



**MECcheck<sup>TM</sup>**  
**Trade-Off Worksheet**  
**User's Guide**

1998 and 2000 International Energy Conservation Code  
Version 3.0  
April 2000

MECcheck<sup>TM</sup> was developed by the Building Energy Standards 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 MEC*check* materials.

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1998 and 2000 International Energy Conservation Code  
Version 3.0  
April 2000

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# Introduction to MECcheck

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## 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.

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## 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· ft<sup>2</sup> or 1 W/ft<sup>2</sup> of floor area)
- buildings (or portions of buildings) that are neither heated nor cooled
- buildings designated as historical.

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## About the MEC*check* Materials

The MEC*check* 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 MEC*check* software has a *Code* menu which allows you to select the code for which compliance is to be determined. Two sets of printed MEC*check* 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 MEC*check* 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 MEC*check* materials differ significantly in format from these codes.

The MEC*check* 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 MEC*check* 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 MEC*check* 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.

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## What's in the MEC*check* Guides?

The *Basic Requirements Guide* applies to all residential buildings and should be read by all users of MEC*check* materials. Home builders and designers can then use one of the three MEC*check* 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 *MECcheck 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 *MECcheck* 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 *MECcheck* 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.

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## Who Should Use the MECcheck Materials?

The *MECcheck* 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 *MECcheck* 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.

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## MECcheck 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 MECcheck 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. MECcheck 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.

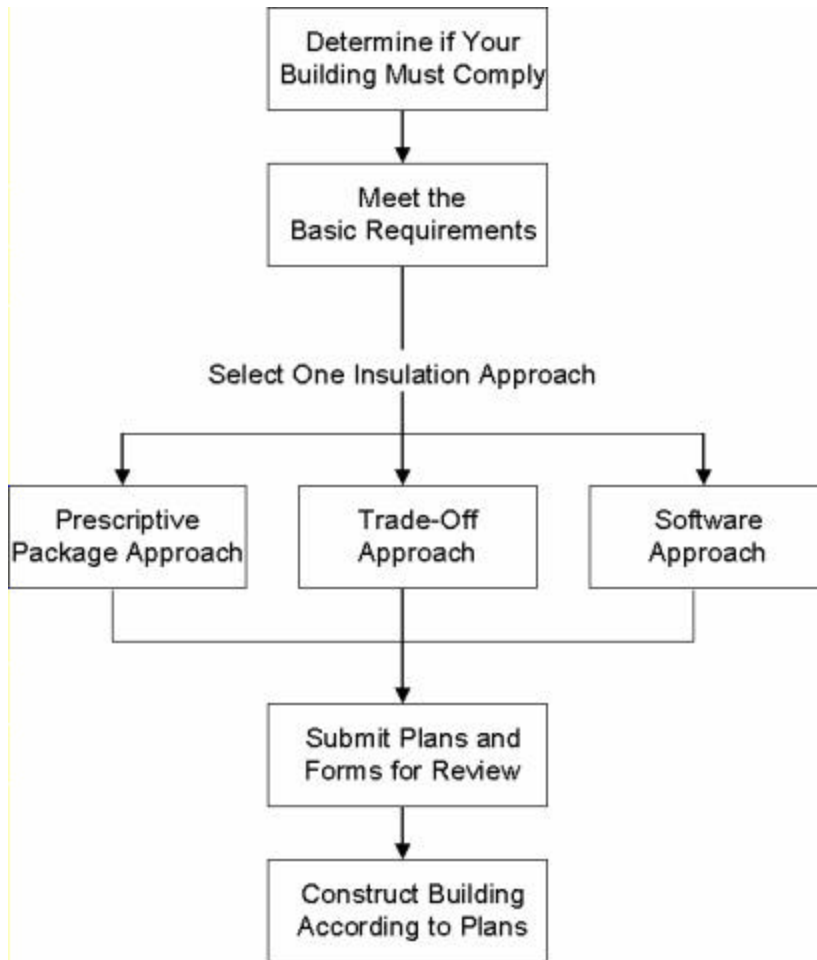


Figure 1. MECcheck Compliance Path



# Basic Requirements Guide

1998 IECC and 2000 IECC

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## Inside This Guide

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

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## 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.

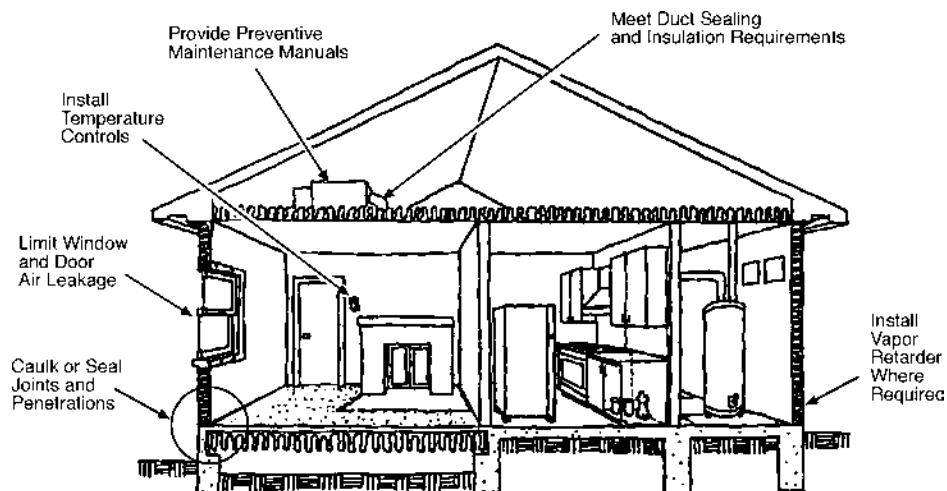


Figure 1. Some of the Basic Requirements

## Air Leakage

(1998: Section 502.3; 2000: Section 502.1.4) 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.

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.

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.

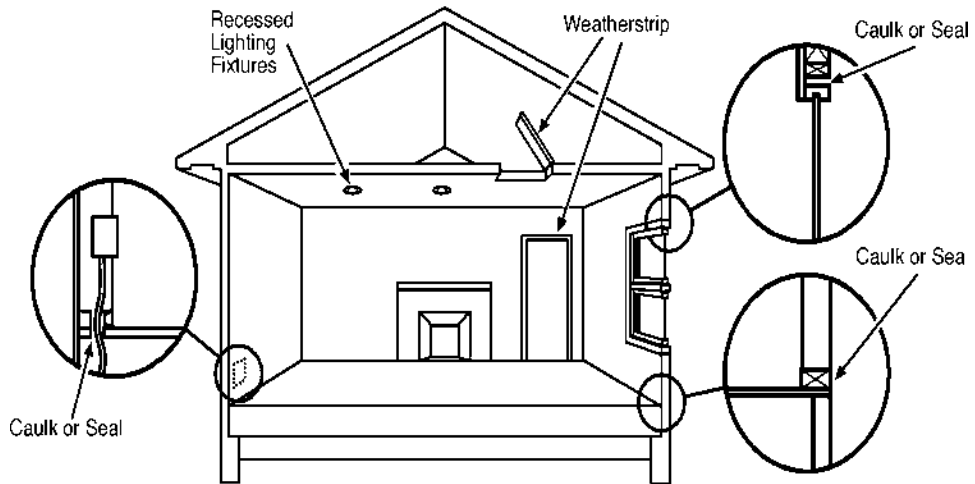


Figure 2. Typical Openings that Should be Sealed

## Vapor Retarders

(1998: Section 502.1.2; 2000: Section 502.1.1) 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 MECcheck 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.
- If other approved means to avoid condensation and leakage of moisture are approved.

2000

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

## Solar Heat Gain Coefficient

(1998: Section 502.4; 2000: Section 502.1.5) In climate Zones 1-7, the area-weighted average solar heat gain coefficient (SHGC) of all windows, glazed doors, and skylights cannot exceed 0.4. The SHGC must be determined in accordance with NFRC 200 and labeled and certified by the manufacturer, or taken from the default SHGC table in Appendix B. SHGC values may be adjusted to reflect the effects of any permanent

exterior solar shading devices, such as shade screens. 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 MECcheck software, the SHGC requirement will be included in the *Inspection Checklist* for all applicable locations.

When a shading coefficient (SC) is used, it can be converted to an SHGC by multiplying the SC value by 0.87:

$$\text{SHGC} = \text{SC} \times 0.87$$

2000

## Exposed Foundation Insulation

(Section 102.4.1) Exterior foundation wall and slab perimeter insulation must have a rigid, opaque, and weather-resistant covering that prevents the degradation of the insulation's performance. The protective covering must cover the exposed (above-grade) area of the insulation and extend to a minimum of 6 in. (153 mm) below grade.

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## Materials and Equipment Information

2000

(Section 102.2) All insulation, caulking and weatherstripping, windows and skylights, and mechanical and water heating equipment must be installed in accordance with the manufacturer's installation instructions.

(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.

(1998: Section 102.4.1; 2000: Section 102.5.1) 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.

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# 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 MEC*check* materials.

## Duct Insulation

(Section 503.3.3.3) 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: Insulation is not required on factory-installed plenums, casings, or ductwork furnished as part of the HVAC equipment.

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 MEC*check* 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.

Table 2. 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
Zones 15-19	R-5	R-8

## Duct Construction

- 1998 (Section 503.3.3.4) Ducts in unconditioned spaces, including the unconditioned side of enclosed stud bays or joist cavities used to transport air, must be fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric, or tapes. Duct tape is not permitted.
- 2000 (Section 503.3.3.4.2) All joints, seams, and connections must be securely fastened with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric, or tapes. Duct tape is not permitted.  
Exception: Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. w.g. (500 Pa).
- 2000 Ducts shall be supported every 10 feet or in accordance with the manufacturer's instructions. Cooling ducts with exterior insulation must be covered with a vapor retarder. Air filters are required in the return air system.



*Duct with mastic*





(Section 503.3.3.7) 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

(Section 503.3.2.1) Each dwelling unit is considered a zone and must have at least one thermostat provided for each separate system (heating and cooling).

(Section 503.3.2.2) Each heating and cooling system must have a thermostat capable of being set:

- down to 55°F or lower when used to control heating
- up to 85°F or higher when used to control cooling
- with a temperature range or deadband of at least 5°F when used to control both heating and cooling.



*Thermostat*



## Heat Pump Thermostats

(Section 503.3.2.3) 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

(Section 503.3.3) All HVAC piping (such as in hydronic heating systems) installed in unconditioned spaces and conveying fluids at temperatures greater than 105°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 <sup>(a)</sup>

Piping System Types	Fluid Temp Range (°F)	Insulation Thickness in Inches by Pipe Sizes <sup>(b)</sup>			
		Runouts 2in. <sup>(c)</sup>	1 in. and less	1.25 in. to 2 in.	2.5 in. to 4 in.
<b>Heating Systems</b>					
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
<b>Cooling Systems</b>					
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

### Heat Traps

(1998: Section 504.9; 2000: Section 504.7) Water heaters with vertical pipe risers must have a heat trap on both the inlet and outlet unless the water heater has an integral heat trap or is part of a circulating system.

## Swimming Pools

(1998: Section 504.5; 2000: Section 504.3) 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).

(1998: Section 504.5.3; 2000: Section 504.3.3) All swimming pool pumps must be equipped with a time clock.

## Circulating Service Hot Water Systems

(1998: Section 504.6; 2000: Section 504.4) 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.

(1998: Section 504.7; 2000: Section 504.5) 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.

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## Electrical

(Section 505.1) All dwelling units in multifamily buildings must be equipped with separate electric meters.

## 1998 International Energy Conservation Code Summary of Basic Requirements

<b>Air Leakage</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul>
<b>Vapor Retarder</b>	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors, except in exempted locations.
<b>SHGC</b>	In zones 1-7, the area-weighted average SHGC of all glazing cannot exceed 0.4.
<b>Materials and Insulation Information</b>	<ul style="list-style-type: none"> <li>• Materials and equipment must be installed in accordance with the manufacturer's installation instructions.</li> <li>• Materials and equipment must be identified so that compliance can be determined.</li> <li>• Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided.</li> <li>• Insulation R-values, glazing and door U-factors and SHGC values (in zones 1-7), and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.</li> </ul>
<b>Duct Insulation</b>	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>Exception:</i> Factory-installed plenums, casings, or ductwork furnished as part of the HVAC equipment.
<b>Duct Construction</b>	<ul style="list-style-type: none"> <li>• Ducts in unconditioned spaces, including the unconditioned side of enclosed stud bays or joist cavities used to transport air, must be fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric, or tapes. Duct tape is not permitted.</li> <li>• The HVAC system must provide a means for balancing air and water systems.</li> </ul>
<b>Temperature Controls</b>	<ul style="list-style-type: none"> <li>• 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="margin-left: 40px;">Heating Only                                 55EF - 75EF</li> <li style="margin-left: 40px;">Cooling Only                                     70EF - 85EF</li> <li style="margin-left: 40px;">Heating and Cooling                         55EF - 85EF</li> </ul> </li> <li>• 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.</li> <li>• 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.</li> </ul>
<b>HVAC Piping Insulation</b>	HVAC piping in unconditioned spaces conveying fluids above 105EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.
<b>Swimming Pools</b>	<ul style="list-style-type: none"> <li>• All heated swimming pools must have an on/off pool heater switch.</li> <li>• Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources.</li> <li>• All swimming pool pumps must be equipped with a time clock.</li> </ul>
<b>Service Water Heating</b>	<ul style="list-style-type: none"> <li>• Water heaters with vertical pipe risers must have a heat trap on both the inlet and outlet unless the water heater has an integral heat trap or is part of a circulating system.</li> <li>• Circulating hot water systems must have automatic or manual controls and pipes must be insulated to the levels shown on the reverse side of this sheet.</li> </ul>
<b>Electric Systems</b>	Each multifamily dwelling unit must be equipped with separate electric meters.

# 1998 International Energy Conservation 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<sup>(a)</sup>*

Piping System Types	Fluid Temp Range (°F)	Insulation Thickness in Inches by Pipe Sizes <sup>(b)</sup>			
		Runouts 2 in. <sup>(c)</sup>	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
<b>Heating Systems</b>					
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
<b>Cooling Systems</b>					
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 <sup>(a)</sup>				
Heated Water Temperature (°F)	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.

## 2000 International Energy Conservation Code Summary of Basic Requirements

<b>Air Leakage</b>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul>
<b>Vapor Retarder</b>	Vapor retarders must be installed on the warm-in-winter side of all non-vented framed ceilings, walls, and floors, except in exempted locations.
<b>SHGC</b>	In zones 1-7, the area-weighted average SHGC of all glazing cannot exceed 0.4.
<b>Materials and Insulation Information</b>	<ul style="list-style-type: none"> <li>• Materials and equipment must be installed in accordance with the manufacturer's installation instructions.</li> <li>• Materials and equipment must be identified so that compliance can be determined.</li> <li>• Manufacturer manuals for all installed heating and cooling equipment and service water heating equipment must be provided.</li> <li>• Insulation R-values, glazing and door U-factors and SHGC values (in zones 1-7), and heating and cooling equipment efficiency (if high-efficiency credit is taken) must be clearly marked on the building plans or specifications.</li> <li>• Exterior foundation wall and slab perimeter insulation must have a rigid, opaque, and weather-resistant covering that prevents degradation of the insulation's performance, covers the exposed (above-grade) area of the insulation, and extends to a minimum of 6 in. (153 mm) below grade.</li> </ul>
<b>Duct Insulation</b>	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>Exception:</i> Factory-installed plenums, casings, or ductwork furnished as part of the HVAC equipment.
<b>Duct Construction</b>	<ul style="list-style-type: none"> <li>• All joints, seams, and connections must be securely fastened with welds, gaskets, mastics (adhesives), mastic-plus-embedded-fabric, or tapes. Duct tape is not permitted. <i>Exception:</i> Continuously welded and locking-type longitudinal joints and seams on ducts operating at less than 2 in. w.g. (500 Pa).</li> <li>• Ducts must be supported every 10 feet or in accordance with the manufacturer's instructions.</li> <li>• Cooling ducts with exterior insulation must be covered with a vapor retarder.</li> <li>• Air filters are required in the return air system.</li> <li>• The HVAC system must provide a means for balancing air and water systems.</li> </ul>
<b>Temperature Controls</b>	<ul style="list-style-type: none"> <li>• 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="margin-left: 40px;">Heating Only                                 55EF - 75EF</li> <li style="margin-left: 40px;">Cooling Only                                     70EF - 85EF</li> <li style="margin-left: 40px;">Heating and Cooling                         55EF - 85EF</li> </ul> </li> <li>• A means to partially restrict or shut off the heating and/or cooling input to each zone or floor must be provided for single-family homes and to each room for multifamily buildings.</li> <li>• 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.</li> </ul>
<b>HVAC Piping Insulation</b>	HVAC piping in unconditioned spaces conveying fluids above 105EF or chilled fluids at less than 55EF must be insulated to the levels shown on the reverse side of this sheet.
<b>Swimming Pools</b>	<ul style="list-style-type: none"> <li>• All heated swimming pools must have an on/off pool heater switch.</li> <li>• Heated pools require a pool cover unless over 20% of the heating energy is from non-depletable sources.</li> <li>• All swimming pool pumps must be equipped with a time clock.</li> </ul>
<b>Service Water Heating</b>	<ul style="list-style-type: none"> <li>• Water heaters with vertical pipe risers must have a heat trap on both the inlet and outlet unless the water heater has an integral heat trap or is part of a circulating system.</li> <li>• Circulating hot water systems must have automatic or manual controls and pipes must be insulated to the levels shown on the reverse side of this sheet.</li> </ul>
<b>Electric</b>	Each multifamily dwelling unit must be equipped with separate electric meters.

