Research Report

Evaluation of Reflective and Non-Reflective Airspaces for Energy Code and FTC R-value Rule Compliance

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About this Research Report:
Applied Building Technology Group (ABTG) is committed to using sound science and generally accepted engineering practice to develop research supporting the reliable design and installation of foam sheathing. ABTG's work with respect to foam sheathing is provided through a grant by the Foam Sheathing Committee (FSC) of the American Chemistry Council. Foam sheathing research reports, code compliance documents, educational programs and best practices can be found at www.continuousinsulation.org.

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Introduction:

The presence of an airspace enclosed within a building envelope assembly is known to contribute to the overall thermal performance of the assembly. But, the actual R-value of an airspace can vary significantly depending on various conditions of use, such as the air-tightness of the assembly of materials enclosing an airspace. While conventional “mass” insulation materials (e.g., fiberglass batts, cellulose, spray foam, or rigid foam boards) also have variable thermal performance depending on conditions of use, the degree of variability is generally much smaller and more tolerable from a design and code compliance standpoint.

The concern with variability and reliability of thermal performance applies to all types of airspaces, including those that use reflective materials adjacent to the airspace to achieve a higher R-value. Unfortunately, the important criteria or conditions of use are often overlooked or misunderstood, resulting in non-compliant applications of airspaces and potentially mischaracterized airspace R-values. This problem is particularly relevant to the use of reflective and non-reflective airspaces located behind typical exterior wall coverings which exhibit varying degrees of air-permeability and are often intentionally vented to promote air exchange for drying and water management purposes.[1] Consequently, such airspaces behind cladding are far from airtight and the rate of air-exchange in actual use can significantly erode claimed R-values which are based on conditions of an idealized (airtight) airspace. Where considered to be a “home insulation” product, false claims regarding R-values can result in civil penalties to manufacturers and contractors of as much as $11,000 per occurrence under the Federal Trade Commission’s (FTC) “R-value Rule” (FTC, 2005). Refer to Appendix A for an example of the FTC’s commitment to prosecute non-compliances and also letters of concern from EPA Energy Star regarding applications of reflective airspaces.

To help resolve the concerns described above, this research report reviews current technical knowledge and regulatory requirements in order to provide guidance for appropriate R-value characterization and limitations of use for airspaces within building assemblies for code compliance. It is based on a prior review of literature and deliberations regarding this matter which occurred under the purview of the Envelope Subcommittee of the ASHRAE 90.1 consensus standard committee (ASHRAE, 2013a). Many of the findings reported herein have contributed to improvements in the treatment and characterization of airspaces, including determination of R-values and limitations of use, now specified in the 2016 edition of the ASHRAE 90.1 standard.

Background:

ASHRAE Handbook of Fundamentals and Related Research

The magnitude of thermal resistance (R-value) provided by an airspace located within a building assembly depends on a number of factors including:

1. Size and orientation of the airspace
2. Shape of surfaces forming the airspace
3. Reflectivity (or emissivity) of the surfaces facing the airspace
4. For reflective airspaces, the durability and degree of fouling of the reflective surface over time.
5. Direction of heat flow relative to airspace orientation (i.e., seasonally changing heat flow direction up or down through a horizontal airspace)
6. Natural convection (movement of air within the airspace due to thermal gradients)
7. Mass air exchange with the airspace due to air leakage or venting of the airspace (caused by wind- and buoyancy-driven pressure differentials causing air to move into and out of the airspace).

The first six items in the list above can alter the R-value assigned to an air cavity by a factor of 4 or more based on the range of conditions represented in Figure 1. More significantly, the seventh item in the list relating to air exchange or air-tightness of the airspace can contribute to the loss of thermal performance such that the R-value of a typical airspace behind vinyl siding can be reduced by a factor of as much as 6, resulting in a tested (actual) R-value of only 15% of that reported in Figure 1 (Exova, 2011). Consequently, it is very important to properly characterize the R-value of an airspace and to construct it in a manner consistent with the conditions used to determine an R-value for energy code and regulatory compliance purposes. In most cases, the R-values reported for airspaces are based on and rely upon the construction of airspaces that permit essentially no air leakage to or from the airspace (e.g., airtight).

[1] Typical exterior wall coverings include brick veneer, vinyl siding, and various types of lap siding (fiber cement, wood, etc.).

Table 3 Effective Thermal Resistance of Plane Air Spaces,[a,b,c] h·ft²·°F/Btu

Position of Air Space	Direction of Heat Flow	Air Space Mean Temp.[d], °F	Air Space Temp. Diff.,[d] °F	Effective Emittance ε_{eff}[d,e] 0.5 in. Air Space[c] 0.03	0.05	0.2	0.5	0.82	0.75 in. Air Space[c] 0.03	0.05	0.2	0.5	0.82
…													
Vertical	Horiz. →	90	10	2.47	2.34	1.67	1.06	0.77	3.50	3.24	2.08	1.22	0.84
		50	30	2.57	2.46	1.84	1.23	0.90	2.91	2.77	2.01	1.30	0.94
		50	10	2.66	2.54	1.88	1.24	0.91	3.70	3.46	2.35	1.43	1.01
		0	20	2.82	2.72	2.14	1.50	1.13	3.14	3.02	2.32	1.58	1.18
		0	10	2.93	2.82	2.20	1.53	1.15	3.77	3.59	2.64	1.73	1.26
		–50	20	2.90	2.82	2.35	1.76	1.39	2.90	2.83	2.36	1.77	1.39
		–50	10	3.20	3.10	2.54	1.87	1.46	3.72	3.60	2.87	2.04	1.56
…													
		Air Space		1.5 in. Air Space[c]					3.5 in. Air Space[c]				
Vertical	Horiz. →	90	10	3.99	3.66	2.25	1.27	0.87	3.69	3.40	2.15	1.24	0.85
		50	30	2.58	2.46	1.84	1.23	0.90	2.67	2.55	1.89	1.25	0.91
		50	10	3.79	3.55	2.39	1.45	1.02	3.63	3.40	2.32	1.42	1.01
		0	20	2.76	2.66	2.10	1.48	1.12	2.88	2.78	2.17	1.51	1.14
		0	10	3.51	3.35	2.51	1.67	1.23	3.49	3.33	2.50	1.67	1.23
		–50	20	2.64	2.58	2.18	1.66	1.33	2.82	2.75	2.30	1.73	1.37
		–50	10	3.31	3.21	2.62	1.91	1.48	3.40	3.30	2.67	1.94	1.50

Figure 1. Vertical airspace R-values excerpted from Table 3 in Chapter 26 of the ASHRAE *Handbook of Fundamentals* (ASHRAE, 2013b).

