



Town of Canton, Massachusetts

BUILDING DEPARTMENT

LOWER LEVEL MEMORIAL HALL

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BUILDING COMMISSIONER

EDWARD T. WALSH

BUILDING DIVISION
ELECTRICAL DIVISION
PLUMBING/GAS DIVISION

STOVE INSTALLATION

These are the installation clearances as required by the Uniform Building Code of this Commonwealth. There is a building permit requirement, together with a fee of \$25.00.

A stove purchased after January 1, 1980 requires that it be tested and accepted by an approved agency.

Once the stove is installed according to the proper requirements, contact the Building Department for an inspection prior to lighting the stove.

A handwritten signature in black ink, appearing to read "Edward T. Walsh".

Edward T. Walsh
Building Commissioner



Mitt Romney
Governor

Kerry Healey
Lieutenant Governor

The Commonwealth of Massachusetts

Department of Public Safety

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Edward A. Flynn
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SUMMARY OF REQUIREMENTS FOR THE INSTALLATION AND USE OF WOOD-BURNING STOVES AND OTHER SOLID FUEL- BURNING HEATING APPLIANCES

Given the expected demands on fossil fuels (oil and gas) for the 2005 – 2006 winter heating season, it is anticipated that many Massachusetts homeowners may seek to supplement the heating of their homes by using wood or other solid fuels this winter. Remember, you are bringing FIRE into your home by installing a solid fuel-burning appliance. **It is recommended that smoke detectors and carbon monoxide (CO) detectors be installed prior to use.**

This information is intended for those who are considering using solid fuel-burning equipment and fireplaces to heat their homes. While specific sections of the Massachusetts State Building Code (780 CMR) are identified for informational use only, this Fact Sheet should not be used as a substitute for all applicable requirements of the Building Code or the Appliance Manufacturer's installation, operation and maintenance requirements.

General Requirements

Solid fuel-burning appliances include: factory-built fireplaces, coal-burning appliances, wood stoves, wood pellet stoves, corn and nut shell-burning pellet stoves, wood-fired boilers and any other solid fuel-burning appliance intended to provide heat to a building or space within a building, as well as certain ancillary components such as factory-built chimneys, vent piping and certain specialized installation components for some products.

In general, solid fuel-burning appliances utilized within the dwelling **must be**:

- I. Listed as tested in accordance with National Safety Standards and labeled for the intended use.
- II. Placed a safe and established distance from combustible materials such as wood, draperies, furniture, carpets, wood flooring, etc..
- III. Properly vented to the outside of the building.
- IV. Installed and operated in accordance with all applicable Building Code requirements and those of the appliance manufacturer.
- V. Inspected by building official to ensure compliance with the Building Code.
- VI. Maintained in accordance with the appliance manufacturer's requirements.

***** More information may be found at the DPS website at www.mass.gov/dps**

CHECKLIST REQUIRMENTS FOR THE INSTALLATION AND USE OF WOOD BURNING AND OTHER SOLID FUEL-BURNING HEATING APPLIANCES

1.	Solid Fuel Burning Appliance is Listed and Labeled.	
2.	Installer holds a Construction Supervisor License (CSL) (unless the homeowner is going to install the appliance).	
3.	If installation is an owner-occupied building of up to 4 units, the individual signing the contract with the homeowner holds a Home Improvement Contractor Registration.	
4.	The Building Permit is obtained prior to installation.	
5.	The location where the appliance is being installed has a satisfactory supply of fresh air.	
6.	The location where the appliance is being installed is NOT near flammable vapors, gasoline, explosives or other combustible liquids, fibers or dust.	
7.	The location where the appliance is being installed provides for the required clearances from combustible construction and other objects such as furniture, drapes, carpets, etc., etc.	
8.	The location where the appliance is being installed has proper floor protection/hearth extension under or in front of the appliance.	
9.	The appliance has proper venting to the outside of the building.	
10.	If the appliance vents through a chimney, the connector pipe from the appliance to the chimney is the correct type and size and is installed with the required clearances to combustibles.	
11.	If the appliance vents through combustible walls or roof or ceiling, the vent system uses listed thimbles or specialized piping or free clearances where the vent system passes through combustible construction.	
12.	The appliance does not share a flue or vent with other appliances.	
13.	The building inspector has inspected the appliance after installation but before use.	

