



Prescriptive Packages User's Guide

1992, 1993, and 1995 Model Energy Code

Version 3.5

April 2003

REScheck™ was developed by the Building Energy Codes Program at Pacific Northwest National Laboratory for use by the U.S. Department of Housing and Urban Development (HUD) and the Rural Economic and Community Development (RECD) under contract with the U.S. Department of Energy's Office of Codes and Standards. Pacific Northwest National Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

We encourage any questions, comments, or suggestions you may have regarding the RES*check* materials.

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Definitions

Introduction to REScheck

What are the MEC and IECC?

The Model Energy Code (MEC) contains energy-related building requirements applying to many new U.S. residences. The MEC was previously maintained by the Council of American Building Officials (CABO), which was comprised of the three U.S. model code groups: the Building Officials and Code Administrators, International (BOCA); the International Conference of Building Officials (ICBO); and the Southern Building Code Congress International (SBCCI). These groups subsequently combined into an “umbrella” organization called the International Code Council (ICC). The ICC issued the 1998 MEC under a new name, the 1998 International Energy Conservation Code (IECC).

Both the MEC and the IECC codes contain energy-related requirements applying to many new U.S. residences. The U.S. Department of Housing and Urban Development (HUD) loan guarantee program requires compliance with the MEC. The Rural Economic and Community Development (RECD, formerly the Farmer’s Home Administration) loan guarantee program requires that single-family buildings comply with the MEC. Several states have also adopted the MEC or IECC as their residential energy code.

The MEC and IECC codes specify thermal envelope requirements for one- and two-family residential buildings and multifamily residential buildings three stories or less in height. A major focus of the code provisions is on the building envelope insulation and window requirements, which are more stringent in colder climates. Maximum U-factor requirements are specified for walls, ceilings, floors, crawl space walls, and basement walls and minimum R-value requirements are specified for slab floors. To comply with the code, a building must be constructed with components meeting or exceeding these requirements. However, the U-factor of a given assembly may be increased or the R-value of a given assembly may be decreased, provided the total heat gain or loss for the entire building does not exceed the total resulting from conformance with the requirements. Other requirements focus on the heating and cooling system (including ducts), water-heating systems, and air leakage.

What Buildings Must Comply?

The code applies to new residential buildings, three stories or less in height, and additions to such buildings. Residential buildings are defined as detached one- and two-family buildings (referred to as single-family buildings or type A1 in the code) and multifamily buildings (such as apartments, condominiums, townhouses, dormitories, and rowhouses). Multifamily buildings have three or more attached dwelling units and are referred to as

type A2 in the code. Throughout these materials, generic references to “building(s)” signify residential buildings three stories or less in height.

When over 10% of the area of any floor of a residential building is used for commercial purposes, the portion of the building used for commercial purposes must meet the requirements of the commercial energy code. In such cases, the code will only apply to those portions of the building that are used for residential purposes. Multifamily buildings four or more stories above grade are considered commercial buildings.

Exemptions

The following building categories are exempted from the provisions of the code:

- existing buildings
- very low-energy buildings (<3.4 Btu/h·ft² or 1 W/ft² of floor area)
- buildings (or portions of buildings) that are neither heated nor cooled
- buildings designated as historical.

About the REScheck Materials

The REScheck materials are applicable to the 1992, 1993, and 1995 MEC and the 1998 and 2000 IECC, and refer to these codes collectively as the code. The REScheck software has a *Code* menu which allows you to select the code for which compliance is to be determined. Two sets of printed REScheck materials are available; one set for the three MEC code editions and a second set for the two IECC code editions. Although these codes are quite similar, there are some differences in the code requirements that occasionally must be reflected in the text of the materials. When a block of text or a table only applies to a certain edition of the code, the applicable year is printed in the margin to the left of the text or table.

The REScheck materials provide guidance on how to meet the code requirements. Making the MEC and IECC simple and understandable was the major motivation for developing them. The desire for simplicity and clarity led to changes in format, deletion of redundant text, and deletion of text that had no impact. If you are familiar with the MEC and/or IECC, you will note that the REScheck materials differ significantly in format from these codes.

The REScheck materials were created for HUD and RECD. Check with your building department or other state or local building code enforcement authority to verify that the REScheck materials are accepted in your jurisdiction, because some of the requirements may be superseded by state laws or local ordinances.

It is not necessary to have a copy of the code to use any REScheck materials. Although the *Basic Requirements Guide* lists code section numbers for cross reference, it is not necessary to refer to the referenced sections. All references to figures and tables in a specific guide refer to figures and tables located in that guide unless specifically stated otherwise.

What's in the REScheck Guides?

The *Basic Requirements Guide* applies to all residential buildings and should be read by all users of REScheck materials. Home builders and designers can then use one of the three REScheck approaches to show compliance with the insulation and window requirements. The prescriptive package approach is described in the *Prescriptive*

Package User's Guide. The software approach is described in the *Software User's Guide*. The trade-off approach is described in the *Trade-Off Worksheet User's Guide*. The *REScheck Workbook* is a collection of guides which includes the *Basic Requirements Guide*, the *Prescriptive Package User's Guide*, the *Trade-Off Worksheet User's Guide*, and the *Software User's Guide*, with the software diskette attached to the last page.

The *Basic Requirements Guide* discusses all of the basic requirements except for the insulation and window requirements (which are covered in other sections). The basic requirements represent minimum criteria that must be met regardless of which insulation compliance approach you choose. These criteria include provisions that limit air leakage through the building envelope and regulate heating and cooling systems and duct insulation levels.

The *Prescriptive Package User's Guide* describes the simplest of the three compliance approaches. With this approach, you select a package of insulation and window requirements from a list of packages developed for a specific climate zone. Each package specifies insulation levels, glazing areas, glazing U-factors, and sometimes heating and cooling equipment efficiency. Once selected, simply meet or exceed all requirements listed in the package to achieve compliance. Few calculations are required.

The *Trade-Off Worksheet User's Guide* briefly describes a "pencil-and-paper" compliance approach. The trade-off approach enables you to trade off insulation and window efficiency levels in different parts of the building. You can trade off ceiling, wall, floor, basement wall, slab-edge, and crawl space wall insulation; glazing and door areas; and glazing and door U-factors. The trade-off approach calculates whether your home as a whole meets the overall code insulation and window requirements.

The *Software User's Guide* explains how to use the *REScheck* software approach. The software approach is the most flexible of the three compliance approaches. The software allows trade-offs between all building envelope components and heating and cooling equipment efficiencies. With minimal input, you can quickly compare different insulation levels to select a package that works best for your proposed building. Unlike the prescriptive package and trade-off approaches, the software approach enables you to trade off basement wall, slab-edge, and crawl space wall insulation depth as well as insulation R-value. The software automatically generates a report that can be submitted for plan review to document compliance.

Several forms, worksheets, and lists are included with the *REScheck* materials to help determine and document compliance. You may make multiple copies of the forms and distribute them freely. Alternative forms that provide the same information may also be used if they are approved by your jurisdiction.

Who Should Use the REScheck Materials?

The *REScheck* materials were designed to guide builders and designers, plan check personnel, and field inspectors through the code compliance process. All necessary compliance forms, reference materials, and explanations are included.

Builders and Designers can follow each step of the compliance process presented in the *REScheck* guides. The *Basic Requirements Guide* describes code requirements that must be satisfied by all residences. The *Prescriptive Package User's Guide*, the *Software User's Guide*, and the *Trade-Off Worksheet User's Guide* offer a choice of approaches, any of which can be used to show compliance with the insulation and window requirements of the code.

Plan Check Personnel can use the *Plan Check and Field Inspection Guide* as a guide to ensure that building plans and specifications comply with the code. If questions arise, the

plan reviewer can trace the compliance steps used by the applicant and reference the steps in the other guides.

Field Inspectors and Site Superintendents can use *the Plan Check and Field Inspection Guide* to ensure that all of the applicable code requirements have been installed in a building. The features that meet these requirements must be included on the building plans or specifications and on compliance forms. *The Basic Requirements Guide* will also be of interest to field inspectors and site superintendents. It describes the features that must be installed in the building regardless of the compliance approach chosen.

REScheck Compliance Process?

Figure 1 illustrates the steps you should follow to determine compliance with the code.

Step 1: Determine If Your Building Must Comply with the Code. (See What Buildings Must Comply? in this introduction.)

Step 2: Meet the Basic Requirements. The basic requirements discussed in the *Basic Requirements Guide* must be incorporated into the design.

Step 3: Use One of Three Compliance Approaches for Insulation and Windows. Select one of the three compliance approaches described in the *Prescriptive Package User's Guide*, *the Software User's Guide*, and *the Trade-Off Worksheet User's Guide*. Examining the prescriptive packages for the building location will give you an idea of the insulation requirements. Use the selected approach to determine the insulation and window requirements. Document compliance on the form(s) provided for the selected approach.

Step 4: Submit Building Plans and Compliance Forms for Plan Review. Submit REScheck forms or their equivalent, building plans, and specifications for plan review. The compliance forms must match the building plans and specifications.

Step 5: Construct the Building According to Approved Plans. In most jurisdictions, construction may begin after a building permit is issued. It is required to have the approved set of plans and specifications at the job site for use by the field inspector. REScheck forms or their equivalent must be re-submitted if changes from the approved plans or specifications are made that increase the glazing area, decrease insulation R-values, or decrease equipment efficiencies of the building.

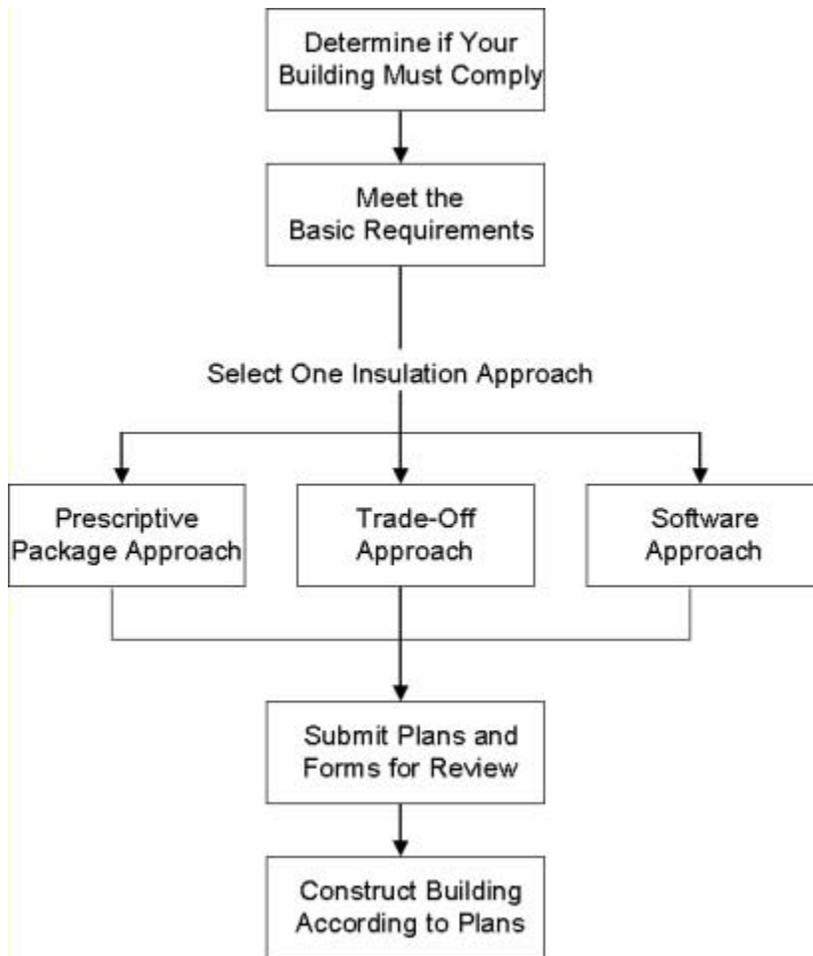


Figure 1. REScheck Compliance Path

Basic Requirements Guide

1992 MEC, 1993 MEC, and 1995 MEC

Inside This Guide

Air Leakage
Vapor Retarders
Materials and Equipment Information
Heating and Cooling
Service (Potable) Water Heating
Electrical

Basic Requirements

The code specifies basic requirements that are mandatory for all buildings. Some of these requirements apply to the heating and cooling system (including ducts), hot water system, and electrical system. Other requirements apply to material and equipment identification and to sealing the building envelope. This guide discusses the code basic requirements, except for the insulation and window requirements (which are covered in other guides). Each requirement in this guide lists the corresponding code section number as a reference.

Figure 1 graphically illustrates several basic requirements. Refer to the *Summary of Basic Requirements* provided with this guide for a one-page listing of the requirements discussed below.

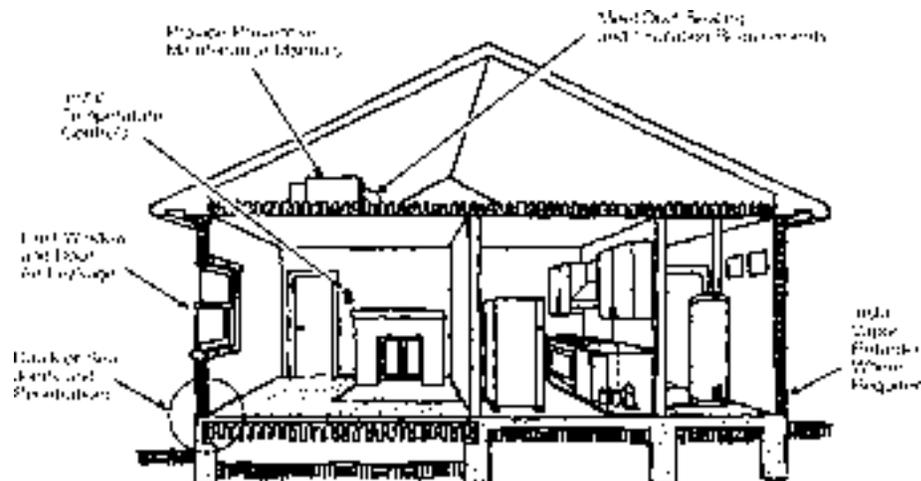


Figure 1. Some of the Basic Requirements

Air Leakage

(1992: Section 502.4.3; 1993: Section 502.3.3; 1995: Sections 502.3.3 and 502.3.4) All joints and penetrations in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed in an approved manner. The following areas should be sealed using appropriate materials :

- exterior joints around window and door frames



- between wall sole plates, floors, and exterior wall panels



- openings for plumbing, electricity, refrigerant, and gas lines in exterior walls, floors, and roofs





- openings in the attic floor (such as where ceiling panels meet interior and exterior walls and masonry fireplaces)
- service and access doors or hatches
- openings for plumbing and gas lines in the subfloor and interior plates of kitchens and bathrooms
- all other similar openings in the building envelope
- recessed lighting fixtures.

1995

Sealants used between dissimilar materials (such as between the sole plate and a slab floor) must allow for the expansion and contraction of the materials.

1995

Recessed lighting fixtures must be 1) IC rated with no penetrations, or 2) IC rated in accordance with ASTM 283, or 3) installed inside an air-tight assembly with a 0.5 inch (12.76 mm) clearance from any combustible material and a 3 inch (76 mm) clearance from insulation material.

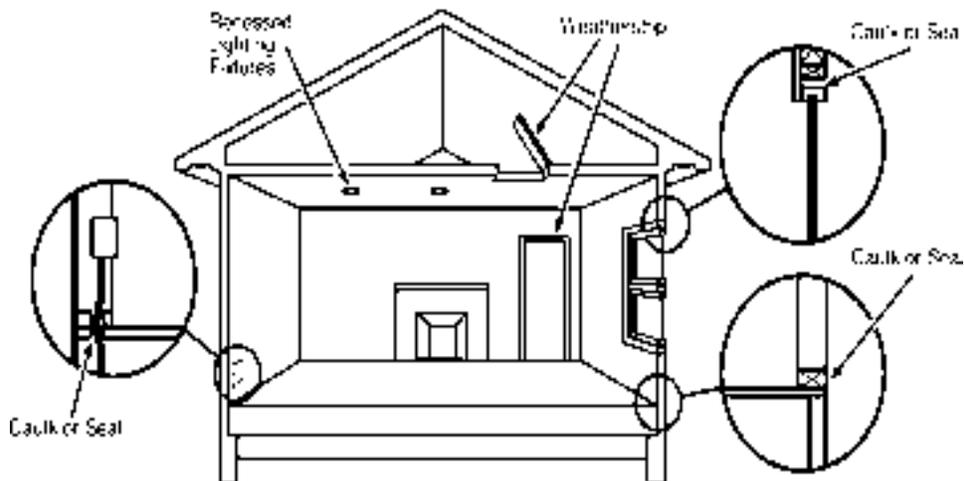


Figure 2. Typical Openings that Should be Sealed

Vapor Retarders

(Section 501.1.4) Vapor retarders must be installed in all non-vented framed ceilings, walls, and floors. Non-vented areas are framed cavities without vents or other openings allowing the free movement of air. The vapor retarder must have a perm rating of 1.0 or less and must be installed on the "warm-in-winter side" of the insulation (between the insulation and the conditioned space).

Exemptions: Vapor retarders are not required:

- In the climate zones identified in Table 1. Exempted climate zones are also identified with an "(H)" in the state county listing in Appendix E and on the state maps included with the prescriptive packages. If you are using the REScheck software, the vapor retarder requirement is printed in the *Inspection Checklist*. If the requirement is not printed in the checklist, the building's location is exempt.
- Where moisture or its freezing will not damage the materials.

Table 1. Vapor Retarder Requirement Exemptions

State(s)	Zones
Texas	2-5
Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina	4-6
Arkansas, Tennessee	6-7
Florida, Hawaii, Louisiana, Mississippi	All

Materials and Equipment Information

(Section 104.2) Insulation R-values and glazing and door U-factors must be clearly marked on the building plans or specifications. If two or more different insulation levels exist for the same component, record each level separately on the plans or specifications. For example, if the walls adjacent to the garage have less insulation than the other walls, both insulation levels must be noted. If credit is taken for high-efficiency heating or

cooling equipment, the equipment efficiency, make and model number must also be marked on the plans or specifications.

(Section 102.1) Materials and equipment must be identified in a manner that will allow compliance with the code to be determined. There are several ways to label materials and equipment to satisfy this requirement.

- Provide labels on all pertinent materials and equipment. For example, the R-value of the insulation is often pre-printed directly on the insulation or can be determined from a striping code. Window U-factors are often included on the manufacturer label posted directly on the window.
- Provide contractor statements certifying the products they have installed. For example, the insulation contractor should certify the R-value of the installed insulation.
- An optional *Energy Label* is included in Appendix D. Materials and equipment can be identified on this label which should then be posted in the residence (e.g., on the main fuse box, on a garage wall, in the utility room) to document the energy efficiency features of the building.

1995

(1995: Section 102.1.3) For blown or sprayed insulation, the initial installed thickness, the settled thickness, the coverage area, and the number of bags must be clearly posted at the job site. In attics, thickness markers must be placed at least once every 300 square feet.

(Section 102.2) Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided to the homeowner.

Heating and Cooling

Heating and Cooling Equipment Efficiencies

The code defines heating and cooling equipment efficiency requirements. However, federal regulations have restricted manufactured equipment efficiency minimums to levels at or above these code requirements. Because new equipment efficiencies below the code requirements can no longer be manufactured, these requirements have been omitted from the REScheck materials.

Duct Insulation

(1992 and 1993: Section 503.9.1; 1995: Section 503.7.1) Supply- and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces (spaces neither heated nor cooled) must be insulated to the minimum R-value specified in Table 2. Unconditioned spaces include ventilated crawl spaces, ventilated attics, and framed cavities in those floor, wall, and ceiling assemblies which a) separate conditioned space from unconditioned space or outside air and b) are uninsulated on the side facing away from conditioned space.

Exceptions: Duct insulation is not required in the following cases:

- within heating, ventilating, and air conditioning (HVAC) equipment
- for exhaust air ducts
- when the design temperature difference between the air in the duct and the surrounding air is 15°F or less.

Additional insulation with vapor barrier must be provided if condensation will create a problem.

Select the zone number for your building location and find the R-value requirement from Table 2 based on where the ducts are located. For the prescriptive package and trade-off worksheet approaches, your zone number can be found in Appendix E or on the state map included with the prescriptive packages. If you are using the REScheck software, the duct insulation requirement is printed in the *Inspection Checklist*.

When ducts are located in exterior building cavities, either

- The full insulation R-value requirement for that building component must be installed between the duct and the building exterior, in which case the ducts do not require insulation, or
- The ducts must be insulated to the duct R-value requirement given in Table 2 and the duct area must be treated as a separate component. For example, if ducts insulated to R-6 are located in an exterior wall insulated to R-19, the area of the wall minus the duct area is a wall component with R-19 insulation, and the area of the ducts is a wall component with R-6 insulation.