The ASHRAE *Handbook of Fundamentals* (HOF) elaborates on the concerns mentioned above with the following statements regarding reflective insulation systems which rely on the presence of an airspace to control the portion of heat transfer associated with radiation:

> "…**air movement in and out of the enclosed space must be inhibited** or the reduction in radiative heat transfer will be overshadowed by airflow through the space." [p26.5]
>
> "…This includes **reflective surfaces behind siding, which should not be considered reflective insulation** (in most cases, heat transfer is dominated by wind-driven convection, rather than radiant exchange)." [p26.12]
>
> "…surface oxidation, dust accumulation, condensation, and other **factors that change the condition of the low-emittance surface can reduce the thermal effectiveness** (Hooper and Moroz, 1952)." [p26.5]
>
> [bolded text for added emphasis]

More importantly, Table 3 in Chapter 26 of the HOF (see Figure 1) provides tabulated R-values for reflective and non-reflective airspaces with the following qualifying footnote:

> "[b] Values based on data presented by Robinson et al. (1954) …Values apply for ideal conditions (i.e., air spaces of uniform thickness bounded by plane, smooth, parallel surfaces **with no air leakage to or from the space**) …" [p26.14]
>
> [bolded text for added emphasis]

Thus, airspaces with R-values determined in accordance with the HOF or ASHRAE 90.1 provisions should be contained within an essentially airtight enclosure or assembly. Furthermore, it is made clear that airspaces behind typical cladding materials and installations are not considered airtight. R-values for such airspaces must be determined by an appropriate test methodology representative of the conditions of use (more on this topic later).

As further confirmation to the guidance and cautions provided in the HOF, the primary source cited for the reflective and non-reflective airspace R-values reported in Figure 1 provides the following insights (Robinson and Powlitch, 1954):

> Regarding the limitations on applicability of the data, the report indicates "**no leakage of air into or out of the space**" [p14] and that "…**airspaces…may depart significantly from characteristics for which these data are pertinent…may not be completely sealed…heat transfer would be significantly greater**…" [p16].

> Regarding the test data and specimens used to develop the R-values for airspaces, "The faces of panels were made of 19-gage galvanized sheet steel…To **seal the airspaces**, several sheets were screwed to the frames over 1/16" felt strips glued to the wood." [p31]
>
> [bolded text for added emphasis]

Thus, it is clear that airspaces using the R-values provided in Table 3 (Chapter 26) of the HOF are intended to be essentially airtight (i.e., contained within a sealed enclosure made from air-impermeable materials).

As also referenced in the HOF, the study by Goss and Miller (1989) provides additional relevant observations:

> "The **airspaces are supposed to have no air leakage** to other airspaces and to the air located on either side of the building assembly." [p.651]
>
> "…the **inappropriate use of these tables can result in significant errors in predicting the thermal performance of reflective insulation systems**…" [p.657]
>
> "The conditions of application of the ASHRAE airspace R-values are the ideal conditions obtained under laboratory care, which **may not be practical to reproduce in the field during normal building construction with actual reflective insulation building products**." [p.657]
>
> "Use of the ASHRAE one-dimensional calculation methods along with the thermal resistance values for reflective airspaces were **found to over predict the measured thermal performance of the reflective insulation products by about 90% to 300%.**" [p.659]
>
> "…under many common conditions of use, **the aging of reflective insulation will be accompanied by a reduction in its insulating value.**" [p.660]
>
> [bolded text for added emphasis]

The over-prediction of measured thermal performance as mentioned above is corroborated by others (CCHRC, 2011):

> "…the calculation method presented in ASHRAE (2009) is **known to exaggerate the actual performance**…"
>
> [bolded text for added emphasis]

While only briefly mentioned above, aging or durability effects on the performance of reflective insulation systems is addressed in a study by the Oak Ridge National Laboratory (ORNL, 1983) which reports "…decreases in R-value of 10-30% for reflective foils that were found to have stains attributed to the presence of a film of water" [p.17]. For a more severe condition of exposure to an open attic space, a 20-fold increase in emissivity over a 3-year period was attributed to dust accumulation [p.20]. According to Saber (2012), a small increase in emissivity due to fouling of the reflective surface can have a disproportionately large effect on R-value of a reflective airspace. For example, a 20-fold increase in emissivity of the reflective material (from 0.03 to 0.6) can reduce the original (ideal) R-value of the reflective airspace to less than 50% of its original value. This effect is not linearly proportional. For example, a 10-fold increase in emissivity (from 0.03 to 0.3) reduces the R-value to 60% of its original (ideal) value.

To better understand the magnitude of air-leakage of airspaces behind cladding installations, a number of studies characterized the air-flow or air-exchange rate occurring behind actual cladding installations on buildings in the field. The primary interest in these studies was related to understanding the effect of ventilation rates behind cladding on the ability to control moisture and promote drying. A review of data from various studies on ventilation air flows in airspaces behind several types of claddings and installation methods indicates significant but highly variable air exchange rates (Straube and Finch, 2009, pp.6-7). Reported air-exchange rates for airspaces behind cladding varied from 0 to more than 400 ACH depending on a number of factors such as size of vent openings, depth of air-cavity, location of vent openings (top and bottom ventilation or vented only at the bottom), continuity of the vent openings (continuous or intermittent), wind speed conditions and orientation to the building, height of the airspace, temperature differentials, and solar radiation.

For claddings with continuous top and bottom vents with a bug screen, greater airspace ventilation rates occurred than observed for claddings with intermittent vent slots. Actual air exchange rates were also found to be reasonably predictable. For example, a ventilated stucco cladding with a ¾" air cavity demonstrated a typical average air change rate of 100 to 150 ACH (9 to 13 cm/s airflow velocity or 1.6 to 2.5 L/s-m volumetric airflow rate per meter of wall length, measured horizontally) with a minimum 0 ACH and a maximum of slightly more than 500 ACH (which occur infrequently). Conversely, a larger 1.5-in-thick air-cavity behind brick veneer with only intermittent vent slot openings with plastic bug screen inserts at every other brick head joint (top and bottom of the wall), demonstrated a typical average air change rate of 2 to 3 ACH (0.13 to 0.2 cm/s airflow velocity or 0.05 to 0.08 L/s-m volumetric flow rate per meter of wall length, measured horizontally). The presence of bug screens (vent opening obstructions) was noted as having potential to significantly reduce ventilation rates, by an order of magnitude. It was also reported that air-exchange rates for airspaces behind vinyl siding can be expected to experience volumetric air exchange rates in the range of 0.6 to 2.7 L/s-m^2 of vinyl siding surface area (which corresponds to a very large air change rate for typical vinyl siding profile depths).

