greenfiber
us greenfiber, llc

November 29, 2000

Mr. James Mills
Division of Enforcement
Federal Trade Commission
600 Pennsylvania Ave.
Washington, DC 20580

Dear Mr. Mills:

Our industry is experiencing an increasing number of incidents where home inspectors, third party manufactured housing inspectors (DAPIA), or building inspectors are rejecting attics where loose-fill or sprayed insulation is installed. The reason for this is when an inspector finds a thickness measurement less than the required minimum depth as shown on the manufacturers instructions (coverage chart), even though other thickness measurements are in excess of the required minimum depth. The installer is then required to apply additional loose-fill or sprayed insulation to a depth equal to or greater than the required minimum in every area. As a consequence, the actual R-value installed is then higher than the required R-value and at a greater cost to the homeowner.

Experience has shown (Attach. 1) that loose-fill insulation installed in attic spaces can have thickness variations from 5 to15% of the average thickness, rather than being exactly the same depth everywhere. Since it is understandably difficult to install loose-fill or sprayed insulation to a precise thickness at every location, how does this affect the overall R-value? Does the insulation thickness have to be at or above the required minimum thickness at every location to comply with the FTC R-value Rule as some interpret it? If not, are there acceptable methods of determining an "effective (or average, or net) R-value" based on several thickness measurements throughout the insulated area? This would certainly help confirm whether an application of loose-fill or sprayed insulation met the intent of the FTC R-value Rule without additional expense to the homeowner.

The 1995 CABO Model Energy Code (MEC) and the 2000 International Energy Conservation Code (IECC) provide some guidance to an installer in these matters. Section 102.1.2 (MEC, IECC) instructs an installer to provide a dated certification of the R-value, and additionally for loose-fill or sprayed insulation, the initial and settled thickness, coverage area, and number of bags installed must be indicated. Also, for loose-fill or sprayed insulation, Section 102.1.3 (MEC) and Section 102.4.1 (IECC) requires the installer to place at least one marker every 300 square feet throughout the attic. These markers shall be fixed to joists and marked with the minimum installed and minimum settled thickness. The Code additionally requires that the thickness of installed insulation must equal or exceed the minimum **installed** thickness. This instruction in the Code is confusing, since the installed thickness is only attained immediately after installation. An installer may comply with the intent of the Code at the time of installation, yet subsequent inspection could determine the thickness is out of compliance if settling occurs. In contrast, the FTC R-value Rule does not address installed thickness, since the

370 Palm Island, SE
Clearwater, FL 33767
Fax/phone (727) 446-7720

only relevant measure of R-value is with respect to settled thickness. Fortunately, most inspectors realize this and therefore look for violation of the minimum settled thickness.

I have included with this letter, three methodologies that can be used by installers and inspectors in determining an "effective (or average, or net) R-value". The math is easy; however, some level of statistical confidence in the answer should be addressed by requiring a minimum number of measurements, regardless of the area insulated. Although the MEC and IECC require at least one "marker" per 300 square feet, there is no minimum number of markers. According to Dr. David W. Yarbrough, "the minimum number of thickness measurements needed to determine with 98% confidence the average thickness to within 5% has been computed using a procedure discussed in the handbook of experimental statistics published by the U.S. National Bureau of Standards (Attach. 1). The calculation uses 0.025 x thickness as the standard deviation of the insulation thickness distribution and requires with 98% confidence that the measured average insulation thickness be within 2.5% of the true insulation thickness. The result is that a minimum of **six** thickness measurements are needed."

One method developed by example in Attachment 2 is referred to as "The Parallel Path Method". This method provides the most accurate expression of the overall R-value. Another method, referred to as "The Area Percent Method", is a close approximation of the previous method (within 1.0%) and is considerably easier to understand and utilize. The third method, referred to as "The Average Thickness Method", is the simplest to use but the least accurate of the three. Basically, the first two methods are based on a weighted-average of R-values throughout an attic area. The Average Thickness Method simply utilizes an average thickness times the R-value per inch of the insulation material used. Although it is the least accurate, the result will be within 5.0% of the true value provided a minimum of six measurements are averaged. Examples comparing these three methods will be found in Attachment 3. I have also included in Attachment 4, an example of an instruction we could provide to installers and inspectors.