## 2000 International Energy Conservation 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<sup>(a)</sup>*

Piping System Types	Fluid Temp Range (°F)	Insulation Thickness in Inches by Pipe Sizes <sup>(b)</sup>			
		Runouts 2 in. <sup>(c)</sup>	1 in. and Less	1.25 in. to 2 in.	2.5 in. to 4 in.
<b>Heating Systems</b>					
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
<b>Cooling Systems</b>					
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*

Heated Water Temperature (°F)	Insulation Thickness in Inches by Pipe Sizes <sup>(a)</sup>			
	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.

# Trade-Off Worksheet

## User's Guide

1998 IECC and 2000 IECC

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### Inside This Guide

Introduction  
Instructions for Using the Trade-Off Approach  
Quick Compliance  
Compliance Example

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### Introduction

The trade-off approach is a pencil-and-paper method that can be used for one- and two-family (referred to as single-family) and multifamily residential buildings. This approach allows you to trade off insulation and window efficiency levels in different parts of the building envelope. You may trade off ceiling, wall, floor, basement wall, slab-edge, and crawl space wall insulation; window area; and window and door U-factors. The trade-off approach determines whether your building as a whole meets the code insulation and window requirements (refer to the *Basic Requirements Guide* for additional requirements that must also be satisfied).

To determine compliance, you must complete the *Trade-Off Worksheet* provided with this guide. Refer to this worksheet while reading the following sections. To complete the *Trade-Off Worksheet*, enter the area, R-value, and U-factor of each component in your proposed building and calculate the total proposed UA. UA is the value of a building assembly times the surface area of that assembly through which heat flows. The UA for the entire building is the sum of all UAs for each assembly in the building envelope, giving a total UA for the building envelope. A larger UA indicates more heat loss, either because of a larger surface area or higher U-factors (or both).

Next, find the required U-factors for your zone from Table 11 and calculate the total required UA. If the proposed UA is less than or equal to the required UA, your building complies with the code insulation and window requirements.

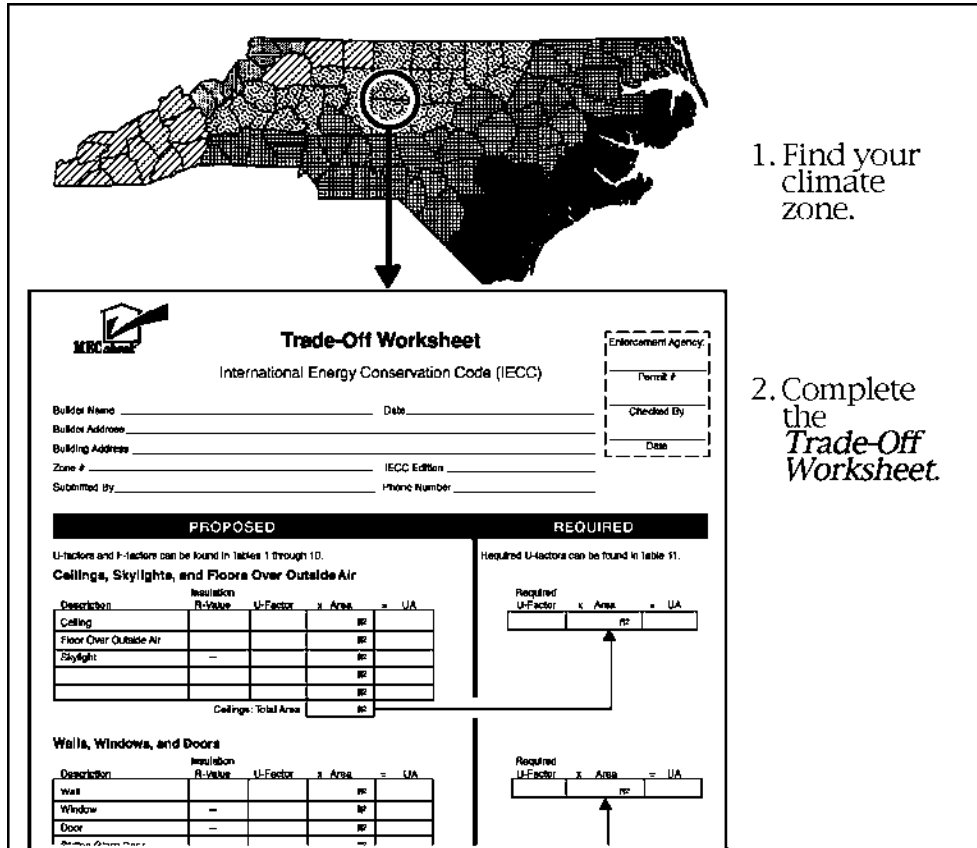


Figure 1. Using the Trade-Off Approach

When applying the trade-off approach to multifamily buildings, the building can be considered as a whole or a separate worksheet can be completed for each individual dwelling unit. Where individual units are identical, one worksheet may be submitted as representative of the others. Contact the authority having jurisdiction to determine which approach to take.

## Instructions for Using the Trade-Off Approach

The *Trade-Off Worksheet* documents compliance with the insulation and window requirements of the code. The following instructions explain how to complete this worksheet. Figure 2 shows an example *Trade-Off 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

Based on the county in which your building is to be located, determine your climate zone number. Your zone number can be found in Appendix E or on the state map included with the prescriptive packages.

### Step 2: Complete the General Information Section

Fill in the information at the top of the worksheet. Be sure to record the climate zone number found in Step 1.



### Step 3: Complete the PROPOSED Section

On the left side of the worksheet, provide the area, R-value, and U-factor for each building component. U-factors are a measure of how well a material conducts heat. Tables 1 through 10 can be used to determine the proposed U-factors needed for completing the *Trade-Off Worksheet*. If your particular construction type is not included in these tables, use U-factors derived through testing or calculation procedures accepted by your local jurisdiction.

#### ***Ceilings, Skylights, and Floors Over Outside Air***

**Ceilings** Enter the R-value of the insulation to be installed in each ceiling component in the *Insulation R-Value* column. 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). Sheathing placed on the roof deck over a ventilated attic does not qualify.

Based on the insulation R-value for each ceiling component, find the corresponding U-factor from Table 1 and enter it in the *Proposed U-Factor* column. If the ceiling is to be constructed so the insulation achieves its full insulation thickness over the plate lines of exterior walls, U-factors from the *Raised Truss* column may be used and this should be noted on the worksheet. Otherwise, U-factors from the *Standard Truss* column must be used.

Enter the net ceiling area (ft<sup>2</sup>) of each component in the *Area* column. The net ceiling area includes the following (see Appendix C for a more complete list):


- flat and cathedral ceilings (excluding skylights)
- dormer roofs
- bay window roofs.

Ceiling area should be measured on the slope of the finished interior surfaces. All ceiling components with the same U-factor can be entered on the worksheet as a single component along with their combined area.

**Floors Over Outside Air** Enter the R-value of the cavity insulation to be installed in each floor over outside air component in the *Insulation R-Value* column. Based on the insulation R-value of the floor component, find the corresponding U-factor from Table 5 and enter it in the *Proposed U-Factor* column.

Floors over outside air include the following:

- floor cantilevers
- floors of an elevated building
- floors of overhangs (such as the floor above a recessed entryway or open carport).



## Trade-Off Worksheet

International Energy Conservation Code (IECC)

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: 1010 CONSTRUCTION AVE. 2 GREENSBORO

Zone #: 8 IECC Edition: 2000

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

PROPOSED

U-factors and F-factors can be found in Tables 1 through 10.

**Ceilings, Skylights, and Floors Over Outside Air**

Description	Insulation R-Value	U-Factor	x Area	= UA
Ceiling w/Attic	R-38	0.030	729 ft <sup>2</sup>	21.9
Floor Over Outside Air	R-30	0.033	32 ft <sup>2</sup>	1.1
Skylight	—		ft <sup>2</sup>	
Ceiling, Vaulted	R-30	0.035	592 ft <sup>2</sup>	20.7
			ft <sup>2</sup>	
Ceilings: Total Area			1353 ft <sup>2</sup>	

**Walls, Windows, and Doors**

Description	Insulation R-Value	U-Factor	x Area	= UA
Wall w/ Sheath	R-13+6	0.060	1339 ft <sup>2</sup>	80.3
Window	—	0.45	204 ft <sup>2</sup>	91.8
Door Entry	—	0.54	20 ft <sup>2</sup>	10.8
Sliding Glass Door	—	0.61	84 ft <sup>2</sup>	51.2
Wall w/o Sheath	R-13	0.082	258 ft <sup>2</sup>	21.2
Door/Garage	—	0.35	18 ft <sup>2</sup>	6.3
			ft <sup>2</sup>	
Walls: Total Area			1923 ft <sup>2</sup>	

**Floors and Foundations**

Description	Insulation Depth	Insulation R-Value	U-Factor or F-Factor	Area or Perimeter	= UA
Floor Over Unconditioned		R-19	0.047	938 ft <sup>2</sup>	44.1
Basement Wall				ft <sup>2</sup>	
Unheated Slab	24 in.	R-8	0.78	82 ft <sup>2</sup>	64.0
Heated Slab	in.			ft <sup>2</sup>	
Crawl Wall	in.			ft <sup>2</sup>	
Total Proposed UA					470.5

REQUIRED

Required U-factors can be found in Table 11.

Required U-Factor	x Area	= UA	
0.036	1353 ft <sup>2</sup>	48.7	
Total Required UA			470.5

Total Proposed UA must be less than or equal to the Total Required UA.

**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 International Energy Conservation Code.

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

Figure 2. Trade-Off Worksheet Step-by-Step

**Skylights** Enter the proposed U-factor of the skylight in the *U-Factor* column. U-factors for skylights must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from Table 9(a).

In Zones 1-7, the area-weighted average solar heat gain coefficient (SHGC) of all windows, glazed doors, and skylights cannot exceed 0.4. While you are not required to enter SHGC values directly on the worksheet, you may be required to submit separate documentation that your building meets this requirement. In the applicable climate zones, SHGC values must be tested and documented in accordance with the NFRC test procedure or taken from Table 9(b).

Enter the area (ft<sup>2</sup>), as measured on the roof slope, of the skylight assembly (including frames and elevated curbs) in the *Area* column.

**Additional Components** Use the blank lines for additional entries if required. For example, if you have two different skylight types with different U-factors, enter each type on a separate line. You can modify or write in descriptions to better fit your proposed building.

Sum the areas of all ceiling, floor over outside air, and skylight components and enter this sum in the space labeled *Ceilings: Total Area*.

## ***Walls, Windows, and Doors***

**Walls** Enter the R-value of the insulation to be installed in each wall component in the *Insulation R-Value* column. R-values for walls represent the sum of the wall cavity insulation plus insulating sheathing (if used). For example, R-13 cavity insulation plus R-6 sheathing is considered R-19 wall insulation. However, the use of insulating sheathing should be specifically indicated on the worksheet. For example, if R-13 batt insulation is to be used with R-6 insulating sheathing, enter "R-13 + R-6" in the *Insulation R-Value* column.

Based on the insulation R-value of the wall component and the type of construction, find the corresponding proposed U-factor for each component in Tables 2, 3 or 4 and enter it in the U-factor column. For above-grade concrete and masonry walls, use the *16 in. O.C. Wall U-Factor* column of Table 2.

Enter the net area (ft<sup>2</sup>) of each wall component in the *Area* column. The net wall area includes the following:

- the opaque area of all above-grade walls enclosing conditioned spaces (excluding doors and windows)
- the area of the band joist and subfloor between floors
- the opaque wall area of conditioned basements with an average depth less than 50% below grade (excluding basement doors and windows but including the below-grade portion of the wall). For further clarification, refer to the basement wall examples given later in this chapter.

The net areas of all wall components with the same U-factor may be combined and entered as a single component on the worksheet.

**Glazing** Enter the proposed U-factors of glazing assemblies (such as windows and sliding glass doors) in the *U-Factor* column. U-factors for skylights should be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from Tables 9(a). Center-of-glass U-factors cannot be used.

In Zones 1-7, the area-weighted average solar heat gain coefficient (SHGC) of all windows, glazed doors, and skylights cannot exceed 0.4. While you are not required to enter SHGC values directly on the worksheet, you may be required to submit separate documentation that your building meets this requirement. In the applicable climate zones, SHGC values must be tested and documented in accordance with the NFRC test procedure or taken from Table 9(b).

In the *Area* column, enter the total area (ft<sup>2</sup>) of all glazing assemblies located in the building envelope. 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. The area of windows in the exterior walls of conditioned basements should be included (windows in unconditioned basements are *NOT* included). Do not include the area of skylights;

skylights are entered in the *Ceilings, Skylights, and Floors Over Outside Air* section of the worksheet.

**Doors** In the *U-Factor* column, enter the proposed U-factors for all doors in the building envelope. U-factors for doors must be tested and documented by the manufacturer in accordance with the NFRC test procedure or taken from Table 10.

If an opaque door with glazing is rated with an aggregate R-value (an R-value that includes both the glass and opaque area), the following equation applies:

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

If a door contains glass and an aggregate R-value or U-factor rating for that door is not available, include the glass area of the door with your glazing and use the opaque door R-value or U-factor to determine compliance of the door. The U-factors listed in Table 10 are only for doors without glass.

Enter the nominal area (ft<sup>2</sup>) or rough opening area of all doors in the *Area* column. Include doors located in the walls of conditioned basements.

**Additional Components** Use the blank lines for additional entries if required. For example, if you have two different window types with different U-factors, enter each type on a separate line. You can modify or write in descriptions to better fit your proposed building.

Sum the areas of all wall components and enter this sum in the space labeled *Walls: Total Area*.

## **Floors and Foundations**

**Floors** Floors over unconditioned spaces include floors over unconditioned crawl spaces, basements, and garages. Floors over outside air should be entered in the *Ceilings, Skylights, and Floors Over Outside Air* section. Enter the R-value of the insulation to be installed in each floor over unconditioned space component in the *Insulation R-Value* column. Enter the corresponding U-factor from Table 5 in the *U-Factor or F-Factor* column. Enter the floor area (ft<sup>2</sup>) in the *Area or Perimeter* column.

**Basement Walls** Enter the R-value of the insulation to be installed in each basement wall component in the *Insulation R-Value* column. If you intend to install insulation on both the exterior and interior of the wall, enter the sum of both R-values. Enter the corresponding proposed U-factor from Table 6 in the *U-Factor or F-Factor* column. Basement walls must be insulated from the top of the basement wall to 10 ft below ground level or to the basement floor, whichever is less. The MECcheck software enables you to trade off the basement wall insulation depth as well as the insulation R-value.

