Pipes in Exterior Walls

Last Updated: 06/04/2014

Scope

Insulate all pipes located in exterior walls.

Insulate all hot and cold water supply pipes.

Avoid locating water pipes in exterior walls. If pipes must be located in exterior walls, in addition to insulating the pipe, ensure that as much cavity insulation as possible is installed between the pipe and the outer surface of the wall.

Zero Energy Ready Home Notes

Homes that will be certified through the DOE Zero Energy Ready Home program must also be certified as meeting EPA’s Indoor airPLUS criteria. EPA’s Indoor airPLUS requires that any water supply pipes located in exterior walls be insulated with pipe wrap.

See the Compliance Tab for related codes and standards requirements, and criteria to meet national programs such as DOE’s Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.
Description

Insulating water pipes can save energy by minimizing heat loss through the piping. Insulating pipes will reduce the risk of condensation forming on the pipes, which can lead to mold and moisture damage. Pipe insulation can protect the pipes from freezing and cracking in the winter, which can cause considerable damage in the walls of the home and result in significant home repair bills for the homeowner. Studies by DOE’s Building America program have shown that distribution heat loss in uninsulated hot water pipes can range from 16% to 23% depending on the climate. Adding 3/4 inch pipe insulation can cut overall water heating energy use by 4% to 5% annually (Backman and Hoeschele 2013).

The best practice for builders and designers is to avoid running water pipes in exterior walls or through unheated attics. It is preferable to design the home so that plumbing fixtures align with interior walls. If pipes must be run in exterior walls, the pipes should be insulated. To further protect the pipes from heat loss, the wall cavity containing the pipes should be air sealed by caulking or foaming all seams between the back wall of the cavity and the framing and by sealing any holes through the framing for the piping. In addition, cavity insulation should be installed behind the pipes, between the pipes and the exterior wall.

If a house has a hydronic (steam or hot water) heating system, heat loss can be reduced by as much as 90% by insulating the steam distribution and return pipes (DOE 2006). In a retrofit of a 19-unit multifamily housing building in Chicago with a central boiler, all of the accessible hot water heating pipes were insulated. (See Figure 1 and Figure 2.) Insulating the pipes with 1 inch of jacketed fiberglass cost $4,720 but the building owners estimated energy cost savings of nearly $2,300 per year, for a 2.1-year payback (Farley and Ruch 2013).
Pipe insulation is available in several forms: tubular pipe sleeves, spiral insulation wrap, and fiberglass batts that can be taped around the pipes. If properly installed, all three can be effective.

Tubular pipe sleeves are made from flexible closed-cell polyethylene or neoprene foam and come pre-cut with a lengthwise seam for easy installation. Some pipe coverings come with adhesive strips already adhered to both sides of the slit. Just peel off the plastic coverings and press together. There are different diameters of sleeves available to accommodate the varying sizes of pipes, so measure pipes before purchasing and match the pipe’s outside diameter to the pipe sleeve’s inside diameter to ensure a snug fit.

Spiral insulation wrap can be made of fiberglass, foil, or polyethylene foam. Simply unroll the material and wrap it around the hot and cold water pipes. Pipes can also be wrapped with fiberglass insulation. The fiberglass may come with a vapor barrier facing on one side or the plastic can be purchased and wrapped around the pipes after the fiberglass insulation is installed. Be sure to wear gloves, goggles, and a dust mask when installing fiberglass.

