

## **DHCD, DBFR 2009 Code Change Process**

### **April 23, 2009 Workgroup 1 (Energy Provisions) Meeting Agenda Package**

#### **CARRY OVER ISSUES FROM LAST WORKGROUP MEETING:**

1. IECC and IRC Chapter 11 administrative provisions and requirements for blower door and duct testing. **(Page 2)**
2. IECC 503.2.11 Outdoor heating. **(Page 13)**
3. IECC 505.6.2 Outside lighting. **(Page 14)**
4. IRC Energy Provisions Comparison **(Page 15)**

#### **NEW ISSUES/PROPOSALS**

1. IECC 402.2.2 Ceilings without attic space **(Page 18)**
2. IECC Table 405.5.2(1) Heating, cooling and service water heating **(Page 20)**
3. IECC 502.4.7 Vestibules **(Page 24)**
4. IECC 503.2.9.1 Air system balancing/commissioning buildings **(Page 32)**
5. Air Conditioning Contractors of America (ACCA) Manual J **(Page 33)**
6. IPC Appendix C Gray Water Recycling Systems **(Page 34)**
7. Federal stimulus money; any effect on adoption or amendment of energy provisions? **(no handout)**

Virginia Department of Housing and Community Development  
Division of Building and Fire Regulation – Technical Assistance Services Office

**DHCD Staff Report on the Administrative Requirements of the IECC and IECC  
Requirements for Blower Door Tests and Duct Tests in both IECC Residential and  
Commercial Buildings**

April 2009

**Discussion**

DHCD staff was assigned the task of researching and reporting back to Workgroup 1 (Energy Issues) two issues; how the administrative provisions of the USBC would interact with administrative provisions of the IECC and of the IRC Chapter 11, such as requirements for alterations, historic buildings, change of occupancy, labeling, testing, etc. and to determine definitively the 2009 IECC and IRC requirements for blower door testing and duct testing.

**Administrative Provisions**

It is clear that conflicts exist between the administrative provisions of the IECC and the IRC energy requirements and the USBC administrative provisions and that changes will have to be made to the USBC administrative provisions if the energy administrative provisions are to be used. Staff recommends the use of Section 103.10 of the USBC, Virginia Construction Code (VCC) as a vehicle for clarifying the use of the administrative provisions in the energy codes. That is the purpose of the section and it has already been used to recognize the use of administrative provisions for special inspections, testing requirements in the referenced codes, the use of the IRC local climatic data table and flood proofing requirements.

A new Item (6) could be added to read:

6. All of Part 1 of Chapter 1 of the International Energy Conservation Code and the provisions of either Chapters 2-5 of International Energy Conservation Code or Chapter 11 of the IRC which address testing, labeling, certification or compliance reports.

**Blower Door and Duct Testing**

Staff could not find any blower door or duct testing requirements in the IECC. The provisions in the IRC are located in Section N1102.4.2 for blower door tests and in Section N1103.2.2 for duct testing. The IRC does not require blower door tests, but lists it as one option to demonstrate compliance. The other option is the visual inspection option. Duct testing is required and either a rough-in stage test or a post-construction stage test is permitted. With the change to Section 103.10 of the VCC above, these testing requirements of the IRC are fully applicable.

# CHAPTER 1

## ADMINISTRATION

### ■ PART 1—SCOPE AND APPLICATION

#### SECTION 101 SCOPE AND GENERAL REQUIREMENTS

**101.1 Title.** This code shall be known as the *International Energy Conservation Code* of [NAME OF JURISDICTION], and shall be cited as such. It is referred to herein as “this code.”

**101.2 Scope.** This code applies to *residential* and *commercial buildings*.

**101.3 Intent.** This code shall regulate the design and construction of buildings for the effective use of energy. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

**101.4 Applicability.** Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern.

**101.4.1 Existing buildings.** Except as specified in this chapter, this code shall not be used to require the removal, *alteration* or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

**101.4.2 Historic buildings.** Any building or structure that is listed in the State or National Register of Historic Places; designated as a historic property under local or state designation law or survey; certified as a contributing resource with a National Register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the National or State Registers of Historic Places either individually or as a contributing building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, are exempt from this code.

**101.4.3 Additions, alterations, renovations or repairs.** Additions, alterations, renovations or repairs to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portion(s) of the existing building or building system to comply with this code. Additions, alterations, renovations or repairs shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code if the addition alone complies or if the exist-

ing building and addition comply with this code as a single building.

**Exception:** The following need not comply provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Glass only replacements in an existing sash and frame.
3. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
4. Construction where the existing roof, wall or floor cavity is not exposed.
5. Reroofing for roofs where neither the sheathing nor the insulation is exposed. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.
6. Replacement of existing doors that separate *conditioned space* from the exterior shall not require the installation of a vestibule or revolving door, provided, however, that an existing vestibule that separates a *conditioned space* from the exterior shall not be removed.
7. Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.
8. Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the *alteration* does not increase the installed interior lighting power.