Enter the opaque wall area (ft<sup>2</sup>) of the basement walls in the *Area or Perimeter* column. Include the entire opaque area of any individual wall with an average depth 50% or more below grade that encloses a conditioned space. The entire area of any basement wall less than 50% below grade is included with above-grade walls and is subject to the above-grade wall requirement. The following examples help to clarify the treatment of wood kneewalls, walk-out basements, and basement walls constructed from specialty foundation systems.

### **Example 1: Wood Kneewalls**

Assume a basement is to be constructed in Zone 8 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.

Each basement wall (as measured from the top of the kneewalls to the basement floor) is at least 50% below grade. Therefore, both the masonry foundation walls and the wood kneewalls must be entered in the *Trade-Off Worksheet* as basement wall components under the *Floors and Foundations* section. Since the kneewalls will be insulated to a different level than the masonry foundation walls, you will need to enter the basement on two lines in the *Trade-Off Worksheet* (use the line labeled *Basement Wall* and use the blank line for the second entry). Refer to Table 6 for U-factors that correspond to both the masonry foundation wall insulated to R-5 (0.115) and the wood kneewalls insulated to R-13 (0.059). All proposed basement wall U-factors should be taken from Table 6, including wood-frame basement walls. Table 11 lists the basement U-factor requirement for Zone 8 as 0.09. This requirement applies to both the masonry and wood portions of the wall, and should be entered on the right side of the worksheet across from both basement wall entries.

### **Example 2: Walk-Out Basement**

Assume an 8 ft basement is to be built in Zone 8 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 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 entered on the *Trade-Off Worksheet* as a basement wall component under the *Floors and Foundations* section. Refer to Table 6 for the basement U-factor that corresponds to R-10 insulation (0.072). The rear wall is not 50% below grade, however, and should be entered as an above-grade wall under the *Walls, Windows, and Doors* section. Refer to Table 2 for the U-factor that corresponds to a 16-in. o.c. above-grade wood-frame wall insulated to R-19 (0.060).

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. Refer to Table 7 for the F-factor corresponding to the R-value and depth of insulation that will be installed.

### **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 in place of the insulation R-value. Refer to Table 6 for the U-factor corresponding to this R-value. For example, if the manufacturer reports an overall wall R-value of R-19, the corresponding U-factor from Table 6 is 0.043.

**Slabs** Enter the R-value of the slab insulation to be installed around the perimeter of each slab-on-grade component in the *Insulation R-Value* column. Enter the corresponding F-factor (slab-edge U-factors are sometimes referred to as F-factors) from Table 7 in the *U-Factor or F-Factor* column. Table 7 offers F-Factors for slab insulation depths of 24 in. or 48 in.

The slab description on the worksheet should indicate the proposed insulation depth (24 in. or 48 in.). The software approach enables you to select additional slab perimeter insulation depths. The slab description should also indicate whether or not the slab is heated. A heated slab is a slab with ducts or hydronic heating elements in or under the slab.

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

Enter the slab perimeter (ft) in the *Area or Perimeter* column of the worksheet.

**Crawl Space Walls** The crawl space wall R-value requirements are for walls of unventilated crawl spaces (i.e. not directly vented to the outside). Enter the R-value to be installed in each crawl space wall component in the *Insulation R-Value* column. Enter the corresponding proposed U-factor from Table 8 in the *U-Factor or F-Factor* column. The crawl space wall insulation must extend from the top of the wall to the inside finished grade or to at least 12 in. below the outside finished grade whichever is greater. If the distance from the outside finished grade to the top of the footing is less than 12 in., the insulation must extend a total vertical plus horizontal distance of 24 in. from the outside finished grade. Enter the total vertical plus horizontal distance of the insulation to be installed in the *Insulation Depth* column.

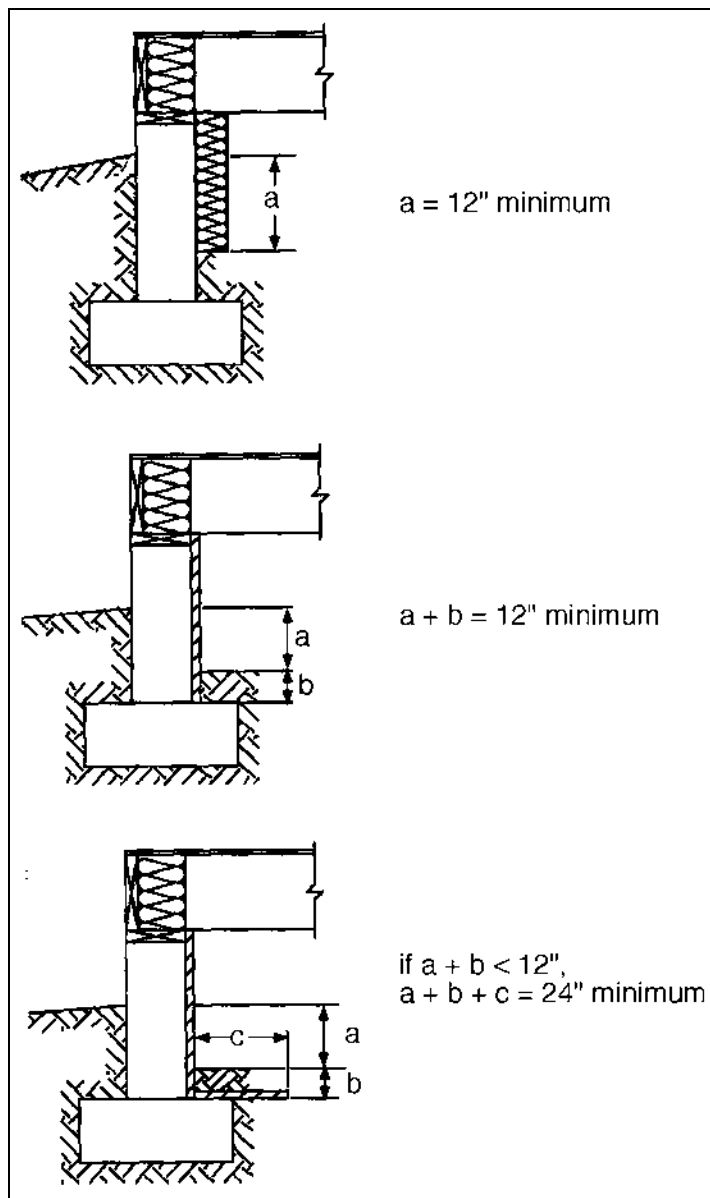


Figure 3. Crawl Space Wall Insulation Depth Requirements

Enter the opaque wall area (ft<sup>2</sup>) of the crawl space walls in the *Area or Perimeter* column.

## Step 4: Compute the Total Proposed UA

Multiply all proposed U-factors by their corresponding area; multiply all proposed slab F-factors by their corresponding perimeter. Enter the results in the *UA* column. Sum the proposed UAs on the left side of the worksheet and enter this sum in the *Total Proposed UA* box. This sum is the total UA of your proposed building.

## Step 5: Complete the REQUIRED Section

Table 11 lists ceiling, wall, floor, basement wall, slab-edge, and crawl space wall U-factor and F-factor requirements for each climate zone (your climate zone number can be found in Appendix E of the *MECcheck Workbook* or on the state map included with the prescriptive packages). Enter the required U-factors and F-factors for your zone in the appropriate *Required U-Factor* column.

Copy the total ceiling and wall areas to the *Area* column on the right side of the worksheet. Copy the area or perimeter of all floor and foundation components to the corresponding box in the *Area or Perimeter* column on the right side of the worksheet.

## Step 6: Compute the Total Required UA

Multiply U-factors in the *Required U-Factor* column by their corresponding area; multiply F-factors by their corresponding perimeter. Enter the results in the *UA* column. Sum the UAs on the right side of the worksheet. Record this sum in the *Total Required UA* box. This value is the total UA of the code building (a building with the same dimensions as your building but insulated to the minimum code requirements).

## Step 7: Check for Compliance

If the *Total Proposed UA* (Step 4) is less than or equal to the *Total Required UA* (Step 6), then your building complies with the code insulation and window requirements. If not, you must adjust the insulation R-values, window or door U-factors, or areas in your proposed building. For example, increasing insulation R-values or reducing the glass area may bring the building design into compliance.

When you are satisfied that your building complies, sign and date the worksheet in the blanks provided. Transfer the proposed R-value and U-factor information from your worksheet to your building plans or specifications.

---

## Quick Compliance

If your proposed ceiling, floor, basement wall, and crawl space wall U-factors and slab-edge F-factors are all less than or equal to the required U-factors and F-factors, no further calculations are required for ceilings and foundations. You do not need to calculate proposed or required building UAs or enter areas in the *Ceilings, Skylights, and Floors Over Outside Air* or *Floor and Foundations* sections. However, you will still need to demonstrate that your wall, window, and door components meet the code requirements by completing the *Walls, Windows, and Doors* section.

If your building meets the following criteria, you can use the Quick Compliance method to demonstrate that your building complies.

- There are no skylight components, and
- all ceiling U-factors are less than or equal to the ceiling U-factor requirement, and
- all floor, basement wall, and crawl space wall U-factors are less than or equal to their corresponding U-factor requirements, and
- all slab F-factors are less than or equal to the slab F-factor requirement, and
- the total proposed UA for the *Walls, Windows, and Doors* section is less than or equal to the required UA for the *Walls, Windows, and Doors* section.

Figure 4 shows a *Trade-Off Worksheet* filled out using the Quick Compliance method. All proposed ceiling, floor, and foundation components have U-factors and F-factors that are less than their corresponding required U-factors and F-factors. Therefore, areas and UA calculations are not required for these components. Note that the total proposed UA for the *Walls, Windows, and Doors* section (219.3) is less than the total required UA (309.7). Hence, the building complies.





## Trade-Off Worksheet

International Energy Conservation Code (IECC)

Builder Name CAREFUL BUILDERS, INC. Date 12/12/00  
 Builder Address 120 "W" ST., GREENSBORO, NORTH CAROLINA 27411  
 Building Address 1010 CONSTRUCTION AVE., GREENSBORO, N.C.  
 Zone # 10 IECC Edition 2000  
 Submitted By JOHN DOE CAREFUL Phone Number 704-321-9445

Enforcement Agency:
Permit #
Checked By
Date

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

U-factors and F-factors can be found in Tables 1 through 10.

### Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Factor	x Area	= UA
Ceiling	<i>R-38</i>	<i>0.03</i>		TP
Floor Over Outside Air				TP
Skylight	-			TP
				TP
				TP
Ceilings: Total Area				TP

Required U-factors can be found in Table 11.

Required U-Factor	x Area	= UA
<i>0.031</i>	TP	TP

### Walls, Windows, and Doors

Description	Insulation R-Value	U-Factor	x Area	= UA
Wall	<i>R-19</i>	<i>0.060</i>	<i>1960</i>	<i>TP 117.6</i>
Window	-	<i>0.40</i>	<i>214</i>	<i>TP 85.6</i>
Door	-	<i>0.37</i>	<i>18</i>	<i>TP 6.7</i>
Sliding Glass Door	-			TP
<i>Door/Entry</i>	-	<i>0.47</i>	<i>20</i>	<i>TP 9.4</i>
				TP
				TP
Walls: Total Area			<i>2212</i>	TP

Required U-Factor	x Area	= UA
<i>0.14</i>	<i>2212</i>	<i>TP 309.7</i>

### Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Factor or F-Factor	x Area or Perimeter	= UA
Floor Over Unconditioned		<i>R-19</i>	<i>0.047</i>		TP
Basement Wall		<i>R-9</i>	<i>0.077</i>		TP
Unheated Slab	in.				TP
Heated Slab	in.				TP
Crawl Wall	in.				TP

Required U-Factor or F-Factor	x Area or Perimeter	= UA
<i>0.050</i>	TP	TP
<i>0.081</i>	TP	TP
	TP	TP
	TP	TP

Total Proposed UA  
**219.3**

Total Required UA  
**309.7**

Total Proposed UA must be less than or equal to the Total Required UA.

**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 International Energy Conservation Code.

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

Figure 4. Trade-Off Worksheet Using Quick Compliance

Table 1. Ceiling U-Factors<sup>(a)</sup>

Insulation R-Value <sup>(a)</sup>	Standard Truss U-Factor	Raised Truss U-Factor <sup>(b)</sup>	Insulation R-Value <sup>(a)</sup>	Standard Truss U-Factor	Raised Truss U-Factor <sup>(b)</sup>
R-0	0.568	0.568	R-33	0.033	0.029
R-7	0.119	0.119	R-34	0.032	0.028
R-8	0.108	0.108	R-35	0.032	0.028
R-9	0.098	0.098	R-36	0.031	0.027
R-10	0.089	0.089	R-37	0.031	0.026
R-11	0.082	0.082	R-38	0.030	0.025
R-12	0.076	0.076	R-39	0.030	0.025
R-13	0.070	0.070	R-40	0.029	0.024
R-14	0.066	0.066	R-41	0.029	0.024
R-15	0.062	0.061	R-42	0.028	0.023
R-16	0.059	0.058	R-43	0.028	0.023
R-17	0.056	0.055	R-44	0.027	0.022
R-18	0.053	0.052	R-45	0.027	0.022
R-19	0.051	0.049	R-46	0.027	0.021
R-20	0.048	0.047	R-47	0.026	0.021
R-21	0.047	0.045	R-48	0.026	0.020
R-22	0.045	0.043	R-49	0.026	0.020
R-23	0.043	0.041	R-50	0.026	0.020
R-24	0.042	0.040	R-51	0.025	0.019
R-25	0.040	0.038	R-52	0.025	0.019
R-26	0.039	0.037	R-53	0.025	0.019
R-27	0.038	0.035	R-54	0.025	0.018
R-28	0.037	0.034	R-55	0.024	0.018
R-29	0.036	0.033	R-56	0.024	0.018
R-30	0.035	0.032	R-57	0.024	0.018
R-31	0.034	0.031	R-58	0.024	0.017
R-32	0.034	0.030	R-59	0.024	0.017

- a. R-values represent the sum of the ceiling cavity insulation plus the R-value of insulating sheathing (if used). For example, R-19 cavity insulation plus R-2 sheathing is reported as R-21 ceiling insulation. 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).
- b. To receive credit for a raised truss, the insulation must achieve its full thickness over the plate lines of exterior walls.

Table 2. Wood-Frame Wall U-Factors <sup>(a, b)</sup>

Insulation R-Value <sup>(c)</sup>	16-in. O.C. Wall U-Factor	24-in. O.C. Wall U-Factor
R-0	0.238	0.241
R-7	0.105	0.104
R-8	0.099	0.097
R-9	0.094	0.092
R-10	0.090	0.088
R-11	0.089	0.087
R-12	0.085	0.083
R-13	0.082	0.080
R-14	0.079	0.077
R-15	0.077	0.074
R-16	0.066	0.064
R-17	0.064	0.062
R-18	0.062	0.060
R-19	0.060	0.059
R-20	0.059	0.057
R-21	0.057	0.056
R-22	0.056	0.054
R-23	0.055	0.053
R-24	0.054	0.052
R-25	0.053	0.051
R-26	0.052	0.050
R-27	0.051	0.049
R-28	0.050	0.048

- a. U-factors are for uncompressed insulation.
- b. U-factors in this table were developed for wood-frame walls, but the *16-in. O.C. Wall U-Factor* column can also be used for above-grade concrete, masonry, and log walls.
- c. Wall R-values are the sum of the cavity insulation plus insulating sheathing (if used).