**How to Insulate Pipes Using Tubular Foam Sleeves**

1. Cut the pipe sleeve to length and wrap it around the pipe, with the slit facing down, making sure there are no gaps between sleeves. To cover bends in the pipe, make a joint at the elbow and angle the ends of the foam to form a mitered corner that fits the angle of the pipe.
2. Remove the paper strips covering the self-sealing, pre-glued seam and press the edges together.
3. Tape over the seams and joints with acrylic or aluminum foil tape to increase durability.
4. Use wire, tape, a plastic tie, or metal clamp to secure the insulation (and plastic covering) to the pipe every 1 to 2 feet.
5. Use caulk or foam to seal any holes where the pipes penetrate walls, floors, ceilings, or framing.
6. If pipes run through exterior wall cavities, insulate the wall cavity just as you would the other cavities if using blown cellulose, fiberglass, or spray foam, which will easily fill in the space behind the pipes. If using fiberglass or mineral wool batts, split the batt lengthwise. Slide half the batt behind the pipes and fit into the cavity. Fit the remainder of the batt in front of the pipes to fill the cavity. Alternatively, cut a piece of rigid foam to fit the wall cavity dimensions. Run a bead of foam adhesive around the back of the foam, slide it behind the pipe and press it into place to seal it to the back wall of the cavity. Use caulk or canned foam to air seal the edges to the framing of the cavity. Lay a split batt over the front of the pipes.

**How to Insulate Pipes Using Spiral Wrap or Fiberglass Batts**

1. Secure the end of the spiral wrap or fiberglass batt on the pipe with tape.
2. Wrap the insulation around the pipe in a spiral fashion, overlapping each successive layer by a ½-inch for tape or half the width of the batt insulation. Wrap batts as loosely as possible, because compressing them will reduce their R-value.
3. If using fiberglass insulation without a moisture barrier, wrap plastic around the insulated pipe and seal with tape to keep the insulation from getting wet.
4. Use wire, tape, a plastic tie, or metal clamp to secure the insulation (and plastic covering) to the pipe every 1 to 2 feet to keep the insulation from sliding.

5. Use caulk or foam to seal any holes where the pipes penetrate walls, floors, ceilings, or framing.

6. If pipes run through exterior wall cavities, insulate the wall cavity just as you would the other cavities if using blown cellulose, fiberglass, or spray foam, which will easily fill in the space behind the pipes. If using fiberglass or mineral wool batts, split the batt lengthwise. Slide half the batt behind the pipes and fit into the cavity. Fit the remainder of the batt in front of the pipes to fill the cavity. Alternatively, cut a piece of rigid foam to fit the wall cavity dimensions. Run a bead of foam adhesive around the back of the foam, slide it behind the pipe and press it into place to seal it to the back wall of the cavity. Use caulk or canned foam to air seal the edges to the framing of the cavity. Lay a split batt over the front of the pipes.

Figure 4. Wrap the insulation around the pipe in a spiral fashion, overlapping each successive layer.

Figure 5. Wrap batt insulation around pipe loosely enough not to compress the insulation and secure with wire or tape.

How to Insulate Steam Pipes

1. Measure the length of the pipe you are insulating and cut the fiberglass sleeve to match. Any surface over 120°F should be insulated, including boiler surfaces, steam and condensate return piping, and fittings. Use 1-inch-thick, heavy-density, resin-bonded fiberglass sleeves approved for steam or hot water heating systems, since other forms of insulation can melt.

2. Open the pre-cut fiberglass sleeve by pulling on the release strip.

3. Fit the sleeve around the pipe and align the self-sealing lap over the sleeve.

4. Seal by rubbing firmly on the adhesive strip to seal the lap to the sleeve.

5. Wrap high-temperature tape around the pipe where two sleeves meet.

6. Install removable insulation jackets on elbows, tees, and other pipe fittings.

7. Use caulk or foam to seal any holes where the pipes penetrate walls, floors, ceilings, or framing.

8. If pipes run through exterior wall cavities, insulate the wall cavity just as you would the other cavities if using blown cellulose, fiberglass, or spray foam, which will easily fill in the space behind the pipes. If using fiberglass or mineral wool batts, split the batt lengthwise. Slide half the batt behind the pipes and fit into the cavity. Fit the remainder of the batt in front of the pipes to fill the cavity. Alternatively, cut a piece of rigid foam to fit the wall cavity dimensions. Run a bead of foam adhesive around the back of the foam, slide it behind the pipe and press it into place to seal it to the back wall of the cavity. Use caulk or canned foam to air seal the edges to the framing of the cavity. Lay a split batt over the front of the pipes.
Figure 6. High-density fiberglass pipe insulation comes with a vapor barrier cover and self-adhesive seam.
Ensuring Success