1992

Table 2. Duct Insulation R-Value Requirement for 1992 MEC

Zone Number	Ducts Located in Attics, Crawl Spaces, Exterior Cavities, Outside	Ducts Located in Unheated Basements
Zones 1-8	R-6	R-6
Zones 9-16	R-8	R-6
Zone 17	R-9	R-6
Zone 18	R-9	R-8
Zone 19	R-11	R-8

1993 1995

Table 2. Duct Insulation R-Value Requirements for 1993 and 1995 MEC

Zone Number	Ducts in Unconditioned Spaces (i.e. Attics, Crawl Spaces, Unheated Basements and Garages, and Exterior Cavities)	Ducts Outside the Building
Zones 1-4	R-5	R-8
Zones 5-14	R-5	R-6.5
Zones 15-19	R-5	R-8

Duct Construction

1992 1993

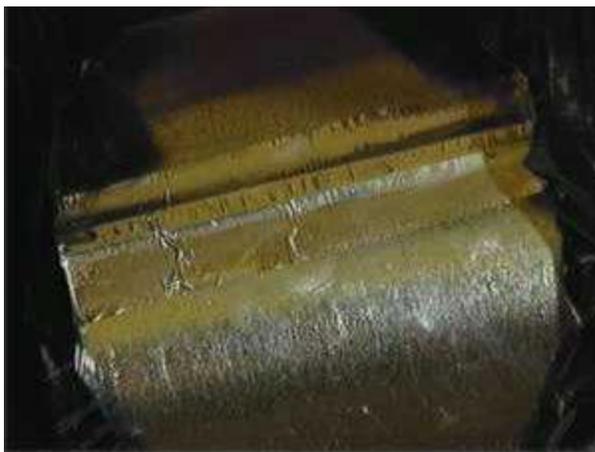
(Section 503.10.2) All transverse joints in ductwork located in unconditioned spaces must be sealed with mastic, tape, or mastic plus tape. Pressure-sensitive tape may be used for fiberglass ductwork.

1995

(Section 503.8.2) Ducts must be sealed using mastic with fibrous backing tape. For fibrous ducts, pressure-sensitive may be used. Other sealants may be approved by the building official. Duct tape is not permitted.



Duct with mastic



(1992 and 1993: Section 503.6; 1995: Section 503.5) The HVAC system must provide a means for balancing air and water systems. For air systems, this requirement can be met by installing manual dampers at each branch of the ductwork or by installing adjustable

registers that can constrict the airflow into a room. For water systems, balancing valves can be installed to control the water flow to rooms or zones.

Temperature Controls

(1992 and 1993: Section 503.8.3.1; 1995: Section 503.6.3.1) For one- and two-family buildings, at least one thermostat must be provided for each separate system (heating, cooling, or combination of heating and cooling). Electric baseboard heaters can be individually controlled by separate thermostats or several baseboard heaters can be controlled by a single thermostat.

(1992 and 1993: Section 503.8.3.2; 1995: Section 503.6.3.2) For multifamily buildings, each dwelling unit must have a separate thermostat and a readily accessible, manual or automatic means to restrict or shut off the heating and/or cooling input to each room must be provided. Operable diffusers or registers that can restrict or shut off the airflow into a room meet this requirement.

(1992 and 1993: Section 503.8.3.3; 1995: Section 503.6.3.2) At least one thermostat must be provided for each system or each zone in the non-dwelling portions of multifamily buildings. For example, separate systems serving interior corridors or attached laundry rooms must have their own thermostat.

(1992 and 1993: Section 503.8; 1995: Section 503.6.1) Each heating and cooling system must have a thermostat with at least the following range:

- Heating only (55°F to 75°F)
- Cooling only (70°F to 85°F)
- Heating and cooling (55°F to 85°F) – the thermostat must be capable of operating the system heating and cooling in sequence (i.e., simultaneous operation is not permitted).



Thermostat

Heat Pump Thermostats

(1992 and 1993: Section 503.4.2.3; 1995: Section 503.3.2.23) Heat pump installations must include a thermostat that can prevent the back-up heat from turning on when the

heating requirements can be met by the heat pump alone. A two-stage thermostat that controls the back-up heat on its second stage meets this requirement.

HVAC Piping Insulation

(1992 and 1993: Section 503.11; 1995: Section 503.9) All HVAC piping (such as in hydronic heating systems) installed in unconditioned spaces and conveying fluids at temperatures greater than 120°F or chilled fluids at less than 55°F must be insulated to the thicknesses specified in Table 3. Pipe insulation is not required for piping installed within HVAC equipment.

Table 3. Minimum HVAC Piping Insulation Thickness ^(a)

Piping System Types	Fluid Temp Range (°F)	Insulation Thickness in Inches by Pipe Sizes ^(b)			
		Runouts 2in. ^(c)	1 in. and less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5
<p>(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:</p> <p style="text-align: center;">New Minimum Thickness = 4.6 x Table 2-3 Thickness/Actual R-Value</p> <p>For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:</p> <p style="text-align: center;">New Minimum Thickness = 4.0 x Table 2-3 Thickness/Actual R-Value</p> <p>(b) For piping exposed to outdoor air, increase thickness by 0.5 in.</p> <p>(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.</p>					

Service (Potable) Water Heating

Swimming Pools

(Section 504.5) All heated swimming pools must be equipped with an on/off pool heater switch mounted for easy access. Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources (such as solar heat).

(Section 504.5.3) All swimming pool pumps must be equipped with a time clock.

Circulating Service Hot Water Systems

(Section 504.6) Circulating hot water systems must have automatic or manual controls that allow the pumps to be conveniently turned off when the hot water system is not in operation.

(Section 504.7) Piping in circulating hot water systems must be insulated to the levels specified in Table 4 unless an engineering calculation is provided that demonstrates that insulation will not reduce the annual energy requirements of the building.

Table 4. Minimum Insulation Thickness for Recirculation Piping

Heated Water Temperature (°F)	Insulation Thickness in Inches by Pipe Sizes (a)			
	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5-2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

Electrical

(1992 and 1993: Section 505.2; 1995: Section 505.1) All dwelling units in multifamily buildings must be equipped with separate electric meters.

1992 Model Energy Code Summary of Basic Requirements

Air Leakage	<ul style="list-style-type: none"> • Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed.
Vapor Retarder	<p>Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials.</p> <ul style="list-style-type: none"> • Texas Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina Zones 4-6 • Arkansas, Tennessee Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi All Zones
Materials and Insulation Information	<ul style="list-style-type: none"> • Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
Duct Insulation	<p>Supply and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces must be insulated to the levels shown on the reverse side of this sheet. <i>Exceptions:</i> Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is 15EF or less.</p>
Duct Construction	<ul style="list-style-type: none"> • All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	<ul style="list-style-type: none"> • Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: <ul style="list-style-type: none"> <li style="padding-left: 40px;">Heating Only 55EF - 75EF <li style="padding-left: 40px;">Cooling Only 70EF - 85EF <li style="padding-left: 40px;">Heating and Cooling 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
HVAC Piping Insulation	<p>HVAC piping in unconditioned spaces conveying fluids at temperatures above 120EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.</p>
Swimming Pools	<ul style="list-style-type: none"> • All heated swimming pools must have an on/off pool heater switch. • Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources. • All swimming pool pumps must be equipped with a time clock.
Circulating Hot Water	<ul style="list-style-type: none"> • Circulating hot water systems must have automatic or manual controls. • Pipes must be insulated to the levels shown on the reverse side of this sheet.
Electric Systems	<p>Each multifamily dwelling unit must be equipped with separate electric meters.</p>

1992 Model Energy Code

Duct Insulation R-Value Requirements

Duct Insulation R-Value Requirements		
Zone Number	Ducts Located In: Attics, Crawl Spaces, Exterior Cavities, Outside	Ducts Located In: Unheated Basements
Zones 1-8	R-6	R-6
Zones 9-16	R-8	R-6
Zone 17	R-9	R-6
Zone 18	R-9	R-8
Zone 19	R-11	R-8

Minimum HVAC Piping Insulation Thickness^(a)

Piping System Types	Fluid Temp Range (EF)	Insulation Thickness in Inches by Pipe Sizes ^(b)			
		Runouts 2 in. ^(c)	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\text{New Minimum Thickness} = \frac{4.6 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

$$\text{New Minimum Thickness} = \frac{4.0 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.

(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Minimum Insulation Thickness for Recirculation Piping

Insulation Thickness in Inches by Pipe Sizes ^(a)				
Heated Water Temperature (EF)	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5 - 2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

1993 Model Energy Code Summary of Basic Requirements

Air Leakage	<ul style="list-style-type: none"> • Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed.
Vapor Retarder	<p>Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials.</p> <ul style="list-style-type: none"> • Texas Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina Zones 4-6 • Arkansas, Tennessee Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi All Zones
Materials and Insulation Information	<ul style="list-style-type: none"> • Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
Duct Insulation	<p>Supply and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces must be insulated to the levels shown on the reverse side of this sheet.</p> <p><i>Exceptions:</i> Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is 15EF or less.</p>
Duct Construction	<ul style="list-style-type: none"> • All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	<ul style="list-style-type: none"> • Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: <ul style="list-style-type: none"> <li style="padding-left: 40px;">Heating Only 55EF - 75EF <li style="padding-left: 40px;">Cooling Only 70EF - 85EF <li style="padding-left: 40px;">Heating and Cooling 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
HVAC Piping Insulation	<p>HVAC piping in unconditioned spaces conveying fluids at temperatures above 120EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.</p>
Swimming Pools	<ul style="list-style-type: none"> • All heated swimming pools must have an on/off pool heater switch. • Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources. • All swimming pool pumps must be equipped with a time clock.
Circulating Hot Water	<ul style="list-style-type: none"> • Circulating hot water systems must have automatic or manual controls. • Pipes must be insulated to the levels shown on the reverse side of this sheet.
Electric Systems	<p>Each multifamily dwelling unit must be equipped with separate electric meters.</p>

1993 Model Energy Code

Duct Insulation R-Value Requirements

Zone Number	Ducts in Unconditioned Spaces (i.e. Attics, Crawl Spaces, Unheated Basements and Garages, and Exterior Cavities)	Ducts Outside the Building
Zones 1-4	R-5	R-8
Zones 5-14	R-5	R-6.5
Zone 15-19	R-5	R-8

Minimum HVAC Piping Insulation Thickness^(a)

Piping System Types	Fluid Temp Range (EF)	Insulation Thickness in Inches by Pipe Sizes ^(b)			
		Runouts 2 in. ^(c)	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\text{New Minimum Thickness} = \frac{4.6 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

$$\text{New Minimum Thickness} = \frac{4.0 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.

(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Minimum Insulation Thickness for Recirculation Piping

Insulation Thickness in Inches by Pipe Sizes ^(a)				
Heated Water Temperature (EF)	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5 - 2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

1995 Model Energy Code Summary of Basic Requirements

Air Leakage	<ul style="list-style-type: none"> • Joints, penetrations, and all other such openings in the building envelope that are sources of air leakage must be caulked, gasketed, weatherstripped, or otherwise sealed. • Recessed lights must be type IC rated and installed with no penetrations or installed inside an appropriate air-tight assembly with a 0.5-in. clearance from combustible materials and 3-in. clearance from insulation.
Vapor Retarder	<p>Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors. This requirement does not apply to the following climate zones nor where moisture or its freezing will not damage the materials.</p> <ul style="list-style-type: none"> • Texas Zones 2-5 • Alabama, Georgia, N. Carolina, Oklahoma, S. Carolina Zones 4-6 • Arkansas, Tennessee Zones 6-7 • Florida, Hawaii, Louisiana, Mississippi All Zones
Materials and Insulation Information	<ul style="list-style-type: none"> • Materials and equipment must be identified so that compliance can be determined. • Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided. • Insulation R-values, glazing and door U-values, and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.
Duct Insulation	<p>Supply and return-air ducts and plenums for heating and cooling systems located in unconditioned spaces must be insulated to the levels shown on the reverse side of this sheet.</p> <p><i>Exceptions:</i> Insulation is not required for exhaust air ducts, ducts within HVAC equipment, and when the design temperature difference between the air in the duct and the surrounding air is 15EF or less.</p>
Duct Construction	<ul style="list-style-type: none"> • All transverse joints must be sealed with mastic, tape, or mastic plus tape. • The HVAC system must provide a means for balancing air and water systems.
Temperature Controls	<ul style="list-style-type: none"> • Thermostats are required for each separate HVAC system in single-family buildings and each dwelling unit in multifamily buildings (non-dwelling portions require one thermostat for each system or zone). Thermostats must have the following ranges: <ul style="list-style-type: none"> <li style="padding-left: 20px;">Heating Only 55EF - 75EF <li style="padding-left: 20px;">Cooling Only 70EF - 85EF <li style="padding-left: 20px;">Heating and Cooling 55EF - 85EF • A manual or automatic means to partially restrict or shut off the heating and/or cooling input to each zone or floor shall be provided for single-family homes and to each room for multifamily buildings. • Heat pumps require a thermostat that can prevent the back-up heat from turning on when the heating requirements can be met by the heat pump alone.
HVAC Piping Insulation	<p>HVAC piping in unconditioned spaces conveying fluids at temperatures above 120EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.</p>
Swimming Pools	<ul style="list-style-type: none"> • All heated swimming pools must have an on/off pool heater switch. • Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources. • All swimming pool pumps must be equipped with a time clock.
Circulating Hot Water	<ul style="list-style-type: none"> • Circulating hot water systems must have automatic or manual controls. • Pipes must be insulated to the levels shown on the reverse side of this sheet.
Electric Systems	<p>Each multifamily dwelling unit must be equipped with separate electric meters.</p>

1995 Model Energy Code

Duct Insulation R-Value Requirements

Zone Number	Ducts in Unconditioned Spaces (i.e. Attics, Crawl Spaces, Unheated Basements and Garages, and Exterior Cavities)	Ducts Outside the Building
Zones 1-4	R-5	R-8
Zones 5-14	R-5	R-6.5
Zone 15-19	R-5	R-8

Minimum HVAC Piping Insulation Thickness^(a)

Piping System Types	Fluid Temp Range (EF)	Insulation Thickness in Inches by Pipe Sizes ^(b)			
		Runouts 2 in. ^(c)	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
Heating Systems					
Low Pressure/Temperature	201-250	1.0	1.5	1.5	2.0
Low Temperature	120-200	0.5	1.0	1.0	1.5
Steam Condensate (for feed water)	Any	1.0	1.0	1.5	2.0
Cooling Systems					
Chilled Water, Refrigerant, and Brine	40-55	0.5	0.5	0.75	1.0
	Below 40	1.0	1.0	1.5	1.5

(a) The pipe insulation thicknesses specified in this table are based on insulation R-values ranging from R-4 to R-4.6 per inch of thickness. For materials with an R-value greater than R-4.6, the insulation thickness specified in this table may be reduced as follows:

$$\text{New Minimum Thickness} = \frac{4.6 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

For materials with an R-value less than R-4, the minimum insulation thickness must be increased as follows:

$$\text{New Minimum Thickness} = \frac{4.0 \times \text{Table 2\&2 Thickness}}{\text{Actual R\&Value}}$$

(b) For piping exposed to outdoor air, increase thickness by 0.5 in.

(c) Applies to runouts not exceeding 12 ft in length to individual terminal units.

Minimum Insulation Thickness for Recirculation Piping

Insulation Thickness in Inches by Pipe Sizes ^(a)				
Heated Water Temperature (EF)	Non-Circulating Runouts	Circulating Mains and Runouts		
	Up to 1 in.	Up to 1.25 in.	1.5 - 2.0 in.	Over 2 in.
170-180	0.5	1.0	1.5	2.0
140-160	0.5	0.5	1.0	1.5
100-130	0.5	0.5	0.5	1.0

(a) Nominal pipe size and insulation thickness.

Prescriptive Packages User's Guide

1992 MEC, 1993 MEC, and 1995 MEC

Inside This Guide

- Quick Start
- Step-By-Step Instructions
- Steel-Frame Wall Equivalent R-Values
- Mass Wall Equivalent R-Values
- Compliance Example

Prescriptive Packages Overview

The REScheck™ Prescriptive Packages were developed to demonstrate compliance with the insulation and window requirements of the Council of American Building Officials (CABO) Model Energy Code (MEC). REScheck includes prescriptive packages that demonstrate compliance with the 1992, 1993, and 1995 editions of the MEC and the 1998 and 2000 editions of the International Energy Conservation Code (IECC). All illustrations in this chapter are based on packages which demonstrate compliance with the 1995 MEC. However, compliance with the other two editions is achieved similarly.

The prescriptive package approach requires minimal calculations and is the simplest method for demonstrating compliance with the code insulation and window requirements for residential buildings (refer to the *Basic Requirements Guide* for additional requirements that must also be satisfied).

The REScheck materials include prescriptive packages for both one- and two-family buildings (referred to as single-family buildings) and multifamily buildings (such as apartments, condominiums, townhouses, dormitories, and rowhouses). Multifamily buildings include residential buildings three stories or less in height with three or more attached dwelling units. When applying the prescriptive packages to multifamily buildings, it is recommended that the packages be applied to the entire building (as opposed to individual dwelling units) if allowed by your jurisdiction.

What's In This User's Guide?

A listing of counties by state and their corresponding climate zone number is provided in Appendix E. You will need to know the climate zone of your building in order to use the

prescriptive package approach. *The Prescriptive Package Worksheet* is included with this guide. Refer to this worksheet while reading the following sections.

Quick Start, provides brief instructions on using the prescriptive packages. These instructions are designed to get you up and running in no time.

Step-By-Step Instructions, provides more detailed instructions for finding your climate zone, selecting a prescriptive package, and documenting compliance using the *Prescriptive Package Worksheet*.

Steel-Frame Wall Equivalent R-Values provides equivalent R-value levels for steel-frame walls, and *Mass Wall Equivalent R-Values* provides equivalent R-value levels for mass walls. The prescriptive packages, which were designed for wood-frame walls, can be used for steel-frame or mass walls by substituting the R-values listed in Tables 1-4 for the R-value requirements in the prescriptive packages.

Compliance Example, provides a step-by-step example of using the prescriptive package approach to demonstrate compliance of a split-level house.

Quick Start

This section provides quick-and-easy instructions for using the REScheck prescriptive packages.

Find Your Climate Zone

The REScheck Prescriptive Packages give requirements for climate zones which fall along county boundaries. You can determine your climate zone from the list of counties given in Appendix E. State maps which indicate climate zones for each county are also available from the Internet or by contacting DOE's BECP at techsupport@becp.pnl.gov. Based on the county in which your building is located, find your climate zone.

Select a Prescriptive Package

Tables of prescriptive packages may have been included with this guide or may be downloaded separately from the Internet. The packages correspond to one of 19 climate zones. The requirements are different for each code edition, so be sure to use tables that correspond to the code edition being used in your jurisdiction.

Each climate zone has a table of prescriptive packages from which you can select one package. If your building meets the insulation R-value, glazing, and heating and/or cooling equipment efficiency requirements specified for the package you select, then the building complies with the code insulation and window requirements. Refer to the first page of the prescriptive package tables for notes that further clarify the requirements.

Complete the Prescriptive Package Worksheet

Fill in the *Prescriptive Package Worksheet* to document your building's compliance with the insulation and window requirements of the code. Be sure to include the climate zone number for your building's location, the prescriptive package number for the package you selected, and the code edition applicable to the selected package. Copy the glazing area percentage, R-value, and U-factor requirements specified in your selected package to the corresponding blanks on the right side of the worksheet. Write in the glazing area of your building and your proposed insulation R-values and glazing and door U-factors on the left side of the worksheet. If the package you selected requires high-efficiency heating or cooling equipment, record the efficiency, make, and model number of the equipment you intend to install.

1. Find your climate zone.

2. Select a Prescriptive Package.

Zone 8 Single-Family Prescriptive Packages - 1995 MEC

Package	MAXIMUM		MINIMUM							Heating/Cooling Equipment Efficiency
	Glazing Area %	Glazing U-Factor	Ceiling R-Value	Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab Perimeter R-Value	Crawl Space Wall R-Value		
1	12%	0.60	R-30	R-13	R-19	R-8	R-4	R-10	Normal	
2	12%	0.45	R-30	R-13	R-11	R-5	R-2	R-6	Normal	
3	15%	0.65	R-38	R-18	R-19	R-8	R-6	R-11	Normal	
4	15%	0.50	R-30	R-13	R-19	R-8	R-5	R-10	Normal	
5	15%	0.40	R-38	R-13	R-11	R-5	R-2	R-6	Normal	
6	18%	0.55	R-38	R-18	R-19	R-8	R-6	R-11	Normal	

3. Complete the *Prescriptive Package Worksheet*.

Prescriptive Package Worksheet
CABO Model Energy Code (MEC)

Enforcement Agency: _____
 Permit # _____
 Checked By _____
 Date _____

Builder Name _____ Date _____
 Builder Address _____
 Building Address _____
 Zone Number _____ Package Number _____ MEC Edition _____
 Submitted By _____ Phone Number _____

PROPOSED **REQUIRED**

Glazing Area

100 X $\frac{\text{Glazing Area} + \text{Gross Wall Area}}{\text{Proposed Glazing Area}}$ = %
 Maximum Glazing Area %

Figure 1. Using the Prescriptive Packages

Check for Compliance

Your building complies if:

- your glazing area is less than or equal to the required glazing area, and
- all proposed insulation R-values are greater than or equal to all required insulation R-values, and
- all proposed glazing and door U-factors are less than or equal to all required glazing and door U-factors, and
- your heating and cooling equipment meets the requirements specified for the package you selected (see Footnote 9).

Step-By-Step Instructions

The *Prescriptive Package Worksheet* included with this guide can be used to document compliance with the insulation and window requirements of the code. The following instructions explain how to complete this worksheet. Figure 2 shows an example *Prescriptive Package Worksheet*. The numbers in Figure 2 identify the various locations on this worksheet that correspond to the following steps.

Step 1: Find Your Climate Zone

The REScheck Prescriptive Packages give requirements for climate zones which fall along county boundaries. You can determine your climate zone from the list of counties given in Appendix E. State maps which indicate climate zones for each county are also available from the Internet or by contacting DOE's BECP at techsupport@becp.pnl.gov. Based on the county in which your building is located, find your climate zone.

Step 2: Select a Prescriptive Package

The tables of prescriptive packages correspond to one of 19 climate zones. The requirements are different for each code edition, so be sure to use tables that correspond to the code edition being used in your jurisdiction. Locate the table of prescriptive packages for the climate zone you identified in Step 1.

