex ducts are used, care must be taken to prevent air flow restriction such as those resulting from "pinching" ducts or from kinks caused by bending them at a tight radius.

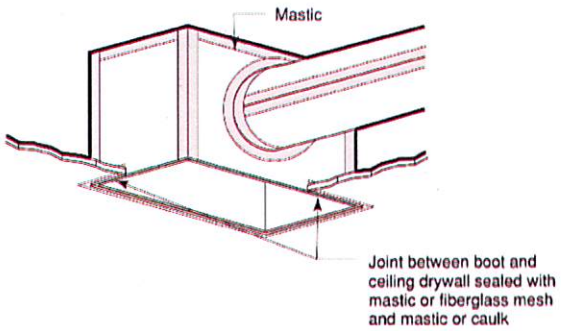
Connections between grilles, registers and ducts at ceilings, floors or knee walls typically leak where the boot does not seal tightly to the grille or gypsum board. Air from the attic, basement, or crawlspace can leak in or out where the ducts connect to the boot.

If the gap between boots and gypsum board opening or subfloor openings is kept to less than 3/8-inch, a bead of sealant or mastic may be used to seal the gap. Where gaps are larger than 3/8-inch, fabric and mastic should both be used. The optimum approach is to keep the gaps to less than 3/8-inch and use a bead of sealant. This requires careful coordination with the drywall contractor to make sure that the rough openings for the boots are cut no more than 3/8-inch bigger than the actual boot size on all sides.

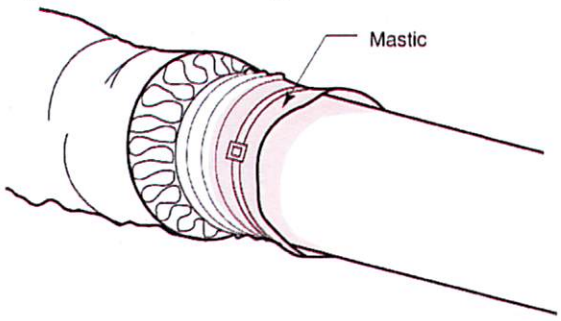
Floor Boot Air Sealing



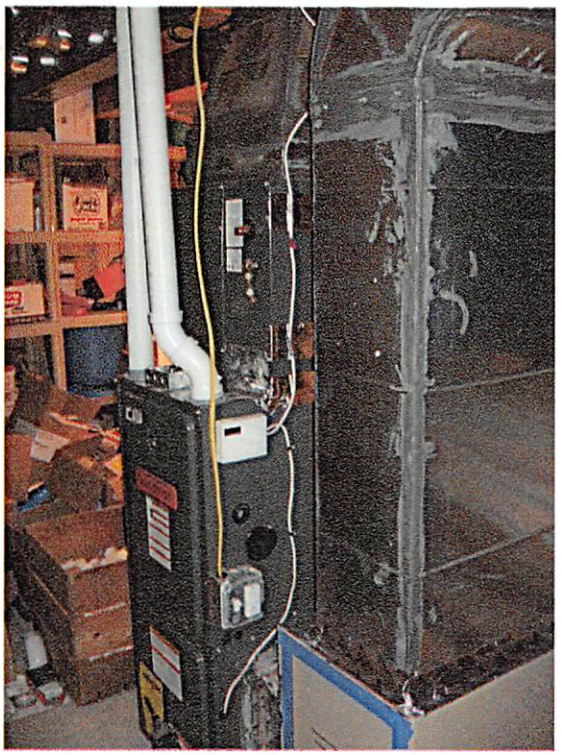
Ceiling Boot Air Sealing



Rigid to Flex Air Sealing



Retrofit Sealing of Air Handler and Plenum



Metal duct system with mastic joints

Suggestions for Further Research:

Frequently Asked Questions. RCD Corporation, www.rcdmastics.com/faq.asp