***If you have any questions about properly installing a solid fuel-burning appliance, you should contact the Building Inspector**

**It is strongly recommended that smoke detectors and carbon monoxide detectors are installed prior to using solid fuel-burning heating appliances.

DETAILED FACT SHEET

REQUIREMENTS FOR THE INSTALLATION AND USE OF WOOD-BURNING AND OTHER SOLID FUEL-BURNING HEATING APPLIANCES & THE USE OF FIREPLACES

Given the expected demands on fossil fuels (oil and gas) for the 2005 – 2006 winter heating season, it is anticipated that many Massachusetts homeowners may seek to supplement the heating of their homes by using wood or other solid fuels this winter.

Remember, you are bringing FIRE into your home by installing a solid fuel-burning appliance. Safety is **imperative**.

The following information is intended to assist those considering using solid fuel-burning equipment and fireplaces to heat their homes. While specific sections of the Massachusetts State Building Code (780 CMR) are identified for informational use only, please note this Fact Sheet should not be used as a substitute for all applicable requirements of the Building Code or the Appliance Manufacturer's installation, operation and maintenance requirements.

General Requirements

Solid fuel-burning appliances include: factory-built fireplaces, coal-burning appliances, wood stoves, wood pellet stoves, corn and nut shell-burning pellet stoves, wood-fired boilers and any other solid fuel-burning appliance intended to provide heat to a building or space within a building, as well as certain ancillary components such as factory-built chimneys, vent piping and certain specialized installation components for some products.

In general, solid fuel-burning appliances utilized within the dwelling **must be**:

- I. Listed as tested in accordance with National Safety Standards and labeled for the intended use.
- II. Placed a safe and established distance from combustible materials such as wood, draperies, furniture, carpets, wood flooring, etc..
- III. Properly vented to the outside of the building.
- IV. Installed and operated in accordance with all applicable Building Code requirements and those of the appliance manufacturer.
- V. Maintained in accordance with the appliance manufacturer's requirements.

*****It is recommended that smoke detectors and carbon monoxide (CO) detectors be installed prior to use of a solid fuel-burning appliance.**

I. Listed and Labeled for the Intended Use
(See 780 CMR 3610.6, inclusive and the Appliance label)

For safety purposes, solid fuel-burning appliances are tested to recognized National Standards and listed as satisfying such tests. The Building Code requires that the listed information is printed on a label permanently attached to the heating appliance.

As a minimum, such labeling is required to identify the *Manufacturer, Make and Model Appliance, Testing Laboratory name, Date tested, Clearances to combustibles, Floor Protection Requirements, National Test Standard and Label Serial Number*. If the heating appliance is a central heating appliance (as opposed to a room heater/stove), the label will also identify whether the appliance is a *boiler or warm air furnace*.

Please note that while new solid fuel burning products without proper listing information may be sold in Massachusetts or New England generally, the **installation of these unlisted or improperly listed new products is prohibited by the Building Code**. The Building Code does provide an exemption for those products which pre-date the labeling requirement in 1982, however *only* if these older products are already installed.

Listings include:

Underwriters Laboratory Standard (UL) **127. UL 1482. UL 737. UL 103. UL 1777**

American Society for Testing Materials **ASTM-E 1509**.

II. Installed with a Building Permit and in Acceptable Locations

(See 780 CMR, Sections 108.3.5, 110, 111, 3610.6 and Regulations R5 and R6 and the Appliance Manufacturer's Installation Manual)

Prior to the installation of any solid fuel-burning appliance, you **MUST** obtain a building permit through your local Municipal Building Department.