We would greatly appreciate your review and subsequent opinion as to whether any or all of these methods meet the intent of the FTC R-value Rule (16 CFR Part 460). Hopefully we could have a response before January 1, 2001.

Best regards,

Ivan T. Smith
Technical Director

370 Palm Island, SE
Clearwater, FL 33767
Fax/phone (727) 446-7720

ATTACH 1

R & D Services , Inc.

1770 Spring Road , Lenoir City , TN 37771 Phone (423) 988-6996

Evaluation of Installed Thermal Insulation

The specified thermal resistance of loose-fill or stabilized cellulosic thermal insulation installed in residential attics or the roof cavities of manufactured home units is achieved when the manufacturer's specified thickness and weight of insulation are present. The thermal resistance of a layer of insulation depends on both thickness and density. A precise determination, therefore, of in-situ R value requires measurement of both density and thickness.

The development by a manufacturer of installation information is such that if the correct weight of material (or number of bags) is installed and the manufacturer's specified thickness is present, then the specified R value should be achieved. Care must be taken to determine whether thicknesses being measured are "installed" thicknesses or the thickness after all material settling has been completed.

A quality control check on cellulosic insulation installed in a manufactured home roof cavity based on thickness measurements of insulation thickness is possible and can provide meaningful results. The first step in such a QC program should be to verify the calculation of the amount of insulation that should be installed in the roof cavity. The second step should be a verification that the correct amount of material has been installed. A visual check of the installed insulation should be sufficient verification that the material has been distributed uniformly. There should be no obvious mounds of insulation or uninsulated areas above conditioned space. After determining that the correct amount of insulation has been installed the QC inspection can move to determining the average thickness of the installed insulation.

The average R-value is generally taken to be the QC measure of interest provided that the visual check for uniformity is satisfied. This R value can be related to thickness if the conditions in the preceding discussion are met. Experience in the past (Ref. 1) has shown that insulations installed in attic spaces have thickness variations from 5 to 15 % of the average thickness. Individual thickness measurements made at various locations will vary, this is to be expected. Similarly, the R value will vary from point to point in an attic or roof cavity. A QC check that uses a number of thickness measurements to arrive at an average value for the insulation thickness is recommended. Two questions, however, must be answered. The first question concerns the number of individual measurements that should be taken to establish the average insulation thickness. The second question concerns interpretation of the results.

The Federal Trade Commission rule on labeling of home insulation (Ref. 2) requires that a specific specimen of insulation must have an R value that is at least 90% of the

manufacturer's claimed value. The "Rule" also requires that the manufacturer's claimed values be backed by test data that validates the claimed values. Using the FTC Rule as a starting point, a reasonable QC check would be for the R value of a single unit to be at least 90% of the claimed value. It is suggested, therefore, that the target for measured average thickness be 95% of the manufacturer's specified thickness. The measured average insulation thickness will be used as an estimate of the true average thickness. Since there is a distribution of actual thicknesses, there will be a number of different values for the average thickness calculated from a few thickness measurements. It is recommended , therefore, that an average measured thickness, that is at least 95% of the manufacturer's specified thickness, be used as a quality control check. A statistical analysis is used to determine the number of insulation thickness measurements that should be completed on a single unit to satisfy the above requirements

The number of thickness measurement needed to determine with 98% confidence the average insulation thickness to within 5% has been computed using a procedure discussed in the handbook of experimental statistics published by the U.S. National Bureau of Standards (Ref. 3). The calculation uses 0.025 X thickness as the standard deviation of the insulation thickness distribution and requires with 98% confidence that the measured average insulation thickness be within 2.5% of the true insulation thickness. **The result is that six thickness measurements are needed.**

A recommended QC procedure involves the following steps.

(1) Verify the calculation of bags or pounds of insulation required for the unit being checked.

