



**Pennsylvania's  
ALTERNATIVE  
Residential  
Energy  
Provisions**

**2006**





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Residential  
Energy  
Provisions**

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## Preface

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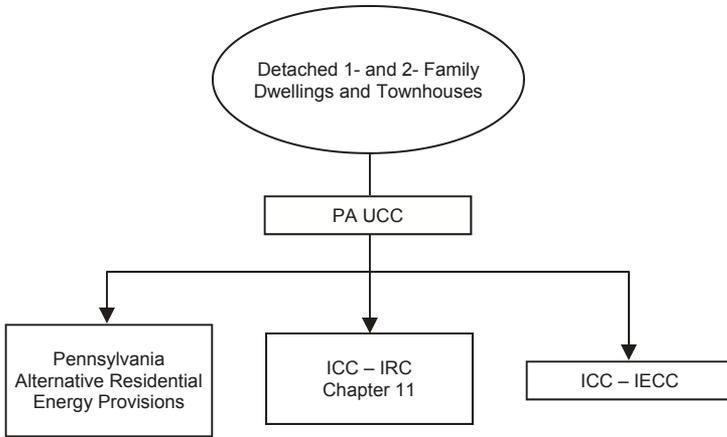
In November 1999, the Pennsylvania Legislature passed ACT 45, known as the Uniform Construction Code (UCC), into law mandating a statewide building code across Pennsylvania. Act 45 requires the Pennsylvania Department of Labor and Industry (DLI) to promulgate regulations to implement the requirements of the legislation and, in addition, to consider the development of alternative prescriptive methods for energy conservation that account for the various climatic regions within the Commonwealth. In deriving these energy standards, the DLI was to seek to balance energy savings with initial construction costs.

The PHRC developed *Pennsylvania Alternative Residential Energy Provisions* (PA-Alt) for consideration by DLI to meet their legislated mandate. The PA-Alt was developed with the intent of being:

- simpler to build to and easier to enforce;
- more rational and flexible;
- focused on Pennsylvania in terms of climatic and other conditions; and,
- equivalent to the International Energy Conservation Code (IECC).

The initial version of the PA-Alt was developed in 2000 and was based on the 2000 IECC and IRC. The second version was updated to the 2003 IECC. This document is the third reiteration of the PA-Alt and is equivalent to the 2006 IECC.

This PA-Alt document is just that: an alternative to Chapter 11 of the IRC. It is intended to supplement the IRC and, as far as possible, to be consistent in format and general intent. The scope and definitions used in the IRC apply. The flowchart that follows illustrates how this proposed alternative path fits into the overall regulatory structure for Pennsylvania's UCC. It is important to note that a choice needs to be made by the builder or design professional between the PA-Alternative, the IRC and, the IECC.



**Flowchart showing the various Regulatory Paths for Space Conditioning Energy Compliance**

Financial support for work on the development of Pennsylvania's Alternative Residential Energy Provisions was provided by the Commonwealth of Pennsylvania through the Pennsylvania Department of Community and Economic Development, the Hankin Endowment, the Pennsylvania State University and the members of the PHRC.

This alternative was developed by the PHRC as a service to DLI on behalf of all the consumers of housing in Pennsylvania.

Mark R. Fortney  
Director

## SECTION PA100 ADMINISTRATION

**PA101 Scope.** The provisions of this document regulates the energy efficiency for the design and construction of buildings regulated by the International Residential Code (IRC).

**Exception:** Portions of the building envelope that do not enclose conditioned space.

**PA102 Compliance.** Compliance shall be demonstrated by either meeting the requirements of this document or the International Residential Code (IRC) or the International Energy Conservation Code (IECC) adopted by the Commonwealth of Pennsylvania.

**PA103 Identification.** Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

**PA104 Building thermal envelope insulation.** An *R*-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches (305 mm) or more wide. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the area covered and *R*-value of installed thickness shall be listed on the certificate. The insulation installer shall sign, date and post the certificate in a conspicuous location on the job site.

**PA104.1 Blown or sprayed roof/ceiling insulation.** The thickness of blown in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 ft<sup>2</sup> (28 m<sup>2</sup>) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) high. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be listed on the certificate provided by the insulation installer.

**PA104.2 Insulation mark installation.** Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

**PA105 Fenestration product rating.** *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Products lacking such a labeled *U*-factor shall be assigned a default *U*-factor from IRC 2006 Tables N1101.5(1) and N1101.5(2). The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer.