Additionally, except for homeowner installation for one-and two-family "stand alone" dwellings, the contractor who is installing the solid fuel-burning appliance must be licensed as a Construction Supervisor in accordance with 780 CMR. You may obtain the license status of individual contractors by making written request to the Department of Public Safety (the Department) for this information.

Further, in addition to the requirement for the Construction Supervisor License, if the installation is intended for an existing residential building which has 1-4 units and is owner-occupied, the person with whom the homeowner is contracting for the installation **MUST** hold a Home Improvement Contractor Registration.

This Registration is issued by the Department. You may obtain the Registration status of individuals by making written request to the Department for this information.

II. Installed with a Building Permit and in Acceptable Locations (continued)

(See 780 CMR Sections 3610.6.3 and 3610.6.4)

Solid fuel burning appliances must be installed where there is sufficient air to properly support safe, efficient combustion of the solid fuel. The appliance should not be installed where flammable vapors or dust or combustible fibers would be expected.

A small, tight, enclosed space is not a good place to locate a fuel-burning appliance as inefficient combustion may increase the production of dangerous Carbon Monoxide gas which could lead to serious injury or death.

III. Placed a Safe and Established Distance from Combustible Materials

(See 780 CMR 3610.6.8, inclusive and the Appliance Manufacturer's installation requirements)

Solid fuel-burning appliances manufactured after about 1982 are required to list safe and appropriate clearance distances from combustibles on a permanently attached label and in the Manufacturer's Installation/User's Manuals. The fuel-burning appliance must be installed in accordance with the Manufacturer's specifications and you should never allow a solid fuel-burning appliance to be installed too close to combustible materials.

IV. Properly Vented to the Outside of the Building

(See 780 CMR 3610.6, inclusive as well as adhering to the Appliance Manufacturer's installation and labeling requirements)

Solid fuel-burning appliances produce very hot exhaust gases and noxious products of combustion. It is imperative that these appliances be properly vented to the outside of the building.

In general, the solid fuel-burning appliance venting system must be appropriate for the specific appliance being vented (properly sized, properly supported and made of the appropriate metal material for the fuel being burned) and be properly isolated from any combustible building structure or draperies and combustible finishes.

The Building Code has requirements for the clearances to combustibles of the connector pipe connecting the heating appliance to a chimney; for the venting of solid fuel-burning appliances through chimney flues; and for certain appliances to be installed in, and vented through, a masonry fireplace. The Building Code also recognizes “through-the-sidewall” venting of devices such as pellet stoves.

Please refer to the Building Code (780 CMR) for these specific requirements.

Installation techniques involving special thimbles and multi-walled piping which create physical clearances from the vent piping to combustible wall/roof construction must be employed when a vent system passes from the inside of the building to the outside of the building either through the exterior wall or roof/ceiling of the building.

MULTIPLE FLUE CONNECTIONS – For safety reasons, the State Building Code (780 CMR), as well as the Fuel Gas and Plumbing Code (248 CMR) and the State Fire Code (527 CMR) typically **do not allow** a solid fuel-burning appliance to vent through a flue used by another appliance.

Similarly, most solid fuel-burning appliance manufacturers do not allow shared flue venting with another appliance. However, even if a solid fuel-burning appliance is allowed by the manufacturer to share a common flue with another appliance, *this may still be prohibited by law in Massachusetts*. Therefore, it is imperative to consult with your local building official before making such flue connections

V. Installed and Operated in Accordance with Building Code Requirements and the Requirements of the Appliance Manufacturer.

(See 780 CMR 3610, inclusive and the Appliance Manufacturer’s installation, operation and maintenance requirements)

FLOOR PROTECTION, HEARTH-LIKE STRUCTURES AND HEARTH RUGS, HEARTH MATS, TILE-BOARD AND SIMILAR FLOOR PROTECTORS

(See Appendix K of 780 CMR and the Manufacturer’s requirements)

Solid fuel-burning appliances can radiate significant amounts of heat energy from the underside of the appliance or through glass fireplace doors. Therefore, it is necessary to know what floor protection is required when such appliances are being installed on combustible floors.