Table 3. 16-in. O.C. Steel-Frame Wall U-Factors

Cavity R-Value	Insulating Sheathing R-Value										
	R-0	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
R-0	0.270	0.258	0.205	0.170	0.146	0.127	0.113	0.101	0.092	0.084	0.078
R-11	0.120	0.118	0.106	0.096	0.087	0.080	0.074	0.069	0.065	0.061	0.057
R-13	0.114	0.111	0.100	0.091	0.084	0.077	0.072	0.067	0.063	0.059	0.056
R-15	0.109	0.107	0.096	0.088	0.081	0.075	0.070	0.065	0.061	0.058	0.054
R-19	0.101	0.099	0.090	0.083	0.077	0.071	0.066	0.062	0.059	0.055	0.052
R-21	0.098	0.096	0.088	0.081	0.075	0.070	0.065	0.061	0.058	0.054	0.052
R-25	0.094	0.093	0.085	0.078	0.073	0.068	0.063	0.060	0.056	0.053	0.051

Table 4. 24-in. O.C. Steel-Frame Wall U-Factors

Cavity R-Value	Insulating Sheathing R-Value										
	R-0	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10
R-0	0.270	0.258	0.205	0.170	0.146	0.127	0.113	0.101	0.092	0.084	0.078
R-11	0.106	0.104	0.095	0.086	0.080	0.074	0.069	0.064	0.060	0.057	0.054
R-13	0.100	0.098	0.090	0.082	0.076	0.071	0.066	0.062	0.058	0.055	0.052
R-15	0.094	0.093	0.085	0.078	0.073	0.068	0.063	0.060	0.056	0.053	0.051
R-19	0.088	0.086	0.080	0.074	0.069	0.064	0.060	0.057	0.054	0.051	0.049
R-21	0.085	0.084	0.077	0.072	0.067	0.063	0.059	0.056	0.053	0.050	0.048
R-25	0.081	0.080	0.074	0.069	0.064	0.060	0.057	0.054	0.051	0.049	0.046

Table 5. Floor U-Factors

Insulation R-Value	Floor U-Factor
R-0	0.249
R-7	0.096
R-11	0.072
R-13	0.064
R-15	0.057
R-19	0.047
R-21	0.044
R-26	0.037
R-30	0.033

Table 6. Basement U-Factors<sup>(a)</sup>

Insulation R-Value	Basement Wall U-Factor	Insulation R-Value	Basement Wall U-Factor
R-0	0.360	R-10	0.072
R-1	0.244	R-11	0.067
R-2	0.188	R-12	0.062
R-3	0.155	R-13	0.059
R-4	0.132	R-14	0.055
R-5	0.115	R-15	0.052
R-6	0.102	R-16	0.050
R-7	0.092	R-17	0.047
R-8	0.084	R-18	0.045
R-9	0.077	R-19	0.043
		R-20	0.041

- a. Insulation R-values represent the sum of exterior and/or interior insulation. Basement walls must be insulated from the top of the basement wall to 10 ft below ground level or to the floor of the basement, whichever is less.

Table 7. Slab F-Factors

Perimeter Insulation R-Value	Slab F-Factor	
	2-ft Insulation Depth	4-ft Insulation Depth
R-0	1.04	1.04
R-1	0.91	0.89
R-2	0.86	0.83
R-3	0.83	0.79
R-4	0.82	0.76
R-5	0.80	0.74
R-6	0.79	0.73
R-7	0.79	0.71
R-8	0.78	0.70
R-9	0.77	0.69
R-10	0.77	0.68
R-11		0.68
R-12		0.67
R-13		0.66
R-14		0.66
R-15		0.65
R-16		0.65
R-17		0.65
R-18		0.64
R-19		0.64
R-20		0.64

Table 8. Crawl Space Wall U-Factors

<b>Insulation R-Value</b>	<b>Crawl Space Wall U-Factor</b>
R-0	0.477
R-1	0.313
R-2	0.235
R-3	0.189
R-4	0.158
R-5	0.136
R-6	0.120
R-7	0.107
R-8	0.096
R-9	0.088
R-10	0.081
R-11	0.075
R-12	0.069
R-13	0.065
R-14	0.061
R-15	0.057
R-16	0.054
R-17	0.051
R-18	0.049
R-19	0.047
R-20	0.045

Table 9a. U-Factors for Windows, Glazed Doors, and Skylights<sup>(a)</sup>

Frame Material and Product Type <sup>(a)</sup>	Single Glazed	Double Glazed
<b>Metal Without Thermal Break</b>		
Operable (including sliding and swinging glass doors)	1.27	0.87
Fixed	1.13	0.69
Garden window	2.60	1.81
Curtain wall	1.22	0.79
Skylight	1.98	1.31
Site-assembled sloped/overhead glazing	1.36	0.82
<b>Metal With Thermal Break</b>		
Operable (including sliding and swinging glass doors)	1.08	0.65
Fixed	1.07	0.63
Curtain wall	1.11	0.68
Skylight	1.89	1.11
Site-assembled sloped/overhead glazing	1.25	0.70
<b>Reinforced Vinyl/Metal-Clad Wood</b>		
Operable (including sliding and swinging glass doors)	0.90	0.57
Fixed	0.98	0.56
Skylight	1.75	1.05
<b>Wood/Vinyl/Fiberglass</b>		
Operable (including sliding and swinging glass doors)	0.89	0.55
Fixed	0.98	0.56
Garden window	2.31	1.61
Skylight	1.47	0.84
Glass Block Assemblies	0.60	

a. The U-factors in these tables can be used in the absence of test U-factors. The product cannot receive credit for a feature that cannot be clearly detected. Where a composite of materials from two different product types is used, the product must be assigned the higher U-factor.

Table 9b. SHGC Values for Windows, Glazed Doors, and Skylights<sup>(a)</sup>

Product Description	Single Glazed				Double Glazed			
	Clear	Bronze	Green	Gray	Clear + Clear	Bronze + Clear	Green + Clear	Gray + Clear
Metal frames								
Operable	0.75	0.64	0.62	0.61	0.66	0.55	0.53	0.52
Fixed	0.78	0.67	0.65	0.64	0.68	0.57	0.55	0.54
Nonmetal frames								
Operable	0.63	0.54	0.53	0.52	0.55	0.46	0.45	0.44
Fixed	0.75	0.64	0.62	0.61	0.66	0.54	0.53	0.52

a. SHGC values may be adjusted to reflect the effects of any permanent exterior solar shading devices, such as shade screens.

Table 10. U-Factor Table for Non-Glazed Doors<sup>(a)</sup>

<b>Steel Doors</b>		
Without Foam Core	0.60	
With Foam Core	0.35	
<b>Wood Doors</b>	<b>Without Storm</b>	<b>With Storm</b>
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

a. The U-factors in these tables can be used in the absence of test U-factors. The product cannot receive credit for a feature that cannot be clearly detected. Where a composite of materials from two different product types is used, the product must be assigned the higher U-factor.



Table 11. U-Factor and F-Factor Requirements by Climate Zone

Climate Zone	Ceiling U-Factor	Single-Family Wall U-Factor	Multi-Family Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Unheated Slab U-Factor	Heated Slab U-Factor	Crawl Space Wall U-Factor
1	0.047	0.25	0.38	0.08	0.360	1.04	1.04	0.477
2	0.044	0.23	0.35	0.08	0.360	1.04	0.79	0.137
3	0.042	0.21	0.31	0.07	0.360	1.04	0.79	0.137
4	0.039	0.20	0.28	0.07	0.121	1.04	0.79	0.137
5	0.036	0.18	0.25	0.07	0.113	1.04	0.79	0.124
6	0.036	0.17	0.22	0.05	0.106	0.82	0.79	0.111
7	0.036	0.16	0.22	0.05	0.098	0.82	0.79	0.098
8	0.036	0.16	0.22	0.05	0.090	0.82	0.79	0.085
9	0.033	0.15	0.22	0.05	0.082	0.82	0.79	0.071
10	0.031	0.14	0.22	0.05	0.081	0.81	0.79	0.058
11	0.028	0.13	0.22	0.05	0.080	0.81	0.79	0.058
12	0.026	0.13	0.22	0.05	0.079	0.80	0.79	0.058
13	0.026	0.12	0.20	0.05	0.078	0.74	0.71	0.058
14	0.026	0.11	0.18	0.05	0.077	0.73	0.70	0.058
15	0.026	0.11	0.15	0.05	0.075	0.72	0.69	0.058
16	0.026	0.11	0.15	0.05	0.052	0.71	0.69	0.058
17	0.026	0.11	0.12	0.05	0.052	0.69	0.67	0.058
18	0.026	0.10	0.12	0.05	0.052	0.68	0.66	0.058
19	0.025	0.10	0.12	0.04	0.052	0.66	0.65	0.058

## Compliance Example

Assume that you plan to build the house shown in Figure 5 on a lot located in Greensboro, North Carolina. Greensboro is in Guilford County and is designated as Zone 8 on the North Carolina state map.

Table 12 lists the components that make up the building envelope, the areas of each of these components, and the proposed insulation R-values and window and door U-factors. Figure 6 shows how to determine proposed and required U-factors using Tables 1 through 11. The completed *Trade-Off Worksheet* is shown in Figure 7.

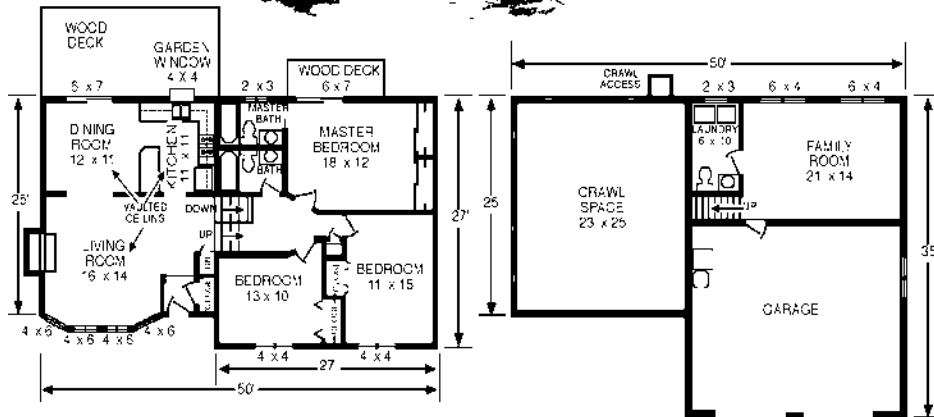


Figure 5. Example House

Table 12. Example House Specifications

Building Component	Area	Insulation Level
Ceilings		
With Attic (Std. Truss)	729 ft <sup>2</sup>	R-38
Vaulted	592 ft <sup>2</sup>	R-30
Walls (2x4 @ 16-in. O.C.)		
Without Sheathing(a)	276 ft <sup>2</sup> (gross) 258 ft <sup>2</sup> (net)	R-13
With Sheathing	1647 ft <sup>2</sup> (gross) 1339 ft <sup>2</sup> (net)	R-19 (R-13 cavity + R-6 sheathing)
Windows	204 ft <sup>2</sup>	U-0.45
Sliding Glass Doors	84 ft <sup>2</sup>	U-0.61
Doors		
Entrance	20 ft <sup>2</sup>	U-0.54
Garage to Family Room	18 ft <sup>2</sup>	U-0.35
Floors		
Over Garage	363 ft <sup>2</sup>	R-19
Over Crawl Space	575 ft <sup>2</sup>	R-19
Slab (Unheated)	82 ft <sup>2</sup> (perimeter)	R-8 (2-ft depth)
Bay Window Floor	32 ft <sup>2</sup>	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

Only the building components that are part of the building envelope are entered on the *Trade-Off Worksheet*. Building envelope components are those that separate conditioned spaces (heated or cooled rooms) from unconditioned spaces (rooms that are not heated or cooled) or from outside air. 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. 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 portion adjacent to the crawl space is part of the building envelope because it separates the conditioned laundry from the unconditioned crawl space. The portion adjacent to the kitchen can be ignored. The wall between the portion adjacent to the kitchen can also be ignored. Likewise, the wall between the upstairs bathroom 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. Table 13 lists the walls that are part of the building envelope and indicates whether sheathing is installed on them (which is relevant when determining the R-value of the wall).

Table 13. Walls Comprising the Building Envelope

Wall	Sheathing?	Gross Area	Net Area <sup>(a)</sup>
All walls between interior conditioned space and outside air	Yes	1647	1339
The wall between the family room and the garage	No	192	174
The wall between the garage and the living room	No	44	44
The wall between the laundry and the crawl space	No	40	40
(a) Net area does not include doors and windows.			

**Floors** The example house has a conditioned floor area of 1714 ft<sup>2</sup>, but 378 ft<sup>2</sup> of the floor area is located over the family room and is not part of the building envelope (both the family room and the rooms above it are conditioned). The living room, dining room, and kitchen are over unheated crawl space. The family room and garage both have slab-on-grade floors. The floor of the bay window is a floor over outside air which is subject to the ceiling requirement rather than the requirement for floors over conditioned space.

**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 PROPOSED Section

Areas and proposed R-values for the example house are given in Table 12. Refer to the example Trade-Off Worksheet illustrated in Figure 7 when reading the following sections.

## **Ceilings, Skylights, and Floors Over Outside Air**

The ceiling over the dining room, living room, and kitchen is vaulted – the rest is a flat ceiling under an attic space. Enter R-38 as the proposed insulation R-value for the portion of the ceiling with an attic. Use the blank space to create a second ceiling component for the vaulted ceiling and enter R-30 as the proposed insulation R-value for the vaulted ceiling. The floor of the bay window is a floor over outside air component. Enter R-30 as the proposed insulation R-value for the *Floor Over Outside Air* component.

Refer to Table 1 for the U-factors corresponding to your proposed ceiling R-values. Table 1 lists R-value to U-factor conversions for ceilings with standard and raised trusses. You are building a standard truss with R-38 insulation in the ceiling with an attic space, and R-30 insulation in the vaulted ceiling. R-38 insulation with a standard truss corresponds to a U-factor of 0.030. R-30 insulation corresponds to a U-factor of 0.035. Enter 0.030 in the *U-Factor* column for the *Ceiling w/Attic* component and enter 0.035 in the *U-Factor* column for the *Ceiling, Vaulted* component.

Table 5 lists the U-factor for floors having R-30 insulation as 0.033. Enter 0.033 in the *U-Factor* column for the *Floors Over Outside Air* component.

In the *Area* column, enter 729 ft<sup>2</sup> for the ceiling with attic, 592 ft<sup>2</sup> for the vaulted ceiling, and 32 ft<sup>2</sup> for the bay window floor. Sum the areas of all ceiling components and enter this sum (1353 ft<sup>2</sup>) in the space labeled *Ceilings: Total Area*.

There are no skylights in the example house, so the space for skylight components may be left blank.

## **Walls, Windows, and Doors**

All walls that make up the building envelope will have R-13 cavity insulation, but not all of these walls will have R-6 exterior sheathing (see Table 13). Therefore, you must enter two wall components on the *Trade-Off Worksheet*. Enter R-13 + R-6 (R-13 cavity insulation plus R-6 sheathing) as the proposed insulation R-value for the walls with sheathing and R-13 as the proposed insulation R-value for the walls without sheathing. Use a blank line to record the second component. The example worksheet in Figure 7 illustrates how these two wall components are labeled.

Refer to Table 2 and the *16-in. O.C. Wall U-Factor* column for the U-factors that correspond to the proposed R-values. The walls with sheathing have an effective R-value of R-19, which corresponds to a U-factor of 0.060. The walls without sheathing have an R-value of R-13, which corresponds to a U-factor of 0.082. Enter 0.060 in the *U-Factor* column for the *Wall w/Sheathing* component and enter 0.082 in the *U-Factor* column for the *Wall w/o Sheathing* component.

Enter the net opaque wall area for each wall component in the *Area* column. The net wall area for each component will be equal to the gross wall area minus openings for windows, doors, sliding glass doors, etc. In this example, the only opening in the walls without sheathing is the door from the garage to the living room. The entry door, the windows, and the sliding glass doors are all subtracted from the gross area of the walls with sheathing.

$$\text{Net Wall Area (with sheathing)} = 1647 - 204 - 84 - 20 = 1339$$

$$\text{Net Wall Area (without sheathing)} = 276 - 18 = 258$$

Enter 1339 ft<sup>2</sup> for the wall with sheathing and 258 ft<sup>2</sup> for the wall without sheathing.

The windows and sliding glass doors have been rated and labeled by the manufacturer in accordance with the NFRC test procedure. The windows have a U-factor of 0.45 and the sliding glass doors have a U-factor of 0.61. Enter the window and sliding glass door areas and their corresponding U-factors.