Select a package for your building from this table. If your building meets the insulation R-value, glazing, and heating and cooling efficiency requirements specified by the package you select, then the building complies with the code insulation and window requirements. Refer to the first page of the prescriptive packages for notes that further clarify the requirements.

The glazing U-factor and the glazing area percentage listed for each package are the maximum allowed for that package. The area of a glazing assembly is the interior surface area of the entire assembly, including glazing, sash, curbing and other framing elements. The areas of all glazing assemblies (including windows, sliding glass doors, skylights, and windows of conditioned basements) must be included when computing the total glazing area (see Footnote 1).

The nominal area or rough opening is also acceptable for flat windows and doors. The glazing area and window U-factor requirements for any package can be altered by using the *Glazing Area/U-Factor Trade-Off Worksheet* (instructions are given on the worksheet). Use of this worksheet does not alter the insulation R-value and equipment efficiency requirements in the package.

The insulation R-values listed for each package are the minimum allowed for that package. R-value requirements refer to the R-value of the insulation only. Wall and ceiling insulation R-values refer to the sum of the stud cavity insulation plus insulated sheathing (if used). For example, an R-16 wall requirement can be met with R-13 cavity insulation and R-3 sheathing. It is important to select a package consistent with the proposed framing used in the building. For example, it would be impossible to comply with a package specifying R-38 ceiling insulation (approximately 12 in. thick) if the building plans include a cathedral ceiling with 2x8 framing (approximately 7.5 in. thick).

Some of the packages specify high-efficiency heating equipment (*High Heating*), or high-efficiency cooling equipment (*High Cooling*), or a combination of both (*High Heat/Cool*). High-efficiency heating units have an annual fuel utilization efficiency (AFUE) of at least 90% or a heating seasonal performance factor (HSPF) of at least 7.8. High-efficiency cooling units have a seasonal energy efficiency ratio (SEER) of at least 12.0. For example, if you intend to install a 10 SEER air conditioner and a 92% AFUE furnace, the *High Heating* packages would apply to your building, but *High Cooling* and *High Heat/Cool* packages would not. If you plan to install more than one piece of heating equipment or more than one piece of cooling equipment, the equipment with the lowest efficiency must meet or exceed the efficiency required by the selected package. AFUE, HSPF, and SEER ratings can be obtained from manufacturer data sheets or certified product directories.

Step 3: Complete the General Information Section

Fill in the information at the top of the *Prescriptive Package Worksheet*. Be sure to record your climate zone number, prescriptive package number, and code edition.



Prescriptive Package Worksheet

CABO Model Energy Code (MEC)

Enforcement Agency: _____

Permit # _____

Checked By _____

Date _____

Builder Name CAREFUL BUILDERS, INC. Date 12/12/00

Builder Address 120 "W" ST., GREENSBORO, NORTH CAROLINA 27411

Building Address 010 CONSTRUCTION AVE. GREENSBORO, NORTH CAROLINA 3

Zone Number 8 Package Number 4 MEC Edition 1995

Submitted By JOHN DOE CAREFUL Phone Number 704-321-9445

PROPOSED
REQUIRED

Glazing Area

$100 \times \frac{288}{1923} = 15.0\%$
Glazing Area Gross Wall Proposed Glazing Area
5

15 %
Maximum Glazing Area

R-Value

Description	Comments	Proposed R-Value
Ceiling		R- 30
Wall	6	R- 13
Floor Over Unconditioned Space		R- 19
Floor Over Outside Air		R- 30
Basement Wall		R- N/A
Slab Floor	Unheated, 24" Depth	R- 8
Crawl Space Wall		R- N/A

Minimum R-Value
R- 30
R- 13
R- 19
R- 30
R- 8 4
R- 5
R- 10

U-Factor

Description	Comments	Proposed U-Factor
Glazing	7 See back	U- 0.50
Opaque Door	Front door exempt	U- 0.35

Maximum U-Factor
U- 0.50
U- 0.35

Equipment Efficiency (This section may be left blank if *Normal* is selected on the right.)

Heating _____ AFUE/HSPF 8

Cooling _____ SEER _____
Efficiency Make & Model Number

Check One

Normal

High Heating

High Cooling

High Heating & Cooling

Statement of Compliance: The proposed building design presented in these documents is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the requirements of the CABO Model Energy Code. 9

John Doe Careful Careful Builders, Inc. 12/12/00
Builder/Designer Company Name Date

Figure 2. Prescriptive Package Worksheet Step-by-Step (illustration based on 1995 MEC)

Step 4: Complete the Required Section

Copy the *Glazing Area* percentage from the prescriptive package you have chosen to the space labeled *Maximum Glazing Area*. Depending on the package you have selected, this percentage will range from 12% to 25% for single-family buildings or 15% to 30% for multifamily buildings.

Copy the insulation R-value and glazing U-factor requirements from the selected prescriptive package to the *Minimum R-Value* and *Maximum U-Factor* sections of the worksheet. The required R-value for floors over outside air is the same as that for ceilings, so copy the ceiling R-value requirement from the selected prescriptive package to the *Minimum R-Value* box for floors over outside air. The slab R-value requirement is for unheated slabs. In all locations except Zone 1, add an additional R-2 if you intend to install a heated slab. A heated slab has ducts or hydronic heating elements in or under the slab.

If high-efficiency heating equipment is specified in the package you have chosen, put an "X" in the box labeled *High Heating*. If high-efficiency cooling equipment is specified in the package you have chosen, put an "X" in the box labeled *High Cooling*. If both are specified, put an "X" in the box labeled *High Heating & Cooling*. If normal heating and cooling efficiency is specified in the package you selected, put an "X" in the box labeled *Normal*.

Step 5: Complete the Proposed Glazing Area Section

Calculate the total area (ft²) of all glazing assemblies (windows, sliding glass doors, skylights, etc.) located in the building envelope. The area of an assembly is the interior surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. The nominal area or rough opening is acceptable for flat windows. The area of windows in the exterior walls of conditioned basements should be included. Windows in unconditioned basements are *NOT* included. Record the total area of all applicable assemblies in the space labeled *Glazing Area*.

Next, calculate the gross wall area (ft²) and record this area in the space labeled *Gross Wall Area*. The gross wall area includes the following:

- all above-grade walls enclosing conditioned spaces (including attic kneewalls and skylight shafts)
- the peripheral edges of the floors (the area of the band joist and perimeter framing between floors)
- walls of conditioned basements with an average depth less than 50% below grade (include the entire wall area – even the below-grade portions). For further clarification, refer to the basement wall examples given in Step 6.
- all windows and doors (including windows and doors in conditioned basements).

Divide the glazing area by the gross wall area and multiply by 100 to determine the *Proposed Glazing Area* percentage.

Step 6: Complete the Proposed R-Value Section

Record the proposed R-value of the insulation to be installed in each applicable ceiling, wall, floor, basement wall, slab-edge, and crawl space wall component in the *Proposed R-Value* column of the worksheet.

Multiple R-Values and U-Factors Some components may consist of more than one R-value (e.g., part of the ceiling may be insulated to R-38 and part to R-19). If each component R-value is greater than or equal to the required R-value, record the lowest component R-value. However, if one of the R-values is less than the required R-value, perform an area-weighted average R-value calculation using *the R-Value/U-Factor Weighted Average Worksheet*. If the resulting average R-value is greater than or equal to the required R-value, the component complies and the average R-value should be transferred to the *Prescriptive Package Worksheet*.

Some buildings will use more than one glazing or door U-factor (e.g., windows and sliding glass doors with different U-factors may both be installed). If each U-factor is less than or equal to the required U-factor, record the highest (in value) component U-factor. However, if one of the U-factors exceeds the maximum U-factor requirement, perform an area-weighted average U-factor calculation using the *R-Value/U-Factor Weighted Average Worksheet*. If the resulting average U-factor is less than or equal to the required U-factor, the component complies and the average U-factor should be transferred to the *Prescriptive Package Worksheet*.

Ceiling R-Value Proposed R-values for ceilings represent the sum of the cavity insulation plus insulating sheathing (if used). For ventilated ceilings, insulating sheathing must be placed between the conditioned space and the ventilated portion of the roof (typically applied to the trusses or rafters immediately behind the drywall or other ceiling finish material).

The ceiling R-value requirements do not assume a raised or oversized truss construction. If the insulation achieves the full insulation thickness over the plate lines of exterior walls, R-30 insulation may be used to meet an R-38 insulation requirement and R-38 insulation may be used to meet an R-49 insulation requirement (see Footnote 3). If you are taking credit for a raised or oversized truss, note this in the *Comments* section of the worksheet.

Wall R-Value R-values for walls represent the sum of the cavity insulation plus insulating sheathing (if used). The wall R-value requirements are for wood-frame walls. However, the packages may be adapted for steel-frame and mass walls by using Tables 1 through 4. The use of steel-frame or mass walls should be noted in the *Comments* section of the worksheet.

Floor R-Value Floors over unconditioned space include floors over unconditioned crawl spaces, basements, and garages. Floors over outside air include floor cantilevers, the floor of an elevated building, and floors of overhangs (such as the floor above a recessed entryway or open carport). Floors over outside air must meet the ceiling R-value requirement.

Basement R-Value Basement walls that enclose conditioned spaces must be insulated from the top of the basement wall to 10 ft below ground level or to the basement floor, whichever is less. If you intend to install insulation on both the exterior and interior of the wall, provide the sum of both R-values.

1992 1993 Walls of conditioned basements with an average depth 50% or more below grade are considered basement walls; walls over 50% above grade are considered above-grade walls and must meet the wall R-value requirement for the package.

1995 Any individual wall of a conditioned basement with an average depth 50% or more below grade is considered a basement wall; a wall over 50% above grade is considered an above-grade wall and must meet the wall R-value requirement for the package.

The following examples help to clarify the treatment of basements with wood kneewalls, walk-out basements, and basement walls constructed from specialty foundation systems.

Example 1: Wood Kneewalls

Assume a basement is to be constructed with 3-ft-high wood kneewalls built on a 5-ft-high concrete foundation. R-13 insulation will be installed in the wood kneewall cavities and R-5 rigid insulation will be installed on the concrete foundation walls. The wood kneewalls are completely above grade and fully insulated. The concrete foundation walls are 4 ft below grade and fully insulated.

Because each basement wall is at least 50% below grade, both the masonry foundation and the wood kneewalls must be insulated to at least the basement R-value requirement specified in the selected prescriptive package. If the basement wall R-value requirement in the selected prescriptive package is R-5 or less, both the wood kneewalls and the concrete foundation walls meet the requirement and you may enter R-5 for the proposed

R-value of the basement walls. If, however, the requirement is greater than R-5, you will have to perform an area-weighted average U-factor calculation using the *R-Value/U-Factor Weighted Average Worksheet* to verify that the average basement wall R-value meets or exceeds the required R-value.

Example 2: Walk-Out Basement

Assume an 8-ft basement is to be built on a slope so that the front wall is 7 ft below grade and the rear wall is totally above grade. The ground level along both side walls is sloped so that approximately 50% of each wall is below grade. The rear basement wall will be wood-frame construction with R-19 insulation. The other three walls will be concrete walls with R-10 insulation. All four walls will be fully insulated.

Because the front and side walls are at least 50% below grade, they must be insulated to at least the basement R-value requirement specified in the selected prescriptive package. The rear wall is not 50% below grade, however, and is therefore subject to the above-grade wall requirement. Note that the basement floor along the rear wall should be considered a slab-on-grade component. Slab insulation should be installed along the basement floor for the length of the rear wall. The slab insulation must meet or exceed the slab R-value requirement specified for the selected package.

Example 3: Specialty Foundation Systems

Manufacturers of insulating foam concrete form systems and pre-manufactured concrete panels with integrated insulation generally supply R-value ratings for the entire wall, not just the insulation. Where the R-value of the insulation alone is not known, the manufacturer overall wall R-value rating may be used.

Slab R-Value The prescriptive package slab R-value requirements are for unheated slabs. Add an additional R-2 for heated slabs, except in Zone 1 which does not require slab insulation. For packages with a slab insulation requirement, the insulation must extend a total linear distance of at least 24 in. in Zones 2-12 and 48 in. in Zones 13-19. In the *Comments* section, indicate whether the slab will be heated or unheated. A heated slab is a slab with ducts or hydronic heating elements in or under the slab.

Slab Insulation Depth Slab insulation can be installed using any of several different configurations. Refer to the definition of Slab Insulation for a description and illustration of acceptable configurations.

Crawl Space Wall R-Value The crawl space wall R-value requirements are for walls of unventilated crawl spaces (i.e., not directly vented to the outside). The crawl space wall insulation must extend from the top of the wall to the inside finished grade. If the inside finished grade is less than 12 inches (305 mm) below the outside finished grade or the vertical wall insulation stops less than 12 inches below the outside grade, the insulation must instead extend vertically and horizontally a minimum of 24 linear inches (601 mm) from the outside grade level. Figure 3 illustrates the crawl space wall insulation depth requirements.

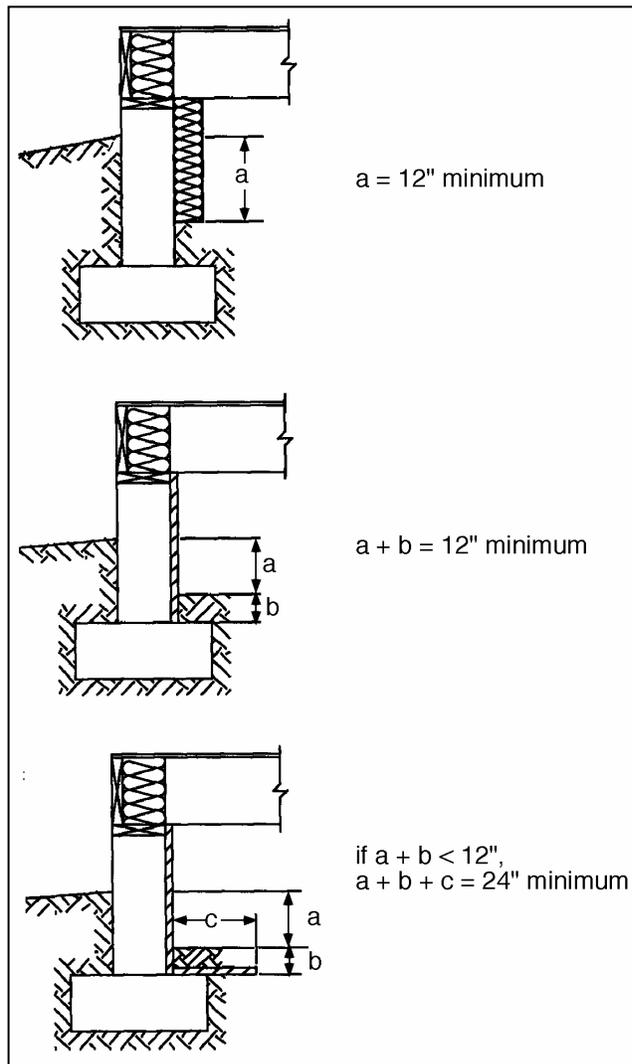


Figure 3. Crawl Space Wall Insulation Depth Requirement

Step 7: Complete the Proposed U-Factor Section

Glazing Record the proposed U-factors for glazing assemblies (such as windows, skylights, and sliding glass doors) in the *Proposed U-Factor* column of the worksheet. Up to 1% of the total allowed glazing area may be excluded from the U-factor requirement.

1992 1993 U-factors for glazing should be tested and documented by the manufacturer in accordance with the NFRC test procedure, taken from Appendix B, or derived from an alternate test procedure or table accepted by your local jurisdiction. Center-of-glass U-factors cannot be used.

1995 U-factors for glazing should be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from Appendix B. Center-of-glass U-factors cannot be used.

Doors In the *Proposed U-Factor* column of the worksheet, record the proposed U-factors for all opaque doors in the building envelope.

1992 1993 U-factors for doors must be based on manufacturer data, taken from Appendix B, or derived from an alternate test procedure or table accepted by your local jurisdiction.

1995 U-factors for doors must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from Appendix B.

The U-factor requirement for all doors in the building envelope (regardless of the prescriptive package chosen) is 0.35. The prescriptive package approach allows you to exclude one door from this requirement. If more than one door fails to meet the 0.35 U-factor requirement, perform an area-weighted average U-factor calculation using the *R-Value/U-Factor Weighted Average Worksheet* (one door may also be excluded from this calculation). If a door contains glass and an aggregate U-factor rating for that door is not available, include the glass area of the door with your glazing and use the opaque door U-factor from Appendix B to determine compliance with the door.

Step 8: Complete Equipment Efficiency Section

If the *Heating/Cooling Equipment Efficiency* column is marked *Normal* for the package you have selected, leave this section blank. If high-efficiency heating or cooling equipment is specified in the package you select, record the proposed equipment efficiency in the space(s) labeled *Efficiency* and record the equipment make and model number in the space(s) labeled *Make and Model Number*. If you plan to install more than one piece of heating equipment or more than one piece of cooling equipment, you must enter the efficiency of the unit with the lowest rating.

Step 9: Check for Compliance

Compliance is achieved if:

- the *Proposed Glazing Area* percentage is less than or equal to the *Maximum Glazing Area* percentage, and
- all R-values in the *Proposed R-Value* column are greater than or equal to the corresponding values in the *Minimum R-Value* column, and
- all glazing and door U-factors in the *Proposed U-Factor* column are less than or equal to the corresponding values in the *Maximum U-Factor* column, and
- your selected package specifies *Normal* equipment; OR your package specifies *High Heating* equipment and your proposed heating equipment has an AFUE of at least 90% or an HSPF of at least 7.8; OR your package specifies *High Cooling* equipment and your proposed heating equipment has a SEER of at least 12; OR your package specifies *High Heat/Cool* and your proposed equipment meets both of the above-listed requirements.

If all components do not meet the requirements of the selected prescriptive package, you can select another package, modify the design to meet the selected package requirements, or select another compliance approach.

When you have completed the *Prescriptive Package Worksheet*, sign and date the worksheet in the blanks provided. Transfer the insulation R-values and glazing and door U-factors to the building plans or specifications. If you are taking credit for high-efficiency equipment, also transfer the efficiency, make, and model number of the equipment.

Steel-Frame Wall Equivalent R-Values

The REScheck Prescriptive Packages give R-value requirements for wood-frame walls. Steel-frame walls can comply with these requirements if equivalent cavity and sheathing insulation R-values are selected from the following tables. Use Table 1 for 16-in. O.C. steel-frame wall constructions. Use Table 2 for 24-in. O.C. steel-frame wall constructions.

The left column lists the wood-frame wall R-value requirements specified in the prescriptive packages. The right column lists equivalent steel-frame wall cavity and sheathing R-value requirements. An equivalent steel wall must be insulated to one of the cavity plus sheathing R-value combinations listed to the right of the wood-frame wall requirement.

Example: A steel-frame house is being built to the specifications of the 1995 MEC Single-Family Prescriptive Package 5 in Zone 8. The wood-frame wall R-value requirement for this package is R-13. The steel-frame walls are to be 16-in. O.C. construction with R-5 sheathing. The Table 1 for the 1995 MEC indicates that R-11 cavity insulation must be installed. The other acceptable combinations are R-15 cavity insulation with R-4 sheathing and R-21 cavity insulation with R-3 sheathing.

1992 1993

Table 1. 16-in. O.C. Steel-Frame Wall Equivalent R-Values

Wood-Frame Wall R-Value	Equivalent Steel-Frame Wall Cavity and Sheathing R-Value(a)
R-11	R-0+R-10, R-11+R-5, R-15+R-4, R-21+R-3
R-13	R-11+R-6, R-15+R-5, R-21+R-4
R-14	R-11+R-7, R-15+R-6, R-19+R-5
R-15	R-11+R-7, R-19+R-6, R-25+R-5
R-16	R-11+R-9, R-15+R-8, R-21+R-7
R-17	R-11+R-10, R-15+R-9, R-21+R-8
R-18	R-13+R-10, R-19+R-9, R-25+R-8
R-19	R-15+R-10, R-21+R-9
R-20	R-19+R-10, R-25+R-9
R-21	R-25+R-10
(a) The cavity insulation R-value requirement is listed first, followed by the sheathing R-value requirement.	

1992 1993

Table 2. 24-in. O.C. Steel-Frame Wall Equivalent R-Values

Wood-Frame Wall R-Value	Equivalent Steel-Frame Wall Cavity and Sheathing R-Value(a)
R-11	R-0+R-10, R-11+R-4, R-13+R-3, R-19+R-2, R-25+R-0
R-13	R-11+R-5, R-15+R-4, R-19+R-3, R-25+R-2
R-14	R-11+R-6, R-13+R-5, R-19+R-4, R-25+R-3
R-15	R-11+R-6, R-15+R-5, R-19+R-4, R-25+R-3
R-16	R-11+R-8, R-15+R-7, R-19+R-6, R-25+R-5
R-17	R-11+R-9, R-13+R-8, R-19+R-7, R-25+R-6
R-18	R-11+R-10, R-13+R-9, R-15+R-8, R-21+R-7
R-19	R-11+R-10, R-15+R-9, R-19+R-8, R-25+R-7
R-20	R-13+R-10, R-15+R-9, R-21+R-8
R-21	R-15+R-10, R-19+R-9, R-25+R-8
(a) The cavity insulation R-value requirement is listed first, followed by the sheathing R-value requirement.	