The appliances must have floor protection clearances and other requirements listed on the label or otherwise in the Installation Manual.

On matters of floor protection, appliance Installation Manuals will typically use terminology addressing *thermal conductivity* (*k*) and/or *thermal resistance* (“*R*”) and for guidance on such requirements seek expert assistance and Building Official inspection/approval of floor protection.

Typically a decorative tile-covered or brick-faced insulation board hearth extension will have much too high of a “*k*” value (too low an “*R*” value). You should consult the Manufacturer’s requirements and Appendix K of 780 CMR. Additional technical guidance on how to calculate “*k*” and “*R*”, is available on the Board of Building Regulations and Standards web page @ www.mass.gov/bbrs as part of the Solid Fuel-Burning Appliance information under “IMPORTANT LIFE SAFETY MESSAGES”.

Please be aware that while rug-like hearth mats may be non combustible, they may not be safe to use. They often allow too high a “*k*” value (too low an “*R*” value) for a combustible floor finish or substructure.

If you have any questions on this issue, you should contact your local building official.

VI. Prior to use, the Solid Fuel-burning Appliance Installation Must be Inspected by the Building Official to Ensure Compliance to the Building Code

(See 780 CMR, Sections 108.3.5, 110, 111, 3610.6 and Regulations R5 and R6 and the Appliance Manufacturer’s Installation Manual)

VII. Maintained in Accordance with the Appliance Manufacturer’s Requirements

(See the Appliance Manufacturer’s operations and maintenance requirements)

Solid fuel-burning appliances must be properly maintained in order to perform efficiently. Failure to maintain vent terminations and chimney openings can result in serious injury and death due to potential build up of carbon monoxide gas in the building.

You should only use appropriate fuels such as seasoned wood and proper type of coal or pellets. **Never** use liquid or gaseous fuels in a solid fuel-burning appliance or otherwise substitute a fuel type.

You must regularly clean vents and chimneys to avoid creosote build up which may cause chimney and vent fires.

MASONRY FIREPLACES, FACTORY-BUILT FIREPLACES AND MASONRY AND FACTORY-BUILT CHIMNEYS

For 1 & 2 Family “stand-alone” dwellings, fireplaces and chimney systems are addressed in 780 CMR 3610.1 through 3610.5.

Any fireplace or chimney installation, construction or reconstruction requires a building permit before any such work may begin.

Additionally construction inspections by the building official are required.

FREQUENTLY ASKED QUESTIONS

QUESTION 1 - I saw a new solid fuel-burning appliance for sale which didn't have a listing label, but the salesperson said the label wasn't needed and the product was approved for sale in Massachusetts. Does the Building Code approve individual, solid fuel-burning appliances without the label?

ANSWER 1 –While the Building Code itself does not approve individual products, it does require that all solid fuel-burning appliances which are to be installed in Massachusetts carry a permanently attached label on the appliance indicating that it has successfully passed certain National Standards Tests and otherwise conforms to the listing requirements. Therefore, **if you are looking for a new appliance and it is not properly listed and labeled, do not buy it for use in Massachusetts.**

QUESTION 2 – If I live in a “stand-alone” one- or two-family dwelling, can I install the solid fuel-burning appliance myself?

ANSWER 2 – A homeowner of a one- or two-family “stand-alone” dwelling is allowed to perform building permissible work without having a Construction Supervisors License (see also 780 CMR, Section 108.3.5) **however** the homeowner is required to obtain a building permit for such installation, and otherwise comply with all applicable requirements of the Building Code and of the manufacturer.

QUESTION 3 – If I am the owner of an existing one- to four family, owner-occupied residential building and I want to hire someone to install a solid fuel-burning appliance; does that individual or company need to have a Home Improvement Contractor Registration (HICR)?

ANSWER 3 – Depending on how the contract is structured, most likely YES. If the total Contract cost is \$500.00 or greater, then yes, the person with whom you contract for such services is required to be Registered with the Department as a Home Improvement Contractor in accordance with the requirements of MGL c.142A and 780 CMR R6.