**101.4.4 Change in occupancy or use.** Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code. Where the use in a space changes from one use in Table 505.5.2 to another use in Table 505.5.2, the installed lighting wattage shall comply with Section 505.5.

**101.4.5 Change in space conditioning.** Any nonconditioned space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

**101.4.6 Mixed occupancy.** Where a building includes both *residential* and *commercial* occupancies, each occupancy shall be separately considered and meet the applicable provisions of Chapter 4 for *residential* and Chapter 5 for *commercial*.

**101.5 Compliance.** *Residential buildings* shall meet the provisions of Chapter 4. *Commercial buildings* shall meet the provisions of Chapter 5.

**101.5.1 Compliance materials.** The *code official* shall be permitted to approve specific computer software, worksheets, compliance manuals and other similar materials that meet the intent of this code.

**101.5.2 Low energy buildings.** The following buildings, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this code shall be exempt from the *building thermal envelope* provisions of this code:

1. Those with a peak design rate of energy usage less than 3.4 Btu/h-ft<sup>2</sup> (10.7 W/m<sup>2</sup>) or 1.0 watt/ft<sup>2</sup> (10.7 W/m<sup>2</sup>) of floor area for space conditioning purposes.
2. Those that do not contain *conditioned space*.

### SECTION 102 ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

**102.1 General.** This code is 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 *code official* as meeting the intent of this code.

**102.1.1 Above code programs.** The *code official* or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this code. Buildings *approved* in writing by such an energy efficiency program shall be considered in compliance with this code. The requirements identified as "mandatory" in Chapters 4 and 5 of this code, as applicable, shall be met.

## PART 2—ADMINISTRATION AND ENFORCEMENT

### SECTION 103 CONSTRUCTION DOCUMENTS

**103.1 General.** Construction documents and other supporting data shall be submitted in one or more sets with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the *code official* is authorized to require necessary construction documents to be prepared by a registered design professional.

**Exception:** The *code official* is authorized to waive the requirements for construction documents or other supporting data if the *code official* determines they are not necessary to confirm compliance with this code.

**103.2 Information on construction documents.** Construction documents shall be drawn to scale upon suitable material. Electronic media documents are permitted to be submitted

when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment as herein governed. Details shall include, but are not limited to, as applicable, insulation materials and their *R*-values; fenestration *U*-factors and SHGCs; area-weighted *U*-factor and SHGC calculations; mechanical system design criteria; mechanical and service water heating system and equipment types, sizes and efficiencies; economizer description; equipment and systems controls; fan motor horsepower (hp) and controls; duct sealing, duct and pipe insulation and location; lighting fixture schedule with wattage and control narrative; and air sealing details.

**103.3 Examination of documents.** The *code official* shall examine or cause to be examined the accompanying construction documents and shall ascertain whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances.

**103.3.1 Approval of construction documents.** When the *code official* issues a permit where construction documents are required, the construction documents shall be endorsed in writing and stamped "Reviewed for Code Compliance." Such *approved* construction documents shall not be changed, modified or altered without authorization from the *code official*. Work shall be done in accordance with the *approved* construction documents.

One set of construction documents so reviewed shall be retained by the *code official*. The other set shall be returned to the applicant, kept at the site of work and shall be open to inspection by the *code official* or a duly authorized representative.

**103.3.2 Previous approvals.** This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been heretofore issued or otherwise lawfully authorized, and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

**103.3.3 Phased approval.** The *code official* shall have the authority to issue a permit for the construction of part of an energy conservation system before the construction documents for the entire system have been submitted or *approved*, provided adequate information and detailed statements have been filed complying with all pertinent requirements of this code. The holders of such permit shall proceed at their own risk without assurance that the permit for the entire energy conservation system will be granted.

**103.4 Amended construction documents.** Changes made during construction that are not in compliance with the *approved* construction documents shall be resubmitted for approval as an amended set of construction documents.

**103.5 Retention of construction documents.** One set of *approved* construction documents shall be retained by the *code official* for a period of not less than 180 days from date of completion of the permitted work, or as required by state or local laws.

## Part IV—Energy Conservation

### CHAPTER 11 ENERGY EFFICIENCY

#### SECTION N1101 GENERAL

**N1101.1 Scope.** This chapter regulates the energy efficiency for the design and construction of buildings regulated by this code.

**Exception:** Portions of the building envelope that do not enclose *conditioned space*.

**N1101.2 Compliance.** Compliance shall be demonstrated by either meeting the requirements of the *International Energy Conservation Code* or meeting the requirements of this chapter. Climate zones from Figure N1101.2 or Table N1101.2 shall be used in determining the applicable requirements from this chapter.

**N1101.2.1 Warm humid counties.** Warm humid counties are identified in Table N1101.2 by an asterisk.

**N1101.3 Identification.** Materials, systems and *equipment* shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

**N1101.4 Building thermal envelope insulation.** An *R*-value identification *mark* shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or more wide. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be listed on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the area covered and *R*-value of installed thickness shall be listed on the certificate. The insulation installer shall sign, date and post the certificate in a conspicuous location on the job site.