Table 1. 16-in. O.C. Steel-Frame Wall Equivalent R-Values

Wood-Frame Wall R-Value	Equivalent Steel-Frame Wall Cavity and Sheathing R-Value ^(a)
R-11	R-0+R-9, R-11+R-4, R-15+R-3, R-21+R-2
R-13	R-11+R-5, R-15+R-4, R-21+R-3
R-14	R-11+R-6, R-13+R-5, R-19+R-4
R-15	R-11+R-6, R-15+R-5, R-19+R-4
R-16	R-11+R-8, R-15+R-7, R-21+R-6
R-17	R-11+R-9, R-13+R-8, R-19+R-7
R-18	R-11+R-9, R-15+R-8, R-21+R-7
R-19	R-11+R-10, R-13+R-9, R-19+R-8, R-25+R-7
R-20	R-11+R-10, R-13+R-9, R-19+R-8
R-21	R-13+R-10, R-19+R-9, R-25+R-8
R-22	R-13+R-10, R-19+R-9
R-24	R-19+R-10, R-25+R-9
R-25	R-19+R-10
R-26	R-19+R-11, R-21+R-10
(a) The cavity insulation R-value requirement is listed first, followed by the sheathing R-value requirement.	

Table 2. 24-in. O.C. Steel-Frame Wall Equivalent R-Values

Wood-Frame Wall R-Value	Equivalent Steel-Frame Wall Cavity and Sheathing R-Value ^(a)
R-11	R-0+R-9, R-11+R-3, R-15+R-2, R-25+R-0
R-13	R-11+R-4, R-15+R-3, R-19+R-2
R-14	R-11+R-5, R-13+R-4, R-15+R-3, R-21+R-2
R-15	R-11+R-5, R-13+R-4, R-19+R-3, R-21+R-2
R-16	R-11+R-7, R-13+R-6, R-19+R-5, R-25+R-4
R-17	R-11+R-8, R-13+R-7, R-15+R-6, R-21+R-5
R-18	R-11+R-8, R-13+R-7, R-19+R-6, R-25+R-5
R-19	R-11+R-9, R-13+R-8, R-15+R-7, R-21+R-6
R-20	R-11+R-9, R-13+R-8, R-19+R-7, R-21+R-6
R-21	R-11+R-9, R-15+R-8, R-21+R-7
R-22	R-11+R-10, R-13+R-9, R-19+R-8, R-21+R-7
R-24	R-11+R-10, R-15+R-9, R-19+R-8
R-25	R-13+R-10, R-19+R-9, R-21+R-8
R-26	R-15+R-10, R-19+R-9, R-25+R-8
(a) The cavity insulation R-value requirement is listed first, followed by the sheathing R-value requirement.	

Mass Wall Equivalent R-Values

The REScheck Prescriptive Packages give R-value requirements for wood-frame walls. High mass walls in some locations have lower insulation requirements than wood-frame walls, with more credit given in warmer locations. The following tables can be used to determine the equivalent insulation requirements when high-mass walls are used instead of wood-frame walls. To qualify as a high-mass wall, the heat capacity of the exterior wall must be greater than or equal to 6 Btu/ft² °F [123 kJ/m² K] of exterior wall area. Masonry and concrete walls having a mass greater than or equal to 30 lb/ft² (146 kg/m²) and solid walls having a mass greater than or equal to 20 lb/ft² (98 kg/m²) will meet this requirement.

Use Table 3 for mass walls with exterior or integral insulation and Table 4 for mass walls with interior insulation. The left column lists the wood-frame wall R-value requirements specified in the prescriptive packages. The right column lists equivalent mass wall insulation R-value requirements.

Example: A house with high-mass walls is being built to the specifications of Prescriptive Package 5 in Zone 8. The wood-frame wall R-value requirement for this package is R-13. The mass walls will have exterior insulation. Table 3 for the 1995 MEC indicates that in Zone 8, R-6 exterior insulation may be installed instead of R-13.

1992 1993

Table 3. High-Mass Wall Equivalent R-Values; Exterior or Integral Insulation for 1992 and 1993 MEC

Wood-Frame Wall R-Value	Equivalent High-Mass Wall R-Value					
	Zones 1 to 4	Zones 5 to 8	Zones 9 to 11	Zones 12 to 13	Zones 14 to 15	Zones 16 to 19
R-11	R-6	R-6	R-8	R-9	R-10	R-11
R-13	R-7	R-7	R-8	R-9	R-11	R-12
R-14	R-7	R-7	R-9	R-10	R-11	R-13
R-15	R-7	R-8	R-9	R-10	R-11	R-13
R-16	R-7	R-8	R-9	R-10	R-12	R-14
R-17	R-8	R-8	R-9	R-11	R-12	R-14
R-18	R-8	R-9	R-10	R-11	R-13	R-15
R-19	R-9	R-9	R-11	R-12	R-14	R-17
R-20	R-9	R-10	R-11	R-13	R-15	R-18
R-21	R-9	R-10	R-11	R-13	R-15	R-18
R-22	R-9	R-10	R-11	R-13	R-16	R-19
R-23	R-10	R-10	R-12	R-13	R-16	R-19
R-24	R-10	R-10	R-12	R-14	R-16	R-20
R-25	R-10	R-10	R-12	R-14	R-17	R-20
R-26	R-10	R-11	R-12	R-14	R-17	R-21

Table 4. High-Mass Wall Equivalent R-Values; Interior Insulation for 1992 and 1995 MEC

Wood-Frame Wall R-Value	Equivalent High-Mass Wall R-Value					
	Zones 1 to 4	Zones 5 to 8	Zones 9 to 11	Zones 12 to 13	Zones 14 to 15	Zones 16 to 19
R-11	R-11	R-11	R-12	R-12	R-14	R-14
R-13	R-13	R-13	R-13	R-14	R-15	R-15
R-14	R-14	R-14	R-14	R-15	R-16	R-16
R-15	R-15	R-15	R-15	R-16	R-16	R-16
R-16	R-15	R-15	R-15	R-16	R-16	R-16
R-17	R-15	R-15	R-15	R-17	R-17	R-17
R-18	R-16	R-16	R-16	R-18	R-18	R-18
R-19	R-18	R-18	R-18	R-22	R-22	R-22
R-20	R-20	R-20	R-20	R-22	R-22	R-22
R-21	R-21	R-21	R-21	R-23	R-23	R-23
R-22	R-22	R-22	R-22	R-24	R-24	R-24
R-23	R-22	R-22	R-22	R-24	R-24	R-24
R-24	R-23	R-23	R-23	R-25	R-25	R-25
R-25	R-24	R-24	R-24	R-25	R-25	R-25
R-26	R-25	R-25	R-25	R-26	R-26	R-26

Table 3. High-Mass Wall Equivalent R-Values; Exterior or Integral Insulation for 1995 MEC

Wood-Frame Wall R-Value	Equivalent High-Mass Wall R-Value					
	Zones 1 to 4	Zones 5 to 8	Zones 9 to 11	Zones 12 to 13	Zones 14 to 15	Zones 16 to 19
R-11	R-6	R-6	R-7	R-8	R-9	R-10
R-13	R-6	R-6	R-8	R-9	R-10	R-11
R-14	R-6	R-7	R-8	R-9	R-10	R-11
R-15	R-7	R-7	R-8	R-9	R-10	R-12
R-16	R-7	R-7	R-8	R-9	R-11	R-12
R-17	R-7	R-7	R-9	R-10	R-11	R-13
R-18	R-7	R-7	R-9	R-10	R-11	R-13
R-19	R-8	R-9	R-10	R-11	R-13	R-15
R-20	R-8	R-9	R-10	R-11	R-13	R-16
R-21	R-8	R-9	R-10	R-12	R-14	R-16
R-22	R-8	R-9	R-10	R-12	R-14	R-17
R-23	R-9	R-9	R-11	R-12	R-14	R-17
R-24	R-9	R-9	R-11	R-12	R-14	R-27
R-25	R-9	R-10	R-11	R-13	R-15	R-18
R-26	R-9	R-10	R-11	R-13	R-15	R-18

Table 4. High-Mass Wall Equivalent R-Values; Interior Insulation for 1995 MEC

Wood-Frame Wall R-Value	Equivalent High-Mass Wall R-Value					
	Zones 1 to 4	Zones 5 to 8	Zones 9 to 11	Zones 12 to 13	Zones 14 to 15	Zones 16 to 19
R-11	R-10	R-10	R-11	R-11	R-12	R-12
R-13	R-11	R-11	R-12	R-12	R-14	R-14
R-14	R-12	R-12	R-12	R-12	R-15	R-15
R-15	R-13	R-13	R-13	R-13	R-15	R-15
R-16	R-13	R-13	R-13	R-14	R-15	R-15
R-17	R-14	R-14	R-14	R-15	R-16	R-16
R-18	R-15	R-15	R-15	R-15	R-16	R-16
R-19	R-16	R-16	R-16	R-19	R-19	R-19
R-20	R-16	R-16	R-16	R-20	R-20	R-20
R-21	R-17	R-17	R-17	R-21	R-21	R-21
R-22	R-17	R-17	R-17	R-21	R-21	R-21
R-23	R-18	R-18	R-18	R-22	R-22	R-22
R-24	R-19	R-19	R-19	R-22	R-22	R-22
R-25	R-20	R-20	R-20	R-22	R-22	R-22
R-26	R-21	R-21	R-21	R-23	R-23	R-23

Compliance Example

Assume that you plan to build the single-family house shown in Figure 4 on a lot located in Greensboro, North Carolina. Greensboro is in Guilford County and is designated as Zone 8 (see Appendix E). For the purposes of this example, assume you have chosen Package 4 from the single-family prescriptive packages offered for Zone 8. Compliance for a multifamily building is handled in much the same way, only packages should be selected from the tables developed specifically for multifamily buildings.

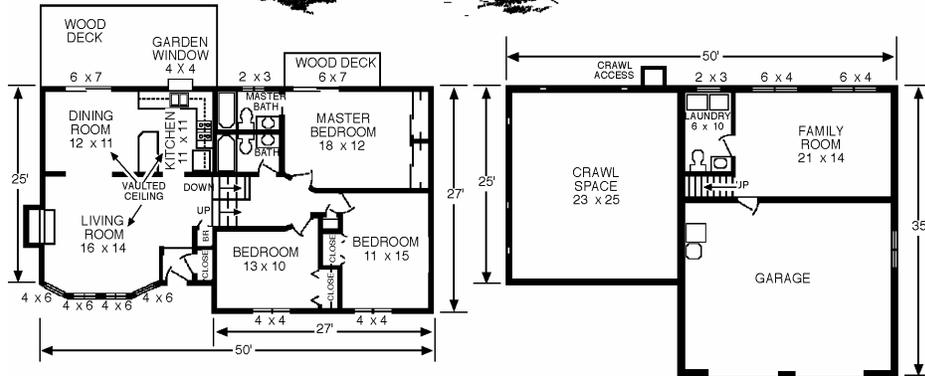


Figure 4. Example House

Table 5 lists the components that make up the building envelope, the dimensions of some of these components, and the proposed insulation R-values and window and door U-factors. Figure 5 shows how to determine the proposed and required R-values recorded on the *Prescriptive Package Worksheet*.

Table 5. Example House Specifications

Building Component	Area	Insulation Level
Ceilings		
With Attic (Std. Truss)	N/A	R-38
Vaulted	N/A	R-30
Walls (2x4 @ 16-in. O.C.)		
Without Sheathing(a)	276 ft ² (gross)	R-13
With Sheathing	1647 ft ² (gross)	R-19 (R-13 cavity + R-6 sheathing)
Windows	204 ft ²	U-0.45
Sliding Glass Doors	84 ft ²	U-0.61
Doors		
Entrance	N/A	U-0.54
Garage to Family Room	N/A	U-0.35
Floors		
Over Garage	N/A	R-19
Over Crawl Space	N/A	R-19
Slab (Unheated)	N/A	R-8 (24-in. depth)
Bay Window Floor	N/A	R-30
(a) Walls without sheathing are located between the family room and the garage, the laundry room and the crawl space, and the garage and the living room.		

Determine Which Components are Part of the Building Envelope

The advantage of the prescriptive package approach over the trade-off approach and the software approach is that you are not required to know the areas of many of the building components (Table 1 lists only the areas that you will need). You **DO** need to compute a glazing area percentage, however, and this computation requires the gross wall area and total glazing area. Before you can determine the gross wall area of your building, you must first determine which walls are part of the building envelope and which are not. Only the building components that are part of the building envelope are relevant.

Building envelope components are those that separate conditioned spaces (heated or cooled rooms) from outside air or from unconditioned spaces (rooms that are neither heated nor cooled). Walls, floors, and other building components separating two conditioned spaces are **NOT** part of the building envelope.

Walls In this example, the garage is unconditioned, so the exterior garage walls are not part of the building envelope. The wall between the conditioned family room and the unconditioned garage is part of the building envelope, including the wall of the stairwell facing the garage. Likewise, the wall between the garage and the living room is part of the building envelope.

Part of the laundry room wall separates the laundry room from the crawl space and the other part separates the laundry room from the kitchen. The wall portion adjacent to the crawl space is part of the building envelope because it separates the conditioned laundry from the unconditioned crawl space. The wall portion adjacent to the kitchen can be ignored because it separates two conditioned spaces. The wall portion adjacent to the family room can also be ignored. Likewise, the wall between the upstairs bathrooms and the kitchen and the wall between the center bedroom and the living room are not part of the building envelope. Portions of both of these walls are also adjacent to outside air, and those portions are part of the building envelope. The following walls are part of the building envelope and their areas need to be included when computing the gross wall area:

- all walls between interior conditioned space and outside air
- the walls between the family room and the garage
- the walls between the garage and the living room
- the wall between the laundry room and the crawl space.

Ceilings The dining room, living room, bay window roof, and entryway have a vaulted ceiling that will be insulated to R-30. The rest of the home has a ceiling with attic which will be insulated to R-38.

Floors The floor of the bay window is considered a floor over outside air and must meet the ceiling R-value requirement. The floors over the garage and the crawl space are floors over unconditioned space, and must meet the floor R-value requirement. Because the floor over the crawl space is to be insulated, the crawl space is not part of the building envelope and the crawl space walls are not considered. The family room has a slab-on-grade floor which must meet the slab perimeter R-value requirement.

Glazing and Doors There are two sliding glass doors in the building envelope – one leading from the dining room to the larger deck and one leading from the master bedroom to the smaller deck. There are two opaque doors in the building envelope – the front entry door and the door leading from the garage into the family room.

Complete the Required Section

Transfer all of the requirements specified by Package 4 to the right side of the *Prescriptive Package Worksheet* (in the *REQUIRED* section). Record the maximum allowed glazing area (15% in this example) in the space labeled *Maximum Glazing Area*. Transfer the R-value and U-factor requirements from the package to the boxes under the *Minimum R-Value* and *Maximum U-Factor* columns. Note that floors over outside air must meet the prescriptive package ceiling R-value requirement (R-30 in this example), so the ceiling requirement is listed across from the *Floor Over Outside Air* component. The U-factor requirement for all doors is 0.35, so this value has been entered on the worksheet for you (one door may be exempted from this requirement). Package 4 specifies *Normal* heating equipment efficiency, so place an "X" in the *Normal* box.

Complete the Proposed R-Value Section

Record the R-values of the insulation that you intend to install in the *Proposed R-Value* column. These proposed values are listed in Table 5. The example house does not have a basement, so place "N/A" in the *Proposed R-Value* column for basement walls to indicate that they are not applicable. Although there is a crawl space, it is ventilated and the insulation will be installed on the floor over the crawl space, so place "N/A" in the *Proposed R-Value* column for crawl space walls as well.

Ceiling R-Value Two ceiling insulation R-values will be installed in the house. R-38 insulation is proposed for the flat ceiling below a vented attic and R-30 insulation is proposed for the vaulted ceiling. The selected package requires a minimum of R-30 ceiling insulation. Because the lowest proposed R-value (R-30 for the vaulted ceiling) is greater than or equal to the minimum required (also R-30), you may enter R-30 in the *Proposed R-Value* column for ceilings. You do not need to calculate an average R-value for ceilings. If the required ceiling R-value is greater than the R-value you plan to install in one part of the ceiling, but is less than the R-value you plan to install in another part of the ceiling, you may be able to meet or exceed the required ceiling R-value with the area-weighted average R-value. You can calculate this average R-value using the *R-Value/U-Factor Weighted Average Worksheet*.

R-30 insulation is proposed for the floor of the bay window (floors over outside air are subject to the ceiling R-value requirement). Enter R-30 in the *Proposed R-Value* column for floors over outside air.

Wall R-Value Most of the walls will be insulated with R-13 cavity insulation and covered with R-6 insulating sheathing. Cavity insulation and sheathing can be added together – in this case resulting in R-19. However, R-13 cavity insulation without sheathing will be installed on walls between

- the family room and the garage
- the laundry room and the crawl space
- the garage and the living room.

The selected package requires a minimum of R-13 wall insulation. Because the lowest proposed wall R-value (R-13) is greater than or equal to the minimum required (also R-13), you are not required to calculate an average R-value for walls. Enter R-13 in the *Proposed R-Value* column for walls.

Floor R-Value The floor above the crawl space and the floor over the garage are both floors over unconditioned space. Both of these floors will be insulated with R-19 batt insulation. Enter R-19 for the *Floor Over Unconditioned Space* component.

Slab R-Value Enter R-8 for the *Slab Floor* component. In the *Comments* column, indicate that the slab will be unheated. In all locations except Zone 1, heated slabs have more stringent requirements than unheated slabs (see Footnote 7). Also indicate the

depth of the insulation you intend to install (slab insulation must extend 24 in. in Zones 2-12 and 48 in. in Zones 13-19).

Complete the Proposed U-Factor Section

Glazing U-Factor Two different glazing U-factors were proposed. The windows have a U-factor of 0.45 and the sliding glass doors have a U-factor of 0.61, both of which have been rated and labeled by the manufacturer in accordance with the NFRC test procedure. Because 0.61 is greater than the maximum U-factor specified in the package (0.50), you must calculate an area-weighted average U-factor. Complete the *R-Value/U-Factor Weighted Average Worksheet* and transfer the results to the *Prescriptive Package Worksheet*. Figure 5 shows the portion of the *R-Value/U-Factor Weighted Average Worksheet* used to calculate the average glazing U-factor for this house (0.50). If both proposed U-factors had been less than or equal to the required U-factor, then the weighted-average computation would not have been necessary and you could have recorded the higher of the two U-factors.

Door U-Factor The U-factor requirement for all opaque doors (regardless of the prescriptive package chosen) is 0.35. The entry door has a U-factor of 0.54 and the door from the garage to the family room has a U-factor of 0.35. Therefore, the entry door does not meet the U-factor requirement and the garage door does meet it exactly. On average, the proposed door U-factors will clearly not comply with this or any other package. However, one door may be exempted from this requirement (see Note b). This exemption allows one door to exceed the 0.35 U-factor requirement. Because the entry door of the example house may be exempted and the garage door complies, record the U-factor of the garage door (0.35) as the *Proposed U-Factor* for the *Door* component. If more than one door had exceeded the door U-factor requirement, an area-weighted average of all non-exempted doors would have been necessary to show compliance.

Complete the Proposed Heating Efficiency Section

The selected package does not require high-efficiency equipment. You may leave this section blank.

Check for Compliance

To verify compliance with the requirements of Prescriptive Package 4 for Zone 8, compare the *PROPOSED* and *REQUIRED* sections of the *Prescriptive Package Worksheet*.

- The *Proposed Glazing Area* is less than or equal to the allowed *Maximum Glazing Area*, and
- the *Proposed R-Values* for each of the building components are greater than or equal to the required *Minimum R-Values*, and
- the *Proposed U-Factors* for glazing and doors are less than or equal to the required *Maximum U-Factors*, and
- there are no equipment efficiency requirements.

You have demonstrated that your building design complies with the code insulation and window requirements (congratulations!). Sign and date the worksheet.

Zone 8 Single-Family Prescriptive Packages - 1995 MEC

Package	MAXIMUM		MINIMUM							Heating/Cooling Equipment Efficiency
	Glazing Area %	U-Factor	Ceiling R-Value	Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab Perimeter R-Value	Crawl Space Wall R-Value		
1	12%	0.60	R-30	R-13	R-19	R-8	R-4	R-10	Normal	
2	12%	0.45	R-30	R-13	R-11	R-5	R-2	R-6	Normal	
3	15%	0.65	R-38	R-18	R-19	R-8	R-6	R-11	Normal	
4	15%	0.50	R-30	R-13	R-19	R-8	R-5	R-10	Normal	
5	15%	0.40	R-38	R-13	R-11	R-5	R-2	R-6	Normal	
6	18%	0.55	R-38	R-18	R-19	R-8	R-6	R-11	Normal	

Select a prescriptive package.

Prescriptive Package Worksheet
CABO Model Energy Code (MEC)

Builder Name: CAREFUL BUILDERS, INC. Date: 12/12/00
 Building Address: 120 W ST, GREENSBORO, NORTH CAROLINA 27411
 Building Address: 1010 CONSTRUCTION AVE, GREENSBORO, NORTH CAROLINA
 Zone Number: 8 Package Number: 4 MEC Edition: 1995
 Submitted By: JOHN DOE CAREFUL Phone Number: 336-321-9445

PROPOSED **REQUIRED**

Glazing Area
 $100 \times \frac{288}{1923} = 15.0\%$
 Glazing Area: 288 Gross Wall Area: 1923 Proposed Glazing Area: 15.0%
 Minimum Glazing Area: 15%

R-Value

Description	Comments	Proposed R-Value	Minimum R-Value
Ceiling		R-30	R-30
Wall		R-13	R-13
Floor Over Unconditioned Space		R-19	R-19
Floor Over Outside Air		R-30	R-30
Basement Wall		R-8	R-8
Slab Floor	Unheated, 24" Depth	R-5	R-5
Crawl Space Wall		R-8	R-10

U-Factor

Description	Comments	Proposed U-Factor	Minimum U-Factor
Glazing	See back	U-0.50	U-0.50
Opaque Door	Front door exempt	U-0.35	U-0.35

Equipment Efficiency (This section may be left blank if Normal is selected on the right)
 Heating: A/UA/ISPT Normal
 Cooling: SEER High Cooling High Heating & Cooling

Check One
 Normal
 High Heating
 High Cooling
 High Heating & Cooling

Statement of Compliance: The proposed building design represented in these documents is consistent with the building plans, specifications, and other data/notes submitted with the permit application. The proposed building has been designed to meet the requirements of the CABO Model Energy Code.
 John Doe Careful Careful Builders, Inc. 12/12/00
 Submitter/Designer Company Name Date

Transfer the requirements from the prescriptive package to the Minimum R-Value and Maximum U-Value sections of the Prescriptive Package Worksheet.