Additionally, if the Contract cost is \$1000.00 or greater, then the contract must be in writing and comply with the requirements of MGL c.142A and 780 CMR R6.

QUESTION 4 – Is the contractor who is installing a solid fuel-burning appliance required to be licensed as a Construction Supervisor?

ANSWER 4 – Yes, unless the homeowner is entitled to the Construction Supervisor License Exception as set forth in 780 CMR 108.3.5 (see Question 2 /Answer 2 above).

QUESTION 5 – My central heating appliance is connected to my chimney flue, can I also connect a solid fuel-burning appliance to this flue?

ANSWER 5 – No. The Building Code prohibits such connections.

QUESTION 6 – I have an older solid fuel-burning appliance which was manufactured prior to the 1982 labeling requirements and is already installed. Can I use this appliance even though it has no label?

ANSWER 6 – The Building Code allows for the use of a non-conforming, non-labeled appliance if it is already installed, however it is important that you refer to the Building Code, (780 CMR 3610.6.11) for further guidance as well as your local building inspector when working with an older, non-labeled appliance.

QUESTION 7 – If I can't get the exact fuel that my solid fuel-burning appliance requires, can I substitute a different fuel in that solid fuel-burning appliance?

ANSWER 7 – No, A solid fuel-burning appliance must be operated with the intended fuel for which it is listed to ensure safe operation.

QUESTION 8 – My solid fuel-burning appliance Installation/User's Manual states that the hearth extension floor protection must meet a minimum thermal conductivity ("k") or maximum thermal resistance ("R") and that the hearth extension must also be of non-combustible finish. Can I use substitute a non-combustible hearth rug for the hearth extension?

ANSWER 8 – Probably not. Although the hearth rug is non-combustible, it may not have the necessary low thermal conductivity ("k") or high thermal resistance ("R") to slow the release of heat energy into the combustible floor system that the hearth rug is covering. Even if you install non-combustible decorative ceramic tile over insulating board or heavy plywood, this is usually insufficient to provide a sufficiently low thermal conductivity (or sufficiently high thermal resistance) for appliances. (refer to Appendix K of 780 CMR for guidance on determining the thermal conductivity "k" . Additional technical guidance on how to calculate "k", etc. is available on the Board of Building Regulations and Standards web page @ www.mass.gov/bbrs.

QUESTION 9 – I am installing a “zero clearance” factory-built fireplace which has a number of metal standoffs or tabs on the outside which make contact with the rough wood framing. Can I remove or bend these tabs to make it easier to install the factory built fireplace into the rough frame structure?

ANSWER 9 – NO! The standoffs or tabs are specifically designed to keep the hot portions of the factory-built fireplace away from combustible construction. The term “zero clearance” is somewhat misleading and means that the extremely hot portions of the steel factory-built fireplace must never contact combustible structure. The installation instructions for factory-built fireplaces will contain clear guidance on clearances to combustibles, including clearances to combustible structure and combustible decorative trim.

IMPORTANT GENERAL NOTE

(Relating to floor protection for solid fuel floor protection and gas fireplace hearth extensions)

Note that the thermal conductivity (“k”) of common brick is approximately 5 and various types of decorative tile range from 12 to 21 and it is common for solid fuel-burning appliance Manufacturers and Manufacturers of decorative gas fireplaces to have floor protection/hearth extension requirements of “k” < 1.0 (5, or 12 to 21 are > 1.0) so it becomes apparent that simple tile or brick-faced floor protection could require very high performance (low thermal conductivity / high thermal resistance) insulating backer board systems in order to ensure proper floor protection/hearth extension systems.