Neither of the doors (entrance and garage) have tested U-factors, so use Table 10 to determine their default U-factors. The entry door is an opaque wood panel door with 7/16-in. panels and no storm door, corresponding to a U-factor of 0.54. The door from the garage to the family room is a metal door with foam core, corresponding to a U-factor of 0.35. Because the doors have different U-factors, each must be entered on a separate line on the *Trade-Off Worksheet*. Enter the door areas and their corresponding U-factors.

Sum the areas of all wall components (including the windows and doors) and enter this sum (1923 ft<sup>2</sup>) in the space labeled *Walls: Total Area*.

### **Floors and Foundations**

Two floor and foundation components must be considered. The floor over the garage and the floor over the crawl space are floors over unconditioned spaces. R-19 insulation will be installed in both. Therefore, these floor components can be combined. The slab floor, however, must be considered separately. Enter R-19 as the proposed insulation R-value for the floors over conditioned spaces and R-8 as the proposed insulation R-value for the slab perimeter.

Refer to Table 5 for the floor U-factor corresponding to your proposed floor R-value. A floor R-value of R-19 corresponds to a U-factor of 0.047. Refer to Table 7 for the slab F-factor corresponding to your proposed slab R-value. Note that Table 7 lists R-value to F-factor conversions for insulation installed to either 24 in. or 48 in. The slab perimeter insulation will be installed to 24 in. A slab R-value of R-8 corresponds to an F-factor of 0.78 under the *24-in. Insulation Depth* column.

In the *Area or Perimeter* column, enter 938 ft<sup>2</sup> as the combined area of the two floor components over unconditioned space and 82 ft for the slab perimeter. Note that slab components require a perimeter -- not an area.

### **Compute the Total Proposed UA**

For each building component, multiply the proposed U-factor or F-factor by its corresponding area or perimeter and enter the result in the proposed *UA* column. For example, the *Ceiling w/Attic* component has a U-factor of 0.030 and an area of 729 ft<sup>2</sup>, resulting in a UA of 21.9.

$$\text{Ceiling w/Attic UA} = 0.030 \times 729 = 21.9$$

Sum the UAs on the left side of the worksheet and enter this sum (413.4) in the space labeled *Total Proposed UA*.

### **Check for Compliance**

The sum in the *Total Proposed UA* box (413.4) is less than the sum in the *Total Required UA* box (470.5), indicating that your building complies with the code insulation and window requirements (congratulations!). Sign and date the worksheet.

Table 1. Ceiling U-Factors

Insulation R-Value	Standard Truss U-Factor	Raised Truss U-Factor	Insulation R-Value	Standard Truss U-Factor	Raised Truss U-Factor
R-1	0.98	0.8	R-33	0.055	0.09
R-7	0.19	0.19	R-34	0.052	0.08
R-8	0.16	0.18	R-35	0.05	0.08
R-9	0.158	0.18	R-36	0.05	0.07
R-10	0.159	0.18	R-37	0.05	0.06
R-11	0.152	0.18	R-38	0.05	0.05
R-12	0.15	0.16	R-39	0.05	0.05
R-13	0.15	0.15	R-40	0.05	0.04
R-14	0.146	0.15	R-41	0.05	0.04
R-15	0.142	0.15	R-42	0.05	0.04
R-16	0.139	0.15	R-43	0.05	0.04
R-17	0.138	0.15	R-44	0.05	0.02
R-18	0.133	0.15	R-45	0.05	0.02
R-19	0.131	0.149	R-46	0.05	0.02
R-20	0.128	0.147	R-47	0.05	0.02
R-21	0.127	0.148	R-48	0.05	0.02
R-22	0.125	0.143	R-49	0.05	0.02
R-23	0.123	0.141	R-50	0.05	0.02
R-24	0.122	0.140	R-51	0.05	0.09
R-25	0.121	0.138	R-52	0.05	0.09
R-26	0.119	0.137	R-53	0.05	0.09
R-27	0.118	0.135	R-54	0.05	0.08
R-28	0.117	0.134	R-55	0.05	0.08
R-29	0.116	0.133	R-56	0.05	0.08
R-30	0.115	0.132	R-57	0.05	0.08

Table II. U-Factor/F-Factor Requirements by Climate Zone

Climate Zone	Ceiling U-Factor	Single Family Wall U-Factor	Multi Family Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Unheated Slab F-Factor	Heated Slab U-Factor	Crawl Space Wall U-Factor
1	0.047	0.25	0.38	0.08	0.30	1.04	1.04	0.27
2	0.044	0.23	0.35	0.08	0.30	1.04	1.04	0.17
3	0.042	0.21	0.32	0.07	0.30	1.04	1.04	0.17
4	0.039	0.2	0.28	0.07	0.25	1.04	1.04	0.17
5	0.037	0.18	0.25	0.07	0.23	1.04	1.04	0.124
6	0.036	0.17	0.22	0.08	0.20	0.82	0.79	0.11
7	0.036	0.16	0.22	0.08	0.18	0.82	0.79	0.08
8	0.036	0.16	0.22	0.08	0.18	0.82	0.79	0.08
9	0.038	0.15	0.22	0.08	0.18	0.82	0.79	0.11
10	0.032	0.14	0.22	0.08	0.18	0.81	0.79	0.08
11	0.028	0.13	0.22	0.08	0.18	0.81	0.79	0.08
12	0.026	0.13	0.22	0.08	0.179	0.81	0.79	0.08
13	0.026	0.12	0.20	0.08	0.178	0.74	0.71	0.08
14	0.026	0.11	0.18	0.08	0.177	0.73	0.71	0.08
15	0.026	0.11	0.15	0.08	0.175	0.72	0.69	0.08
16	0.026	0.11	0.15	0.08	0.182	0.71	0.69	0.08
17	0.026	0.11	0.12	0.08	0.182	0.69	0.67	0.08

Table 2. Wood-Frame Wall U-Factors

Insulation R-Value	16-in. O.C. Wall U-Factor
R-1	0.28
R-7	0.15
R-8	0.149
R-9	0.144
R-10	0.14
R-11	0.139
R-12	0.135
R-13	0.132
R-14	0.127
R-15	0.126
R-16	0.125
R-17	0.124
R-18	0.123
R-19	0.122
R-20	0.121
R-21	0.12

Table 5. Floor U-Factor

Insulation R-Value	Floor U-Factor
R-1	0.29
R-7	0.16
R-11	0.12
R-13	0.114
R-15	0.11
R-19	0.07
R-21	0.064
R-26	0.057
R-33	0.033

### Trade-Off Worksheet

International Energy Conservation Code (IECC)

Builder Name: CAREFUL BUILDERS, INC. Date: 12/12/00  
 Builder Address: 120 W ST, GREENSBORO, NORTH CAROLINA 27411  
 Building Address: 1010 CONSTRUCTION AVE., GREENSBORO, N.C.  
 Year: B IECC Edition: 2000  
 Submitted by: JOHN DOE CAREFUL phone no.: 704-321-4445

PROPOSED				REQUIRED			
U-Factors and F-Factors can be found in Table 1 through 10							
Ceilings, Skylights, and Floors Over Outside Air							
Description	R-Value	U-Factor	Area	U-Factor	Area	U-Factor	Area
Ceiling w/Attic	R-13	0.030	729 sq ft	0.036	729 sq ft	21.9	26.2
Floor Over Outside Air	R-19	0.033	32 sq ft	0.036	32 sq ft	1.1	1.2
Skylight	-	-	19 sq ft	-	-	-	-
Ceiling Vaulted	R-30	0.035	592 sq ft	0.036	592 sq ft	20.7	21.3
Ceiling Total Area			1353 sq ft				
Walls, Windows, and Doors							
Description	R-Value	U-Factor	Area	U-Factor	Area	U-Factor	Area
Wall w/Sheath	R-13	0.080	1339 sq ft	0.16	1923 sq ft	60.3	907.7
Windows	-	0.45	204 sq ft	0.16	204 sq ft	91.8	91.8
Door Entry	-	0.54	20 sq ft	0.16	20 sq ft	70.8	70.8
Sliding Glass Door	-	0.87	84 sq ft	0.16	84 sq ft	51.2	51.2
Wall w/o Sheath	R-13	0.082	268 sq ft	0.16	268 sq ft	21.2	21.2
Door/Garage	-	0.84	18 sq ft	0.16	18 sq ft	6.3	6.3
Wall Total Area			1923 sq ft				
Floors and Foundations							
Description	Insulation Depth	R-Value	U-Factor	Area of Perimeter	F-Factor	Area of Perimeter	F-Factor
Floor Over Unheated Space	8 in.	R-19	0.047	938 sq ft	0.05	938 sq ft	44.7
Basement Wall	8 in.	R-19	0.047	938 sq ft	0.05	938 sq ft	44.7
Unheated Slab	8 in.	R-19	0.047	938 sq ft	0.05	938 sq ft	44.7
Heated Slab	8 in.	R-19	0.047	938 sq ft	0.05	938 sq ft	44.7
Crawl Space	8 in.	R-19	0.047	938 sq ft	0.05	938 sq ft	44.7
Total Proposed UA			413.4	Total Required UA: 420.5			

Total Proposed UA must be less than or equal to the Total Required UA

Prepared by: John Doe Careful Date: 12/12/00  
 Prepared for: Careful Builders, Inc. Date: 12/12/00

Table 7. Slab F-Factors

Perimeter Insulation R-Value	24-in. Insulation Depth
R-1	1.04
R-1	0.91
R-2	0.86
R-3	0.83
R-4	0.82
R-5	0.80
R-6	0.79
R-7	0.78
R-8	0.78
R-10	0.77

Figure 6. Determining U-Factors



# Trade-Off Worksheet

International Energy Conservation Code (IECC)

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 1010 CONSTRUCTION AVE., GREENSBORO, N.C.  
 Zone # 8 IECC Edition 2000  
 Submitted By JOHN DOE CAREFUL Phone Number 704-321-9445

<b>PROPOSED</b>	<b>REQUIRED</b>
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U-factors and F-factors can be found in Tables 1 through 10.

### Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Factor	x Area	= UA
Ceiling w/Attic	R-38	0.030	729 ft <sup>2</sup>	21.9
Floor Over Outside Air	R-30	0.033	32 ft <sup>2</sup>	1.1
Skylight	-		ft <sup>2</sup>	
Ceiling, Vaulted	R-30	0.035	592 ft <sup>2</sup>	20.7
			ft <sup>2</sup>	
Ceilings: Total Area			<b>1353 ft<sup>2</sup></b>	

Required U-factors can be found in Table 11.

Required U-Factor	x Area	= UA
0.036	1353 ft <sup>2</sup>	48.7

### Walls, Windows, and Doors

Description	Insulation R-Value	U-Factor	x Area	= UA
Wall w/Sheath	R-13+6	0.060	1339 ft <sup>2</sup>	80.3
Window	-	0.45	204 ft <sup>2</sup>	91.8
Door Entry	-	0.54	20 ft <sup>2</sup>	10.8
Sliding Glass Door	-	0.61	84 ft <sup>2</sup>	51.2
Wall w/o Sheath	R-13	0.082	258 ft <sup>2</sup>	21.2
Door/Garage	-	0.35	18 ft <sup>2</sup>	6.3
			ft <sup>2</sup>	
Walls: Total Area			<b>1923 ft<sup>2</sup></b>	

Required U-Factor	x Area	= UA
0.16	1923 ft <sup>2</sup>	307.7

### Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Factor or F-Factor	Area or Perimeter	= UA
Floor Over Unconditioned		R-19	0.047	938 ft <sup>2</sup>	44.1
Basement Wall				ft <sup>2</sup>	
Unheated Slab	24 in.	R-8	0.78	82 ft	64.0
Heated Slab	in.			ft	
Crawl Wall	in.			ft <sup>2</sup>	

Required U-Factor or F-Factor	Area or Perimeter	= UA
0.05	938 ft <sup>2</sup>	46.9
	ft <sup>2</sup>	
0.82	82 ft	67.2
	ft	
	ft <sup>2</sup>	

Total Proposed UA  
**413.4**

Total Required UA  
**470.5**

Total Proposed UA must be less than or equal to the Total Required UA.

**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 International Energy Conservation Code.

John Doe Careful  
Builder/Designer

Careful Builders, Inc.  
Company Name

12/12/00  
Date

Figure 7. Completed Trade-Off Worksheet



# Trade-Off Worksheet

International Energy Conservation Code (IECC)

Enforcement Agency:
Permit #
Checked By
Date

Builder Name \_\_\_\_\_ Date \_\_\_\_\_  
 Builder Address \_\_\_\_\_  
 Building Address \_\_\_\_\_  
 Zone # \_\_\_\_\_ IECC Edition \_\_\_\_\_  
 Submitted By \_\_\_\_\_ Phone Number \_\_\_\_\_

## PROPOSED

## REQUIRED

U-factors and F-factors can be found in Tables 1 through 10.

Required U-factors can be found in Table 11.

### Ceilings, Skylights, and Floors Over Outside Air

Description	Insulation R-Value	U-Factor	x Area	= UA
Ceiling			ft <sup>2</sup>	
Floor Over Outside Air			ft <sup>2</sup>	
Skylight	—		ft <sup>2</sup>	
			ft <sup>2</sup>	
			ft <sup>2</sup>	
Ceilings: Total Area			ft <sup>2</sup>	

Required U-Factor x Area = UA

	ft <sup>2</sup>	
--	-----------------	--

### Walls, Windows, and Doors

Description	Insulation R-Value	U-Factor	x Area	= UA
Wall			ft <sup>2</sup>	
Window	—		ft <sup>2</sup>	
Door	—		ft <sup>2</sup>	
Sliding Glass Door	—		ft <sup>2</sup>	
			ft <sup>2</sup>	
			ft <sup>2</sup>	
			ft <sup>2</sup>	
Walls: Total Area			ft <sup>2</sup>	

Required U-Factor x Area = UA

	ft <sup>2</sup>	
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### Floors and Foundations

Description	Insulation Depth	Insulation R-Value	U-Factor or F-Factor	x Area or Perimeter	= UA
Floor Over Unconditioned				ft <sup>2</sup>	
Basement Wall				ft <sup>2</sup>	
Unheated Slab	in.			ft	
Heated Slab	in.			ft	
Crawl Wall	in.			ft <sup>2</sup>	

Required U-Factor or F-Factor x Area or Perimeter = UA

	ft <sup>2</sup>	
	ft <sup>2</sup>	
	ft	
	ft	
	ft <sup>2</sup>	

Total Proposed UA

Total Required UA

Total Proposed UA must be less than or equal to the Total Required UA.

**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 International Energy Conservation Code.

Builder/Designer \_\_\_\_\_ Company Name \_\_\_\_\_ Date \_\_\_\_\_



# Appendix A: Additions

1998 IECC and 2000 IECC

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## What is an Addition?

*1998* 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. An addition is any extension or increase in the height, conditioned floor area, or conditioned volume of a building.

*2000* Additions, alterations, and repairs to existing buildings must comply with code requirements when the addition, alteration, or repair is within the scope of the code and would not otherwise be exempted. An addition is any extension or increase in the height, conditioned floor area, or conditioned volume of a building. An alteration is any construction renovation, or change in the mechanical system that involves an extension, addition, or change to the arrangement, type, or purpose of the original installation. A repair includes the reconstruction or renewal of any part of an existing building for maintenance purposes.

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. However, replacement windows that are not part of an addition must meet the prescriptive U-factor requirements given in Table 1.

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## 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.
- Additions less than 500 ft<sup>2</sup> (46.5 m<sup>2</sup>) of conditioned floor area may meet the prescriptive envelope requirements in Table 1. To use this table, the total area of windows, doors, and skylights cannot exceed 40% of the gross wall and roof area of the addition.