(2) Verify the insulation thickness that is required for the specified R value.

(3) Visually check the uniformity of the installed insulation.

(4) Measure insulation thicknesses to within one millimeter or 0.05 inches at six randomly selected locations.

(5) Calculate an average insulation thickness from the six individual thicknesses.

(6) Compare the measured average thickness with the required thickness. The average measured thickness for one unit should be at least 95% of the required thickness. The measured average thicknesses for a large number of units (20 for example) should be averaged to show that they met or exceed the required thickness.

If the running average of roof cavity insulation thicknesses fall below the manufacturer's specified value, then either the correct number of bags are not being installed, or the installation technique is flawed. The bag count can be readily checked. The installation technique can be checked by measuring the density of insulation that is delivered by the insulation blowing equipment being used and comparing this number with the manufacturer's specification.

The six steps outlined above will provide with 98% confidence that the actual average insulation thickness is greater than 90% of that required by the manufacturer.

Example: Required thickness: 5.67 inches
95 % of required thickness: 5.39 inches

		Set One	Set Two	Set Three
Measurements:	(inches)	5.10	5.95	4.95
		5.70	4.80	4.50
		5.45	6.20	6.35
		5.50	5.95	5.85
		5.75	6.30	5.95
		5.55	5.90	6.25
Average		5.51 inches	5.85 inches	5.64 inches

The values 5.51, 5.85, and 5.64 are greater than 5.39, so all three example sets pass. The average of a large number of average measured insulation thicknesses, however, should not be less that 5.67 inches. The average of the three sets in the above example is 5.67.

Further elaboration of the suggested procedure or questions concerning the methodology will be taken care of upon request.

David W. Yarbrough, PE
R&D Services

REFERENCES

1. D.W.Yarbrough, R.S. Graves, and D.L. McElroy," Thickness and Density Measurements for Attic Loose-Fill Thermal Insulation in Eight Cities", ORNL/TM-10414, Oak Ridge National Laboratory (1987) p.18 .

2. Federal Trade Commission," Labeling and Advertising of Home Insulation", 16 CRF 460, August 15, 1980, reissued annually.

3. M.G. Natrella,"Experimental Statistics", National Bureau of Standards Handbook 91, U.S. Government Printing Office (1963) p. 2-10 .

ATTACH 2

Mr. Ivan Smith
US GreenFiber, LLC
370 Palm Island SE
Clearwater, Florida 33767

October 6, 2000

Dear Ivan:
The averaging of R-values for a layer of insulation with thicknesses that vary with location can be accomplished using the method introduced in "Collected Papers in Heat Transfer Vol.1 pp 71-79 (1988). There are practical cases where the insulation layer can be divided into a number of discrete areas . Each area (subscript I) has an R-value R_i , and the fraction of the total area that is assigned to this area is f_i. The R-value for the entire layer is then given by the following equation.

$$R = (\sum f_i / R_i)^{-1}$$ with the summation extending over all regions.

The above equation will be demonstrated by two examples.

Example one: three regions

area one	200 ft^2	R_1 = 15 ft^2•h•°F/Btu
area two	300 ft^2	R_2 = 20
area three	50 ft^2	R_3 = 8
total	550	
area fractions		f_1 = 0.364
		f_2 = 0.545
		f_3 = 0.091

$$R = (0.364/15 + 0.545/20 + 0.091/8)^{-1} = 15.9$$

Example two: two regions

area one	500 ft^2	R_1 = 25
area two	500 ft^2	R_2 = 35
		f_1 = 0.5
		f_2 = 0.5

$$R = (0.5/25 + 0.5/35)^{-1} = 29.2$$

R&D Services, Inc.

P.O. Box 2400
Cookeville, Tennessee
38502-2400

931-372-8871
931-525-3896 FAX

e-mail: rdserv@usit.net
http://www.rdservices.com

The method demonstrated in Examples one and two can be readily extended to any number of regions. If the number of regions becomes very large, the summation is replaced by an integration. This method is like the isothermal planes (parallel heat path) model discussed in the ASHRAE Handbook of Fundamentals.