Avoid installing pipes in exterior walls. If they must be placed in exterior walls, ensure that the pipes are insulated and that adequate cavity insulation is installed behind the pipes. Air seal the wall cavity to prevent cold air from flowing around the pipes.
Climate

In cold climates, avoid putting pipes in unconditioned attics. Avoid putting pipes in exterior walls.
Training

Right and Wrong Images
None Available
Compliance

The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

Zero Energy Ready Home

Homes that will be certified through the DOE Zero Energy Ready Home program must also be certified as meeting EPA’s Indoor airPLUS criteria. EPA’s Indoor airPLUS requires that any water supply pipes located in exterior walls be insulated with pipe wrap.

2009 IECC

Table 402.4.2 Plumbing and wiring – Insulation is placed between outside wall and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.

R403.3: Mechanical system piping capable of carrying fluids above 105°F or below 55°F should be insulated to at least R-3.

403.4: Water piping for hot water recirculating systems should be insulated to at least R-2.

2012 IECC

Table 402.4.1.1 Plumbing and wiring – Batt insulation should be cut to fit around wiring and plumbing in exterior walls; insulation that conforms to the space should fill in the space behind the piping and wiring.

R403.3 Mechanical system piping capable of carrying fluids above 105°F or below 55°F shall be insulated to a minimum of R-3.

R403.4.2 Hot water pipe should be insulated to at least R-3 if it meets any of the following conditions: is in unconditioned space, is larger than ¾ inch diameter, serves more than one dwelling, runs from the water heater to the kitchen, runs from the water heater to a distribution manifold, is located under the floor slab, is buried, is used in a recirculation system other than a demand recirculation system, or exceeds the following maximum run length from the distribution manifold to the point of use: 30 feet for 3/8 inch pipe, 20 ft for ½ in., 10 ft for ¾ in., or 5 ft for >3/4 in.

2015 and 2018 IECC

Table 402.4.1.1 Plumbing and wiring – Batt insulation should be cut to fit around wiring and plumbing in exterior walls; insulation that conforms to the space should fill in the space behind the piping and wiring.

R403.4 Mechanical system piping capable of carrying fluids above 105°F or below 55°F shall be insulated to a minimum of R-3.

R403.5.3 Hot water pipe should be insulated to at least R-3 if it meets any of the following conditions: is in unconditioned space, is larger than ¾ inch diameter, serves more than one dwelling, runs from the water heater to a distribution manifold, is located under the floor slab, is buried, is used in a recirculation system other than a demand recirculation system.


Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)
## More Info.
Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our [webmaster](mailto:webmaster@yourdomain.com) if you find broken links.

### Case Studies
None Available

### References and Resources*

<table>
<thead>
<tr>
<th>Reference Code</th>
<th>Title</th>
<th>Author(s)</th>
<th>Organization(s)</th>
<th>Publication Date</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>2009 IECC - International Energy Conservation Code</td>
<td>International Code Council</td>
<td>ICC</td>
<td>January, 2009</td>
<td>Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.</td>
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<tr>
<td>3.</td>
<td>2015 IECC - International Energy Conservation Code</td>
<td>International Code Council</td>
<td>ICC</td>
<td>May, 2014</td>
<td>Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.</td>
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<tr>
<td>4.</td>
<td>2018 IECC - International Energy Conservation Code</td>
<td>International Code Council</td>
<td>ICC</td>
<td>November, 2017</td>
<td>Code establishing a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.</td>
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<tr>
<td>7.</td>
<td>Mechanical Insulation Design Guide - Installation</td>
<td>NMIC</td>
<td>NMIC</td>
<td>April, 2012</td>
<td>Web resource that lays out the pre-work considerations, methods and finishes for installing mechanical insulation.</td>
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Validation of a Hot Water Distribution Model Using Laboratory and Field Data

Author(s): Backman, Hoeschele
Organization(s): ARBI, Davis Energy Group
Publication Date: July, 2013

Research study comparing TRNSYS Type 604 pipe model against laboratory pipe heat loss test data and detailed field monitoring data.

*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

Contributors to this Guide
The following authors and organizations contributed to the content in this Guide.

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