Assembly: Glazing

Component Description	R-Value	U-Value (1 + R-Value)	Area	U-Value x Area (UA)
Windows	—	0.45	204	92
Glass Doors	—	0.61	84	51
			Total Area = 288	Total UA = 143

Transfer weighted average R-value from the R-Value/U-Value Weighted Average Worksheet to the Prescriptive Package Worksheet.

Total Area	+	Total UA	=	Weighted Average R-Value
143		288		0.50
Total UUA	÷	Total Area	=	Weighted Average U-Value

Figure 5. Determining Proposed and Required R-Values and U-Factors



Prescriptive Package Worksheet

CABO Model Energy Code (MEC)

Enforcement Agency:
Permit #
Checked By
Date

Builder Name _____ Date _____
 Builder Address _____
 Building Address _____
 Zone Number _____ Package Number _____ MEC Edition _____
 Submitted By _____ Phone Number _____

PROPOSED	REQUIRED
----------	----------

Glazing Area

$$100 \times \frac{\text{Glazing Area}}{\text{Gross Wall Area}} = \text{Proposed Glazing Area} \%$$

_____ %
Maximum Glazing Area

R-Value

Description	Comments	Proposed R-Value
Ceiling		R-
Wall		R-
Floor Over Unconditioned Space		R-
Floor Over Outside Air		R-
Basement Wall		R-
Slab Floor		R-
Crawl Space Wall		R-

Minimum R-Value
R-

U-Factor

Description	Comments	Proposed U-Factor
Glazing		U-
Opaque Door		U-

Maximum U-Factor
U-
U- 0.35

- Check One
- Normal
 - High Heating
 - High Cooling
 - High Heating & Cooling

Equipment Efficiency (This section may be left blank if Normal is selected on the right.)

Heating _____ AFUE/HSPF _____
 Cooling _____ SEER _____
 Efficiency _____ Make & Model Number _____

Statement of Compliance: The proposed building design represented in these documents is consistent with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the requirements of the CABO Model Energy Code.

Builder/Designer _____ Company Name _____ Date _____

R-Value/U-Factor Weighted Average Worksheet



(optional)

Assembly:

Component Description	R-Value	U-Factor (1 ÷ R-Value)	Area	U-Factor x Area (UA)
			Total Area =	Total UA =

$$\frac{\text{Total Area}}{\text{Total UA}} = \text{Weighted Average R-Value}$$

$$\frac{\text{Total UA}}{\text{Total Area}} = \text{Weighted Average U-Factor}$$

Assembly:

Component Description	R-Value	U-Factor (1 ÷ R-Value)	Area	U-Factor x Area (UA)
			Total Area =	Total UA =

$$\frac{\text{Total Area}}{\text{Total UA}} = \text{Weighted Average R-Value}$$

$$\frac{\text{Total UA}}{\text{Total Area}} = \text{Weighted Average U-Factor}$$

R-Value/U-Factor Weighted Average Worksheet: Examples

This worksheet can be used to calculate the average R-value of two or more building components of the same type but with different R-values, or to calculate the average U-factor of two or more glazing or door components with different U-factors.

R-Value Example: Our example has a ceiling with attic component insulated to R-38 and covering 729 ft², and a vaulted ceiling component insulated to R-30 and covering 592 ft². After entering these values and performing the indicated calculations, the weighted average R-value for these components is determined to be R-34.3. These two ceiling components, taken together, will meet the requirements of any prescriptive package that has a ceiling R-value requirement of R-34 or less.

Assembly: <i>Ceilings</i>				
Component Description	R-Value	U-Factor (1 ÷ R-Value)	Area	U-Factor x Area (UA)
<i>with Attic</i>	38	0.026	729	19.0
<i>Vaulted</i>	30	0.033	592	19.5
			Total Area = 1321	Total UA = 38.5

<u>1321</u>	+	<u>38.5</u>	=	<u>34.3</u>
Total Area		Total UA		Weighted Average R-Value

<u>143</u>	+	<u>288</u>	=	<u>0.50</u>
Total UA		Total Area		Weighted Average U-Factor

U-Factor Example: Our example house has two glazing components; windows with a U-factor of 0.45 and a combined area of 204 ft² and sliding glass doors with a U-factor of 0.61 and a total area of 84 ft². After entering these values and performing the indicated calculations, the weighted average U-factor for these components is determined to be 0.50. These two glazing components, taken together, will meet the requirements of any prescriptive package that has a glazing U-factor requirement of 0.50 or higher.

Assembly: <i>Glazing</i>				
Component Description	R-Value	U-Factor (1 ÷ R-Value)	Area	U-Factor x Area (UA)
<i>Windows</i>	—	0.45	204	92
<i>Glass Doors</i>	—	0.61	84	51
			Total Area = 288	Total UA = 143

<u>143</u>	+	<u>288</u>	=	<u>0.50</u>
Total UA		Total Area		Weighted Average U-Factor

Glazing Area/U-Factor Trade-Off Worksheet (optional)

The glazing area and U-factor requirements for any prescriptive package can be altered to better meet your building design. Any combination of area and U-factor that satisfies the following relationship can be used:

$$\text{New Area} \times \text{New U-Factor} \leq \text{Package Area} \times \text{Package U-Factor}$$

Where *Package Area* and *Package U-Factor* are the area and U-Factor in the prescriptive package you have selected and *New Area* and *New U-Factor* are your altered glazing and U-factor combination.

Fill in the following blanks and attach this worksheet to the *Prescriptive Package Worksheet*. See the back side of this worksheet for examples.

Zone Number _____	Package Number _____	
MEC Edition _____		
Package Glazing Requirements:		
_____	X	_____ = _____
Glazing Area %		Glazing U-Factor Package Glazing Total
New Glazing Requirements:		
_____	X	_____ = _____
Glazing Area %		Glazing U-Factor New Glazing Total

}

New Glazing Total must be less than or equal to Package Glazing Total.

Example 1 (based on 1995 Single Family Packages):

Refer to the single family prescriptive packages for Zone 8. Package 3 lists a maximum glazing area percentage of 15% and a maximum U-factor of 0.65. The *Package Glazing Total* (area x U-factor) for this package is 9.8. Assume, however, that your building design calls for a glazing area of 17%. To determine the maximum allowable U-factor for a 17% glazing area, divide the *Package Glazing Total* by 17%:

$$\text{New Glazing U-Factor} = (15 \times 0.65) \div 17 = 0.57$$

The new glazing requirements are a glazing area percentage of 17% and a U-factor of 0.57.

Zone Number	<u>8</u>	Package Number	<u>3</u>	
MEC Edition	<u>1995</u>			
Package Glazing Requirements:				
<u>15</u>	x	<u>0.65</u>	=	<u>9.8</u>
Glazing Area %		Glazing U-Factor		Package Glazing Total
New Glazing Requirements:				
<u>17</u>	x	<u>0.57</u>	=	<u>9.7</u>
Glazing Area %		Glazing U-Factor		New Glazing Total

} *New Glazing Total must be less than or equal to Package Glazing Total.*

Example 2 (based on 1995 Single-Family Packages):

The *Glazing Area/U-Factor Trade-Off Worksheet* is also useful if you prefer to install windows with a U-factor that is different from the package requirement. As in the previous example, assume that you have selected Package 3 from Zone 8, but prefer to use windows with a U-factor of 0.72. To determine the maximum allowable area for windows with a U-factor of 0.72, divide the *Package Glazing Total* by 0.72:

$$\text{New Window U-Factor} = (15 \times 0.65) \div 17 = 0.57$$

The new glazing requirements are a glazing area percentage of 13.5% and a U-factor of 0.72.

Zone Number	<u>8</u>	Package Number	<u>3</u>	
MEC Edition	<u>1995</u>			
Package Glazing Requirements:				
<u>15</u>	x	<u>0.65</u>	=	<u>9.8</u>
Glazing Area %		Glazing U-Factor		Package Glazing Total
New Glazing Requirements:				
<u>13.5</u>	x	<u>0.72</u>	=	<u>9.7</u>
Glazing Area %		Glazing U-Factor		New Glazing Total

} *New Glazing Total must be less than or equal to Package Glazing Total.*

Appendix A: Additions

1992 MEC, 1993 MEC, and 1995 MEC

What is an Addition?

Additions to existing buildings must comply with code requirements when the addition is within the scope of the code and would not otherwise be exempted. Although not specifically defined in the code, building codes typically define an addition as any increase in a building's habitable floor area (which can be interpreted as any increase in the conditioned floor area).

Additions include new construction, such as a conditioned bedroom, sunspace, or enclosed porch added to an existing building. Additions also include existing spaces converted from unconditioned or exempt spaces to conditioned spaces.

For example, a finished basement, an attic converted to a bedroom, and a carport converted to a den, are additions. An unconditioned garage converted to a bedroom is an addition, but the addition of an unconditioned garage would not be considered within the scope of the code, since the code applies to heated or cooled (conditioned) spaces. If a conditioned floor area is expanded, such as a room made larger by moving out a wall, only the newly conditioned space must meet the code. A flat window added to a room does not increase the conditioned space and thus is not an addition by this definition.

Compliance Options for Additions

The addition (the newly conditioned floor space) complies with the code if it complies with all of the applicable code requirements. For example, requirements applicable to the addition of a new room would most likely include insulating the exterior walls, ceiling, and floor to the levels specified in the code; sealing all joints and penetrations; installing a vapor retarder in unventilated framed walls, floors, and ceilings; identifying installed insulation R-values and window U-factors; and insulating and sealing any ducts in unconditioned portions or exterior components (walls, ceilings, or floors) of the new space.

There are three approaches by which an addition can comply with the code:

- The addition as defined above meets all code requirements. This approach does not require that the original portion of the building meet code requirements.
- If the building with the addition complies with the code, the addition will also comply, regardless of whether the addition complies alone. For example, a sunroom that does not comply with the code is added to a house. If the entire house (with the sunroom) complies, the addition also complies.

- The addition, including possible concurrent renovation, does not increase the whole building UA or energy use. The change in UA or energy use can be shown by any of the commonly used code compliance tools. For example, additions that add rooms while simultaneously upgrading the existing HVAC system, windows, and/or insulation often reduce the energy use or UA of the existing part of the home, more than offsetting the added space to the home.

Appendix B: Default U-Factors

1992 MEC, 1993 MEC, and 1995 MEC

Glazing and Door Defaults

The following tables provide default U-factors for glazing and doors based on the glazing or door features. The U-factors in these tables can be used in the absence of NFRC-labeled values.

Glazing and doors cannot receive credit for features that cannot be clearly detected, such as argon gas fills and low-emissivity (low-E) coatings. Windows with these features may achieve much lower U-factors than those listed in Table 1. For example, a double-pane wood or vinyl window with low-E glass may have a U-factor around 0.38. The same window with argon gas may be rated at 0.34. Therefore, it may be advantageous to use tested, documented, and labeled U-factors for these types of windows.

Where a composite of materials from two different product types is used, the window or door must be assigned the higher U-factor.

Table 1. U-Factors for Windows, Glazed Doors, and Skylights

Frame/Glazing Features	Single Pane	Double Pane
Metal Without Thermal Break		
Operable	1.30	0.87
Fixed	1.17	0.69
Door	1.26	0.80
Skylight	2.02	1.30
Metal With Thermal Break		
Operable	1.07	0.67
Fixed	1.11	0.63
Door	1.10	0.66
Skylight	1.93	1.13
Metal-Clad Wood		
Operable	0.98	0.60
Fixed	1.05	0.58
Door	0.99	0.57
Skylight	1.50	0.88
Wood/Vinyl		
Operable	0.94	0.56
Fixed	1.04	0.57
Door	0.98	0.56
Skylight	1.47	0.85
Glass Block Assemblies	0.60	

Table 2. U-Factors for Non-Glazed Doors

Steel Doors		
Without Foam Core	0.60	
With Foam Core	0.35	
Wood Doors	Without Storm	With Storm
Panel With 7/16-in. Panels	0.54	0.36
Hollow Core Flush	0.46	0.32
Panel With 1 1/8-in. Panels	0.39	0.28
Solid Core Flush	0.40	0.26

Appendix C: Building Envelope

What Is The Building Envelope?

The code requirements are intended to limit heat loss and air leakage through the building envelope. The building envelope includes all of the building components that separate conditioned spaces from unconditioned spaces or from outside air. For example, the walls and doors between an unheated garage and a living area are part of the building envelope; the walls separating an unheated garage from the outside are not. Walls, floors, and other building components separating two conditioned spaces (such as an interior partition wall) are *NOT* part of the building envelope, nor are common or party walls which separate dwelling units in multifamily buildings.

You can think of the building envelope as the boundary separating the inside from the outside and through which heat is transferred. Areas that have no heating or cooling sources are considered to be outside the building envelope. A space is conditioned if heating and/or cooling is deliberately supplied to it or is indirectly supplied through uninsulated surfaces of water or heating equipment or through uninsulated ducts.

To use the REScheck materials, you must specify proposed insulation levels for ceiling, wall, floor, basement wall, slab-edge, and crawl space wall components located in the building envelope. In some case it may be unclear how to classify a given building element. For example, are skylight shafts considered a wall component or a ceiling component? The following table can be used to help determine how a given building envelope assembly should be entered in the REScheck materials.

Ceiling Components

Ceiling	Flat ceilings Cathedral or vaulted ceilings Dormer roofs Bay window roofs Overhead portions of an interior stairway to an attic Access doors or hatches Treyed ceilings
Floors Over Outside Air(a)	Floors of overhangs (such as the floor above a recessed entryway or carport) Floor cantilevers Floors of an elevated home Bay window sill Access doors or hatches
Skylights	Skylight assemblies less than 60° from horizontal
(a) The insulation requirements for floors over outside air are the same as those for ceilings.	

Wall Components

Wall	Opaque portions of above-grade walls Basement walls and kneewalls less than 50% below grade Peripheral edges of floors Between floor spandrels Gables walls bounding conditioned space Dormer walls Walls enclosing a mansard roof Roof or attic kneewalls Through-wall chimneys Walls of an interior stairway to an unconditioned basement Skylight shafts Sloped building components 60° or greater from horizontal
Glazing	Windows (including windows of conditioned basements)
Door	Opaque portions of all doors (including basement doors)

Floor and Foundation Components

Floor Over Unconditioned Space	Floors over an unconditioned crawl space, basement, garage, or similar unconditioned space Access doors or hatches
Basement Wall	Opaque portions of basement walls 50% or more below grade and basement kneewalls (if part of a basement wall 50% or more below grade)
Slab Floor	Perimeter edges of slab-on-grade floors
Crawl Space Wall	Walls of unventilated crawl spaces below uninsulated floors

Appendix D: Forms

1992 MEC, 1993 MEC, and 1995 MEC

Energy Label and Take-Off Worksheet

The following forms are included in this Appendix:

- *Energy Label* – Describes the energy efficiency features installed in the residence. This label is optional. It may be posted at the building site or provided to the home buyer.
- *Take-Off Worksheet* – Provides a form for building take-offs.

Energy Label



Street Address _____

This home includes the following energy features:

Insulation R-Values

Glazing/Door U-Factors

Insulating
Sheathing R-Value

U-Factor

_____ Ceiling

_____ Windows

_____ Ceiling

_____ Windows

_____ Wall

_____ Sliding Glass Doors

_____ Wall

_____ Doors

_____ Floor

_____ Doors

_____ Basement Wall

_____ Crawl Space Wall

_____ Slab

_____ Duct

Mechanical System

Type and Fuel

Efficiency

Heating System

Cooling System

_____ SEER

Water Heater

_____ EF

Other Energy Features

Builder _____ Date _____



Take-Off Worksheet

Builder Name _____ Date _____
 Builder Address _____
 Building Address _____
 Submitted By _____ Phone Number _____

Ceilings, Skylights, and Floors Over Outside Air

Description	Area	Insulation R-Value	Skylight U-Factor
Ceiling	ft ²		—
Floor Over Outside Air	ft ²		—
Skylight	ft ²	—	

Walls, Windows, and Doors

Description	Area	Insulation R-Value	Glazing/Door U-Factor
Wall	ft ²		—
Window	ft ²	—	
Door	ft ²	—	
Sliding Glass Door	ft ²	—	

Floors and Foundations

Description	Area or Perimeter	Insulation R-Value	Insulation Depth
Floor Over Unconditioned Space	ft ²		—
Basement Wall	ft ²		
Unheated Slab	ft		
Heated Slab	ft		
Crawl Space Wall	ft ²		

Equipment Efficiency (This section may be left blank if no credit will be taken for high-efficiency equipment.)

Heating _____ AFUE/HSPF _____

Cooling _____ SEER _____
 Efficiency _____ Make & Model Number _____

Appendix E: Climate Zones by States and Counties

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
ALABAMA		Morgan	8	Yukon Flats	19	Howard (H)	7	Colusa	6
Autauga (H)	6	Perry (H)	5	Yukon-Koyukuk	19	Independence	8	Contra Costa	6
Baldwin (H)	4	Pickens (H)	6	Yupit	18	Izard	8	Del Norte	9
Barbour (H)	5	Pike (H)	5			Jackson	8	El Dorado	8
Bibb (H)	6	Randolph	7	ARIZONA		Jefferson (H)	6	Fresno	6
Blount	7	Russell (H)	5	Apache	13	Johnson	8	Glenn	6
Bullock (H)	5	Shelby (H)	6	Cochise	6	Lafayette (H)	6	Humboldt	9
Butler (H)	5	St Clair (H)	6	Coconino	14	Lawrence	8	Imperial	3
Calhoun (H)	6	Sumter (H)	5	Gila	8	Lee (H)	7	Inyo	9
Chambers (H)	6	Talladega (H)	6	Graham	6	Lincoln (H)	6	Kern	5
Cherokee	7	Tallapoosa (H)	6	Greenlee	6	Little River (H)	6	Kings	6
Chilton (H)	6	Tuscaloosa (H)	6	La Paz	3	Logan (H)	7	Lake	8
Choctaw (H)	5	Walker (H)	6	Maricopa	3	Lonoke (H)	7	Lassen	13
Clarke (H)	5	Washington (H)	5	Mohave	7	Madison	9	Los Angeles	4
Clay	7	Wilcox (H)	5	Navajo	10	Marion	9	Madera	6
Cleburne	7	Winston	7	Pima	4	Miller (H)	6	Marin	6
Coffee (H)	4			Pinal	4	Mississippi	8	Mariposa	8
Colbert	8	ALASKA BOROUGHS		Santa Cruz	6	Monroe (H)	7	Mendocino	8
Conecuh (H)	5	AND REAA's		Yavapai	10	Montgomery	8	Merced	6
Coosa (H)	6	Adak Region	16	Yuma	3	Nevada (H)	6	Modoc	15
Covington (H)	4	Alaska Gateway	19			Newton	9	Mono	15
Crenshaw (H)	5	Aleutian Region	17	ARKANSAS		Ouachita (H)	6	Monterey	6
Cullman	7	Aleutians East	17	Arkansas (H)	6	Perry (H)	7		
Dale (H)	4	Anchorage	17	Ashley (H)	6	Phillips (H)	7		
Dallas (H)	5	Annette Island	15	Baxter	9	Pike (H)	7		
De Kalb	8	Bering Straits	19	Benton	9	Poinsett	8		
Elmore (H)	6	Bristol Bay	17	Boone	9	Polk	8		
Escambia (H)	4	Chatham	16	Bradley (H)	6	Pope	8		
Etowah	7	Chugach	17	Calhoun (H)	6	Prairie (H)	7		
Fayette	7	Copper River	18	Carroll	9	Pulaski (H)	7		
Franklin	8	Delta/Greely	18	Chicot (H)	6	Randolph	8		
Geneva (H)	4	Denali	18	Clark (H)	6	Saline (H)	7		
Greene (H)	5	Fairbanks N. Star	18	Clay	8	Scott (H)	7		
Hale (H)	5	Haines	16	Cleburne	8	Searcy	9		
Henry (H)	4	Iditarod Area	19	Cleveland (H)	6	Sebastian	8		
Houston (H)	4	Juneau	16	Columbia (H)	6	Sevier (H)	7		
Jackson	8	Kashunamit	18	Conway (H)	7	Sharp	8		
Jefferson (H)	6	Kenai Peninsula	17	Craighead	8	St Francis (H)	7		
Lamar	7	Ketchikan Gateway	15	Crawford	8	Stone	9		
Lauderdale	8	Kodiak Island	16	Crittenden (H)	7	Union (H)	6		
Lawrence	8	Kuspuk	18	Cross (H)	7	Van Buren	8		
Lee (H)	6	Lake & Peninsula	17	Dallas (H)	6	Washington	9		
Limestone	8	Lower Kuskokwim	18	Desha (H)	6	White (H)	7		
Lowndes (H)	5	Lower Yukon	18	Drew (H)	6	Woodruff (H)	7		
Macon (H)	6	Matanuska-Susitna	17	Faulkner (H)	7	Yell (H)	7		
Madison	8	North Slope	19	Franklin	8				
Marengo (H)	5	Northwest Arctic	19	Fulton	8	CALIFORNIA			
Marion	7	Pribilof Islands	17	Garland (H)	7	Alameda	6		
Marshall	8	Sitka	15	Grant (H)	6	Alpine	15		
Mobile (H)	4	Southeast Island	15	Greene	8	Amador	8		
Monroe (H)	5	Southwest Region	17	Hempstead (H)	7	Butte	6		
Montgomery (H)	6	Yakutat	17	Hot Spring (H)	7	Calaveras	8		