**PA106 Installation.** All materials, systems and equipment shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

**PA106.1 Protection of exposed foundation insulation.** Insulation applied to the exterior of basement walls, crawl space walls, and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (152 mm) below grade.

**PA107 Above code programs.** The building official or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this chapter. Buildings approved in writing by such an energy efficiency program shall be considered in compliance with this document.

**PA108 Certificate.** A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall be completed by the builder or registered design professional. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and/or floor) and ducts outside conditioned spaces; *U*-factors for fenestration; and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the type and efficiency of heating, cooling and service water heating equipment.



## SECTION PA400 PERSCRIPTIVE REQUIREMENTS

### PA401 - Building Thermal Envelope

**PA401.1 General.** The building thermal envelope shall meet the requirements of Table PA401.1 based on the climate zone specified in PA301.1.

**PA401.1.1 R-value computation.** Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films.

**Table PA401.1  
Insulation and Fenestration Requirements by Component<sup>a</sup>**

	Climate Zone		
	South	Central	North
Fenestration <i>U</i> -Factor	0.40	0.35	0.35
Skylight <i>U</i> -Factor <sup>b</sup>	0.60	0.60	0.60
Ceiling <i>R</i> -Value	38	38	49
Wood Frame Wall <i>R</i> -Value	13	19 or 13+5 <sup>f</sup>	19 or 13+5 <sup>f</sup>
Mass Wall <i>R</i> -Value	5	13	15
Floor <i>R</i> -Value	19	30 <sup>e</sup>	30 <sup>e</sup>
Basement <sup>c</sup> Wall <i>R</i> -Value	10 / 13	10 / 13	10 / 13
Slab <sup>d</sup> <i>R</i> -Value & Depth	10, 2 ft	10, 2 ft	10, 4 ft
Crawl Space <sup>c</sup> Wall <i>R</i> -Value	10 / 13	10 / 13	10 / 13

For SI: 1 foot = 304.8 mm.

- a. *R*-values are minimums. *U*-factors and SHGC are maximums. *R*-19 shall be permitted to be compressed into a 2 x 6 cavity.
- b. The fenestration *U*-factor column excludes skylights.
- c. The first *R*-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
- d. *R*-5 shall be added to the required slab edge *R*-values for heated slabs.
- e. Or insulation sufficient to fill the framing cavity, *R*-19 minimum.
- f. "13+5" means *R*-13 cavity insulation plus *R*-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least *R*-2.

**PA401.1.2 *U*-factor alternative.** An assembly with a *U*-factor equal to or less than that specified in Table PA401.1.2 shall be permitted as an alternative to the *R*-value in Table PA401.1.

**Exception:** For mass walls not meeting the criterion for insulation location in Section PA401.2.3, the *U*-factor shall be permitted to be:

1. *U*-factor of 0.10 in South Zone
2. *U*-factor of 0.082 in Central Zone

**Table PA401.1.2**  
**Equivalent *U*-factors<sup>a</sup>**

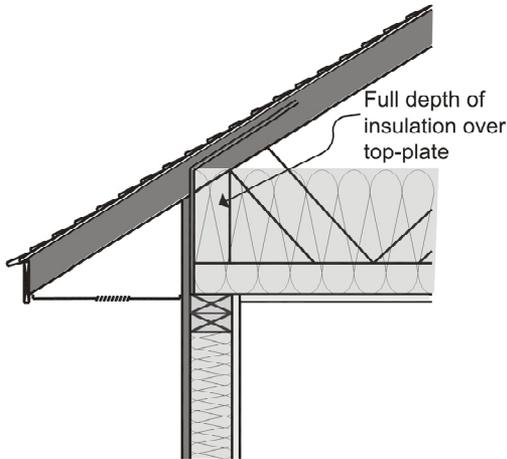
	Climate Zone		
	South	Central	North
Ceiling <i>U</i> -Factor	0.030	0.030	0.026
Frame Wall <i>U</i> -Factor	0.082	0.060	0.060
Mass Wall <i>U</i> -Factor	0.141	0.082	0.06
Floor <i>U</i> -Factor	0.047	0.033	0.033
Basement Wall <i>U</i> -Factor	0.059	0.059	0.059
Crawl Space Wall <i>U</i> -Factor	0.065	0.065	0.065

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

**PA401.1.3 Total UA alternative.** If the total building thermal envelope UA (sum of *U*-factor times assembly area) is less than or equal to the total UA resulting from using the *U*-factors in Table PA401.1.2, (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with PA401.1. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials as calculated by software such as REScheck.