The report by Straube and Finch (2009) also cites a study which measured ventilation air-flow rates in airspaces behind large cladding panels on a three story building. The hourly air-flow rates were measured between 5 cm/s and 15 cm/s when the building was exposed to wind speeds between 1 and 3 m/s (2.2 to 6.7 mph). These results also appear to be consistent with those reported above. Also, the authors promote increasing vent opening sizes and the airspace thickness to increase the ventilation airflow rate as a means of improving the drying and moisture management of walls constructed of moisture sensitive materials.

Straube and Burnett (1998) make the following assessment of literature on air-flow behind cladding:

> “A review of the literature, simple calculations, and field measurements of ventilation pressures (Straube and Burnett, 1995) show that the flow generated by typical driving pressures (1 to 2 Pascals) can be expected to be in the order of 0.2 – 2 m^3/h per m^2 of cladding depending on the vent area and the depth and degree of blockage of the air space. Field measurements of well-ventilated wall systems (vent areas of more than 1% of wall area) typically experience flow velocities of 0.05 to 0.2 m/s (Jung 1985, Popp et al 1980, Kuenzel et al 1983) although Schwarz (1973) and Uvslokk (1988) both found higher average velocities.”

Based on the above reviewed data, it appears that a typical (annual average) airflow velocity within or air change rate for an airspace behind cladding might differ by more than an order of magnitude depending on a number of factors relating to the restriction of air-flow (e.g., obstructions and vent opening conditions) and driving forces (e.g., wind pressure and buoyancy). This wide range of air change rates will effect significant differences in the ability of sidings and walls to dry after wetting episodes as well as the ability of the air-space to provide some level of thermal resistance for energy code compliance purposes. Thus, moisture control goals for venting exterior walls and the use of airspaces behind cladding for thermal control (R-value) present somewhat conflicting objectives. Improving the one necessarily reduces the other (except perhaps for conditions where siding is solar-heated in cooling-dominated climates). Interestingly, keeping bugs out of walls and maximizing air-space R-values seem to work hand in hand – obstructing inlet and outlet vents with bug screens (or inserts) appears to significantly reduce ventilation flow rates behind cladding which would improve the R-value of a ventilated airspace (but reduce drying ventilation effectiveness). Perhaps there is an optimal balance in these inter-related and competing objectives.

In accordance with the FTC R-value Rule requirements (addressed later), the ASTM C1363-11 (ASTM, 2011) test method has been used to benchmark the R-value of a reflective airspace behind vinyl siding on a typical wall assembly including 2x4 studs, fiberglass batt insulation, wood structural panel sheathing, a reflective insulation house wrap, and vinyl siding (Exova, 2011). The overall wall R-value test data is shown in the Table 1 for a sequence of conditions allowing the airspace R-value to be isolated.

Wall Assembly Description	Test No.	Uniform Exterior Air Velocity (ft/s)	Wall R-value (°F-ft²-hr/Btu)
OSB, R15 Batt, 2x4 studs at 16"oc, ½" GWB	1	9.0	11.82
Same as Test 1, except reflective insulation wrap included over OSB	2	9.0	12.78
Same as Test 2, except vinyl siding included over reflective wrap	3	9.0	13.12
	4	1.64	13.15
	5	18.0	13.18
Same as Test 1, except vinyl siding directly over OSB (no reflective wrap)	6	9.0	12.46
Note: Test data is reported to have a +/- 0.2R error band.			

Table 1: Overall Wall R-Value of a Sequence of Wall Assembly Conditions

The following findings are derived from the incremental wall assembly test data shown in Table 1:

1. The difference between test #1 and test #3 demonstrates that the R-value contribution of the reflective insulation wrap, airspace and vinyl siding is approximately R-1.3. This R-value suggests that the reflective airspace and vinyl siding contributed not more than about R-0.3 given that the reflective insulation wrap itself had a nominal mass R-value of about R-1.0 based on the difference between test #1 and test #2.

2. In tests #3 through #5, variation in exterior side uniform air-flow in the hot-box chamber has little effect on the measured thermal performance of the overall wall assembly (and thus the airspace R-value). This finding addresses a commonly misunderstood purpose for the airflow in the chamber of the ASTM C1363 test apparatus. This airflow is not an aerodynamic wind flow that induces pressure differences and air-exchange into and out of the assembly or through the cladding as would occur on an actual building exposed to wind. It merely creates a mixing effect and a standardized outdoor air-film condition on the surface of the tested assembly.

3. Based on the difference between test #1 and #6, the R-value of a non-reflective air-space and vinyl siding provides an R-value of about R-0.64. Evidently, the presence of a reflective surface in a very leaky air space provides little to no thermal benefit (see Item 1) relative to an air-space formed with non-reflective surfaces.

In comparison, the HOF reports an R-value of R-0.62 for hollow-backed vinyl siding over sheathing (see Figure 2 below) which is consistent with the ASTM C1363 test data reported above. However, the HOF also provides an R-value of R-2.96 for “foil-backed” vinyl siding (see Figure 2 below) which is inconsistent with the above test data. Evidently, it must be based on an idealized (airtight) airspace assumption that is not valid for a reflective airspace behind vinyl siding. Vinyl siding is known to be an air-permeable cladding by (1) its declaration as a “vented cladding” in Section R702.7 of the International Residential Code (IRC) (ICC, 2018a), (2) its use of pressure-equalized wind loads for design wind pressure ratings in accordance with ASTM D3679-13 (ASTM, 2013), and (3) general recognition of this same pressure-equalization effect for air-permeable claddings in the ASCE 7-10 (ASCE, 2010) wind load provisions (Section 30.1.5 and related commentary). Consequently, the R-value of R-2.96 for foil-backed vinyl siding appears to be an error and is likely based on calculations per the ASHRAE HOF with the unrealistic assumption of no air-leakage through the vinyl siding. Thus, use of this value should not be considered as consistent the technical intent of the FTC R-value Rule (FTC, 2005) and current U.S. model energy codes (ICC 2018a; ICC 2018b) which are addressed later.

Table 1 Building and Insulating Materials: Design Values[a] (*Continued*)

Description	Density, lb/ft^3	Conductivity[b] k, Btu·in/h·ft^2·°F	Resistance R, h·ft^2·°F/Btu	Specific Heat, Btu/lb·°F	Reference[l]
Hardboard siding .... 7/16 in.	—	—	0.15	0.35	
Wood, drop, 8 in. .... 1 in.	—	—	0.79	0.28	
Wood, bevel					
8 in., lapped .... 1/2 in.	—	—	0.81	0.28	
10 in., lapped .... 3/4 in.	—	—	1.05	0.28	
Wood, plywood, 3/8 in., lapped	—	—	0.59	0.29	
Aluminum, steel, or vinyl,[h, i] over sheathing				—	
hollow-backed	—	—	0.62	0.29[i]	
insulating-board-backed .... 3/8 in.	—	—	1.82	0.32	
foil-backed .... 3/8 in.	—	—	2.96	—	
Architectural (soda-lime float) glass	158	6.9	—	0.21	

Figure 2. Siding R-values excerpted from Table 1 in Chapter 26 of the ASHRAE *Handbook of Fundamentals* (ASHRAE, 2013b).