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Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Napa	6	Kiowa	13	Collier (H)	1	Baldwin (H)	6	Habersham	8
Nevada	11	Kit Carson	13	Columbia (H)	3	Banks	7	Hall	7
Orange	4	La Plata	15	Dade (H)	1	Barrow	7	Hancock (H)	6
Placer	8	Lake	17	De Soto (H)	2	Bartow	7	Haralson	7
Plumas	13	Larimer	13	Franklin (H)	3	Ben Hill (H)	5	Harris (H)	6
Riverside	4	Las Animas	11	Duval (H)	3	Berrien (H)	4	Hart	7
Sacramento	6	Lincoln	13	Escambia (H)	4	Bibb (H)	5	Heard (H)	6
San Benito	6	Logan	13	Flagler (H)	3	Bleckley (H)	5	Henry	7
San Bernardino	4	Mesa	13	Franklin (H)	4	Brantley (H)	4	Houston (H)	5
San Diego	3	Mineral	17	Gadsden (H)	4	Brooks (H)	4	Irwin (H)	5
San Francisco	6	Moffat	15	Gilchrist (H)	3	Bryan (H)	4	Jackson	7
San Joaquin	6	Montezuma	15	Glades (H)	1	Bulloch (H)	5	Jasper (H)	6
San Luis Obispo	6	Montrose	13	Gulf (H)	4	Burke (H)	6	Jeff Davis (H)	4
San Mateo	6	Morgan	13	Hamilton (H)	3	Butts	7	Jefferson (H)	6
Santa Barbara	5	Otero	11	Hardee (H)	2	Calhoun (H)	5	Jenkins (H)	5
Santa Clara	6	Ouray	15	Hendry (H)	1	Camden (H)	4	Johnson (H)	5
Santa Cruz	6	Park	17	Hernando (H)	2	Candler (H)	5	Jones (H)	6
Shasta	6	Phillips	13	Highlands (H)	2	Carroll	7	Lamar (H)	6
Sierra	11	Pitkin	17	Hillsborough (H)	2	Catoosa	8	Lanier (H)	4
Siskiyou	11	Prowers	11	Holmes (H)	4	Charlton (H)	4	Laurens (H)	5
Solano	6	Pueblo	11	Indian River (H)	2	Chatham (H)	4	Lee (H)	5
Sonoma	6	Rio Blanco	15	Jackson (H)	4	Chattahoochee (H)	5	Liberty (H)	4
Stanislaus	6	Rio Grande	17	Jefferson (H)	4	Chattooga	8	Lincoln (H)	6
Sutter	6	Routt	17	Lafayette (H)	3	Cherokee	8	Long (H)	4
Tehama	6	Saguache	16	Lake (H)	2	Clarke	7	Lowndes (H)	4
Trinity	9	San Juan	17	Lee (H)	1	Clay (H)	5	Lumpkin	8
Tulare	6	San Miguel	15	Leon (H)	4	Clayton	7	Macon (H)	5
Tuolumne	8	Sedgwick	13	Levy (H)	2	Clinch (H)	4	Madison	7
Ventura	4	Summit	17	Liberty (H)	4	Cobb	7	Marion (H)	5
Yolo	6	Teller	13	Madison (H)	3	Coffee (H)	5	Mcduffie (H)	6
Yuba	6	Washington	13	Manatee (H)	2	Colquitt (H)	4	Mcintosh (H)	4
		Weld	13	Marion (H)	2	Columbia (H)	6	Meriwether (H)	6
		Yuma	13	Martin (H)	1	Cook (H)	4	Miller (H)	4
COLORADO				Monroe (H)	1	Coweta	7	Mitchell (H)	4
Adams	13			Nassau (H)	3	Crawford (H)	5	Monroe (H)	6
Alamosa	16	CONNECTICUT		Okaloosa (H)	4	Crisp (H)	5	Montgomery (H)	5
Arapahoe	13	Fairfield	12	Okeechobee (H)	2	Dade	8	Morgan (H)	6
Archuleta	16	Hartford	13	Orange (H)	2	Dawson	8	Murray	8
Baca	11	Litchfield	14	Osceola (H)	2	De Kalb	7	Muscogee (H)	5
Bent	11	Middlesex	12	Palm Beach (H)	1	Decatur (H)	4	Newton	7
Boulder	13	New Haven	12	Pasco (H)	2	Dodge (H)	5	Oconee	7
Chaffee	16	New London	12	Pinellas (H)	2	Dooly (H)	5	Oglethorpe	7
Cheyenne	13	Tolland	14	Polk (H)	2	Dougherty (H)	5	Paulding	7
Clear Creek	17	Windham	14	Putnam (H)	3	Douglas	7	Peach (H)	5
Conejos	16			Santa Rosa (H)	4	Early (H)	5	Pickens	8
Costilla	16	DELAWARE		Sarasota (H)	2	Echols (H)	4	Pierce (H)	4
Crowley	11	Kent	9	Seminole (H)	2	Effingham (H)	4	Pike (H)	6
Custer	16	New Castle	10	St Johns (H)	3	Elbert	7	Polk	7
Delta	13	Sussex	9	St Lucie (H)	2	Emanuel (H)	5	Pulaski (H)	5
Denver	13			Sumter (H)	2	Evans (H)	4	Putnam (H)	6
Dolores	15	DC		Suwannee (H)	3	Fannin	8	Quitman (H)	5
Douglas	13	Washington	10	Taylor (H)	3	Fayette	7	Rabun	8
Eagle	15			Union (H)	3	Floyd	7	Randolph (H)	5
El Paso	13	FLORIDA		Volusia (H)	2	Forsyth	8	Richmond (H)	6
Elbert	13	Alachua (H)	3	Wakulla (H)	4	Franklin	7	Rockdale	7
Fremont	11	Baker (H)	3	Walton (H)	4	Fulton	7	Schley (H)	5
Garfield	15	Bay (H)	4	Washington (H)	4	Gilmer	8	Screven (H)	5
Gilpin	13	Bradford (H)	3			Glascock (H)	6	Seminole (H)	4
Grand	17	Brevard (H)	2	GEORGIA		Glynn (H)	4	Spalding	7
Gunnison	17	Broward (H)	1	Appling (H)	4	Gordon	8	Stephens	7
Hinsdale	17	Calhoun (H)	4	Atkinson (H)	4	Grady (H)	4	Stewart (H)	5
Huerfano	11	Charlotte (H)	2	Bacon (H)	4	Greene (H)	6	Sumter (H)	5
Jackson	17	Citrus (H)	2	Baker (H)	4	Gwinnett	7	Talbot (H)	5
Jefferson	13	Clay (H)	3						

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Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Taliaferro (H)	6	Jefferson	16	Jo Daviess	14	Allen	13	Posey	10
Tattnall (H)	4	Jerome	14	Johnson	10	Bartholomew	11	Pulaski	13
Taylor (H)	5	Kootenai	14	Kane	14	Benton	13	Putnam	12
Telfair (H)	5	Latah	14	Kankakee	13	Blackford	13	Randolph	13
Terrell (H)	5	Lemhi	15	Kendall	13	Boone	12	Ripley	11
Thomas (H)	4	Lewis	15	Knox	13	Brown	11	Rush	12
Tift (H)	5	Lincoln	15	La Salle	13	Carroll	13	Scott	11
Toombs (H)	4	Madison	16	Lake	14	Cass	13	Shelby	12
Towns	8	Minidoka	15	Lawrence	11	Clark	10	Spencer	10
Treutlen (H)	5	Nez Perce	12	Lee	14	Clay	12	St Joseph	13
Troup (H)	6	Oneida	15	Livingston	13	Clinton	13	Starke	13
Turner (H)	5	Owyhee	12	Logan	12	Crawford	11	Steuben	14
Twiggs (H)	5	Payette	12	Macon	12	Daviess	11	Sullivan	11
Union	8	Power	15	Macoupin	11	De Kalb	13	Switzerland	10
Upson (H)	5	Shoshone	14	Madison	10	Dearborn	11	Tippecanoe	13
Walker	8	Teton	16	Marion	11	Decatur	12	Tipton	13
Walton	7	Twin Falls	14	Marshall	13	Delaware	13	Union	12
Ware (H)	4	Valley	16	Mason	12	Dubois	11	Vanderburgh	10
Warren (H)	6	Washington	13	Massac	10	Elkhart	13	Vermillion	12
Washington (H)	6			Mcdonough	13	Fayette	12	Vigo	12
Wayne (H)	4	ILLINOIS		Mchenry	14	Floyd	10	Wabash	14
Webster (H)	5	Adams	12	Mclean	12	Fountain	12	Warren	12
Wheeler (H)	5	Alexander	10	Menard	12	Franklin	12	Warrick	10
White	8	Bond	11	Mercer	13	Fulton	14	Washington	11
Whitfield	8	Boone	14	Monroe	10	Gibson	10	Wayne	12
Wilcox (H)	5	Brown	12	Montgomery	11	Grant	13	Wells	13
Wilkes	7	Bureau	13	Morgan	12	Greene	11	White	13
Wilkinson (H)	5	Calhoun	11	Moultrie	12	Hamilton	12	Whitley	14
Worth (H)	5	Carroll	14	Ogle	14	Hancock	12		
		Cass	12	Peoria	13	Harrison	10	IOWA	
HAWAII		Champaign	12	Perry	10	Hendricks	12	Adair	14
Hawaii (H)	1	Christian	11	Piatt	12	Henry	12	Adams	13
Honolulu (H)	1	Clark	12	Pike	12	Howard	13	Allamakee	15
Kalawao (H)	1	Clay	11	Pope	10	Huntington	14	Appanoose	13
Kauai (H)	1	Clinton	10	Pulaski	10	Jackson	11	Audubon	14
Maui (H)	1	Coles	12	Putnam	13	Jasper	13	Benton	14
		Cook	14	Randolph	10	Jay	13	Black Hawk	15
IDAHO		Crawford	11	Richland	11	Jefferson	10	Boone	14
Ada	12	Cumberland	12	Rock Island	13	Jennings	11	Bremer	15
Adams	15	De Kalb	14	Saline	10	Johnson	12	Buchanan	15
Bannock	15	De Witt	12	Sangamon	12	Knox	11	Buena Vista	15
Bear Lake	15	Douglas	12	Schuyler	12	Kosciusko	14	Butler	15
Benewah	14	Du Page	14	Scott	12	La Porte	13	Calhoun	15
Bingham	15	Edgar	12	Shelby	11	Lagrange	14	Carroll	14
Blaine	15	Edwards	11	St Clair	10	Lake	13	Cass	14
Boise	15	Effingham	11	Stark	13	Lawrence	11	Cedar	14
Bonner	15	Fayette	11	Stephenson	14	Madison	13	Cerro Gordo	15
Bonneville	15	Ford	13	Tazewell	12	Marion	12	Cherokee	15
Boundary	15	Franklin	10	Union	10	Marshall	13	Chickasaw	15
Butte	16	Fulton	13	Vermilion	12	Martin	11	Clarke	13
Camas	15	Gallatin	10	Wabash	11	Miami	14	Clay	15
Canyon	12	Greene	11	Warren	13	Monroe	11	Clayton	15
Caribou	15	Grundy	13	Washington	10	Montgomery	12	Clinton	13
Cassia	14	Hamilton	10	Wayne	11	Morgan	12	Crawford	14
Clark	15	Hancock	13	White	10	Newton	13	Dallas	14
Clearwater	12	Hardin	10	Whiteside	14	Noble	14	Davis	13
Custer	16	Henderson	13	Will	13	Ohio	11	Decatur	13
Elmore	13	Henry	13	Williamson	10	Orange	11	Delaware	15
Franklin	15	Iroquois	13	Winnebago	14	Owen	12	Des Moines	13
Fremont	16	Jackson	10	Woodford	13	Parke	12	Dickinson	15
Gem	13	Jasper	11			Perry	10	Dubuque	14
Gooding	13	Jefferson	11	INDIANA		Pike	11	Emmet	15
Idaho	15	Jersey	10	Adams	13	Porter	13	Fayette	15

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Floyd	15	Woodbury	15	Mcperson	11	Bullitt	10	Mason	11
Franklin	15	Worth	15	Meade	10	Butler	9	Mccracken	9
Fremont	13	Wright	15	Miami	10	Caldwell	9	Mccreary	10
Greene	14			Mitchell	12	Calloway	9	Mclean	9
Grundy	15	KANSAS		Montgomery	9	Campbell	11	Meade	9
Guthrie	14	Allen	10	Morris	11	Carlisle	9	Menifee	10
Hamilton	15	Anderson	10	Morton	10	Carroll	10	Mercer	10
Hancock	15	Atchison	11	Nemaha	11	Carter	11	Metcalfe	9
Hardin	15	Barber	9	Neosho	9	Casey	10	Monroe	9
Harrison	14	Barton	11	Ness	12	Christian	9	Montgomery	10
Henry	13	Bourbon	10	Norton	13	Clark	10	Morgan	10
Howard	15	Brown	11	Osage	10	Clay	10	Muhlenberg	9
Humboldt	15	Butler	10	Osborne	12	Clinton	10	Nelson	10
Ida	15	Chase	10	Ottawa	11	Crittenden	9	Nicholas	11
Iowa	14	Chautauqua	9	Pawnee	11	Cumberland	9	Ohio	9
Jackson	14	Cherokee	9	Phillips	12	Daviess	9	Oldham	10
Jasper	14	Cheyenne	13	Pottawatomie	11	Edmonson	9	Owen	10
Jefferson	13	Clark	10	Pratt	10	Elliot	11	Owsley	10
Johnson	13	Clay	11	Rawlins	13	Estill	10	Pendleton	11
Jones	14	Cloud	12	Reno	11	Fayette	10	Perry	10
Keokuk	13	Coffey	10	Republic	12	Fleming	11	Pike	10
Kossuth	15	Comanche	9	Rice	11	Floyd	10	Powell	10
Lee	13	Cowley	9	Riley	11	Franklin	10	Pulaski	10
Linn	14	Crawford	9	Rooks	12	Fulton	9	Robertson	11
Louisa	13	Decatur	13	Rush	11	Gallatin	11	Rockcastle	10
Lucas	13	Dickinson	11	Russell	11	Garrard	10	Rowan	11
Lyon	15	Doniphan	11	Saline	11	Grant	11	Russell	10
Madison	14	Douglas	10	Scott	12	Graves	9	Scott	11
Mahaska	13	Edwards	11	Sedgwick	10	Grayson	9	Shelby	10
Marion	13	Elk	9	Seward	10	Green	9	Simpson	9
Marshall	14	Ellis	12	Shawnee	11	Greenup	11	Spencer	10
Mills	13	Ellsworth	11	Sheridan	12	Hancock	9	Taylor	9
Mitchell	15	Finney	11	Sherman	13	Hardin	9	Todd	9
Monona	14	Ford	11	Smith	12	Harlan	10	Trigg	9
Monroe	13	Franklin	10	Stafford	11	Harrison	11	Trimble	10
Montgomery	13	Geary	11	Stanton	11	Hart	9	Union	9
Muscatine	13	Gove	12	Stevens	10	Henderson	9	Warren	9
Obrien	15	Graham	12	Sumner	9	Henry	10	Washington	10
Osceola	15	Grant	11	Thomas	13	Hickman	9	Wayne	10
Page	13	Gray	11	Trego	12	Hopkins	9	Webster	9
Palo Alto	15	Greeley	12	Wabaunsee	11	Jackson	10	Whitley	10
Plymouth	15	Greenwood	10	Wallace	12	Jefferson	10	Wolfe	10
Pocahontas	15	Hamilton	11	Washington	12	Jessamine	10	Woodford	10
Polk	14	Harper	9	Wichita	12	Johnson	11		
Pottawattamie	14	Harvey	11	Wilson	9	Kenton	11	LOUISIANA	
Poweshiek	14	Haskell	11	Woodson	10	Knott	10	Acadia (H)	4
Ringgold	13	Hodgeman	11	Wyandotte	11	Knox	10	Allen (H)	4
Sac	15	Jackson	11			Larue	9	Ascension (H)	4
Scott	13	Jefferson	11	KENTUCKY		Laurel	10	Assumption (H)	3
Shelby	14	Jewell	12	Adair	9	Lawrence	11	Avoyelles (H)	5
Sioux	15	Johnson	11	Allen	9	Lee	10	Beauregard (H)	4
Story	14	Kearny	11	Anderson	10	Leslie	10	Bienville (H)	6
Tama	14	Kingman	10	Ballard	9	Letcher	10	Bossier (H)	6
Taylor	13	Kiowa	10	Barren	9	Lewis	11	Caddo (H)	6
Union	13	Labette	9	Bath	11	Lincoln	10	Calcasieu (H)	4
Van Buren	13	Lane	12	Bell	10	Livingston	9	Caldwell (H)	6
Wapello	13	Leavenworth	11	Boone	11	Logan	9	Cameron (H)	4
Warren	14	Lincoln	11	Bourbon	10	Lyon	9	Catahoula (H)	5
Washington	13	Linn	10	Boyd	11	Madison	10	Claiborne (H)	6
Wayne	13	Logan	12	Boyle	10	Magoffin	10	Concordia (H)	5
Webster	15	Lyon	11	Bracken	11	Marion	10	De Soto (H)	5
Winnebago	15	Marion	11	Breathitt	10	Marshall	9	East Baton Rouge (H)	4
Winneshiek	15	Marshall	12	Breckenridge	9	Martin	11	East Carroll (H)	6

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
East Feliciana (H)	4	York	15	Clinton	14	Wayne	13	Polk	17
Evangeline (H)	4			Crawford	15	Wexford	15	Pope	16
Franklin (H)	6	MARYLAND		Delta	16			Ramsey	15
Grant (H)	5	Allegany	12	Dickinson	16	MINNESOTA		Red Lake	17
Iberia (H)	4	Anne Arundel	9	Eaton	14	Aitkin	17	Redwood	15
Iberville (H)	4	Baltimore	10	Emmet	15	Anoka	16	Renville	15
Jackson (H)	6	Baltimore City	9	Genesee	14	Becker	17	Rice	15
Jefferson (H)	3	Calvert	9	Gladwin	15	Beltrami	17	Rock	15
Jefferson Davis (H)	4	Caroline	9	Gogebic	17	Benton	16	Roseau	17
La Salle (H)	5	Carroll	11	Grand Traverse	15	Big Stone	16	Scott	15
Lafayette (H)	4	Cecil	10	Gratiot	14	Blue Earth	15	Sherburne	16
Lafourche (H)	3	Charles	9	Hillsdale	14	Brown	15	Sibley	15
Lincoln (H)	6	Dorchester	9	Houghton	17	Carlton	17	St Louis	17
Livingston (H)	4	Frederick	11	Huron	14	Carver	15	Stearns	16
Madison (H)	6	Garrett	13	Ingham	14	Cass	17	Steele	15
Morehouse (H)	6	Harford	10	Ionia	14	Chippewa	16	Stevens	16
Natchitoches (H)	5	Howard	10	Iosco	15	Chisago	16	Swift	16
Orleans (H)	3	Kent	10	Iron	17	Clay	17	Todd	16
Ouachita (H)	6	Montgomery	10	Isabella	15	Clearwater	17	Traverse	16
Plaquemines (H)	3	Prince Georges	10	Jackson	14	Cook	17	Wabasha	15
Pointe Coupee (H)	4	Queen Annes	9	Kalamazoo	14	Cottonwood	15	Wadena	17
Rapides (H)	5	Somerset	9	Kalkaska	15	Crow Wing	17	Waseca	15
Red River (H)	5	St Marys	9	Kent	14	Dakota	15	Washington	15
Richland (H)	6	Talbot	9	Keweenaw	17	Dodge	15	Watsonwan	15
Sabine (H)	5	Washington	11	Lake	15	Douglas	16	Wilkin	17
St Bernard (H)	3	Wicomico	9	Lapeer	14	Faribault	15	Winona	15
St Charles (H)	3	Worcester	9	Leelanau	15	Fillmore	15	Wright	16
St Helena (H)	4			Lenawee	14	Freeborn	15	Yellow Medicine	15
St James (H)	3	MASSACHUSETTS		Livingston	14	Goodhue	15		
St John The Baptist (H)	3	Barnstable	12	Luce	16	Grant	16	MISSISSIPPI	
St Landry (H)	4	Berkshire	14	Mackinac	16	Hennepin	15	Adams (H)	5
St Martin (H)	4	Bristol	12	Macomb	14	Houston	15	Alcorn	7
St Mary (H)	3	Dukes	12	Manistee	15	Hubbard	17	Amite (H)	4
St Tammany (H)	4	Essex	13	Marquette	16	Isanti	16	Attala (H)	6
Tangipahoa (H)	4	Franklin	14	Mason	15	Itasca	17	Benton	7
Tensas (H)	5	Hampden	14	Mecosta	15	Jackson	15	Bolivar (H)	6
Terbonne (H)	3	Hampshire	14	Menominee	16	Kanabec	16	Calhoun (H)	6
Union (H)	6	Middlesex	13	Midland	15	Kandiyohi	16	Carroll (H)	6
Vermilion (H)	4	Nantucket	12	Missaukee	15	Kittson	17	Chickasaw (H)	6
Vernon (H)	5	Norfolk	13	Monroe	13	Koochiching	17	Choctaw (H)	6
Washington (H)	4	Plymouth	12	Montcalm	14	Lac Qui Parle	15	Claiborne (H)	5
Webster (H)	6	Suffolk	13	Montmorency	15	Lake	17	Clarke (H)	5
West Baton Rouge (H)	4	Worcester	14	Muskegon	14	Lake Of The Woods	17	Clay (H)	6
West Carroll (H)	6			Newaygo	15	Le Sueur	15	Coahoma	7
West Feliciana (H)	4	MICHIGAN		Oakland	14	Lincoln	15	Copiah (H)	5
Winn (H)	5	Alcona	15	Oceana	15	Lyon	15	Covington (H)	5
		Alger	16	Ogemaw	15	Mahnomen	17	De Soto	7
MAINE		Allegan	14	Ontonagon	17	Marshall	17	Forrest (H)	5
Androscoggin	15	Alpena	15	Osceola	15	Martin	15	Franklin (H)	5
Aroostook	17	Antrim	15	Oscoda	15	Mcleod	15	George (H)	4
Cumberland	15	Arenac	15	Otsego	15	Meeker	16	Greene (H)	5
Franklin	16	Baraga	17	Ottawa	14	Mille Lacs	16	Grenada (H)	6
Hancock	15	Barry	14	Presque Isle	15	Morrison	16	Hancock (H)	4
Kennebec	15	Bay	15	Roscommon	15	Mower	15	Harrison (H)	4
Knox	15	Benzie	15	Saginaw	14	Murray	15	Hinds (H)	6
Lincoln	15	Berrien	14	Sanilac	14	Nicollet	15	Holmes (H)	6
Oxford	16	Branch	14	Schoolcraft	16	Nobles	15	Humphreys (H)	6
Penobscot	15	Calhoun	14	Shiawassee	14	Norman	17	Issaquena (H)	6
Piscataquis	17	Cass	14	St Clair	14	Olmsted	15	Itawamba	7
Sagadahoc	15	Charlevoix	15	St Joseph	14	Otter Tail	17	Jackson (H)	4
Somerset	17	Cheboygan	15	Tuscola	14	Pennington	17	Jasper (H)	5
Waldo	15	Chippewa	16	Van Buren	14	Pine	16	Jefferson (H)	5
Washington	15	Clare	15	Washtenaw	13	Pipestone	15	Jefferson Davis (H)	5