I will look forward to further discussions of this interesting technical question.

Sincerely,

David

David W. Yarbrough, PhD, PE
President

ATTACH 3

Comparison of Parallel Path vs. Area Percent vs. Average Thickness Methods of Calculating Total R-Value

Attic Section	Area (ft^2)	Fraction (f)	Depth (in.)	Area R-value
1	100	0.048	8.00	29.6
2	200	0.095	7.75	28.7
3	300	0.143	9.00	33.3
4	400	0.190	8.25	30.5
5	500	0.238	7.25	26.8
6	600	0.286	6.75	25.0
	2100	1	7.833	

Calculations: R-value of Insulation Material = 3.7 R/in

	METHODS: Parallel Path	Area Percent	Average Thickness
Total R-Value	27.95	28.23	28.98

Equations:

Linear Path $R = ((f_1 / R_1) + (f_2 / R_2) + \ldots + (f_6 / R_6)) - 1$

Area Percent $R = ((f_1 * R_1) + (f_2 * R_2) + \ldots + (f_6 * R_6))$

Average Thickness: $R = ((\text{Depth } 1 + \text{Depth } 2 + \ldots + \text{Depth } 6) / 6) * R/in$

Comparison of Parallel Path vs. Area Percent vs. Average Thickness Methods of Calculating Total R-Value

Attic Section	Area (ft^2)	Fraction (f)	Depth (in.)	Area R-value
1	600	0.286	8.00	29.6
2	500	0.238	7.75	28.7
3	400	0.190	9.00	33.3
4	300	0.143	8.25	30.5
5	200	0.095	7.25	26.8
6	100	0.048	6.75	25.0
	2100	1	7.833	

Calculations: R-value of Insulation Material = 3.7 R/in

	METHODS: Parallel Path	Area Percent	Average Thickness
Total R-Value	29.57	29.73	28.98

Equations:

Linear Path $R = ((f_1 / R_1) + (f_2 / R_2) + \ldots + (f_6 / R_6))-1$

Area Percent $R = ((f_1 * R_1) + (f_2 * R_2) + \ldots + (f_6 * R_6))$

Average Thickness: R = ((Depth 1 + Depth 2 +...+ Depth 6) / 6) * R/in

Comparison of Parallel Path vs. Area Percent vs. Average Thickness Methods of Calculating Total R-Value

Attic Section	Area (ft^2)	Fraction (f)	Depth (in.)	Area R-value
1	400	0.190	8.00	29.6
2	300	0.143	7.75	28.7
3	100	0.048	9.00	33.3
4	600	0.286	8.25	30.5
5	200	0.095	7.25	26.8
6	500	0.238	6.75	25.0
	2100	1	7.833	

Calculations: R-value of Insulation Material = 3.7 R/in

	METHODS:		
	Parallel Path	Area Percent	Average Thickness
Total R-Value	28.34	28.54	28.98

Equations:

Linear Path $R = ((f_1 / R_1) + (f_2 / R_2) + \ldots + (f_6 / R_6))-1$

Area Percent $R = ((f_1 * R_1) + (f_2 * R_2) + \ldots + (f_6 * R_6))$

Average Thickness $R = ((\text{Depth 1} + \text{Depth 2} + \ldots + \text{Depth 6}) / 6) * R/in$

ATTACH 4

How to Meet the Attic Insulation Depth Requirements with GreenFiber Insulation

"Minimum depth" and R-Value

The Federal Trade Commission requires that all loose fill insulation materials be applied to a minimum depth to attain a specified R-value. For example, GreenFiber Stabilized cellulose's specification for an R-30 is to install slightly more than 28 bags every 1000 square feet to a *minimum depth of 8.1 inches*.

Continuing with the R-30 example, an interpretation might be that the depth can never be lower than 8.1 inches in an attic. That is **not** what is being asked of an applicator. Both the insulation industry and FTC recognize that loose fill materials will never be installed to a perfectly even depth. Requiring that no area be less than 8.1 inches actually results in an R-value higher than R-30 and a higher installed cost for the applicator.