The ASTM C1363 test data presented in Table 1 also can be considered non-conservative (overstating the airspace R-value) because the test method does not include a means to address or induce ventilation airflow behind or through the siding layer. To address this shortcoming of the ASTM C1363 test method, one test project modified the ASTM C1363 test method to include a means of inducing a ventilation air-flow (i.e., 7 cm/s) in the 1-inch-thick airspace behind a typical brick veneer installation over an insulating building wrap material with a semi-reflective surface (ATI, 2009). Unfortunately, the analysis of the test data did not take into account the added heat flow path created by the enthalpy change of the induced ventilation air-flow entering and exiting the airspace behind the brick veneer. Even so, the test apparatus modification to induce ventilation air-flow behind the cladding appears workable as an appropriate means to qualify airspace R-values. But, the 7 cm/s airflow rate may be non-conservative or conservative for different variations of cladding materials and installation (venting) methods as reviewed earlier in this research report.

An ASHRAE research project is currently under development to address an appropriate means of using the ASTM C1363 test method (or similar test method) to assess the R-value of ventilated airspaces behind cladding. However, as currently written, the ASTM C1363 test method does not include appropriate means to address typical airspaces behind claddings that, necessarily and for practical reasons, do not provide an airtight enclosure of the airspace. Thus, it may be advisable for the time being to assign an R-value of zero (0) to such airspaces as also recommended by the HOF for similar non-ideal airspace conditions. Alternatively, an indoor air-film value of approximately 0.6 R could be assigned as a "default" R-value for vented and ventilated airspaces behind cladding with the cladding material R-value and exterior air-film R-value ignored (since a ventilated airspace will tend to thermally disconnect the cladding from the remainder of the wall assembly).

Review of Regulatory Requirements

C303.1.4 Insulation product rating.

The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (CFR Title 16, Part 460) in units of h • ft^2 • °F/Btu at a mean temperature of 75°F (24°C).

C303.1.4.1 Insulated siding.

The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C1363. Installation for testing shall be in accordance with the manufacturer's instructions.

The International Energy Conservation Code (IECC) and the International Residential Code (IRC) similarly address requirements for insulation materials as follows (ICC 2018a; ICC 2018b):

While only the Federal Trade Commission can enforce the civil penalties associated with the FTC "R-value Rule" for home insulation products, the IECC and IRC reference the FTC R-value Rule as the basis for insulation R-value requirements for use in commercial and residential building construction. Prior to 2018, the IECC and IRC do not have any additional requirements specifically related to the treatment of airspaces when used to contribute to the thermal resistance of a building assembly. Therefore, it is important to understand the requirements of the FTC R-value Rule as relevant to qualification of airspace R-values:

I. Introduction

The R-value Rule specifies substantiation and disclosure requirements for thermal insulation products used in the residential market, and <u>prohibits certain claims unless they are true</u>…

II. Overview of the Rule

A. Products Covered

The R-value Rule covers all "<u>home insulation products</u>."…Reflective insulations (primarily aluminum foil) reduce heat transfer <u>when installed facing an airspace</u>…

B. Parties Covered

The Rule applies to home insulation manufacturers, professional installers, retailers who sell insulation to consumers for do-it-yourself installation, and new home sellers (including sellers of manufactured housing). It also applies to testing laboratories that conduct R-value tests for home insulation manufacturers or other sellers who use the test results as the basis for making R-value claims about home insulation products.

C. Basis for the Rule

The Commission issued the R-value Rule to prohibit, on an industry-wide basis, <u>specific unfair or deceptive acts or practices</u>…

§ 460.1 What this regulation does.

This regulation deals with home insulation labels, fact sheets, ads, and other promotional materials in or affecting commerce, as ''commerce'' is defined in the Federal Trade Commission Act. If you are covered by this regulation, breaking any of its rules is an unfair and deceptive act or practice or an unfair method of competition under section 5 of that Act. <u>You can be fined heavily (up to $11,000 plus an adjustment for inflation, under § 1.98 of this chapter) each time you break a rule</u>.

§460.5 R-value tests.

(a) All types of insulation except aluminum foil must be tested with ASTM C177-04…ASTM C518-04…ASTM C1363-97…or ASTM C1114-00…The tests must be done at a mean temperature of 75 [degrees] Fahrenheit and with a temperature differential of 50 [degrees] Fahrenheit plus or minus 10 degrees Fahrenheit. The tests must be done on the insulation material alone (excluding any airspace) …

(b) Single sheet systems of aluminum foil…To get the R-value for a specific emissivity level, air space, and direction of heat flow, use the tables in the most recent edition of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) Fundamentals Handbook, if the product is intended for applications that meet the conditions specified in the tables.

(c) Aluminum foil systems with more than one sheet, and single sheet systems of aluminum foil that are intended for applications that do not meet the conditions specified in the tables in the most recent edition of the ASHRAE Fundamentals Handbook, must be tested with ASTM C 1363–97, ''Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus,'' in a test panel constructed according to ASTM C 1224–03, ''Standard Specification for Reflective Insulation for Building Applications,'' and under the test conditions specified in ASTM C 1224–03. To get the R-value from the results of those tests, use the formula specified in ASTM C 1224–03.

(d) For insulation materials with foil facings, you must test the R-value of the material alone (excluding any air spaces) under the methods listed in paragraph (a) of this section. You can also determine the R-value of the material in conjunction with an air space. You can use one of two methods to do this:

(1) You can test the system, with its air space, under ASTM C1363-97….
(2) You can add up the test R-value of the material and the R-value of the air space. To get the R-value of the air space, you must follow the rules in paragraph (b) of this section.

[underlining added for emphasis]

Based on the above excerpts from the FTC R-value Rule, the R-value of a reflective airspace can use the tabulated R-value in the HOF only if the air-space meets the conditions specified in the HOF tables (see previous review of conditions associated with the HOF tables including "uniform thickness bounded by plane, smooth, parallel surfaces with no air leakage to or from the space"). If the airspace does not meet these conditions, then it must be tested in accordance with ASTM C 1363 under test conditions specified in ASTM C 1224 and the R-value determined using the formula specified in ASTM C 1224. Based on data previously reviewed in this research report, it is clear that airspaces behind many typical cladding types do not comply with conditions specified in the tables of the HOF. Also, the ASTM C 1224 standard only addresses the use of reflective insulation products in the cavity of a wood frame wall. As mentioned previously, the ASTM C 1363 test method does not include a means to address air-flows in vented or ventilated airspaces behind cladding materials. Therefore, the R-value of reflective airspaces behind cladding cannot be appropriately assessed within the current scope of application of the HOF tables, ASTM C 1363, and ASTM C 1224. The same concern also applies to non-ideal and non-reflective airspaces (although these airspaces inherently have lower R- value). But, the FTC R-value Rule does not address this condition because the R-value of a non-reflective airspace is not associated with an insulation material per se.