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Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Jones (H)	5	Caldwell	12	Osage	11	Jefferson	15	Deuel	14
Kemper (H)	6	Callaway	11	Ozark	9	Judith Basin	15	Dixon	14
Lafayette	7	Camden	11	Pemiscot	9	Lake	15	Dodge	13
Lamar (H)	4	Cape Girardeau	9	Perry	10	Lewis And Clark	15	Douglas	13
Lauderdale (H)	6	Carroll	12	Pettis	11	Liberty	16	Dundy	13
Lawrence (H)	5	Carter	10	Phelps	10	Lincoln	15	Fillmore	13
Leake (H)	6	Cass	11	Pike	12	Madison	15	Franklin	13
Lee	7	Cedar	11	Platte	11	McCone	15	Frontier	13
Leflore (H)	6	Chariton	12	Polk	10	Meagher	15	Furnas	13
Lincoln (H)	5	Christian	10	Pulaski	10	Mineral	15	Gage	13
Lowndes (H)	6	Clark	13	Putnam	13	Missoula	15	Garden	14
Madison (H)	6	Clay	11	Ralls	12	Musselshell	15	Garfield	14
Marion (H)	4	Clinton	12	Randolph	12	Park	15	Gosper	13
Marshall	7	Cole	11	Ray	11	Petroleum	15	Grant	14
Monroe (H)	6	Cooper	11	Reynolds	10	Phillips	16	Greeley	14
Montgomery (H)	6	Crawford	10	Ripley	9	Pondera	16	Hall	13
Neshoba (H)	6	Dade	10	Saline	11	Powder River	15	Hamilton	13
Newton (H)	6	Dallas	10	Schuyler	13	Powell	16	Harlan	13
Noxubee (H)	6	Daviess	12	Scotland	13	Prairie	15	Hayes	13
Oktibbeha (H)	6	De Kalb	12	Scott	9	Ravalli	15	Hitchcock	13
Panola	7	Dent	10	Shannon	10	Richland	15	Holt	14
Pearl River (H)	4	Douglas	10	Shelby	12	Roosevelt	16	Hooker	14
Perry (H)	5	Dunklin	9	St Charles	10	Rosebud	15	Howard	14
Pike (H)	4	Franklin	10	St Clair	11	Sanders	15	Jefferson	13
Pontotoc	7	Gasconade	11	St Francois	10	Sheridan	16	Johnson	13
Prentiss	7	Gentry	13	St Louis	10	Silver Bow	16	Kearney	13
Quitman	7	Greene	10	St Louis City	10	Stillwater	15	Keith	14
Rankin (H)	6	Grundy	12	Ste Genevieve	10	Sweet Grass	15	Keya Paha	14
Scott (H)	6	Harrison	13	Stoddard	9	Teton	15	Kimball	14
Sharkey (H)	6	Henry	11	Stone	9	Toole	16	Knox	14
Simpson (H)	5	Hickory	11	Sullivan	12	Treasure	15	Lancaster	13
Smith (H)	5	Holt	12	Taney	9	Valley	16	Lincoln	14
Stone (H)	4	Howard	11	Texas	10	Wheatland	15	Logan	14
Sunflower (H)	6	Howell	9	Vernon	11	Wibaux	15	Loup	14
Tallahatchie	7	Iron	10	Warren	11	Yellowstone	15	Madison	14
Tate	7	Jackson	11	Washington	10	Yellowstone		Mpgherson	14
Tippah	7	Jasper	9	Wayne	10	National Park	15	Merrick	13
Tishomingo	7	Jefferson	10	Webster	10			Morrill	14
Tunica	7	Johnson	11	Worth	13	NEBRASKA		Nance	13
Union	7	Knox	12	Wright	10	Adams	13	Nemaha	13
Walthall (H)	4	Laclede	10			Antelope	14	Nuckolls	13
Warren (H)	6	Lafayette	11	MONTANA		Arthur	14	Otoe	13
Washington (H)	6	Lawrence	10	Beaverhead	15	Banner	14	Pawnee	13
Wayne (H)	5	Lewis	12	Big Horn	15	Blaine	14	Perkins	13
Webster (H)	6	Lincoln	11	Blaine	16	Boone	14	Phelps	13
Wilkinson (H)	4	Linn	12	Broadwater	15	Box Butte	15	Pierce	14
Winston (H)	6	Livingston	12	Carbon	15	Boyd	14	Platte	13
Yalobusha	7	Macon	12	Carter	15	Brown	14	Polk	13
Yazoo (H)	6	Madison	10	Cascade	15	Buffalo	13	Red Willow	13
		Maries	11	Chouteau	15	Burt	14	Richardson	13
MISSOURI		Marion	12	Custer	15	Butler	13	Rock	14
Adair	12	Mcdonald	9	Daniels	16	Cass	13	Saline	13
Andrew	12	Mercer	13	Dawson	15	Cedar	14	Sarpy	13
Atchison	13	Miller	11	Deer Lodge	16	Chase	13	Saunders	13
Audrain	12	Mississippi	9	Fallon	15	Cherry	14	Scotts Bluff	14
Barry	9	Moniteau	11	Fergus	15	Cheyenne	14	Seward	13
Barton	10	Monroe	12	Flathead	16	Clay	13	Sheridan	15
Bates	11	Montgomery	11	Gallatin	15	Colfax	13	Sherman	14
Benton	11	Morgan	11	Garfield	15	Cuming	14	Sioux	15
Bollinger	10	New Madrid	9	Glacier	16	Custer	14	Stanton	14
Boone	11	Newton	9	Golden Valley	15	Dakota	14	Thayer	13
Buchanan	12	Nodaway	13	Granite	16	Dawes	15	Thomas	14
Butler	9	Oregon	9	Hill	16	Dawson	13	Thurston	14

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Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Valley	14	Catron	11	Nassau	11	Davidson	8	Wake	7
Washington	13	Chaves	7	New York	10	Davie	8	Warren	8
Wayne	14	Cibola	12	Niagara	14	Duplin (H)	6	Washington	7
Webster	13	Colfax	13	Oneida	15	Durham	8	Watauga	11
Wheeler	14	Curry	9	Onondaga	14	Edgecombe	7	Wayne	7
York	13	De Baca	9	Ontario	14	Forsyth	8	Wilkes	9
		Dona Ana	7	Orange	12	Franklin	8	Wilson	7
NEVADA		Eddy	7	Orleans	14	Gaston	7	Yadkin	8
Carson City	12	Grant	9	Oswego	14	Gates	7	Yancey	11
Churchill	12	Guadalupe	9	Otsego	15	Graham	9		
Clark	5	Harding	11	Putnam	12	Granville	8	NORTH DAKOTA	
Douglas	13	Hidalgo	7	Queens	10	Greene	7	Adams	16
Elko	15	Lea	7	Rensselaer	14	Guilford	8	Barnes	17
Esmeralda	12	Lincoln	9	Richmond	11	Halifax	7	Benson	17
Eureka	15	Los Alamos	13	Rockland	12	Harnett	7	Billings	16
Humboldt	13	Luna	7	Saratoga	14	Haywood	9	Botineau	17
Lander	13	Mckinley	13	Schenectady	14	Henderson	9	Bowman	16
Lincoln	12	Mora	15	Schoharie	15	Hertford	7	Burke	17
Lyon	13	Otero	7	Schuyler	15	Hoke	7	Burleigh	16
Mineral	12	Quay	8	Seneca	14	Hyde (H)	6	Cass	17
Nye	12	Rio Arriba	12	St Lawrence	15	Iredell	8	Cavalier	17
Pershing	12	Roosevelt	8	Steuben	15	Jackson	9	Dickey	16
Storey	12	San Juan	12	Suffolk	11	Johnston	7	Divide	17
Washoe	12	San Miguel	12	Sullivan	15	Jones (H)	6	Dunn	16
White Pine	15	Sandoval	13	Tioga	15	Lee	7	Eddy	17
		Santa Fe	13	Tompkins	15	Lenoir	7	Emmons	16
NEW HAMPSHIRE		Sierra	8	Ulster	15	Lincoln	7	Foster	17
Belknap	15	Socorro	9	Warren	15	Macon	9	Golden Valley	16
Carroll	15	Taos	15	Washington	15	Madison	9	Grand Forks	17
Cheshire	15	Torrance	11	Wayne	14	Martin	7	Grant	16
Coos	16	Union	11	Westchester	12	McDowell	8	Griggs	17
Grafton	15	Valencia	10	Wyoming	14	Mecklenburg	7	Hettinger	16
Hillsborough	15			Yates	14	Mitchell	11	Kidder	17
Merrimack	15	NEW YORK				Montgomery	7	La Moure	16
Rockingham	15	Albany	14	NORTH CAROLINA		Moore	7	Logan	16
Stafford	15	Allegany	15	Alamance	8	Nash	7	Mchenry	17
Sullivan	15	Bronx	11	Alexander	8	New Hanover (H)	6	Mcintosh	16
		Broome	15	Alleghany	11	Northampton	7	Mckenzie	16
NEW JERSEY		Cattaraugus	15	Anson	7	Onslow (H)	6	Mclean	17
Atlantic	10	Cayuga	14	Ashe	11	Orange	8	Mercer	16
Bergen	12	Chautauqua	13	Avery	11	Pamlico (H)	6	Morton	16
Burlington	11	Chemung	15	Beaufort (H)	6	Pasquotank	7	Mountrail	17
Camden	10	Chenango	15	Bertie	7	Pender (H)	6	Nelson	17
Cape May	10	Clinton	15	Bladen (H)	6	Perquimans	7	Oliver	16
Cumberland	10	Columbia	13	Brunswick (H)	6	Person	8	Pembina	17
Essex	11	Cortland	15	Buncombe	9	Pitt	7	Pierce	17
Gloucester	10	Delaware	15	Burke	8	Polk	7	Ramsey	17
Hudson	11	Dutchess	13	Cabarrus	7	Randolph	8	Ransom	16
Hunterdon	12	Erie	14	Caldwell	8	Richmond	7	Renville	17
Mercer	11	Essex	16	Camden	7	Robeson	7	Richland	16
Middlesex	11	Franklin	16	Carteret (H)	6	Rockingham	8	Rolette	17
Monmouth	11	Fulton	15	Caswell	8	Rowan	7	Sargent	16
Morris	12	Genesee	14	Catawba	8	Rutherford	7	Sheridan	17
Ocean	11	Greene	14	Chatham	8	Sampson (H)	6	Sioux	16
Passaic	12	Hamilton	16	Cherokee	9	Scotland	7	Slope	16
Salem	10	Herkimer	15	Chowan	7	Stanly	7	Stark	16
Somerset	12	Jefferson	15	Clay	9	Stokes	9	Steele	17
Sussex	13	Kings	10	Cleveland	7	Surry	9	Stutsman	17
Union	11	Lewis	15	Columbus (H)	6	Swain	9	Towner	17
Warren	12	Livingston	14	Craven (H)	6	Transylvania	9	Traill	17
		Madison	14	Cumberland	7	Tyrrell (H)	6	Walsh	17
NEW MEXICO		Monroe	14	Currituck	7	Union	7	Ward	17
Bernalillo	9	Montgomery	14	Dare (H)	6	Vance	8	Wells	17

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Williams	17	Noble	12	Jefferson (H)	6	Klamath	14	Mercer	14
OHIO		Ottawa	13	Johnston (H)	6	Lake	15	Mifflin	12
Adams	11	Paulding	14	Kay	9	Lane	10	Monroe	13
Allen	13	Perry	12	Kingfisher	8	Lincoln	11	Montgomery	11
Ashland	13	Pickaway	12	Kiowa	7	Linn	10	Montour	13
Ashtabula	13	Pike	11	Latimer	7	Malheur	12	Northampton	12
Athens	11	Portage	13	Le Flore	7	Marion	10	Northumberland	13
Auglaize	13	Preble	12	Lincoln	7	Morrow	12	Perry	12
Belmont	12	Putnam	13	Logan	8	Multnomah	10	Philadelphia	10
Brown	11	Richland	13	Love (H)	6	Polk	10	Pike	13
Butler	12	Ross	12	Major	9	Sherman	13	Potter	15
Carroll	13	Sandusky	13	Marshall (H)	6	Tillamook	11	Schuykill	13
Champaign	13	Scioto	11	Mayes	8	Umatilla	12	Snyder	13
Clark	13	Seneca	13	Mcclain	7	Union	13	Somerset	13
Clermont	11	Shelby	13	Mccurtain	7	Wallowa	15	Sullivan	14
Clinton	12	Stark	13	Mcintosh	7	Wasco	13	Susquehanna	15
Columbiana	13	Summit	13	Murray	7	Washington	10	Tioga	15
Coshocton	12	Trumbull	13	Muskogee	7	Wheeler	13	Union	13
Crawford	13	Tuscarawas	13	Noble	8	Yamhill	10	Venango	14
Cuyahoga	13	Union	13	Nowata	9			Warren	14
Darke	13	Van Wert	13	Okfuskee	7	PENNSYLVANIA		Washington	12
Defiance	14	Vinton	11	Oklahoma	8	Adams	11	Wayne	15
Delaware	13	Warren	12	Okmulgee	8	Allegheny	12	Westmoreland	13
Erie	13	Washington	11	Osage	8	Armstrong	13	Wyoming	14
Fairfield	12	Wayne	13	Ottawa	9	Beaver	12	York	11
Fayette	12	Williams	14	Pawnee	8	Bedford	13		
Franklin	12	Wood	14	Payne	8	Berks	12	RHODE ISLAND	
Fulton	14	Wyandot	13	Pittsburg	7	Blair	13	Bristol	12
Gallia	11			Pontotoc	7	Bradford	15	Kent	12
Geauga	13	OKLAHOMA		Pottawatomie	7	Bucks	11	Newport	12
Greene	12	Adair	8	Pushmataha (H)	6	Butler	14	Providence	14
Guernsey	12	Alfalfa	9	Roger Mills	9	Cambria	13	Washington	12
Hamilton	11	Atoka	7	Rogers	9	Cameron	15		
Hancock	13	Beaver	10	Seminole	7	Carbon	13	SOUTH CAROLINA	
Hardin	13	Beckham	8	Sequoyah	7	Centre	13	Abbeville	7
Harrison	13	Blaine	8	Stephens	7	Chester	11	Aiken (H)	6
Henry	14	Bryan	7	Texas	10	Clarion	14	Allendale (H)	5
Highland	11	Caddo	8	Tillman	7	Clearfield	15	Anderson	7
Hocking	12	Canadian	8	Tulsa	8	Clinton	13	Bamberg (H)	5
Holmes	13	Carter (H)	6	Wagoner	8	Columbia	13	Barnwell (H)	5
Huron	13	Cherokee	8	Washington	9	Crawford	14	Beaufort (H)	5
Jackson	11	Choctaw (H)	6	Washita	8	Cumberland	12	Berkeley (H)	5
Jefferson	13	Cimarron	10	Woods	9	Dauphin	12	Calhoun (H)	6
Knox	13	Cleveland	7	Woodward	9	Delaware	10	Charleston (H)	5
Lake	13	Coal	7			Elk	15	Cherokee	7
Lawrence	11	Comanche	7	OREGON		Erie	14	Chester	7
Licking	12	Cotton	7	Baker	15	Fayette	12	Chesterfield	7
Logan	13	Craig	9	Benton	10	Forest	15	Clarendon (H)	6
Lorain	13	Creek	8	Clackamas	10	Franklin	11	Colleton (H)	5
Lucas	14	Custer	8	Clatsop	11	Fulton	12	Darlington (H)	6
Madison	12	Delaware	8	Columbia	11	Greene	12	Dillon (H)	6
Mahoning	13	Dewey	9	Coos	9	Huntingdon	12	Dorchester (H)	5
Marion	13	Ellis	9	Crook	14	Indiana	13	Edgefield (H)	6
Medina	13	Garfield	8	Curry	9	Jefferson	15	Fairfield	7
Meigs	11	Garvin	7	Deschutes	14	Juniata	12	Florence (H)	6
Mercer	13	Grady	7	Douglas	9	Lackawanna	14	Georgetown (H)	5
Miami	13	Grant	9	Gilliam	12	Lancaster	11	Greenville	7
Monroe	12	Greer	7	Grant	15	Lawrence	14	Greenwood	7
Montgomery	12	Harmon	7	Harney	15	Lebanon	12	Hampton (H)	5
Morgan	12	Harper	9	Hood River	12	Lehigh	12	Horry (H)	5
Morrow	13	Haskell	7	Jackson	11	Luzerne	13	Jasper (H)	5
Muskingum	12	Hughes	7	Jefferson	13	Lycoming	13	Kershaw	7
		Jackson	7	Josephine	9	Mckean	15	Lancaster	7