How can an applicator be certain that the proper R-Value is installed?

It is standard industry practice to use a visual examination of an insulated area to ensure the proper R-value is in place. The insulation must be at a specified level on an R-value marker and the surrounding material must be reasonably close to the same level.

To facilitate the examination, the Model Energy Code requires dividing an attic in sections no greater than 300 square feet. The overall attic R-value is determined by adding the R-values of all of the proportional sections in an attic. *(See weighted average explanation below.)*

The simplest way to meet the standard is to fasten R-value markers every eight feet. (This will actually exceed the standard, but it is an easy rule-of-thumb.) Assuming trusses are used, a marker should be fastened to every fourth 24-inch-on-center truss or every sixth 16-inch-on-center truss. The markers should always face an attic access such as a scuttle hole.

How can an attic with areas less than the "minimum depth" have the correct R-value?

An attic's R-value is best determined by using weighted average to determine an attic's overall R-value. Here's an example:

1200 square foot attic with four 300 square foot sections:

Section	Observed R-Value	Percent of Attic	Conversion (add these for net R-value)
Section 1	R-28	25%	7
Section 2	R-32	25%	8
Section 3	R-31	25%	7.75
Section 4	R-30	25%	7.5
Net R-value (sum of "Conversion" column)			30.25

As mentioned above, an attic's overall R-value is reached only if the material in each section is representative of the R-value shown on its marker.

IECC

TABLE 101.4.2.4
PRESCRIPTIVE ENVELOPE COMPONENT CRITERIA ADDITIONS TO AND REPLACEMENT WINDOWS FOR EXISTING SINGLE-FAMILY RESIDENTIAL BUILDINGS

HEATING DEGREE DAYS	MAXIMUM	MINIMUM					
	Fenestration *U*-value	Ceiling *R*-value[a]	Wall *R*-value	Floor *R*-value	Basement wall *R*-value[b]	Slab pe... *R*-value a... depth	...rvalue
0 - 1,999	0.75	R-26	R-13	R-11	R-5	R-0	R-5
2,000 - 3,999	0.5	R-30	R-13	R-19	R-8	R-5, 2 ft.	R-10
4,000 - 5,999	0.4	R-38	R-18	R-21	R-10	R-9, 2 ft.	R-19
6,000 - 8,499	0.35	R-49	R-21	R-21	R-11	R-13, 4 ft.	R-20
8,500 - 12,999	0.35	R-49	R-21	R-21	R-19	R-18, 4 ft.	R-20

For **SI:** 1 foot = 304.8 mm.

[a] "Ceiling *R*-value" shall be required for flat or inclined (cathedral) ceilings. Floors over outside air shall meet "ceiling *R*-value" requirements.

[b] Basement wall insulation shall be installed in accordance with Section 502.2.1.6.

[c] Slab perimeter insulation shall be installed in accordance with Section 502.2.1.4. An additional R-2 shall be added to "slab perimeter *R*-value" in the table if the slab is heated.

[d] "Crawl space wall *R*-value" shall apply to unventilated crawl spaces only. Crawl space insulation shall be installed per Section 502.2.1.5.

101.4.3 Mixed occupancy. When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, the major use shall be considered the building occupancy.

SECTION 102
MATERIALS AND EQUIPMENT

102.1 Identification. Materials, equipment and systems shall be identified in accordance with Sections 102.1.1 and 102.1.2.

102.1.1 General. Materials, equipment and systems shall be identified in a manner that will allow a determination of their compliance with the applicable provisions of this code.

102.1.2 Building envelope insulation. A thermal resistance (*R*) identification mark shall be applied by the manufacturer to each piece of building envelope insulation 12 inches (305 mm) or greater in width.

Alternatively, the insulation installer shall provide a signed and dated certification for the insulation installed in each element of the building envelope, listing the type of insulation, the manufacturer and the *R*-value. For blown-in or sprayed insulation, the installer shall also provide the initial installed thickness, the settled thickness, the coverage area and the number of bags installed. The installer shall post the certification in a conspicuous place on the job site.