## PA401.2 Specific insulation requirements.

**PA401.2.1 Ceilings with attic spaces.** When Table PA401.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. See Figure PA401.2.1.



**Figure PA401.2.1: Reduced Ceiling Insulation**

**PA401.2.2 Ceilings without attic spaces.** Where Table PA401.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30.

**PA401.2.3 Mass walls.** Mass walls for the purposes of this Chapter shall be considered walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs. The provisions of Section PA401.1 for mass walls shall be applicable when at least 50 percent of the required insulation R-value is on the exterior of, or integral to, the wall. Walls that do not meet this criterion for insulation placement shall meet the wood frame wall insulation requirements of Section PA401.1.

**Exception:** For walls that do not meet this criterion for insulation placement, the minimum added insulation R-value shall be permitted to be:

1. R-value of 10 in the South Zone
2. R-value of 13 in the Central Zone

**PA401.2.5 Floors.** Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

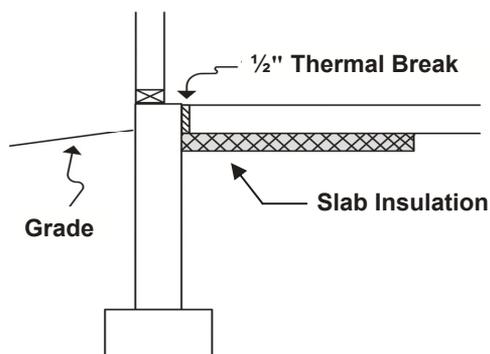
**PA401.2.6 Basement walls.** Walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet (3048 mm) below grade or to the basement floor, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections PA401.1 and PA401.2.5.

**PA401.2.7 Slab-on-grade floors.** Slab-on-grade floors with a floor surface less than 12 inches (305 mm) below grade shall be insulated in accordance with Table PA401.1. The insulation can be installed on either the exterior or interior of the foundation wall.

**Exterior Insulation:** Exterior insulation shall be installed from the top of the slab and extend the distance provided in Table PA401.1 by any combination of vertical insulation or horizontal insulation extending away from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil.

**Interior Insulation:** Interior insulation shall be installed from the bottom of the slab and extend the distance provided in Table PA401.1 by any combination of vertical insulation or horizontal insulation extending under the slab. The slab edge shall be separated from the foundation wall by a ½ inch thermal break as per Figure PA401.2.7. A thermal break shall be created by a material suitable for ground contact, which includes, but is not limited to, asphalt impregnated fiber board or extruded polystyrene.

Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.



**Figure PA401.2.7: Interior Slab Insulation**

**PA401.2.8 Crawl space walls.** As an alternative to insulating floors over crawl spaces, crawl space walls shall be permitted to be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the exterior finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous vapor retarder. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

**PA401.2.9 Masonry veneer.** Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

**PA401.2.10 Thermally isolated sunroom insulation.** The minimum ceiling insulation *R*-values shall be R-19 in the South zone and R-24 in the Central and North zones. The minimum wall *R*-value shall be R-13. New wall(s) separating a sunroom from conditioned space shall meet the building thermal envelope requirements.

### **PA401.3 Fenestration.**

**PA401.3.1 *U*-factor.** An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

**PA401.3.3 Glazed fenestration exemption.** Up to 15 square feet (1.4m<sup>2</sup>) of glazed fenestration per dwelling unit shall be permitted to be exempt from *U*-factor requirements in Section PA401.1.

**PA401.3.4 Opaque door exemption.** One opaque door assembly is exempted from the *U*-factor requirement in Section PA401.1.

**PA401.3.5 Thermally isolated sunroom *U*-factor.** The maximum fenestration *U*-factor shall be 0.50 and the maximum skylight *U*-factor shall be 0.75. New windows and doors separating the sunroom from conditioned space shall meet the building thermal envelope requirements.

**PA401.3.6 Replacement fenestration.** Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor in Table PA401.1.

#### PA401.4 Air leakage.

**PA401.4.1 Building thermal envelope.** The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather-stripped or otherwise sealed with an air barrier material, suitable film or solid material:

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating a garage from conditioned spaces.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Other sources of infiltration.

**PA401.4.2 Fenestration air leakage.** Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot ( $1.5 \text{ L/s/m}^2$ ), and swinging doors no more than 0.5 cfm per square foot ( $2.6 \text{ L/s/m}^2$ ), 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.