CALCULATION OF THERMAL CONDUCTIVITY (“k”) AND OF THERMAL RESISTANCE (“R”) AND CONVERSIONS / FLOOR PROTECTION ISSUES

Overview (for “k”) (a single material being used to ensure Floor Protection)

Thermal conductivity, identified as “k” is the amount of heat (in Btus) that will flow in one hour through one square foot of a uniform material one inch thick for each degree (⁰F) of temperature difference from one side of the material to the other – the larger the “k” value, the more heat energy that can be conducted through the material and the lower the “k” value, the less heat that can be conducted through such material.

The measurement “k” of thermal conductivity is directly applicable to a single material but when more than one material is joined to form a composite material (i.e., ceramic tile over “cement board”), it is necessary to first convert from “k” to “R” (“R” is the “thermal resistance” and “R” values for different materials in a composite can be added whereas “k” values cannot be directly added when dealing with composite floor protection materials).

To convert “k” to “R”: “R” = actual inches of thickness of the material ÷ “k”

To convert “R” to “k”: “k” = actual inches of thickness of the material ÷ “R”

A low value of “k” or a high value of “R” ensures less heat energy is being conducted through the floor protection/hearth extension system.

A high value of “k” or a low value of “R” ensures a greater amount of heat energy is being conducted through the floor protection/hearth extension system.

If the appliance Manufacturer specifies a specific non-combustible material and a thickness then it is a simple matter to utilize what is specified and no calculations are required; additionally, if such non-combustible material of specified thickness is used, then any overlaying, non-combustible decorative materials (tile, brick, etc.) do not have to be accounted for relative to their thermal properties.

If the appliance Manufacturer, specifies a “k” or “R” value of the “hearth/hearth extension/floor protection then one can establish thicknesses and material choices based on the knowledge of materials and the specified “k” or “R” values.

Thermal conductivity “k” can be specified/measured in two different ways:
In the first way “k” is measured/specified per inch of material.

In the second way, “k” is specified for the **actual thickness** of the material being used, even if this thickness is less than or greater than one inch.

EXAMPLE 1:

- (1) “k” **actual thickness** specified by the manufacturer is **known**
- (2) “k” per inch of a material desired to be used is known and the desired material thicknesses available for purchase are **known**.
- (3) It is necessary to calculate the “actual thickness “k” value

PROBLEM SOLUTION – SOLVING FOR AN ACCEPTABLE “k” VALUE for the actual thickness intended installed

The Manufacturer specifies a nominal “k:” value of 0.7 (BTU)/(Ft²) (Hr) (°F) (**actual thickness** performance required)

A particular product, available on the market has a “k” of 0.5 (BTU) (Inch)/Ft²) (Hr) (°F) and is available in ½ inch (0.5 inch) and 1 inch (1.0 inch) thicknesses.

Try the use of the ½ inch product first:

*0.5 (BTU) (~~Inch~~)/Ft²) (Hr) (°F) ÷ 0.5 ~~inch~~ thickness = 1.0 (BTU)/(Ft²) (Hr) (°F) (**actual thickness** performance achieved) but since 1.0 > 0.7 required, the ½ inch thick material is unacceptable (“k” actual installed must be equal to or less than “k” actual thickness required)*

ANSWER 1 - Next, try the 1 inch product:

0.5 (BTU) (~~Inch~~)/Ft²) (Hr) (°F) ÷ 1.0 ~~inch~~ thickness = 0.5 (BTU)/(Ft²) (Hr) (°F) and since 0.5 < 0.7 required, the 1 inch thick product of “k” = 0.5 (BTU) (Inch)/Ft²) (Hr) (°F) is acceptable.

EXAMPLE 2:

- (1) The “k” value (per inch) and the thickness of a specified acceptable material is known.
- (2) An alternative material is desired to be used and the “k” value (per inch) of the alternative material is known.
- (3) It is desired to know what the required thickness of the alternative material must be in order to be equivalent to the specified acceptable material of known “k” and known thickness.

PROBLEM SOLUTION – SOLVING FOR AN ACCEPTABLE THICKNESS OF AN ALTERNATIVE MATERIAL

The Manufacturer has specified a “k” of 0.5 and a thickness of 1.0 inches (per inch).