Table 1. Prescriptive Requirements for Additions and Replacement Window

	Maximum	Minimum					
Climate Zone	Fenestration U-factor (a)	Ceiling R-value (b)	Wall R-value	Floor R-value	Basement wall R-value	Slab perimeter R-value and depth (c)	Crawl space wall R-value (d)
1-4	0.75	R-26	R-13	R-11	R-5	R-0	R-5
5-8	0.5	R-30	R-13	R-19	R-8	R-5, 2 ft	R-10
9-12	0.4	R-38	R-18	R-21	R-10	R-9, 2 ft	R-19
13-15	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft	R-20
16-19	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft	R-20

- a. The area-weighted average U-factor for all windows, doors, and skylights in the addition must not exceed the fenestration U-factor requirement.
- b. Floors over outside air must meet ceiling R-value requirements.
- c. The slab R-value requirements are for unheated slabs. Add an additional R-2 for heated slabs.
- d. The crawl space wall R-value requirements are for walls of unventilated crawl spaces only.
- e. The maximum U-factor for replacement skylights is 0.5 in Zones 5-19.
- f. The area-weighted average solar heat gain coefficient (SHGC) of all windows, glazed doors, and skylights cannot exceed 0.4 in Zones 1-7.

2000  
2000

## Replacement Windows

Replacement windows that are not part of an addition must meet the prescriptive requirements of Table 1. A replacement window is defined as a replacement of the entire unit, including the frame, sash, and glazing.

# Appendix B: Default U-Factors and SHGC Values

1998 IECC and 2000 IECC

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## Glazing and Door Defaults

The following tables provide default U-factors and SHGC values for glazing and doors based on the glazing or door features. The U-factors and SHGC values 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 NFRC-rated test 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 Material and Product Type(a)	Single Glazed	Double Glazed
<b>Metal Without Thermal Break</b>		
Operable (including sliding and swinging glass doors)	1.27	0.87
Fixed	1.13	0.69
Garden window	2.60	1.81
Curtain wall	1.22	0.79
Skylight	1.98	1.31
Site-assembled sloped/overhead glazing	1.36	0.82
<b>Metal With Thermal Break</b>		
Operable (including sliding and swinging glass doors)	1.08	0.65
Fixed	1.07	0.63
Curtain wall	1.11	0.68
Skylight	1.89	1.11
Site-assembled sloped/overhead glazing	1.25	0.70
<b>Reinforced Vinyl/Metal-Clad Wood</b>		
Operable (including sliding and swinging glass doors)	0.90	0.57
Fixed	0.98	0.56
Skylight	1.75	1.05
<b>Wood/Vinyl/Fiberglass</b>		
Operable (including sliding and swinging glass doors)	0.89	0.55
Fixed	0.98	0.56
Garden window	2.31	1.61
Skylight	1.47	0.84
Glass Block Assemblies	0.60	

Table 2. U-Factors for Non-Glazed Doors

<b>Steel Doors</b>		
Without Foam Core	0.60	
With Foam Core	0.35	
<b>Wood Doors</b>		
	<b>Without Storm</b>	<b>With Storm</b>
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

Table 3. SHGC Values for Windows, Glazed Doors, and Skylights<sup>(a)</sup>

Product Description	Single Glazed				Double Glazed			
	Clear	Bronze	Green	Gray	Clear + Clear	Bronze + Clear	Green + Clear	Gray + Clear
Metal frames								
Operable	0.75	0.64	0.62	0.61	0.66	0.55	0.53	0.52
Fixed	0.78	0.67	0.65	0.64	0.68	0.57	0.55	0.54
Nonmetal frames								
Operable	0.63	0.54	0.53	0.52	0.55	0.46	0.45	0.44
Fixed	0.75	0.64	0.62	0.61	0.66	0.54	0.53	0.52

a. SHGC values may be adjusted to reflect the effects of any permanent exterior solar shading devices, such as shade screens.

# Appendix C: Building Envelope

1998 IECC and 2000 IECC

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## 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 MECcheck 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 MECcheck 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

1998 IECC and 2000 IECC

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## 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 <sup>2</sup>		—
Floor Over Outside Air	ft <sup>2</sup>		—
Skylight	ft <sup>2</sup>	—	

## Walls, Windows, and Doors

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

## Floors and Foundations

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

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

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

“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
Mitchell (H)	4	Wilkinson (H)	5	Adams	12	Marion	11	Clay	12
Monroe (H)	6	Worth (H)	5	Alexander	10	Marshall	13	Clinton	13
Montgomery (H)	5			Bond	11	Mason	12	Crawford	11
Morgan (H)	6	<b>HAWAII</b>		Boone	14	Massac	10	Daviess	11
Murray	8	Hawaii (H)	1	Brown	12	McDonough	13	De Kalb	13
Muscogee (H)	5	Honolulu (H)	1	Bureau	13	Mchenry	14	Dearborn	11
Newton	7	Kalawao (H)	1	Calhoun	11	McLean	12	Decatur	12
Oconee	7	Kauai (H)	1	Carroll	14	Menard	12	Delaware	13
Oglethorpe	7	Maui (H)	1	Cass	12	Mercer	13	Dubois	11
Paulding	7			Champaign	12	Monroe	10	Elkhart	13
Peach (H)	5	<b>IDAHO</b>		Christian	11	Montgomery	11	Fayette	12
Pickens	8	Ada	12	Clark	12	Morgan	12	Floyd	10
Pierce (H)	4	Adams	15	Clay	11	Moultrie	12	Fountain	12
Pike (H)	6	Bannock	15	Clinton	10	Ogle	14	Franklin	12
Polk	7	Bear Lake	15	Coles	12	Peoria	13	Fulton	14
Pulaski (H)	5	Benewah	14	Cook	14	Perry	10	Gibson	10
Putnam (H)	6	Bingham	15	Crawford	11	Piatt	12	Grant	13
Quitman (H)	5	Blaine	15	Cumberland	12	Pike	12	Greene	11
Rabun	8	Boise	15	De Kalb	14	Pope	10	Hamilton	12
Randolph (H)	5	Bonner	15	De Witt	12	Pulaski	10	Hancock	12
Richmond (H)	6	Bonneville	15	Douglas	12	Putnam	13	Harrison	10
Rockdale	7	Boundary	15	Du Page	14	Randolph	10	Hendricks	12
Schley (H)	5	Butte	16	Edgar	12	Richland	11	Henry	12
Screven (H)	5	Camas	15	Edwards	11	Rock Island	13	Howard	13
Seminole (H)	4	Canyon	12	Effingham	11	Saline	10	Huntington	14
Spalding	7	Caribou	15	Fayette	11	Sangamon	12	Jackson	11
Stephens	7	Cassia	14	Ford	13	Schuyler	12	Jasper	13
Stewart (H)	5	Clark	15	Franklin	10	Scott	12	Jay	13
Sumter (H)	5	Clearwater	12	Fulton	13	Shelby	11	Jefferson	10
Talbot (H)	5	Custer	16	Gallatin	10	St Clair	10	Jennings	11
Taliaferro (H)	6	Elmore	13	Greene	11	Stark	13	Johnson	12
Tattnall (H)	4	Franklin	15	Grundy	13	Stephenson	14	Knox	11
Taylor (H)	5	Fremont	16	Hamilton	10	Tazewell	12	Kosciusko	14
Telfair (H)	5	Gem	13	Hancock	13	Union	10	La Porte	13
Terrell (H)	5	Gooding	13	Hardin	10	Vermilion	12	Lagrange	14
Thomas (H)	4	Idaho	15	Henderson	13	Wabash	11	Lake	13
Tift (H)	5	Jefferson	16	Henry	13	Warren	13	Lawrence	11
Toombs (H)	4	Jerome	14	Iroquois	13	Washington	10	Madison	13
Towns	8	Kootenai	14	Jackson	10	Wayne	11	Marion	12
Treutlen (H)	5	Latah	14	Jasper	11	White	10	Marshall	13
Troup (H)	6	Lemhi	15	Jefferson	11	Whiteside	14	Martin	11
Turner (H)	5	Lewis	15	Jersey	10	Will	13	Miami	14
Twiggs (H)	5	Lincoln	15	Jo Daviess	14	Williamson	10	Monroe	11
Union	8	Madison	16	Johnson	10	Winnebago	14	Montgomery	12
Upson (H)	5	Minidoka	15	Kane	14	Woodford	13	Morgan	12
Walker	8	Nez Perce	12	Kankakee	13			Newton	13
Walton	7	Oneida	15	Kendall	13	<b>INDIANA</b>		Noble	14
Ware (H)	4	Owyhee	12	Knox	13	Adams	13	Ohio	11
Warren (H)	6	Payette	12	La Salle	13	Allen	13	Orange	11
Washington (H)	6	Power	15	Lake	14	Bartholomew	11	Owen	12
Wayne (H)	4	Shoshone	14	Lawrence	11	Benton	13	Parke	12
Webster (H)	5	Teton	16	Lee	14	Blackford	13	Perry	10
Wheeler (H)	5	Twin Falls	14	Livingston	13	Boone	12	Pike	11
White	8	Valley	16	Logan	12	Brown	11	Porter	13
Whitfield	8	Washington	13	Macon	12	Carroll	13	Posey	10
Wilcox (H)	5			Macoupin	11	Cass	13	Pulaski	13
Wilkes	7	<b>ILLINOIS</b>		Madison	10	Clark	10	Putnam	12

“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
Randolph	13	Dubuque	14	Union	13	Jefferson	11	Washington	12
Ripley	11	Emmet	15	Van Buren	13	Jewell	12	Wichita	12
Rush	12	Fayette	15	Wapello	13	Johnson	11	Wilson	9
Scott	11	Floyd	15	Warren	14	Kearny	11	Woodson	10
Shelby	12	Franklin	15	Washington	13	Kingman	10	Wyandotte	11
Spencer	10	Fremont	13	Wayne	13	Kiowa	10		
St Joseph	13	Greene	14	Webster	15	Labette	9	<b>KENTUCKY</b>	
Starke	13	Grundy	15	Winnebago	15	Lane	12	Adair	9
Steuben	14	Guthrie	14	Winnesheik	15	Leavenworth	11	Allen	9
Sullivan	11	Hamilton	15	Woodbury	15	Lincoln	11	Anderson	10
Switzerland	10	Hancock	15	Worth	15	Linn	10	Ballard	9
Tippecanoe	13	Hardin	15	Wright	15	Logan	12	Barren	9
Tipton	13	Harrison	14			Lyon	11	Bath	11
Union	12	Henry	13	<b>KANSAS</b>		Marion	11	Bell	10
Vanderburgh	10	Howard	15	Allen	10	Marshall	12	Boone	11
Vermillion	12	Humboldt	15	Anderson	10	Mcpherson	11	Bourbon	10
Vigo	12	Ida	15	Atchison	11	Meade	10	Boyd	11
Wabash	14	Iowa	14	Barber	9	Miami	10	Boyle	10
Warren	12	Jackson	14	Barton	11	Mitchell	12	Bracken	11
Warrick	10	Jasper	14	Bourbon	10	Montgomery	9	Breathitt	10
Washington	11	Jefferson	13	Brown	11	Morris	11	Breckenridge	9
Wayne	12	Johnson	13	Butler	10	Morton	10	Bullitt	10
Wells	13	Jones	14	Chase	10	Nemaha	11	Butler	9
White	13	Keokuk	13	Chautauqua	9	Neosho	9	Caldwell	9
Whitley	14	Kossuth	15	Cherokee	9	Ness	12	Calloway	9
		Lee	13	Cheyenne	13	Norton	13	Campbell	11
<b>IOWA</b>		Linn	14	Clark	10	Osage	10	Carlisle	9
Adair	14	Louisa	13	Clay	11	Osborne	12	Carroll	10
Adams	13	Lucas	13	Cloud	12	Ottawa	11	Carter	11
Allamakee	15	Lyon	15	Coffey	10	Pawnee	11	Casey	10
Appanoose	13	Madison	14	Comanche	9	Phillips	12	Christian	9
Audubon	14	Mahaska	13	Cowley	9	Pottawatomie	11	Clark	10
Benton	14	Marion	13	Crawford	9	Pratt	10	Clay	10
Black Hawk	15	Marshall	14	Decatur	13	Rawlins	13	Clinton	10
Boone	14	Mills	13	Dickinson	11	Reno	11	Crittenden	9
Bremer	15	Mitchell	15	Doniphan	11	Republic	12	Cumberland	9
Buchanan	15	Monona	14	Douglas	10	Rice	11	Daviess	9
Buena Vista	15	Monroe	13	Edwards	11	Riley	11	Edmonson	9
Butler	15	Montgomery	13	Elk	9	Rooks	12	Elliot	11
Calhoun	15	Muscatine	13	Ellis	12	Rush	11	Estill	10
Carroll	14	Obrien	15	Ellsworth	11	Russell	11	Fayette	10
Cass	14	Osceola	15	Finney	11	Saline	11	Fleming	11
Cedar	14	Page	13	Ford	11	Scott	12	Floyd	10
Cerro Gordo	15	Palo Alto	15	Franklin	10	Sedgwick	10	Franklin	10
Cherokee	15	Plymouth	15	Geary	11	Seward	10	Fulton	9
Chickasaw	15	Pocahontas	15	Gove	12	Shawnee	11	Gallatin	11
Clarke	13	Polk	14	Graham	12	Sheridan	12	Garrard	10
Clay	15	Pottawattamie	14	Grant	11	Sherman	13	Grant	11
Clayton	15	Poweshiek	14	Gray	11	Smith	12	Graves	9
Clinton	13	Ringgold	13	Greeley	12	Stafford	11	Grayson	9
Crawford	14	Sac	15	Greenwood	10	Stanton	11	Green	9
Dallas	14	Scott	13	Hamilton	11	Stevens	10	Greenup	11
Davis	13	Shelby	14	Harper	9	Sumner	9	Hancock	9
Decatur	13	Sioux	15	Harvey	11	Thomas	13	Hardin	9
Delaware	15	Story	14	Haskell	11	Trego	12	Harlan	10
Des Moines	13	Tama	14	Hodgeman	11	Wabaunsee	11	Harrison	11
Dickinson	15	Taylor	13	Jackson	11	Wallace	12	Hart	9

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Appendix E - Counties by Climate Zone