For commercial building energy efficiency, the 2018 IECC now offers guidance on the use of airspaces to comply with Section C401.2, and addresses the limitation of the ASTM C1363 test with regard to airspaces behind cladding materials by modifying the test to incorporate an airflow of 70 mm/second through the airspace:

C402.2.7 Airspaces.

Where the thermal properties of airspaces are used to comply with this code in accordance with Section C401.2, such airspaces shall be enclosed in an unventilated cavity constructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized where the enclosed airspace is located on the interior side of the continuous air barrier and is bounded on all sides by building components.

Exception: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace at an air movement rate of not less than 70 mm/second.

Previous versions of the IECC also reference the ASHRAE 90.1 standard as an optional compliance path in Chapter 4 as follows:

> **C401.1 Scope.**
>
> The provisions in this chapter are applicable to commercial *buildings* and their *building sites*.
>
> **C401.2 Application.**
>
> Commercial buildings shall comply with one of the following:
>
> 1. The requirements of ANSI/ASHRAE/IESNA 90.1.
> 2. The requirements of Sections C402 through C405 and C408. In addition, commercial buildings shall comply with Section C406 and tenant spaces shall comply with Section C406.1.1.
> 3. The requirements of Sections C402.5, C403.2, C403.3 through C403.3.2, C403.4 through C403.4.2.3, C403.5.5, C403.7, C403.8.1 through C403.8.4, C403.10.1 through C403.10.3, C403.11, C403.12, C404, C405, C407 and C408. The building energy cost shall be equal to or less than 85 percent of the standard reference design building.

Thus, in addition to the FTC R-value Rule requirements (referenced in Chapter 3 of the IECC and not relegated to compliance with ASHRAE 90.1), buildings designed in accordance with ASHRAE 90.1-2013 also must comply with the following specific requirements for airspaces in Appendix A of ASHRAE 90.1 (as modified by Addendum ac for the 2016 edition):

Addendum ac to Standard 90.1-2013

Modify Appendix A as follows, renumbering subsequent sections where applicable (I-P and SI).

A9.4 Calculation Procedures and Assumptions. The following procedures and assumptions shall be used for all calculations. R-values for air films, airspaces, insulation, and building materials shall be taken from Sections A9.4.1 through A9.4.~~3~~4, respectively. In addition, the appropriate assumptions listed in Sections A2 through A8, including framing factors, shall be used.

[. . .]

A9.4.1.3 Interior surfaces are surfaces within enclosed spaces.

A9.4.1.4 ~~The R-value for cavity airspaces shall be taken from Table A9.4A based on the emissivity of the cavity from Table A9.4B. No credit shall be given for airspaces in cavities that are less than 0.5 in. The values for 3.5 in. cavities shall be used for cavities of that width and greater.~~

A9.4.2 Airspaces. The R-value for airspaces shall be taken from Table A9.4.2-1 based on the effective emittance of the surfaces facing the airspace from Table A9.4.2-2 provided the following criteria are satisfied:

a. The airspace shall be an enclosed and unventilated cavity designed to minimize airflow into and out of the enclosed air space. Airflow shall be deemed minimized when the enclosed airspace is located on the interior of the continuous air barrier and bounded on all sides by building components.

b. Reflective insulation as defined in ASTM C1224, where used, shall be fitted closely around all non-heat producing components and taped or otherwise sealed to eliminate gaps or voids through which air, dust, or water vapor has the potential to pass.

c. Nonparallel spaces shall use the average distance to determine the thickness of the airspace.

d. Airspaces less than 0.5 in. (13 mm) thickness shall have no R-value.

e. The R-value for 3.5 in. (89 mm) airspaces shall be used for airspaces of that thickness or greater provided that airspace does not exceed 12 in. (300 mm) between the surfaces at any point.

For material emissivity properties not listed in Table A9.4.2-2, Equation A9.4.2 shall be permitted to calculate the effective emissivity for the airspace.

$$1/e_{eff} = 1/e_1 + 1/e_2 - 1 \qquad \text{(A9.4.2)}$$

where

e_{eff} = effective emittance for the airspace

e_1 = surface 1 emittance

e_2 = surface 2 emittance

TABLE A9.4.2-1 Values For Cavity Air Spaces[a]

Component	Airspace Thickness, in.	Climate Zone 1 Effective Emittance				Climate Zone 2 Effective Emittance				Climate Zone 3 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	0.50	2.5	1.9	1.2	0.9	2.4	1.8	1.2	0.9	2.2	1.7	1.1	0.9
	0.75	3.5	2.4	1.4	1.0	3.2	2.2	1.4	1.0	2.8	2.0	1.3	0.9
	1.50	5.6	3.1	1.7	1.1	4.9	2.9	1.6	1.1	4.2	2.5	1.5	1.0
	3.50	8.0	3.8	1.9	1.2	7.0	3.4	1.7	1.1	5.9	3.0	1.6	1.1
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9
Floor	0.50	1.6	1.3	1.0	0.8	1.8	1.4	1.0	0.8	1.9	1.5	1.1	0.8
	0.75	1.7	1.4	1.0	0.8	2.0	1.5	1.1	0.8	2.4	1.7	1.2	0.9
	1.50	1.9	1.5	1.1	0.8	2.5	1.8	1.2	0.9	3.2	2.1	1.3	0.9
	3.50	2.1	1.6	1.1	0.8	3.2	2.0	1.2	0.9	4.3	2.4	1.4	1.0

Component	Airspace Thickness, in.	Climate Zone 4 Effective Emittance				Climate Zone 5 Effective Emittance				Climate Zone 6 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	0.50	2.0	1.6	1.1	0.8	1.9	1.5	1.1	0.8	1.8	1.4	1.0	0.8
	0.75	2.5	1.8	1.2	0.9	2.3	1.7	1.1	0.9	2.1	1.6	1.1	0.8
	1.50	3.5	2.2	1.3	0.9	3.1	2.0	1.3	0.9	2.8	1.9	1.2	0.9
	3.50	4.7	2.6	1.4	1.0	4.1	2.4	1.4	1.0	3.6	2.2	1.3	0.9
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9
Floor	0.50	2.1	1.6	1.1	0.8	2.2	1.7	1.1	0.9	2.3	1.7	1.2	0.9
	0.75	2.7	1.9	1.2	0.9	2.9	2.0	1.3	0.9	3.1	2.1	1.3	1.0
	1.50	3.9	2.4	1.4	1.0	4.3	2.6	1.5	1.0	4.7	2.7	1.5	1.1
	3.50	5.5	2.9	1.5	1.1	6.0	3.1	1.6	1.1	6.6	3.3	1.7	1.1