102.2 Maintenance information. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. Such label shall include, title or publication number, the operation and maintenance manual for that particular model and type of product. Maintenance instructions shall be furnished for equipment that requires preventive maintenance for efficient operation.

102.3 Fenestration product rating, certification and labeling. *U*-values of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer. The solar heat gain coefficient (SHGC) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and labeled and certified by the manufacturer. Where a shading coefficient for a fenestration product is used, it shall be determined by converting the product's SHGC, as determined in accordance with NFRC 200, to a shading coefficient, by dividing the SHGC by 0.87. Such certified and labeled *U*-values and SHGCs shall be accepted for purposes of determining compliance with the building envelope requirements of this code.

When a manufacturer has not determined product *U*-value in accordance with NFRC 100 for a particular product line, compliance with the building envelope requirements of this code shall be determined by assigning such products a default *U*-value in accordance with Tables 102.3(1) and 102.3(2). When an SHGC or shading coefficient is used for code compliance and a manufacturer has not determined product SHGC in accordance with NFRC 200 for a particular product line, compliance with the building envelope requirements of this code shall be determined by assigning such products a default SHGC in accordance with Table 102.3(3). Product features must be verifiable for the product to qualify for the default value associated with those features. Where the existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials from two different product types is used, the product shall be assigned the higher *U*-value.

102.4 Materials, systems and equipment installation. All insulation materials, caulking and weatherstripping, fenestration assemblies, mechanical equipment and systems components, and water-heating equipment and system components shall be installed in accordance with the manufacturer's installation instructions.

102.4.1 Insulation installation. Roof-ceiling, floor and wall cavity insulation shall be installed in a manner that permits inspection of the manufacturer's *R*-value identification mark.

Alternatively, the thickness of roof-ceiling insulation that is either blown in or sprayed shall be identified by thickness markers that are labeled in inches or millimeters installed at least one for every 300 square feet (28 m^2) through the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness and minimum settled thickness with numbers a minimum of 1.0 inch (25 mm) in height. Each marker shall face the attic access. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

TABLE 102.3(1)
***U*-VALUE DEFAULT TABLE FOR WINDOWS, GLAZED DOORS AND SKYLIGHTS**

FRAME MATERIAL AND PRODUCT TYPE[a]	SINGLE GLAZED	DOUBLE GLAZED
Metal without thermal break		
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
Metal with thermal break		
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
Reinforced vinyl/metal clad wood		
Operable (including sliding and swinging glass doors)	0.90	0.57
Fixed	0.98	0.56
Skylight	1.75	1.05
Wood/vinyl/fiberglass		
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

For **SI:** 1 inch = 25.4 mm.

[a] Glass block assemblies with mortar but without reinforcing or framing shall have a *U*-value of 0.60.

TABLE 102.3(2)
***U*-VALUE DEFAULT TABLE FOR NONGLAZED DOORS**

DOOR TYPE	WITH FOAM CORE	WITHOUT FOAM CORE
Steel doors ($1^3/_4$ inches thick)	0.35	0.60
	WITHOUT STORM DOOR	**WITH STORM DOOR**
Wood doors ($1^3/_4$ inches thick)		
Panel with $^7/_{16}$-inch panels	0.54	0.36
Hollow core flush	0.46	0.32
Panel with $1^1/_8$-inch panels	0.39	0.28
Solid core flush	0.40	0.26

For **SI:** 1 inch = 25.4 mm.

SECTION 103
ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

103.1 General. The provisions of this code are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the building official as meeting the intent of the code.

Compliance with specific provisions of this code shall be determined through the use of computer software, worksheets, compliance manuals and other similar materials when they have been approved by the building official as meeting the intent of this code.

SECTION 104
PLANS AND SPECIFICATIONS

104.1 General. With each application for a building permit, and when required by the building official, plans and specifications shall be submitted. The building official shall be permitted to require that plans and specifications be prepared by an engineer or architect licensed to practice by the state. Designs submitted under the provisions of Chapter 4 shall be prepared by an engineer or architect licensed to practice by the state when not in conflict with state practice acts.