County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Henderson	9	Spencer	10	Sabine (H)	5	Montgomery	10	Houghton	17
Henry	10	Taylor	9	St Bernard (H)	3	Prince Georges	10	Huron	14
Hickman	9	Todd	9	St Charles (H)	3	Queen Annes	9	Ingham	14
Hopkins	9	Trigg	9	St Helena (H)	4	Somerset	9	Ionia	14
Jackson	10	Trimble	10	St James (H)	3	St Marys	9	Iosco	15
Jefferson	10	Union	9	St John The Baptist (H)	3	Talbot	9	Iron	17
Jessamine	10	Warren	9	St Landry (H)	4	Washington	11	Isabella	15
Johnson	11	Washington	10	St Martin (H)	4	Wicomico	9	Jackson	14
Kenton	11	Wayne	10	St Mary (H)	3	Worcester	9	Kalamazoo	14
Knott	10	Webster	9	St Tammany (H)	4			Kalkaska	15
Knox	10	Whitley	10	Tangipahoa (H)	4	<b>MASSACHUSETTS</b>		Kent	14
Larue	9	Wolfe	10	Tensas (H)	5	Barnstable	12	Keweenaw	17
Laurel	10	Woodford	10	Terrebonne (H)	3	Berkshire	14	Lake	15
Lawrence	11			Union (H)	6	Bristol	12	Lapeer	14
Lee	10	<b>LOUISIANA</b>		Vermilion (H)	4	Dukes	12	Leelanau	15
Leslie	10	Acadia (H)	4	Vernon (H)	5	Essex	13	Lenawee	14
Letcher	10	Allen (H)	4	Washington (H)	4	Franklin	14	Livingston	14
Lewis	11	Ascension (H)	4	Webster (H)	6	Hampden	14	Luce	16
Lincoln	10	Assumption (H)	3	West Baton Rouge (H)	4	Hampshire	14	Mackinac	16
Livingston	9	Avoyelles (H)	5	West Carroll (H)	6	Middlesex	13	Macomb	14
Logan	9	Beauregard (H)	4	West Feliciana (H)	4	Nantucket	12	Manistee	15
Lyon	9	Bienville (H)	6	Winn (H)	5	Norfolk	13	Marquette	16
Madison	10	Bossier (H)	6			Plymouth	12	Mason	15
Magoffin	10	Caddo (H)	6	<b>MAINE</b>		Suffolk	13	Mecosta	15
Marion	10	Calcasieu (H)	4	Androscoggin	15	Worcester	14	Menominee	16
Marshall	9	Caldwell (H)	6	Aroostook	17			Midland	15
Martin	11	Cameron (H)	4	Cumberland	15	<b>MICHIGAN</b>		Missaukee	15
Mason	11	Catahoula (H)	5	Franklin	16	Alcona	15	Monroe	13
Mccracken	9	Claiborne (H)	6	Hancock	15	Alger	16	Montcalm	14
Mccreary	10	Concordia (H)	5	Kennebec	15	Allegan	14	Montmorency	15
Mclean	9	De Soto (H)	5	Knox	15	Alpena	15	Muskegon	14
Meade	9	East Baton Rouge (H)	4	Lincoln	15	Antrim	15	Newaygo	15
Menifee	10	East Carroll (H)	6	Oxford	16	Arenac	15	Oakland	14
Mercer	10	East Feliciana (H)	4	Penobscot	15	Baraga	17	Oceana	15
Metcalf	9	Evangeline (H)	4	Piscataquis	17	Barry	14	Ogemaw	15
Monroe	9	Franklin (H)	6	Sagadahoc	15	Bay	15	Ontonagon	17
Montgomery	10	Grant (H)	5	Somerset	17	Benzie	15	Osceola	15
Morgan	10	Iberia (H)	4	Waldo	15	Berrien	14	Oscoda	15
Muhlenberg	9	Iberville (H)	4	Washington	15	Branch	14	Otsego	15
Nelson	10	Jackson (H)	6	York	15	Calhoun	14	Ottawa	14
Nicholas	11	Jefferson (H)	3			Cass	14	Presque Isle	15
Ohio	9	Jefferson Davis (H)	4	<b>MARYLAND</b>		Charlevoix	15	Roscommon	15
Oldham	10	La Salle (H)	5	Allegany	12	Cheboygan	15	Saginaw	14
Owen	10	Lafayette (H)	4	Anne Arundel	9	Chippewa	16	Sanilac	14
Owsley	10	Lafourche (H)	3	Baltimore	10	Clare	15	Schoolcraft	16
Pendleton	11	Lincoln (H)	6	Baltimore City	9	Clinton	14	Shiawassee	14
Perry	10	Livingston (H)	4	Calvert	9	Crawford	15	St Clair	14
Pike	10	Madison (H)	6	Caroline	9	Delta	16	St Joseph	14
Powell	10	Morehouse (H)	6	Carroll	11	Dickinson	16	Tuscola	14
Pulaski	10	Natchitoches (H)	5	Cecil	10	Eaton	14	Van Buren	14
Robertson	11	Orleans (H)	3	Charles	9	Emmet	15	Washtenaw	13
Rockcastle	10	Ouachita (H)	6	Dorchester	9	Genesee	14	Wayne	13
Rowan	11	Plaquemines (H)	3	Frederick	11	Gladwin	15	Wexford	15
Russell	10	Pointe Coupee (H)	4	Garrett	13	Gogebic	17		
Scott	11	Rapides (H)	5	Harford	10	Grand Traverse	15	<b>MINNESOTA</b>	
Shelby	10	Red River (H)	5	Howard	10	Gratiot	14	Aitkin	17
Simpson	9	Richland (H)	6	Kent	10	Hillsdale	14	Anoka	16

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Appendix E - Counties by Climate Zone



County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Becker	17	Polk	17	Issaquena (H)	6	Adair	12	Linn	12
Beltrami	17	Pope	16	Itawamba	7	Andrew	12	Livingston	12
Benton	16	Ramsey	15	Jackson (H)	4	Atchison	13	Macon	12
Big Stone	16	Red Lake	17	Jasper (H)	5	Audrain	12	Madison	10
Blue Earth	15	Redwood	15	Jefferson (H)	5	Barry	9	Maries	11
Brown	15	Renville	15	Jefferson Davis (H)	5	Barton	10	Marion	12
Carlton	17	Rice	15	Jones (H)	5	Bates	11	Medonald	9
Carver	15	Rock	15	Kemper (H)	6	Benton	11	Mercer	13
Cass	17	Roseau	17	Lafayette	7	Bollinger	10	Miller	11
Chippewa	16	Scott	15	Lamar (H)	4	Boone	11	Mississippi	9
Chisago	16	Sherburne	16	Lauderdale (H)	6	Buchanan	12	Moniteau	11
Clay	17	Sibley	15	Lawrence (H)	5	Butler	9	Monroe	12
Clearwater	17	St Louis	17	Leake (H)	6	Caldwell	12	Montgomery	11
Cook	17	Stearns	16	Lee	7	Callaway	11	Morgan	11
Cottonwood	15	Steele	15	Leflore (H)	6	Camden	11	New Madrid	9
Crow Wing	17	Stevens	16	Lincoln (H)	5	Cape Girardeau	9	Newton	9
Dakota	15	Swift	16	Lowndes (H)	6	Carroll	12	Nodaway	13
Dodge	15	Todd	16	Madison (H)	6	Carter	10	Oregon	9
Douglas	16	Traverse	16	Marion (H)	4	Cass	11	Osage	11
Faribault	15	Wabasha	15	Marshall	7	Cedar	11	Ozark	9
Fillmore	15	Wadena	17	Monroe (H)	6	Chariton	12	Pemiscot	9
Freeborn	15	Waseca	15	Montgomery (H)	6	Christian	10	Perry	10
Goodhue	15	Washington	15	Neshoba (H)	6	Clark	13	Pettis	11
Grant	16	Watsonwan	15	Newton (H)	6	Clay	11	Phelps	10
Hennepin	15	Wilkin	17	Noxubee (H)	6	Clinton	12	Pike	12
Houston	15	Winona	15	Oktibbeha (H)	6	Cole	11	Platte	11
Hubbard	17	Wright	16	Panola	7	Cooper	11	Polk	10
Isanti	16	Yellow Medicine	15	Pearl River (H)	4	Crawford	10	Pulaski	10
Itasca	17			Perry (H)	5	Dade	10	Putnam	13
Jackson	15	<b>MISSISSIPPI</b>		Pike (H)	4	Dallas	10	Ralls	12
Kanabec	16	Adams (H)	5	Pontotoc	7	Daviess	12	Randolph	12
Kandiyohi	16	Alcorn	7	Prentiss	7	De Kalb	12	Ray	11
Kittson	17	Amite (H)	4	Quitman	7	Dent	10	Reynolds	10
Koochiching	17	Attala (H)	6	Rankin (H)	6	Douglas	10	Ripley	9
Lac Qui Parle	15	Benton	7	Scott (H)	6	Dunklin	9	Saline	11
Lake	17	Bolivar (H)	6	Sharkey (H)	6	Franklin	10	Schuyler	13
Lake Of The Woods	17	Calhoun (H)	6	Simpson (H)	5	Gasconade	11	Scotland	13
Le Sueur	15	Carroll (H)	6	Smith (H)	5	Gentry	13	Scott	9
Lincoln	15	Chickasaw (H)	6	Stone (H)	4	Greene	10	Shannon	10
Lyon	15	Choctaw (H)	6	Sunflower (H)	6	Grundy	12	Shelby	12
Mahnomen	17	Claiborne (H)	5	Tallahatchie	7	Harrison	13	St Charles	10
Marshall	17	Clarke (H)	5	Tate	7	Henry	11	St Clair	11
Martin	15	Clay (H)	6	Tippah	7	Hickory	11	St Francois	10
McLeod	15	Coahoma	7	Tishomingo	7	Holt	12	St Louis	10
Meeker	16	Copiah (H)	5	Tunica	7	Howard	11	St Louis City	10
Mille Lacs	16	Covington (H)	5	Union	7	Howell	9	Ste Genevieve	10
Morrison	16	De Soto	7	Walthall (H)	4	Iron	10	Stoddard	9
Mower	15	Forrest (H)	5	Warren (H)	6	Jackson	11	Stone	9
Murray	15	Franklin (H)	5	Washington (H)	6	Jasper	9	Sullivan	12
Nicollet	15	George (H)	4	Wayne (H)	5	Jefferson	10	Taney	9
Nobles	15	Greene (H)	5	Webster (H)	6	Johnson	11	Texas	10
Norman	17	Grenada (H)	6	Wilkinson (H)	4	Knox	12	Vernon	11
Olmsted	15	Hancock (H)	4	Winston (H)	6	Laclede	10	Warren	11
Otter Tail	17	Harrison (H)	4	Yalobusha	7	Lafayette	11	Washington	10
Pennington	17	Hinds (H)	6	Yazoo (H)	6	Lawrence	10	Wayne	10
Pine	16	Holmes (H)	6			Lewis	12	Webster	10
Pipestone	15	Humphreys (H)	6	<b>MISSOURI</b>		Lincoln	11	Worth	13

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Wright	10	Wibaux	15	Keya Paha	14	Pershing	12	Luna	7
<b>MONTANA</b>		Yellowstone	15	Kimball	14	Storey	12	Mckinley	13
Beaverhead	15	Yellowstone		Knox	14	Washoe	12	Mora	15
Big Horn	15	National Park	15	Lancaster	13	White Pine	15	Otero	7
Blaine	16	<b>NEBRASKA</b>		Lincoln	14			Quay	8
Broadwater	15	Adams	13	Logan	14	<b>NEW HAMPSHIRE</b>		Rio Arriba	12
Carbon	15	Antelope	14	Loup	14	Belknap	15	Roosevelt	8
Carter	15	Arthur	14	Madison	14	Carroll	15	San Juan	12
Cascade	15	Banner	14	Mcpheerson	14	Cheshire	15	San Miguel	12
Chouteau	15	Blaine	14	Merrick	13	Coos	16	Sandoval	13
Custer	15	Boone	14	Morrill	14	Grafton	15	Santa Fe	13
Daniels	16	Box Butte	15	Nance	13	Hillsborough	15	Sierra	8
Dawson	15	Boyd	14	Nemaha	13	Merrimack	15	Socorro	9
Deer Lodge	16	Brown	14	Nuckolls	13	Rockingham	15	Taos	15
Fallon	15	Buffalo	13	Otoe	13	Strafford	15	Torrance	11
Fergus	15	Buffalo	13	Pawnee	13	Sullivan	15	Union	11
Flathead	16	Burt	14	Perkins	13			Valencia	10
Gallatin	15	Butler	13	Phelps	13	<b>NEW JERSEY</b>			
Garfield	15	Cass	13	Pierce	14	Atlantic	10	<b>NEW YORK</b>	
Glacier	16	Cedar	14	Platte	13	Bergen	12	Albany	14
Golden Valley	15	Chase	13	Polk	13	Burlington	11	Allegany	15
Granite	16	Cherry	14	Red Willow	13	Camden	10	Bronx	11
Hill	16	Cheyenne	14	Richardson	13	Cape May	10	Broome	15
Jefferson	15	Clay	13	Rock	14	Cumberland	10	Cattaraugus	15
Judith Basin	15	Colfax	13	Saline	13	Essex	11	Cayuga	14
Lake	15	Cuming	14	Sarpy	13	Gloucester	10	Chautauqua	13
Lewis And Clark	15	Custer	14	Saunders	13	Hudson	11	Chemung	15
Liberty	16	Dakota	14	Scotts Bluff	14	Hunterdon	12	Chenango	15
Lincoln	15	Dawes	15	Seward	13	Mercer	11	Clinton	15
Madison	15	Dawson	13	Sheridan	15	Middlesex	11	Columbia	13
McCone	15	Deuel	14	Sherman	14	Monmouth	11	Cortland	15
Meagher	15	Dixon	14	Sioux	15	Morris	12	Delaware	15
Mineral	15	Dodge	13	Stanton	14	Ocean	11	Dutchess	13
Missoula	15	Douglas	13	Thayer	13	Passaic	12	Erie	14
Musselshell	15	Dundy	13	Thomas	14	Salem	10	Essex	16
Park	15	Fillmore	13	Thurston	14	Somerset	12	Franklin	16
Petroleum	15	Franklin	13	Valley	14	Sussex	13	Fulton	15
Phillips	16	Frontier	13	Washington	13	Union	11	Genesee	14
Pondera	16	Furnas	13	Wayne	14	Warren	12	Greene	14
Powder River	15	Gage	13	Webster	13			Hamilton	16
Powell	16	Garden	14	Wheeler	14	<b>NEW MEXICO</b>		Herkimer	15
Prairie	15	Garfield	14	York	13	Bernalillo	9	Jefferson	15
Ravalli	15	Gosper	13			Catron	11	Kings	10
Richland	15	Grant	14	<b>NEVADA</b>		Chaves	7	Lewis	15
Roosevelt	16	Greeley	14	Carson City	12	Cibola	12	Livingston	14
Rosebud	15	Hall	13	Churchill	12	Colfax	13	Madison	14
Sanders	15	Hamilton	13	Clark	5	Curry	9	Monroe	14
Sheridan	16	Harlan	13	Douglas	13	De Baca	9	Montgomery	14
Silver Bow	16	Hayes	13	Elko	15	Dona Ana	7	Nassau	11
Stillwater	15	Hitchcock	13	Esmeralda	12	Eddy	7	New York	10
Sweet Grass	15	Holt	14	Eureka	15	Grant	9	Niagara	14
Teton	15	Hooker	14	Humboldt	13	Guadalupe	9	Oneida	15
Toole	16	Howard	14	Lander	13	Harding	11	Onondaga	14
Treasure	15	Jefferson	13	Lincoln	12	Hidalgo	7	Ontario	14
Valley	16	Johnson	13	Lyon	13	Lea	7	Orange	12
Wheatland	15	Kearney	13	Mineral	12	Lincoln	9	Orleans	14
		Keith	14	Nye	12	Los Alamos	13	Oswego	14