Component	Airspace Thickness, in.	Climate Zone 7 Effective Emittance				Climate Zone 8 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	0.50	1.8	1.4	1.0	0.8	1.6	1.3	1.0	0.8
	0.75	2.0	1.6	1.1	0.8	1.8	1.4	1.0	0.8
	1.50	2.6	1.8	1.2	0.9	2.1	1.6	1.1	0.8
	3.50	3.2	2.0	1.3	0.9	2.4	1.7	1.2	0.9
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9
Floor	0.50	2.3	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	3.2	2.2	1.4	1.0	3.4	2.3	1.4	1.0
	1.50	4.9	2.8	1.6	1.1	5.4	3.1	1.7	1.1
	3.50	6.9	3.4	1.7	1.1	7.7	3.7	1.8	1.2

a. Interpolation shall be permitted to be used for effective emittance values and airspace thicknesses between those listed. Extrapolation below an effective emittance of 0.05 is not permitted.

It is interesting to note that ASHRAE 90.1 provides R-values for airspaces that are not entirely consistent with the HOF tables for roof and floor applications (horizontal airspaces). This inconsistency is due to a blending of heat flow directions and associated R-values by weighting them based on cooling and heating degree day values associated with the climate zones as shown in the ASHRAE 90.1 table above. Thus, it could be viewed as conflicting with the FTC R-value Rule which is referenced in Chapter 3 of the IECC whereas ASHRAE 90.1 is referenced only as an alternative to Chapter 4 of the IECC. Consequently, the FTC R-value Rule's requirements may override the above ASHRAE 90.1 tables requiring use of the HOF tables instead. This concern seems to apply only in cases where the use of ASHRAE 90.1 is invoked through the IECC as an alternative path of compliance for commercial building energy efficiency (it would not apply where ASHRAE 90.1 is adopted as a stand-alone regulation for commercial building energy efficiency). This is a matter of local energy code administration and enforcement. The FTC has no jurisdiction over insulation materials when used in commercial building applications.

For wall applications (vertical airspaces), the values in the ASHRAE 90.1 table above do not vary by climate zone because the inward and outward heat flow directions in different seasons of the year do not change the convective conditions within the airspace. Except for rounding, they are consistent with the 50ºF mean temperature and 30ºF temperature differential condition in the HOF tables (see Figure 1). This is the condition that most closely (not exactly) agrees with the 75ºF mean temperature and 30ºF temperature difference required by the FTC R-value Rules' reference to the ASTM C 1224 standard for reflective airspace R-value test conditions.

Setting aside the potential regulatory conflicts described above, the ASHRAE 90.1 standard does provide relevant limitations on the use of the tabulated R-values for airspaces provided in Table A9.4.2-1. These limitations or conditions are listed in Section A9.4.2 above. While condition 'a.' in Section A9.4.2 is not as stringent as the HOF's limitation of "no air leakage", it does require the airspace to be fully enclosed in such a manner as to "minimize" air-leakage. It also gives a deemed-to-comply solution whereby the airspace must be enclosed on all six sides with building components and located on the interior side of the continuous air-barrier. Thus, similar to the HOF, airspaces located behind cladding materials (and outbound of the continuous air barrier layer within the wall assembly) are not permitted to use the R-values in Table A9.4.2-1. Again, appropriate testing must be conducted to determine and R-value for such airspaces as also required by the FTC R-value Rule.

Analysis:

The review of technical literature and regulatory requirements reveals a tangled and somewhat incomplete web of requirements regarding the treatment of reflective and non-reflective airspaces for energy code and FTC R-value Rule compliance. In one sense, the evidence indicates that under ideal conditions, airspaces are able to contribute to the thermal performance of building assemblies, even though the contribution is dynamic (e.g., can vary significantly depending on a number of physical and temporal factors). This has been known for many decades. However, it has become more evident in recent studies that departures from an "ideal" airspace condition can have significant impacts on thermal performance, particularly for airspaces behind cladding materials (or in other similar conditions subject to significant air exchange). Yet, many applications of non-ideal airspaces still errantly rely on ideal airspace assumptions to derive R-values for energy code compliance.

This analysis section attempts to clarify and tabulate regulatory requirements, including recommendations for conditions where requirements may be vague, conflicted, or absent in current regulatory instruments. Any recommendation included herein is intended to be consistent with the review of the relevant technical literature and regulatory requirements provided in the previous section of this research report. The reader is encouraged and cautioned to make their own independent assessment and seek qualified counsel, particularly in regard to technical information and legal implications regarding compliance with the FTC R-value Rule and locally applicable energy code requirements for determination of R-values for airspaces.

Based on the findings of this research report, the following step-by-step guidance is provided as an aid to properly characterizing airspace R-values in a manner that may be considered to be consistent with the technical data and regulatory instruments reviewed in this research report.

STEP 1) Determine the Type of Airspace:

A) **Ideal Airspace**: An airspace as describe in the ASHRAE *Handbook of Fundamentals*, Chapter 26 (and Table 3, footnote 'b') having a uniform thickness bounded by plane, smooth, parallel surfaces with no air leakage to or from the space (e.g., a sealed airspace).

B) Enclosed Airspace (non-ideal):

a. **Case 1 (minimized air leakage):** An airspace enclosed in an unventilated cavity located on the interior side of the continuous air barrier and bounded on all six sides by building components to minimize airflow into and out of the enclosed airspace (based on ASHRAE 90.1-2013 with Addendum ac or ASHRAE 90.1-2016 Section A9.4.2). Airspaces with non-parallel surfaces (non-uniform thickness) shall use the average distance between bounding surfaces to determine the thickness of the airspace.

b. Case 2 (uncontrolled air leakage): An airspace which does not qualify as an ideal airspace or which does not minimize air leakage (Case 1). Examples include airspaces in cavities that are located behind or underneath cladding materials and which are subject to intentional or uncontrolled airflow caused by wind and buoyancy effects acting on vented, ventilated, or air-permeable claddings, and other similar conditions.