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Laurens	7	Mcperson	16	Henry	9	Armstrong	9	Edwards (H)	4
Lee (H)	6	Meade	15	Hickman	9	Atascosa (H)	3	El Paso	6
Lexington (H)	6	Mellette	14	Houston	9	Austin (H)	4	Ellis (H)	5
Marion (H)	6	Miner	15	Humphreys	9	Bailey	9	Erath	5
Marlboro (H)	6	Minnehaha	15	Jackson	9	Banadera (H)	4	Falls (H)	5
Mccormick (H)	6	Moody	15	Jefferson	9	Bastrop (H)	4	Fannin	6
Newberry (H)	6	Pennington	15	Johnson	10	Baylor	7	Fayette (H)	4
Oconee	7	Perkins	15	Knox	8	Bee (H)	3	Fisher	6
Orangeburg (H)	6	Potter	15	Lake	9	Bell (H)	5	Floyd	8
Pickens	7	Roberts	16	Lauderdale	8	Bexar (H)	4	Foard	7
Richland (H)	6	Sanborn	15	Lawrence	8	Blanco (H)	5	Fort Bend (H)	4
Saluda (H)	6	Shannon	15	Lewis	8	Borden	7	Franklin	6
Spartanburg	7	Spink	15	Lincoln	8	Bosque (H)	5	Freestone (H)	5
Sumter (H)	6	Stanley	15	Loudon	8	Bowie	6	Frio (H)	3
Union	7	Sully	15	Macon	9	Brazoria (H)	3	Gaines	7
Williamsburg (H)	6	Todd	14	Madison	8	Brazos (H)	4	Galveston (H)	3
York	7	Tripp	14	Marion	8	Brewster (H)	5	Garza	7
		Turner	15	Marshall	8	Briscoe	8	Gillespie (H)	5
SOUTH DAKOTA		Union	14	Maury	9	Brooks (H)	3	Glasscock	6
Aurora	15	Walworth	15	Mcminn	8	Brown (H)	5	Goliad (H)	3
Beadle	15	Yankton	14	Mcnairy	8	Burleson (H)	4	Gonzales (H)	4
Bennett	14	Ziebach	15	Meigs	8	Burnet (H)	5	Gray	9
Bon Homme	14			Monroe	8	Caldwell (H)	4	Grayson	6
Brookings	16	TENNESSEE		Montgomery	9	Calhoun (H)	3	Gregg	6
Brown	16	Anderson	9	Moore	8	Callahan	6	Grimes (H)	4
Brule	15	Bedford	8	Morgan	10	Cameron (H)	2	Guadalupe (H)	4
Buffalo	15	Benton	9	Obion	9	Camp	6	Hale	8
Butte	15	Bledsoe	8	Overton	9	Carson	9	Hall	8
Campbell	15	Blount	8	Perry	8	Cass	6	Hamilton (H)	5
Charles Mix	14	Bradley	8	Pickett	10	Castro	9	Hansford	9
Clark	16	Campbell	10	Polk	8	Chambers (H)	4	Hardeman	7
Clay	14	Cannon	9	Putnam	9	Cherokee (H)	5	Hardin (H)	4
Codington	16	Carroll	9	Rhea	8	Childress	7	Harris (H)	4
Corson	15	Carter	10	Roane	9	Clay	6	Harrison	6
Custer	15	Cheatham	9	Robertson	9	Cochran	8	Hartley	9
Davison	15	Chester	8	Rutherford	8	Coke	6	Haskell	6
Day	16	Claiborne	10	Scott	10	Coleman (H)	5	Hays (H)	4
Deuel	16	Clay	9	Sequatchie	8	Collin	5	Hemphill	8
Dewey	15	Cocke	9	Sevier	9	Collingsworth	7	Henderson (H)	5
Douglas	14	Coffee	8	Shelby (H)	7	Colorado (H)	4	Hidalgo (H)	2
Edmunds	15	Crockett	8	Smith	9	Comal (H)	4	Hill (H)	5
Fall River	15	Cumberland	9	Stewart	9	Comanche (H)	5	Hockley	8
Faulk	15	Davidson	8	Sullivan	9	Concho (H)	5	Hood (H)	5
Grant	16	De Kalb	9	Sumner	9	Cooke	6	Hopkins	6
Gregory	14	Decatur	8	Tipton	8	Coryell (H)	5	Houston (H)	5
Haakon	15	Dickson	9	Trousdale	9	Cottle	7	Howard	6
Hamlin	16	Dyer	8	Unicoi	10	Crane (H)	5	Hudspeth	6
Hand	15	Fayette (H)	7	Union	9	Crockett (H)	5	Hunt	6
Hanson	15	Fentress	10	Van Buren	9	Crosby	7	Hutchinson	9
Harding	15	Franklin	8	Warren	9	Culberson	6	Irion (H)	5
Hughes	15	Gibson	9	Washington	9	Dallam	9	Jack	6
Hutchinson	14	Giles	8	Wayne	8	Dallas (H)	5	Jackson (H)	3
Hyde	15	Grainger	9	Weakley	9	Dawson	7	Jasper (H)	4
Jackson	14	Greene	9	White	9	De Witt (H)	3	Jeff Davis	6
Jerauld	15	Grundy	9	Williamson	8	Deaf Smith	9	Jefferson (H)	4
Jones	15	Hamblen	9	Wilson	9	Delta	6	Jim Hogg (H)	3
Kingsbury	15	Hamilton	8			Denton	5	Jim Wells (H)	3
Lake	15	Hancock	10	TEXAS		Dickens	7	Johnson (H)	5
Lawrence	15	Hardeman	8	Anderson (H)	5	Dimmit (H)	3	Jones	6
Lincoln	15	Hardin	8	Andrews	6	Donley	8	Karnes (H)	3
Lyman	15	Hawkins	9	Angelina (H)	4	Duval (H)	3	Kaufman	5
Marshall	16	Haywood	8	Aransas (H)	3	Eastland	6	Kendall (H)	5
Mccook	15	Henderson	8	Archer	6	Ector	6	Kenedy (H)	2

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Kent	7	Reeves	6	Box Elder	12	Carroll	11	Roanoke	9
Kerr (H)	5	Refugio (H)	3	Cache	15	Charles City	8	Rockbridge	9
Kimble (H)	5	Roberts	9	Carbon	14	Charlotte	9	Rockingham	11
King	7	Robertson (H)	4	Daggett	15	Chesterfield	9	Russell	10
Kinney (H)	4	Rockwall	5	Davis	12	Clarke	11	Scott	10
Kleberg (H)	2	Runnels (H)	5	Duchesne	15	Craig	10	Shenandoah	11
Knox	7	Rusk (H)	5	Emery	14	Culpeper	10	Smyth	11
La Salle (H)	3	Sabine (H)	5	Garfield	14	Cumberland	9	Southampton	8
Lamar	6	San Augustine (H)	5	Grand	10	Dickenson	10	Spotsylvania	10
Lamb	8	San Jacinto (H)	4	Iron	12	Dinwiddie	8	Stafford	10
Lampasas (H)	5	San Patricio (H)	3	Juab	12	Essex	9	Surry	8
Lavaca (H)	4	San Saba (H)	5	Kane	10	Fairfax	10	Sussex	8
Lee (H)	4	Schleicher (H)	5	Millard	13	Fauquier	10	Tazewell	11
Leon (H)	5	Scurry	7	Morgan	15	Floyd	11	Virginia Beach	8
Liberty (H)	4	Shackelford	6	Piute	13	Fluvanna	9	Warren	11
Limestone (H)	5	Shelby (H)	5	Rich	15	Franklin	10	Washington	11
Lipscomb	9	Sherman	9	Salt Lake	12	Frederick	11	Westmoreland	8
Live Oak (H)	3	Smith (H)	5	San Juan	13	Fredericksburg Giles	10	Wise	10
Llano (H)	5	Somervell (H)	5	Sanpete	14	Gloucester	8	Wythe	11
Loving	6	Starr (H)	2	Sevier	13	Goochland	9	York	8
Lubbock	7	Stephens	6	Summit	15	Grayson	11		
Lynn	7	Sterling	6	Tooele	12	Greene	10	VIRGINIA	
Madison (H)	4	Stonewall	7	Uintah	15	Greensville	8	INDEPENDENT CITIES	
Marion	6	Sutton (H)	5	Utah	12	Halifax	9	Alexandria	10
Martin	6	Swisher	9	Wasatch	15	Hampton	8	Bedford	9
Mason (H)	5	Tarrant (H)	5	Washington	10	Hanover	9	Bristol	11
Matagorda (H)	3	Taylor	6	Wayne	14	Henrico	8	Buena Vista	9
Maverick (H)	3	Terrell (H)	5	Weber	12	Henry	10	Charlottesville	9
Mcculloch (H)	5	Terry	7			Highland	11	Chesapeake	8
Mclennan (H)	5	Throckmorton	6	VERMONT		Isle Of Wight	8	Clifton Forge	10
Mcmullen (H)	3	Titus	6	Addison	15	James City	8	Colonial Hts	9
Medina (H)	4	Tom Green (H)	5	Bennington	15	King And Queen	9	Covington	10
Menard (H)	5	Travis (H)	4	Caledonia	16	King George	9	Danville	9
Midland	6	Trinity (H)	4	Chittenden	15	King William	9	Emporia	8
Milam (H)	4	Tyler (H)	4	Essex	16	Lancaster	8	Fairfax	10
Mills (H)	5	Upshur	6	Franklin	15	Lee	10	Falls Church	10
Mitchell	6	Upton (H)	5	Grand Isle	15	Loudoun	10	Franklin	8
Montague	6	Uvalde (H)	4	Lamoille	16	Louisa	9	Fredericksburg	10
Montgomery (H)	4	Val Verde (H)	4	Orange	16	Lunenburg	9	Galax	11
Moore	9	Van Zandt	5	Orleans	16	Madison	11	Hampton	8
Morris	6	Victoria (H)	3	Rutland	15	Mathews	8	Harrisonburg	11
Motley	7	Walker (H)	4	Washington	16	Mecklenburg	9	Hopewell	8
Nacogdoches (H)	5	Waller (H)	4	Windham	15	Middlesex	8	Lexington	9
Navarro (H)	5	Ward	6	Windsor	15	Montgomery	11	Lynchburg	9
Newton (H)	4	Washington (H)	4			Nansemond	8	Manassas	10
Nolan	6	Webb (H)	3	VIRGINIA		Nelson	9	Manassas Park	10
Nueces (H)	3	Wharton (H)	3	Accomack	8	New Kent	8	Martinsville	10
Ochiltree	9	Wheeler	8	Albemarle	9	Newport News	8	Newport News	8
Oldham	9	Wichita	7	Alleghany	10	Norfolk	8	Norfolk	8
Orange (H)	4	Wilbarger	7	Amelia	9	Northampton	8	Norton	10
Palo Pinto	6	Willacy (H)	2	Amherst	9	Northumberland	8	Petersburg	8
Panola (H)	5	Williamson (H)	4	Appomattox	9	Nottoway	9	Poquoson	8
Parker	5	Wilson (H)	4	Arlington	10	Orange	10	Portsmouth	8
Parmer	9	Winkler	6	Augusta	11	Page	11	Radford	11
Pecos (H)	5	Wise	5	Bath	11	Patrick	10	Richmond	8
Polk (H)	4	Wood	6	Bedford	9	Pittsylvania	9	Roanoke	9
Potter	9	Yoakum	8	Bland	11	Powhatan	9	Salem	9
Presidio (H)	5	Young	6	Botetourt	9	Prince Edward	9	South Boston	9
Rains	6	Zapata (H)	2	Brunswick	8	Prince George	8	Staunton	11
Randall	9	Zavala (H)	3	Buchanan	10	Prince William	10	Suffolk	8
Reagan (H)	5			Buckingham	9	Pulaski	11	Virginia Beach	8
Real (H)	4	UTAH		Campbell	9	Rappahannock	11	Waynesboro	11
Red River	6	Beaver	14	Caroline	9	Richmond	8	Williamsburg	8

“Hot and humid” counties exempt from the vapor retarder requirement are marked with an “(H)”

Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Winchester	11	Kanawha	10	Iron	17	WYOMING			
WASHINGTON		Lewis	12	Jackson	15	Albany	16		
Adams	12	Lincoln	10	Jefferson	15	Big Horn	15		
Asotin	12	Logan	10	Juneau	15	Campbell	15		
Benton	11	Marion	12	Kenosha	15	Carbon	16		
Chelan	12	Marshall	12	Kewaunee	15	Converse	15		
Clallam	12	Mason	11	La Crosse	15	Crook	15		
Clark	11	McDowell	11	Lafayette	15	Fremont	15		
Columbia	12	Mercer	11	Langlade	17	Goshen	14		
Cowlitz	11	Mineral	12	Lincoln	17	Hot Springs	15		
Douglas	14	Mingo	10	Manitowoc	15	Johnson	15		
Ferry	15	Monongalia	12	Marathon	15	Laramie	15		
Franklin	11	Monroe	11	Marinette	15	Lincoln	17		
Garfield	12	Morgan	11	Marquette	15	Natrona	15		
Grant	12	Nicholas	12	Menominee	15	Niobrara	15		
Grays Harbor	11	Ohio	12	Milwaukee	15	Park	15		
Island	12	Pendleton	13	Monroe	15	Platte	14		
Jefferson	11	Pleasants	11	Oconto	15	Sheridan	15		
King	10	Pocahontas	13	Oneida	17	Sublette	17		
Kitsap	11	Preston	13	Outagamie	15	Sweetwater	16		
Kittitas	14	Putnam	10	Ozaukee	15	Teton	17		
Klickitat	12	Raleigh	12	Pepin	15	Uinta	16		
Lewis	11	Randolph	13	Pierce	15	Washakie	15		
Lincoln	15	Ritchie	11	Polk	16	Weston	15		
Mason	11	Roane	11	Portage	15				
Okanogan	15	Summers	12	Price	17				
Pacific	11	Taylor	12	Racine	15				
Pend Oreille	15	Tucker	13	Richland	15				
Pierce	11	Tyler	11	Rock	15				
San Juan	12	Upshur	12	Rusk	16				
Skagit	11	Wayne	10	Sauk	15				
Skamania	11	Webster	12	Sawyer	17				
Snohomish	11	Wetzel	12	Shawano	15				
Spokane	14	Wirt	11	Sheboygan	15				
Stevens	15	Wood	11	St Croix	15				
Thurston	11	Wyoming	11	Taylor	17				
Wahkiakum	11	WISCONSIN		Trempealeau	15				
Walla Walla	11	Adams	15	Vernon	15				
Whatcom	12	Ashland	17	Vilas	17				
Whitman	14	Barron	16	Walworth	15				
Yakima	12	Bayfield	17	Washburn	17				
WEST VIRGINIA		Brown	15	Washington	15				
Barbour	13	Buffalo	15	Waukesha	15				
Berkeley	11	Burnett	17	Waupaca	15				
Boone	10	Calumet	15	Waushara	15				
Braxton	11	Chippewa	15	Winnebago	15				
Brooke	12	Clark	15	Wood	15				
Cabell	10	Columbia	15						
Calhoun	11	Crawford	15						
Clay	11	Dane	15						
Doddridge	12	Dodge	15						
Fayette	12	Door	15						
Gilmer	11	Douglas	17						
Grant	13	Dunn	15						
Greenbrier	12	Eau Claire	15						
Hampshire	11	Florence	17						
Hancock	12	Fond Du Lac	15						
Hardy	12	Forest	17						
Harrison	12	Grant	15						
Jackson	11	Green	15						
Jefferson	11	Green Lake	15						
		Iowa	15						

“Hot and humid” counties exempt from the vapor retarder requirement are marked with an “(H)”

Definitions

REScheck Terms

Addition(s)

An extension or increase in the height, conditioned floor area, or conditioned volume of a building. The code applies to additions of existing buildings.

Alteration

Any construction renovation, or change in a mechanical system that involves an extension, addition, or change to the arrangement, type, or purpose of the original installation.

AFUE

Annual fuel utilization efficiency; combustion heating equipment efficiency is expressed in terms of AFUE. New equipment typically ranges from about 78- to 96-percent AFUE. Higher AFUE ratings indicate more efficient equipment.

Basement Wall(s)

1992, 1993 – Basement walls that enclose conditioned spaces are part of the building envelope. Basement wall refers to the opaque portion of the wall (excluding windows and doors). To be considered a basement wall, at least 50% of the total wall area (including openings) must be below grade. For walls less than 50% below grade, include the entire opaque wall area as part of the above-grade wall.

1995 – Basement walls that enclose conditioned spaces are part of the building envelope. Basement wall refers to the opaque portion of the wall (excluding windows and doors). To be considered a basement wall, at least 50% of the wall's total wall area (including openings) must be below grade. Treat walls on each side of the basement individually when determining if they are above grade or basement walls. For any individual wall less than 50% below grade, indicate the entire opaque wall area of that individual wall as part of the above-grade walls.

BOCA

Building Officials and Code Administrators International, Inc.

Building Envelope

All components of a building that enclose conditioned space. Building envelope components separate conditioned spaces from unconditioned spaces or from outside air (see conditioned space). For example, walls and doors between an unheated garage and a living area are part of the building envelope; walls separating an unheated garage from

the outside are not. Although floors of conditioned basements and conditioned crawl spaces are technically part of the building envelope, the code does not specify insulation requirements for these components and they can be ignored.

Ceiling(s)

The ceiling requirements apply to portions of the roof and/or ceiling through which heat flows. Ceiling components include the interior surface of flat ceilings below attics, the interior surface of cathedral or vaulted ceilings, skylights, or vaulted ceilings, skylights and sloped building assemblies less than 60° from horizontal, but excluding skylight shafts. Refer to Building Envelope Components in Appendix C for a comprehensive list of ceiling components.

Conditioned

See Conditioned Space

Conditioned Space

A space is conditioned if heating and/or cooling is deliberately supplied to it or is indirectly supplied through uninsulated surfaces of water or heating equipment or through uninsulated ducts. For example, a basement with registers or heating devices designed to supply heat is conditioned. An indirectly heated basement is also conditioned if the basement ceiling is not insulated and heat is indirectly supplied to the space, such as through uninsulated ducts or through uninsulated surfaces of water heaters or space heating equipment.

Cooled

A space within a building which is provided with a positive cooling supply.

Crawl Space

The REScheck crawl space wall insulation requirements are for the exterior walls of unventilated crawl spaces (i.e. not directly vented to the outside) below uninsulated floors. A crawl space wall component includes the opaque portion of a wall that encloses a crawl space and is partially or totally below grade, as measured from the sill to the top of the footing.

Crawl Space Wall(s)

The opaque portion of a wall which encloses a crawl space and is partially or totally below grade.

Door

Doors include all openable opaque assemblies located in exterior walls of the building envelope. Doors with glass can be treated as a single door assembly, in which case an aggregate U-factor (a U-factor that includes both the glass and the opaque area) must be used; OR the glass area of the door can be included with the other glazing and an opaque door U-factor can be used to determine compliance of the door.

Dwelling Unit

A single housekeeping unit of one or more rooms providing complete, independent living facilities, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Equipment Efficiency(ies)

The measure of equipment efficiency varies with equipment type. Combustion heating equipment efficiency is expressed in terms of AFUE. New equipment typically ranges from about 78- to 96-percent AFUE. Cooling efficiency for electric air conditioners and heat pumps is expressed in terms of SEER. New equipment ranges from 10 to about 16 SEER. Heat pump heating is expressed in terms of HSPF. New equipment ranges from

about 6.8 to 10.0 HSPF. Higher AFUE, SEER, and HSPF ratings indicate more efficient equipment.

Glazing

Any translucent or transparent material in exterior openings of buildings, including windows, skylights, sliding doors, the glass area of opaque doors, and glass block.

Glazing Area

The area of a glazing assembly is the interior surface area of the entire assembly, including glazing, sash, curbing, and other framing elements. The nominal area or rough opening is also acceptable for flat windows and doors.

Gross Wall Area

1992, 1993 – The gross wall area includes the opaque area of above-grade walls, the opaque area of walls of conditioned basements less than 50% below grade (including the below-grade portions), all windows and doors (including the windows and doors of conditioned basements), and the peripheral edges of floors.

1995 – The gross wall area includes the opaque area of above-grade walls, the opaque area of any individual wall of a conditioned basement less than 50% below grade (including the below-grade portions), all windows and doors (including windows and doors of conditioned basements), and the peripheral edges of floors.

Heated

A space within a building which is provided with a positive heat supply.

Heating Degree Days

A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C), there exists as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F (18°C).

HSPF

Heating seasonal performance factor; heat pump heating is expressed in terms of HSPF. New equipment ranges from about 6.8 to 10.0 HSPF. Higher HSPF ratings indicate more efficient equipment.

HUD

The U.S. Department of Housing and Urban Development

ICBO

The International Conference of Building Officials

ICC

The International Code Council

IECC

The International Energy Conservation Code; formerly known as the MEC

MEC

The Model Energy Code

Multifamily

A multifamily building is a residential building three stories or less in height that contains three or more attached dwelling units. Multifamily buildings include apartments,

condominiums, townhouses, and rowhouses. Hotels and motels are considered commercial rather than residential buildings.

NAECA

The National Appliance Energy Conservation Act of 1987, 42 USC 6291 et seq., as amended, Public Law 100-12.

Net Wall Area

The net wall area includes the opaque wall area of all above-grade walls enclosing conditioned spaces, the opaque area of conditioned basement walls less than 50% below grade (including the below-grade portions), and peripheral edges of floors. The net wall area does not include windows, doors, or other such openings, as they are treated separately.

NFRC

National Fenestration Rating Council

Opaque Areas

Opaque areas referenced in this guide include all areas of the building envelope except openings for windows, skylights, doors, and building service systems. For example, although solid wood and metal doors are opaque, they should not be included as part of the opaque wall area (also referred to as the net wall area).

Repair

A repair includes the reconstruction or renewal of any part of an existing building for maintenance purposes.

Raised Truss

Raised truss refers to any roof/ceiling construction that allows the insulation to achieve its full thickness over the plate line of exterior walls. Several constructions allow for this, including elevating the heel (sometimes referred to as an energy truss, raised-heel truss, or Arkansas truss), use of cantilevered or oversized trusses, lowering the ceiling joists, or framing with a raised rafter plate.

RECD

The Rural Economic and Community Development, formerly the Farmer's Home Administration.

Residences

See Residential Buildings

Residential Buildings

For the purposes of the code, Group R residential buildings include:

- Type A-1 – Detached one- and two-family dwellings; and
- Type A-2 – All other residential buildings, three stories or less in height

R-Value

A measure (h ft² °F/Btu) of thermal resistance, or how well a material or series of materials resists the flow of heat. R-value is the reciprocal of U-factor.

$$R - \text{Value} = \frac{1}{U - \text{Factor}}$$

SBCCI

The Southern Building Code Congress International, Inc.

SEER

Seasonal energy efficiency ratio; cooling efficiency for electric air conditioners and heat pumps is expressed in terms of SEER. New equipment ranges from about 10 to 16 SEER. Higher SEER ratings indicate more efficient equipment.

Single Family

A detached one- and two-family residential building, irrespective of height.

Skylight

Glazing that is horizontal or sloped at an angle less than 60° (1.1 rad) from horizontal.

Slab Edge

Slab edge refers to the perimeter of a slab-on-grade floor, where the top edge of the slab floor is above the finished grade or 12 in. or less below the finished grade. The slab perimeter should include the length of all edges of a slab foundation that are part of the building envelope and are less than 12 in. below grade (i.e. all edges separating conditioned space from unconditioned space).

The insulation can be installed using any of the following configurations, but in all cases it must start at the top of the slab:

- The slab insulation extends from the top of the slab downward to the required depth.
- The slab insulation extends from the top of the slab downward to the bottom of the slab and then horizontally underneath the slab for a minimum total linear distance equal to or greater than the required length.
- The slab insulation extends from the top of the slab downward to the bottom of the slab and then horizontally away from the slab for a minimum total linear distance equal to or greater than the required depth. The horizontal insulation must be covered by pavement or at least 10 in. of soil.

The top edge of insulation installed between the exterior wall and the interior slab can be cut at a 45° angle away from the exterior wall.

Slab-On-Grade Floor

A floor that is poured in direct contact with the earth.

Unconditioned

An enclosed space within a building that is not a conditioned space.

U-Factor

A measure (Btu/h ft² °F) of how well a material or series of materials conducts heat. U-factors for window and door assemblies are the reciprocal of the assembly R-value.

$$U\text{-Factor} = \frac{1}{R\text{-Value}}$$