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Otsego	15	Durham	8	Tyrrell (H)	6	Slope	16	Logan	13
Putnam	12	Edgecombe	7	Union	7	Stark	16	Lorain	13
Queens	10	Forsyth	8	Vance	8	Steele	17	Lucas	14
Rensselaer	14	Franklin	8	Wake	7	Stutsman	17	Madison	12
Richmond	11	Gaston	7	Warren	8	Towner	17	Mahoning	13
Rockland	12	Gates	7	Washington	7	Traill	17	Marion	13
Saratoga	14	Graham	9	Watauga	11	Walsh	17	Medina	13
Schenectady	14	Granville	8	Wayne	7	Ward	17	Meigs	11
Schoharie	15	Greene	7	Wilkes	9	Wells	17	Mercer	13
Schuyler	15	Guilford	8	Wilson	7	Williams	17	Miami	13
Seneca	14	Halifax	7	Yadkin	8			Monroe	12
St Lawrence	15	Harnett	7	Yancey	11	<b>OHIO</b>		Montgomery	12
Steuben	15	Haywood	9			Adams	11	Morgan	12
Suffolk	11	Henderson	9	<b>NORTH DAKOTA</b>		Allen	13	Morrow	13
Sullivan	15	Hertford	7	Adams	16	Ashland	13	Muskingum	12
Tioga	15	Hoke	7	Barnes	17	Ashtabula	13	Noble	12
Tompkins	15	Hyde (H)	6	Benson	17	Athens	11	Ottawa	13
Ulster	15	Iredell	8	Billings	16	Auglaize	13	Paulding	14
Warren	15	Jackson	9	Bottineau	17	Belmont	12	Perry	12
Washington	15	Johnston	7	Bowman	16	Brown	11	Pickaway	12
Wayne	14	Jones (H)	6	Burke	17	Butler	12	Pike	11
Westchester	12	Lee	7	Burleigh	16	Carroll	13	Portage	13
Wyoming	14	Lenoir	7	Cass	17	Champaign	13	Preble	12
Yates	14	Lincoln	7	Cavalier	17	Clark	13	Putnam	13
		Macon	9	Dickey	16	Clermont	11	Richland	13
<b>NORTH CAROLINA</b>		Madison	9	Divide	17	Clinton	12	Ross	12
Alamance	8	Martin	7	Dunn	16	Columbiana	13	Sandusky	13
Alexander	8	Medowell	8	Eddy	17	Coshocton	12	Scioto	11
Alleghany	11	Mecklenburg	7	Emmons	16	Crawford	13	Seneca	13
Anson	7	Mitchell	11	Foster	17	Cuyahoga	13	Shelby	13
Ashe	11	Montgomery	7	Golden Valley	16	Darke	13	Stark	13
Avery	11	Moore	7	Grand Forks	17	Defiance	14	Summit	13
Beaufort (H)	6	Nash	7	Grant	16	Delaware	13	Trumbull	13
Bertie	7	New Hanover (H)	6	Griggs	17	Erie	13	Tuscarawas	13
Bladen (H)	6	Northampton	7	Hettinger	16	Fairfield	12	Union	13
Brunswick (H)	6	Onslow (H)	6	Kidder	17	Fayette	12	Van Wert	13
Buncombe	9	Orange	8	La Moure	16	Franklin	12	Vinton	11
Burke	8	Pamlico (H)	6	Logan	16	Fulton	14	Warren	12
Cabarrus	7	Pasquotank	7	Mchenry	17	Gallia	11	Washington	11
Caldwell	8	Pender (H)	6	Mcintosh	16	Geauga	13	Wayne	13
Camden	7	Perquimans	7	Mckenzie	16	Greene	12	Williams	14
Carteret (H)	6	Person	8	Mclean	17	Guernsey	12	Wood	14
Caswell	8	Pitt	7	Mercer	16	Hamilton	11	Wyandot	13
Catawba	8	Polk	7	Morton	16	Hancock	13		
Chatham	8	Randolph	8	Mountrail	17	Hardin	13	<b>OKLAHOMA</b>	
Cherokee	9	Richmond	7	Nelson	17	Harrison	13	Adair	8
Chowan	7	Robeson	7	Oliver	16	Henry	14	Alfalfa	9
Clay	9	Rockingham	8	Pembina	17	Highland	11	Atoka	7
Cleveland	7	Rowan	7	Pierce	17	Hocking	12	Beaver	10
Columbus (H)	6	Rutherford	7	Ramsey	17	Holmes	13	Beckham	8
Craven (H)	6	Sampson (H)	6	Ransom	16	Huron	13	Blaine	8
Cumberland	7	Scotland	7	Renville	17	Jackson	11	Bryan	7
Currituck	7	Stanly	7	Richland	16	Jefferson	13	Caddo	8
Dare (H)	6	Stokes	9	Rolette	17	Knox	13	Canadian	8
Davidson	8	Surry	9	Sargent	16	Lake	13	Carter (H)	6
Davie	8	Swain	9	Sheridan	17	Lawrence	11	Cherokee	8
Duplin (H)	6	Transylvania	9	Sioux	16	Licking	12	Choctaw (H)	6

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County	Zone	County	Zone	County	Zone	County	Zone	County	Zone
Cimarron	10	Texas	10	Butler	14	York	11	<b>SOUTH DAKOTA</b>	
Cleveland	7	Tillman	7	Cambria	13			Aurora	15
Coal	7	Tulsa	8	Cameron	15	<b>RHODE ISLAND</b>		Beadle	15
Comanche	7	Wagoner	8	Carbon	13	Bristol	12	Bennett	14
Cotton	7	Washington	9	Centre	13	Kent	12	Bon Homme	14
Craig	9	Washita	8	Chester	11	Newport	12	Brookings	16
Creek	8	Woods	9	Clarion	14	Providence	14	Brown	16
Custer	8	Woodward	9	Clearfield	15	Washington	12	Brule	15
Delaware	8			Clinton	13			Buffalo	15
Dewey	9	<b>OREGON</b>		Columbia	13	<b>SOUTH CAROLINA</b>		Butte	15
Ellis	9	Baker	15	Crawford	14	Abbeville	7	Campbell	15
Garfield	8	Benton	10	Cumberland	12	Aiken (H)	6	Charles Mix	14
Garvin	7	Clackamas	10	Dauphin	12	Allendale (H)	5	Clark	16
Grady	7	Clatsop	11	Delaware	10	Anderson	7	Clay	14
Grant	9	Columbia	11	Elk	15	Bamberg (H)	5	Codington	16
Greer	7	Coos	9	Erie	14	Barnwell (H)	5	Corson	15
Harmon	7	Crook	14	Fayette	12	Beaufort (H)	5	Custer	15
Harper	9	Curry	9	Forest	15	Berkeley (H)	5	Davison	15
Haskell	7	Deschutes	14	Franklin	11	Calhoun (H)	6	Day	16
Hughes	7	Douglas	9	Fulton	12	Charleston (H)	5	Deuel	16
Jackson	7	Gilliam	12	Greene	12	Cherokee	7	Dewey	15
Jefferson (H)	6	Grant	15	Huntingdon	12	Chester	7	Douglas	14
Johnston (H)	6	Harney	15	Indiana	13	Chesterfield	7	Edmunds	15
Kay	9	Hood River	12	Jefferson	15	Clarendon (H)	6	Fall River	15
Kingfisher	8	Jackson	11	Juniata	12	Colleton (H)	5	Faulk	15
Kiowa	7	Jefferson	13	Lackawanna	14	Darlington (H)	6	Grant	16
Latimer	7	Josephine	9	Lancaster	11	Dillon (H)	6	Gregory	14
Le Flore	7	Klamath	14	Lawrence	14	Dorchester (H)	5	Haakon	15
Lincoln	7	Lake	15	Lebanon	12	Edgefield (H)	6	Hamlin	16
Logan	8	Lane	10	Lehigh	12	Fairfield	7	Hand	15
Love (H)	6	Lincoln	11	Luzerne	13	Florence (H)	6	Hanson	15
Major	9	Linn	10	Lycoming	13	Georgetown (H)	5	Harding	15
Marshall (H)	6	Malheur	12	Mckean	15	Greenville	7	Hughes	15
Mayes	8	Marion	10	Mercer	14	Greenwood	7	Hutchinson	14
Mcclain	7	Morrow	12	Mifflin	12	Hampton (H)	5	Hyde	15
Mccurtain	7	Multnomah	10	Monroe	13	Horry (H)	5	Jackson	14
Mcintosh	7	Polk	10	Montgomery	11	Jasper (H)	5	Jerould	15
Murray	7	Sherman	13	Montour	13	Kershaw	7	Jones	15
Muskogee	7	Tillamook	11	Northampton	12	Lancaster	7	Kingsbury	15
Noble	8	Umatilla	12	Northumberland	13	Laurens	7	Lake	15
Nowata	9	Union	13	Perry	12	Lee (H)	6	Lawrence	15
Okfuskee	7	Wallowa	15	Philadelphia	10	Lexington (H)	6	Lincoln	15
Oklahoma	8	Wasco	13	Pike	13	Marion (H)	6	Lyman	15
Okmulgee	8	Washington	10	Potter	15	Marlboro (H)	6	Marshall	16
Osage	8	Wheeler	13	Schuykill	13	Mccormick (H)	6	Mccook	15
Ottawa	9	Yamhill	10	Snyder	13	Newberry (H)	6	Mcperson	16
Pawnee	8			Somerset	13	Oconee	7	Meade	15
Payne	8	<b>PENNSYLVANIA</b>		Sullivan	14	Orangeburg (H)	6	Mellette	14
Pittsburg	7	Adams	11	Susquehanna	15	Pickens	7	Miner	15
Pontotoc	7	Allegheny	12	Tioga	15	Richland (H)	6	Minnehaha	15
Pottawatomie	7	Armstrong	13	Union	13	Saluda (H)	6	Moody	15
Pushmataha (H)	6	Beaver	12	Venango	14	Spartanburg	7	Pennington	15
Roger Mills	9	Bedford	13	Warren	14	Sumter (H)	6	Perkins	15
Rogers	9	Berks	12	Washington	12	Union	7	Potter	15
Seminole	7	Blair	13	Wayne	15	Williamsburg (H)	6	Roberts	16
Sequoyah	7	Bradford	15	Westmoreland	13	York	7	Sanborn	15
Stephens	7	Bucks	11	Wyoming	14			Shannon	15

“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
Spink	15	Johnson	10	Armstrong	9	Dickens	7	Jackson (H)	3
Stanley	15	Knox	8	Atascosa (H)	3	Dimmit (H)	3	Jasper (H)	4
Sully	15	Lake	9	Austin (H)	4	Donley	8	Jeff Davis	6
Todd	14	Lauderdale	8	Bailey	9	Duval (H)	3	Jefferson (H)	4
Tripp	14	Lawrence	8	Bandera (H)	4	Eastland	6	Jim Hogg (H)	3
Turner	15	Lewis	8	Bastrop (H)	4	Ector	6	Jim Wells (H)	3
Union	14	Lincoln	8	Baylor	7	Edwards (H)	4	Johnson (H)	5
Walworth	15	Loudon	8	Bee (H)	3	El Paso	6	Jones	6
Yankton	14	Macon	9	Bell (H)	5	Ellis (H)	5	Karnes (H)	3
Ziebach	15	Madison	8	Bexar (H)	4	Erath	5	Kaufman	5
		Marion	8	Blanco (H)	5	Falls (H)	5	Kendall (H)	5
<b>TENNESSEE</b>		Marshall	8	Borden	7	Fannin	6	Kenedy (H)	2
Anderson	9	Maury	9	Bosque (H)	5	Fayette (H)	4	Kent	7
Bedford	8	Mcminn	8	Bowie	6	Fisher	6	Kerr (H)	5
Benton	9	Mcnairy	8	Brazoria (H)	3	Floyd	8	Kimble (H)	5
Bledsoe	8	Meigs	8	Brazos (H)	4	Foard	7	King	7
Blount	8	Monroe	8	Brewster (H)	5	Fort Bend (H)	4	Kinney (H)	4
Bradley	8	Montgomery	9	Briscoe	8	Franklin	6	Kleberg (H)	2
Campbell	10	Moore	8	Brooks (H)	3	Freestone (H)	5	Knox	7
Cannon	9	Morgan	10	Brown (H)	5	Frio (H)	3	La Salle (H)	3
Carroll	9	Obion	9	Burleson (H)	4	Gaines	7	Lamar	6
Carter	10	Overton	9	Burnet (H)	5	Galveston (H)	3	Lamb	8
Cheatham	9	Perry	8	Caldwell (H)	4	Garza	7	Lampasas (H)	5
Chester	8	Pickett	10	Calhoun (H)	3	Gillespie (H)	5	Lavaca (H)	4
Claiborne	10	Polk	8	Callahan	6	Glasscock	6	Lee (H)	4
Clay	9	Putnam	9	Cameron (H)	2	Goliad (H)	3	Leon (H)	5
Cocke	9	Rhea	8	Camp	6	Gonzales (H)	4	Liberty (H)	4
Coffee	8	Roane	9	Carson	9	Gray	9	Limestone (H)	5
Crockett	8	Robertson	9	Cass	6	Grayson	6	Lipscomb	9
Cumberland	9	Rutherford	8	Castro	9	Gregg	6	Live Oak (H)	3
Davidson	8	Scott	10	Chambers (H)	4	Grimes (H)	4	Llano (H)	5
De Kalb	9	Sequatchie	8	Cherokee (H)	5	Guadalupe (H)	4	Loving	6
Decatur	8	Sevier	9	Childress	7	Hale	8	Lubbock	7
Dickson	9	Shelby (H)	7	Clay	6	Hall	8	Lynn	7
Dyer	8	Smith	9	Cochran	8	Hamilton (H)	5	Madison (H)	4
Fayette (H)	7	Stewart	9	Coke	6	Hansford	9	Marion	6
Fentress	10	Sullivan	9	Coleman (H)	5	Hardeman	7	Martin	6
Franklin	8	Sumner	9	Collin	5	Hardin (H)	4	Mason (H)	5
Gibson	9	Tipton	8	Collingsworth	7	Harris (H)	4	Matagorda (H)	3
Giles	8	Trousdale	9	Colorado (H)	4	Harrison	6	Maverick (H)	3
Grainger	9	Unicoi	10	Comal (H)	4	Hartley	9	Mcculloch (H)	5
Greene	9	Union	9	Comanche (H)	5	Haskell	6	Mclennan (H)	5
Grundy	9	Van Buren	9	Concho (H)	5	Hays (H)	4	Mcmullen (H)	3
Hamblen	9	Warren	9	Cooke	6	Hemphill	8	Medina (H)	4
Hamilton	8	Washington	9	Coryell (H)	5	Henderson (H)	5	Menard (H)	5
Hancock	10	Wayne	8	Cottle	7	Hidalgo (H)	2	Midland	6
Hardeman	8	Weakley	9	Crane (H)	5	Hill (H)	5	Milam (H)	4
Hardin	8	White	9	Crockett (H)	5	Hockley	8	Mills (H)	5
Hawkins	9	Williamson	8	Crosby	7	Hood (H)	5	Mitchell	6
Haywood	8	Wilson	9	Culberson	6	Hopkins	6	Montague	6
Henderson	8			Dallam	9	Houston (H)	5	Montgomery (H)	4
Henry	9	<b>TEXAS</b>		Dallas (H)	5	Howard	6	Moore	9
Hickman	9	Anderson (H)	5	Dawson	7	Hudspeth	6	Morris	6
Houston	9	Andrews	6	De Witt (H)	3	Hunt	6	Motley	7
Humphreys	9	Angelina (H)	4	Deaf Smith	9	Hutchinson	9	Nacogdoches (H)	5
Jackson	9	Aransas (H)	3	Delta	6	Irion (H)	5	Navarro (H)	5
Jefferson	9	Archer	6	Denton	5	Jack	6	Newton (H)	4

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

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

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# Definitions

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## MECcheck 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)**

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 MECcheck 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**

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 ( $\text{h ft}^2 \text{ }^\circ\text{F/Btu}$ ) 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.

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

**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

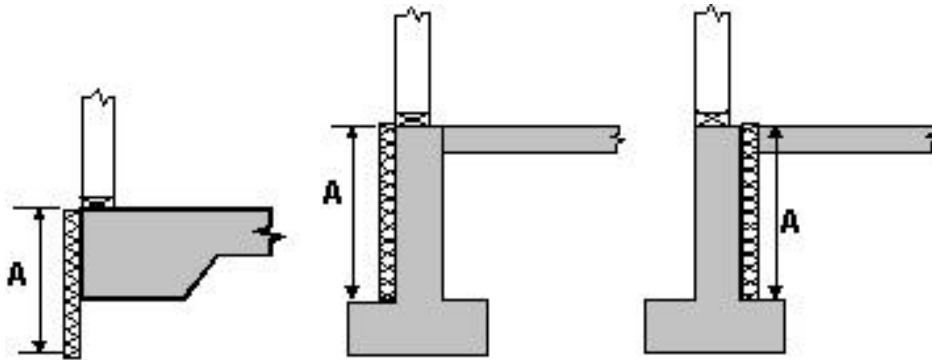
Glazing that is horizontal or sloped at an angle less than  $60^\circ$  (1.1 rad) from horizontal.

## Slab Edge

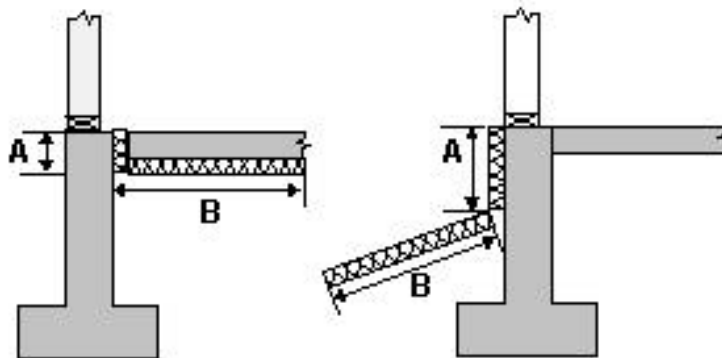
Slab edge refers to the perimeter of a slab-on-grade floor, where the top edge of the slab floor is above the finished grade or 12 in. or less below the finished grade. The slab perimeter should include the length of all edges of a slab foundation that are part of the building envelope and are less than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



A = insulation depth



A + B = insulation depth

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 ft<sup>2</sup> °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.

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