STEP 2) Determine the R-value for the Type of Airspace:

A) Ideal Airspace R-value:

a. For ideal airspaces of 1/2-inch thickness or greater, determine the R-value for the airspace (including R-values for different directions of heat flow as applicable to horizontal airspaces) in accordance with ASHRAE *Handbook of Fundamentals* (Chapter 26), Tables 2 and 3. Unless use conditions dictate otherwise, the R-values shall be based on a mean temperature of 50ºF and temperature difference of 30ºF.[2]

b. For ideal airspaces of less than ½-inch thickness or otherwise not complying with ideal airspace conditions, one of the following two methods shall be used:

   i. Testing – The ideal airspace R-value shall be derived from testing in accordance with ASTM C 1363. For reflective ideal airspaces, the application of the ASTM C 1363 test method shall comply with conditions and formula specified in ASTM C 1224 (e.g., 75ºF mean temperature and 30ºF temperature difference). For horizontal airspaces, testing shall include upward and downward heat flow directions to determine R-values accordingly.

   ii. Calculation – The ideal airspace R-value shall be calculated in accordance with equations in Chapter 4 of the ASHRAE *Handbook of Fundamentals* for combined radiation and convection for heat flow directions and temperature conditions applicable to the end use conditions.

B) Enclosed Airspace R-value:

a. **Case 1 (minimized air leakage)** – One of the following two methods shall be used:

   i. **Prescriptive** – Determine the R-value in accordance with ASHRAE Standard 90.1-2013 (with Addendum ac) or ASHRAE 90.1-2016 Section A9.4.2. Airspaces less than ½-inch thick shall have no R-value. The R-value for 3.5-inch thick airspaces shall be used for airspaces of greater thickness provided the airspace thickness does not exceed 12 inches.

   ii. **Testing** – The airspace R-value shall be derived from testing in accordance with ASTM C 1363. For reflective airspaces, the application of the ASTM C 1363 test method shall comply with conditions and formula specified in ASTM C 1224 (e.g., 75ºF mean temperature and 30ºF temperature difference). For horizontal or sloped airspaces (reflective or non-reflective), testing shall include upward and downward heat flow directions to determine R-values accordingly. A single "effective" R-value for energy code compliance purposes shall be permitted to be derived based on weighting of the R-values for different heat flow directions by the relative magnitude of heating and cooling degree days within each climate zone of ASHRAE 90.1 (refer to Table A9.4.2-1 for benchmark example of this weighting procedure resulting in different airspace R-values for horizontal airspaces in different climate zones).

b. **Case 2 (uncontrolled air leakage)** –

   i. **Prescriptive** – The airspace R-value and the R-value of any material such as cladding to the exterior side of the airspace shall be taken as zero (0). An exterior air-film R-value shall be permitted to be applied.

   ii. **Testing** – The airspace R-value shall be determined in accordance with ASTM C 1363 modified with an air-flow entering the bottom and exiting the top of the airspace. The minimum air-movement rate shall be 3 cm/s for claddings installed in end use with bottom vents only including bug screens or other obstructions in the vent openings; 7 cm/s for claddings with intermittent top and bottom vents including bug screens or other similar obstructions in the vent openings or in the airspace; and 15 cm/s for all claddings having continuous top and bottom vents or claddings that are air-permeable (e.g., distributed ventilation through ports or unsealed seams). The air flow rate and temperature shall be monitored during testing and the enthalpy change of the ventilation air shall be incorporated in the analysis of the R-value of the overall assembly. Where the airspace R-value is to be

[2] The 50ºF mean temperature is stated here for use with Tables in ASHRAE Handbook of Fundamentals which do not include air-space R-values associated with a 75ºF mean temperature as required in ASTM C1224 and referenced by the FTC R-value rule.

reported separately, an additional test shall be conducted without the airspace in such a manner that the difference in results is associated with the thermal contribution of only the airspace or the airspace in combination with a specific cladding material.[3]

Conclusion:

As shown in this research report, many variables and conditions affect the R-value of airspaces. Airspace R-values can vary substantially from those published in ASHRAE *Handbook of Fundamentals*, which are based on idealized conditions of uniform air space thickness, smooth surfaces, and no air leakage to or from the airspace. However, recent advancements in the ASHRAE 90.1 standard have begun to recognize these limitations or use conditions and their effect on the applicability of idealized airspace R-values. This research report has reviewed various sources of technical data and regulatory requirements to better document the implications and recommend appropriate considerations and methods for determining airspace R-values. Toward that end, a step-by-step procedure for identifying the type of airspace has been coupled with appropriate means of determining R-values for various types of airspaces, particularly in relation to air leakage conditions. This information is provided with the intent of fostering appropriate qualification and use of airspaces for energy code and FTC R-value Rule compliance purposes.

[3] An ASHRAE research project is under development to provide a recommended testing approach and criteria for enclosed airspaces described as Case 2 (uncontrolled air leakage) as described herein

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Appendix A:
FTC R-value Rule Enforcement Example & EPA Notices

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R-you up on the R-value Rule?

By: Lesley Fair | Jan 31, 2013 1:00PM

TAGS: Real Estate and Mortgages | Consumer Protection | Advertising and Marketing | Environmental Marketing

It's the time of year when some people are crooning "Baby, it's cold outside." Whether it's winter or summer, proper insulation can keep things comfortable. But how are consumers supposed to make heads or tails of competing claims when buying insulation? That's where the R-value Rule comes in.

The Rule requires insulation manufacturers and sellers to disclose the performance of their products, based on uniform testing procedures. That gives people the apples-to-apples benchmarks they need to comparison shop. If you or your clients are involved in the industry, you'll want to find out more about the government's first litigated case involving deceptive claims for insulation — and the largest ever R-value Rule civil penalty.

When you say insulation, most people think of the fluffy stuff. But under the names Thermalkool, Thermalcool, and Energy Conservation Specialists, Florida-based Edward Sumpolec sold two different types of insulation: liquid coatings, which are applied to surfaces with a roller or paint brush, and foil radiant barriers, long sheets that can be applied in attics. His claims were eye-catching: "Saves 40 to 60% on your energy bills," "This . . . reflective coating will reduce wall and roof temperatures by 50-95 degrees," "Stops 98% of radiant heat," and "4 layered coating system . . . equals R-100 insulating value." Too bad he didn't have proof to back up those promises.

You'll want to check the complaint for details, but the case alleged violations of the FTC Act and the R-value Rule for false and unsubstantiated energy savings and performance claims. The complaint also said the defendant failed to give consumers fact sheets the Rule requires. In addition, claims for the defendant's coating products weren't based on test procedures mandated by the Rule and he failed to make necessary disclosures — for example, the type and thickness of coating needed to get the advertised R-value.

Acting on the FTC's referral, the Department of Justice filed suit against the defendant in 2011. The latest development: a civil penalty of $350,000.

The messages for businesses that manufacture or sell insulation: Energy costs make up a hefty part of every household budget. That's why the FTC takes the R-value Rule seriously. If you haven't reviewed your legal obligations for a while, now's the time for a compliance warm-up. Are your claims substantiated? Do you follow the test procedures in the Rule? Are you keeping the necessary records? Are you making required disclosures clearly and conspicuously? Are you following the requirements about fact sheets? Those are just some of the questions to ask yourself.