The desired alternative material has a “k” value of 1.95 (per inch).

It is only necessary to divide the alternative “k” value by the specified “k” value and then multiply by the specified thickness to determine the necessary thickness of the desired alternative material as demonstrated below:

ANSWER 2: $[1.95 (BTU) (Inch)/Ft^2) (Hr) (°F) ÷ 0.5 (BTU) (Inch)/Ft^2) (Hr) (°F)] \times 1.0 inches = 3.9 inches$ which is the required thickness for the desired alternative material – this thickness is significantly larger than for the specified “k” and specified thickness because the “k” value of the desired alternative material is so much higher than for the specified material.

Addressing Composite Materials
- “R” instead of “k” -

EXAMPLE 3:

- (1) The appliance Manufacturer specifies a specific value of “k” (per inch) and provides a specified thickness of the floor protection system.
- (2) It is desired to know what thickness and combination of materials (forming a composite floor protection system) will be necessary.

PROBLEM SOLUTION – SOLVING FOR AN ACCEPTABLE THICKNESS AND COMBINATION OF MATERIALS WILL SATISFY THE MANUFACTURER’S SPECIFIED “k” AND THICKNESS REQUIREMENTS

ANSWER 3:

The appliance Manufacturer specifies a hearth extension “k” (per inch) of 0.35 and a required thickness of 1 inch.

It is desired to utilize a decorative ceramic tile bonded to an insulating board of “k” (per inch) = to 0.6 and 1 inch thick / the ceramic tile is ¼ inch thick and has a “k” (per inch) of 13.5 - NOTE HOW HIGH THE THERMAL CONDUCTIVITY OF CERAMIC TILE IS; i.e., measurably conductive!

Creating a composite of a ceramic tile, bonded to an insulating board and given the thermal properties as stated above, how thick must the insulating backer board be?

1. First convert “k” to “R” {to convert “k” to “R”; “R” = [actual inches of thickness] ÷ “k” (per inch)}

$$“R”_{\text{specified}} = 1.0 \text{ inch} \div 0.35 \text{ (BTU) } (\cancel{\text{Inch}}) / \text{Ft}^2 \text{ (Hr) } ({}^{\circ}\text{F}) = 2.86 \text{ (}^{\circ}\text{F) (Hr) (Ft}^2) / \text{Btu}$$

$$“R”_{\text{backer board}} = 1.0 \cancel{\text{ inch}} \div 0.6 \text{ (BTU) } (\cancel{\text{Inch}}) / \text{Ft}^2 \text{ (Hr) } ({}^{\circ}\text{F}) = 1.67 \text{ (}^{\circ}\text{F) (Hr) (Ft}^2) / \text{Btu}$$

$$“R”_{\text{ceramic tile}} = 0.25 \cancel{\text{ inch}} \div 13.5 \text{ (BTU) } (\cancel{\text{Inch}}) / \text{Ft}^2 \text{ (Hr) } ({}^{\circ}\text{F}) = 0.019 \text{ (}^{\circ}\text{F) (Hr) (Ft}^2) / \text{Btu}$$

Noting that with composite materials one simply adds “R” values, the total “R” value of ceramic tile bonded to a single backer board sheet is:

$$1.67 + 0.019 = 1.69 \text{ (}^{\circ}\text{F) (Hr) (Ft}^2) / \text{Btu} < \text{the specified “R” value of } 2.86 \text{ (}^{\circ}\text{F) (Hr) (Ft}^2) / \text{Btu}$$

thus a single backer board + ceramic tile system has too low an “R” value.

SOLUTION 3 - Add a second backer board of “R” = 1.67 (°F) (Hr) (Ft²) / Btu so that the total “R” of the desired composite of insulating backer board and decorative ceramic tile is: “R”_{total} = “R”_{backer board w/tile} + “R”_{backer board}
 “R”_{total} = 1.69 + 1.67 = 3.36 (°F) (Hr) (Ft²) / Btu > 2.86 therefore ok.