Exception: For residential buildings having an area of 5,000 square feet (465 m^2) or less, designs submitted under the

TABLE 102.3(3)
SHGC DEFAULT TABLE FOR FENESTRATION

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

MEC

CHAPTER 1
ADMINISTRATION AND ENFORCEMENT

SECTION 101
SCOPE AND GENERAL REQUIREMENTS

101.1 Title. This code shall be known as the *Model Energy Code*, and may be cited as such. It is referred to herein as "this code."

101.2 Intent. The provisions of this code shall regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, service water-heating and illumination systems and equipment which will enable effective use of energy in new building construction. It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of energy.

101.3 Compliance. Compliance with this code shall be determined as follows:

- For residential buildings a systems approach for the entire building and its energy-using sub-systems which may utilize renewable sources (Chapter 4), a component performance approach for various building elements and mechanical systems and components (Chapter 5), or specified acceptable practice (Chapter 6).
- For other than residential buildings a prescriptive, system, or energy cost budget approach (Chapter 7).
- This code is not intended to abridge safety, health or environmental requirements under other applicable codes or ordinances.

101.4 Scope. This code sets forth minimum requirements for the design of new buildings and structures or portions thereof and additions to existing buildings that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage and residential occupancies, as well as those portions of factory and industrial occupancies designed primarily for human occupancy, by regulating their exterior envelopes and the selection of their HVAC, service water heating, electrical distribution and illumination systems and equipment for effective use of energy.

Residential buildings shall be designed and constructed to comply with the requirements of Chapter 4, 5, or 6 of this code. Buildings other than residential buildings shall be designed and constructed to comply with the requirements of Chapter 7.

101.4.1 Building types.

101.4.1.1 Group R residential buildings. For the purposes of this 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.

101.4.1.2 Other buildings. Buildings and structures not included in Section 101.4.1.1.

101.4.2 Exempt buildings.

101.4.2.1. Buildings and structures or portions thereof whose peak design rate of energy usage is less than 3.4 Btu/h per square foot (10.7 W/m^2) or 1.0 watt per square foot (10.7 W/m^2) of floor area for all purposes.

101.4.2.2. Buildings and structures or portions thereof which are neither heated nor cooled.

101.4.3 Application to existing buildings.

101.4.3.1 Additions to existing buildings. Additions to existing buildings or structures may be made to such buildings or structures without making the entire building or structure comply. The new addition shall conform to the provisions of this code as they relate to new construction only.

101.4.3.2 Historic buildings. Historic buildings are exempt from this code. This exemption shall apply to those buildings which have been specifically designated as historically significant by the state or local governing body, or listed in *The National Register of Historic Places* or which have been determined to be eligible for listing.

101.4.3.3 Change of occupancy. A change in the occupancy or use of an existing building or structure constructed under this code which would require an increase in demand for either fossil fuel or electrical energy supply shall not be permitted unless such building or structure is made to comply with the requirements of this code.

101.4.4 Mixed occupancy. When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, the major use shall be considered the building occupancy.

SECTION 102
MATERIALS AND EQUIPMENT

102.1 Identification.

102.1.1 General. Materials and equipment shall be identified in order to show compliance with this code.

102.1.2 Building envelope insulation. A thermal resistance (R) identification mark shall be applied by the manufacturer to each piece of building envelope insulation 12 inches (305 mm) or greater in width.

Alternatively, the insulation installer shall provide a signed and dated certification for the insulation installed in each element of the building envelope, listing the type of insulation, the manufacturer and the R-value. For blown-in or sprayed insulation, the installer shall also provide the initial installed thickness, the settled thickness, the coverage area and the number of bags installed. The installer shall post the certification in a conspicuous place on the job site.

102.1.3 Insulation installation. Roof-ceiling, floor and wall cavity insulation shall be installed in a manner which will permit inspection of the manufacturer's *R*-value identification mark.