**Exceptions:** Site-built windows, skylights and doors.

**PA401.4.3 Recessed lighting.** Recessed luminaries installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces by being:

1. IC-rated and labeled as meeting ASTM E 283, when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity; or
2. IC-rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space; or
3. Located inside an airtight sealed box with clearances of at least 0.5 inch (12.7 mm) from combustible material and 3

inches (76 mm) from insulation.

**PA401.5 Moisture control.** The building design shall not create conditions of accelerated deterioration from moisture condensation. Above-grade frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder. The vapor retarder shall be installed on the warm-in-winter side of the thermal insulation.

**Exceptions:**

1. In construction where moisture or its freezing will not damage the materials.
2. Frame walls, floors and ceilings in the south zone (crawl space floor vapor retarders are not exempt).
3. Where other approved means to avoid condensation are provided.

## SECTION PA402 SYSTEMS

**PA402.1 Controls.** At least one thermostat shall be provided for each separate heating and cooling system.

**PA402.1.1 Heat pump supplementary heat.** Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

**PA402.2 Ducts.**

**PA402.2.1 Insulation.** Supply and return ducts shall be insulated to a minimum of R-8. Ducts in floor trusses and unconditioned basements shall be insulated to a minimum of R-6.

**Exception:** Ducts or portions thereof located completely inside the building thermal envelope.

**PA402.2.2 Sealing.** All ducts, air handlers, filter boxes, and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.3.1 of the *International Residential Code*.

**PA402.2.3 Building cavities.** Building framing cavities shall not be

used as supply ducts.

**PA402.3 Mechanical system piping insulation.** Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-2.

**PA402.4 Circulating hot water systems.** All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

**PA402.5 Mechanical ventilation.** Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

**PA402.6 Equipment sizing.** Heating and cooling equipment shall be sized in accordance with Section M1401.3 of the *International Residential Code*.

## SECTION PA500 EFFICIENCY TRADEOFFS

**PA501 General.** Buildings that utilize high efficiency equipment that meets Section PA502 can reduce the thermal requirements of Section PA400 as allowed by Section PA502. These tradeoffs are intended to provide equivalent energy performance to a dwelling built to Section PA400 and uses the minimum HVAC equipment requirements established by the National Appliance Energy Conservation Act.

**PA502 Allowable Tradeoffs.** Any one of the tradeoffs to reduce thermal envelope requirements may be used instead of the related requirements in Section PA400 if the dwelling meets or exceeds the following minimum equipment efficiency:

**Table PA502  
Efficiency Tradeoffs**

Tradeoff	Component	Reduced R-value	Minimum Equipment Efficiency <sup>c,d</sup>					
			South		Central		North	
			AFUE <sup>a</sup>	HSPF <sup>b</sup>	AFUE <sup>a</sup>	HSPF <sup>b</sup>	AFUE <sup>a</sup>	HSPF <sup>b</sup>
A	Walls between conditioned and unconditioned spaces <sup>e</sup>	R-13	NA	NA	83	8.3	84	9.0
	Floors over unconditioned basements	R-19						
B	Duct insulation Unconditioned Basement	R-4	83 <sup>g</sup>	8.6	84 <sup>g</sup>	9.1	85 <sup>g</sup>	10.6
	Attic & Exterior Walls <sup>f</sup>	R-6	81	8.6 <sup>g</sup>	83 <sup>g</sup>	9.0 <sup>g</sup>	83	10.0 <sup>g</sup>
C	Walls between conditioned and unconditioned spaces <sup>e</sup>	R-13	NA	NA	89	9.8	91	12.2
	Floors over unconditioned basements	R-19						
	Duct insulation <sup>g</sup> Unconditioned Basement	R-4						
	Attic & Exterior Walls <sup>f</sup>	R-6						

- a. Annual Fuel Utilization Efficiency (AFUE) applies to oil and gas furnaces and boilers.
- b. Heating Seasonal Performance Factor (HSPF) applies to heat pumps.
- c. Any Seasonal Energy Efficiency Ratio (SEER) may be used for air conditioning equipment.
- d. For buildings with multiple furnaces, boilers or heat pumps having different AFUE or HSPF values, use the capacity weighted average of the efficiency ratings of the installed equipment to determine whether the building complies with the minimum equipment performance requirement.
- e. Examples include, but are not limited to, walls between the house and garage, and basement stairway walls and ceiling when the floor above an unconditioned basement is insulated.
- f. Ducts in exterior walls with insulated sheathing of R-5 or more do not need to be insulated.
- g. If ducts are located in both the attic and unconditioned basement, R-6 can be used for the attic ducts and R-4 can be used for the unconditioned basement ducts.

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