The case offers another important insight regardless of your line of work. Consumer protection law enforcers take their responsibilities seriously. It's great if an appropriate settlement can be reached without litigation. But if that proves impossible, they're not afraid to present their evidence in court.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF AIR AND RADIATION

Climate Protection Partnerships Division
U.S. EPA 6202J
Washington, DC 20460

April 6, 2015

Dear Reflective Insulation Manufacturer or Interested Party:

In September 2011, the U.S. Environmental Protection Agency (EPA) finalized new participation requirements for the 'Seal and Insulate with ENERGY STAR®' Program for insulation products. Since the implementation of these requirements, several key issues have emerged regarding reflective insulation products that have prompted the EPA to reconsider the applicability of these products within the scope of 'Seal and Insulate with ENERGY STAR.'

These issues include:

- To date, no reflective insulation manufacturer has met the certification requirements for the 'Seal and Insulate with ENERGY STAR' program for any of their products.
- Manufacturers have had a difficult time showing how reflective insulation products can meet building codes as a stand-alone product or integrated into a whole wall, ceiling, roof deck, or floor system insulation strategy.
- Manufacturers claim their products can be used in applications which EPA does not certify. Those uncertified applications may lead consumers to be misled into thinking the products were certified though the EPA recognized certification body for those non-certified applications.

As a result of these concerns, the EPA is considering the removal of reflective insulation from the 'Seal and Insulate with ENERGY STAR' Program and adding it to the list of Excluded Products. The definition of reflective insulation and the list of Excluded Products used by EPA for this program can be found in the "Seal and Insulate with ENERGY STAR Definitions and Testing Requirements."

The EPA invites stakeholders to provide feedback on the issues it described above and whether it should proceed in excluding this product category.

Please submit your comments, supporting information, and relevant data to EPA via email at insulation@energystar.gov. All comments must be received by EPA no later than April 24, 2015.

Thank you for your continued support of the ENERGY STAR program.

Sincerely,

Doug Anderson
Manager, Seal and Insulate with ENERGY STAR Program
U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

March 26, 2012

Dear Radiant Barrier Manufacturer or Interested Party:

In September of 2011, the U.S. Environmental Protection Agency (EPA) finalized new participation requirements for the 'Seal and Insulate with ENERGY STAR' Program for insulation products. During its development, several key issues were raised about radiant barrier products, which have resulted in the exclusion of these products from the new scope of the 'Seal and Insulate with ENERGY STAR' program. These issues include:

- Radiant barrier products, as defined by EPA in the "Seal and Insulate with ENERGY STAR Definitions and Testing Requirements Version 1.0," are not included as a home insulation product in the Federal Trade Commission (FTC) Code of Federal Regulation (CFR) Part 460 "Labeling and Advertising Home Insulation."
- By definition, radiant barrier products do not have an R-value since, for residential applications, they are typically installed in open air spaces like attics, which have significant convective air movement that is difficult to quantify.
- The terms "seal" and "insulate" are not appropriate when applied to radiant barrier products because they are neither sealed nor assigned an R-value.
- Currently, there is no explicit guidance on the effective use of radiant barriers in the International Energy Conservation Code (IECC).
- The cost effectiveness of radiant barrier products is highly variable across climate zones and across various installation scenarios. EPA has not yet developed a way to communicate clearly to consumers the situations in which the product has cost effective benefits within a national program framework.

Note: Reflective insulation products, which are installed in enclosed air spaces (and have very limited but definable air movement), will continue to be included in the program. EPA understands that products are sometimes marketed as both radiant barrier and reflective insulation, as defined in the "Seal and Insulate with ENERGY STAR Definitions and Testing Requirements Version 1.0." In this case, the manufacturer may reapply to participate in the program as a reflective insulation manufacturer and will be required to limit association of the ENERGY STAR (ES) graphics to only the reflective insulation applications.

Although EPA was not able to include radiant barrier products at this time, EPA will continue to work with stakeholders to develop educational and promotional messaging that makes sense for the program.

Due to these unresolved issues, as of May 23, 2012, EPA requires that manufacturers end the labeling of radiant barrier products. All manufacturers labeling radiant barrier products must take the following actions:

- Stop printing any ENERGY STAR logo or graphic on any newly manufactured radiant barrier products or newly printed marketing materials. Manufacturers may continue to use up existing products and materials with the label. Labeled products manufactured before May 23, 2012 do not have to be disposed of. If a manufacturer has a large stockpile or warehouse of products that will not be sold or used by May 23, 2012, EPA suggests stopping the labeling of products immediately.
- Remove references to ENERGY STAR or ENERGY STAR radiant barrier products from all websites.
- Stop using the ENERGY STAR partner mark in reference to the company in marketing materials or on the web. (Manufacturers who make other ENERGY STAR insulation products may continue to use the ENERGY STAR partner logo after May 23, 2012 only once they have met the new participation requirements.)

NOTE: All insulation manufacturers who were previously partnered with the program are currently designated as "inactive" partners as of September 23, 2011, and therefore, are no longer listed in the public database of active partners.

You can find past Webinars explaining the overall changes to the program here, as well as the Seal and Insulate with ENERGY STAR Launch Memo and Definitions and Testing Requirements Version 1.0 released on September 26, 2011.

Radiant Barriers and the ENERGY STAR New Homes Program:

Radiant barriers are referenced in the ENERGY STAR Qualified Homes Version 3 (Rev 5) National Program Requirements. Radiant barriers are listed in the document as an option to meet an ENERGY STAR program requirement to help cool attics containing air ducts in IECC climate zones 1, 2, or 3.

Radiant barrier manufacturers may promote this fact and use the words "ENERGY STAR®" in text referencing the ENERGY STAR Qualified Homes program as long as the text clearly references what section of the Qualified Homes requirements they are referring to, such as:

> "The <*Radiant barrier product*> made by <*manufacturer name*> is designed to meet the Prescriptive Path requirement for homes in IECC Climate Zones1-3 that have more than 10 linear feet of ductwork located in an unconditioned attic. See Exhibit 1 of the *ENERGY STAR Qualified Homes, Version 3 (Rev 05) National Program Requirements* at www.energystar.gov/newhomesguidelines."

Since radiant barriers are no longer an ENERGY STAR product, manufacturers may not use any ENERGY STAR logos, marks, or graphics to promote such products.

Please send any questions or requests for assistance to insulation@energystar.gov.

Thank you for your continued support of the ENERGY STAR program.

Sincerely,

Doug Anderson
EPA Project Manager
Seal and Insulate with ENERGY STAR