Alternatively, the thickness of roof-ceiling insulation that is either blown in or sprayed shall be identified by thickness markers that are labeled in inches installed at least one for every 300 square feet (28 m^2) through the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness and minimum settled thickness with numbers a minimum of 1.0 inch (25 mm) in height. Each marker shall face the attic access. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

102.2 Maintenance information. Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product. Maintenance instructions shall be furnished for equipment which requires preventive maintenance for efficient operation.

102.3 Fenestration product rating, certification and labeling. *U*-values of fenestration products (windows, doors and skylights) shall be determined in accordance with the National Fenestration Rating Council 100-91, *Procedure for Determining Fenestration Product Thermal Properties* (Standard RS-51) by an accredited, independent laboratory, and labeled and certified by the manufacturer. Such certified and labeled values shall be accepted for purposes of determining compliance with the building envelope requirements of this code.

When a manufacturer has not determined product *U*-value in accordance with NFRC 100-91 for a particular product line, compliance with the building envelope requirements of this code shall be determined by assigning such products a default *U*-value in accordance with Tables 102.3a and 102.3b. Product features must be verifiable for the product to qualify for the default value associated with those features. Where the existence of a particular feature cannot be determined with reasonable certainty, the product shall not receive credit for that feature. Where a composite of materials from two different product types are used, the product shall be assigned the higher *U*-value.

SECTION 103
ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

The provisions of this code are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the building official as meeting the intent of the code.

TABLE 102.3a
***U*-VALUE DEFAULT TABLE FOR WINDOWS, GLAZED DOORS AND SKYLIGHTS**

	SINGLE GLAZED	DOUBLE GLAZED
METAL WITHOUT THERMAL BREAK		
Operable	1.30	0.87
Fixed	1.17	0.69
Door	1.26	0.80
Skylight	1.92	1.30
METAL WITH THERMAL BREAK		
Operable	1.07	0.67
Fixed	1.11	0.63
Door	1.10	0.66
Skylight	1.93	1.13
METAL-CLAD WOOD		
Operable	0.98	0.60
Fixed	1.05	0.58
Door	0.99	0.57
Skylight	1.50	0.88
WOOD/VINYL		
Operable	0.94	0.56
Fixed	1.04	0.57
Door	0.98	0.56
Skylight	1.47	0.85

For SI: 1 inch = 25.4 mm.

Glass block assemblies shall have a *U*-value of 0.60.

TABLE 102.3b
***U*-VALUE DEFAULT TABLE FOR NONGLAZED DOORS**

	WITH FOAM CORE	WITHOUT FOAM CORE
STEEL DOORS ($1^3/_4$ INCHES THICK)	0.35	0.60
	WITHOUT STORM DOOR	WITH STORM DOOR
WOOD DOORS ($1^3/_4$ INCHES THICK)		
Panel with $^7/_{16}$-inch panels	0.54	0.36
Hollowcore flush	0.46	0.32
Panel with $1^1/_8$-inch panels	0.39	0.28
Solid core flush	0.40	0.26

For SI: 1 inch = 25.4 mm.

SECTION 104
PLANS AND SPECIFICATIONS

104.1 General. With each application for a building permit, and when required by the building official, plans and specifications shall be submitted. The building official may require that plans and specifications be prepared by an engineer or architect licensed to practice by the state. (Designs submitted under the provisions of Chapter 4 shall be prepared by an engineer or architect licensed to practice by the state.[1])

Exception: For one and two family dwellings and multifamily buildings having an area of 5,000 square feet (46 m^2) or less, designs submitted under the provisions of Chapter 4 may be prepared by anyone having qualifications acceptable to the building official.

104.2 Details. The plans and specifications shall show in sufficient detail pertinent data and features of the building and the equipment and systems as herein governed, including, but not limited to, design criteria, exterior envelope component materi-

[1]Shall be adopted when not in conflict with state practice acts.

12/7/00

TO: JAMES MILLS
FTC
DIV. OF ENFORCEMENT

FROM: IVAN SMITH

16 pgs.