**N1101.4.1 Blown or sprayed roof/ceiling insulation.** The thickness of blown in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 ft<sup>2</sup> (28 m<sup>2</sup>) throughout the *attic* space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch (25 mm) high. Each marker shall face the *attic* access opening. Spray polyurethane foam thickness and installed *R*-value shall be listed on the certificate provided by the insulation installer.

**N1101.4.2 Insulation mark installation.** Insulating materials shall be installed such that the manufacturer's *R*-value *mark* is readily observable upon inspection.

**N1101.5 Fenestration product rating.** *U*-factors 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 manu-

facturer. Products lacking such a *labeled U*-factor shall be assigned a default *U*-factor from Tables N1101.5(1) and N1101.5(2). 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. Products lacking such a *labeled* SHGC shall be assigned a default SHGC from Table N1101.5(3).

**N1101.6 Insulation product rating.** The thermal resistance (*R*-value) of insulation shall be determined in accordance with the CFR Title 16, Part 460, in units of h · ft<sup>2</sup> · °F/Btu at a mean temperature of 75°F (24°C).

**N1101.7 Installation.** All materials, systems and *equipment* shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

**N1101.7.1 Protection of exposed foundation insulation.** Insulation applied to the exterior of *basement* walls, crawl space walls, and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches (152 mm) below *grade*.

**N1101.8 Above code programs.** The *building official* or other authority having *jurisdiction* shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this chapter. Buildings *approved* in writing by such an energy efficiency program shall be considered in compliance with this chapter.

**N1101.9 Certificate.** A permanent certificate shall be posted on or in the electrical distribution panel. The certificate shall not cover or obstruct the visibility of the circuit directory *label*, service disconnect *label* or other required *labels*. The certificate shall be completed by the builder or registered *design professional*. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, *basement wall*, crawlspace wall and/or floor) and ducts outside *conditioned spaces*; *U*-factors for fenestration; and the solar heat gain coefficient (SHGC) of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types and efficiencies of heating, cooling and service water heating *equipment*. Where a gas-fired unvented room heater, electric furnace and/or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be listed for gas-fired unvented room heaters, electric furnaces or electric base board heaters.

TABLE N1101.2—continued  
 CLIMATE ZONES, MOISTURE REGIMES AND WARM-HUMID DESIGNATIONS BY STATE, COUNTY AND TERRITORY

Key:

A—Moist, B—Dry, C—Marine, Absence of moisture designation indicates moisture regime is irrelevant. Asterisk (\*) indicates a warm-humid location.

6A Pepin	6A Trempealeau	6B Campbell	7 Sublette	Northern Mariana Islands 1A (all)*  Puerto Rico 1A (all)*  Virgin Islands 1A (all)*  US TERRITORIES  American Samoa 1A (all)*  Guam 1A (all)*
6A Pierce	6A Vernon	6B Carbon	6B Sweetwater	
6A Polk	7 Vilas	6B Converse	7 Teton	
6A Portage	6A Walworth	6B Crook	6B Uinta	
7 Price	7 Washburn	6B Fremont	6B Washakie	
6A Racine	6A Washington	5B Goshen	6B Weston	
6A Richland	6A Waukesha	6B Hot Springs		
6A Rock	6A Waupaca	6B Johnson		
6A Rusk	6A Waushara	6B Laramie		
6A Sauk	6A Winnebago	7 Lincoln		
7 Sawyer	6A Wood	6B Natrona		
6A Shawano		6B Niobrara		
6A Sheboygan	Wyoming	6B Park		
6A St. Croix	6B Albany	5B Platte		
7 Taylor	6B Big Horn	6B Sheridan		

TABLE N1101.5(1)  
 DEFAULT GLAZED FENESTRATION U-FACTORS

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.2	0.8	2	1.3
Metal with thermal break	1.1	0.65	1.9	1.1
Nonmetal or metal clad	0.95	0.55	1.75	1.05
Glazed block	0.6			

TABLE N1101.5(2)  
 DEFAULT DOOR U-FACTORS

DOOR TYPE	U-FACTOR
Uninsulated metal	1.2
Insulated metal	0.6
Wood	0.5
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE N1101.5(3)  
 DEFAULT GLAZED FENESTRATION SHGC

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

## SECTION N1102 BUILDING THERMAL ENVELOPE

**N1102.1 Insulation and fenestration criteria.** The *building thermal envelope* shall meet the requirements of Table N1102.1 based on the climate zone specified in Table N1101.2.

**N1102.1.1 R-value computation.** Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component *R*-value. The manufacturer's settled *R*-value shall be used for blown insulation. Computed *R*-values shall not include an *R*-value for other building materials or air films.

**N1102.1.2 U-factor alternative.** An assembly with a *U*-factor equal to or less than that specified in Table

N1102.1.2 shall be permitted as an alternative to the *R*-value in Table N1102.1.

**N1102.1.3 Total UA alternative.** If the total *building thermal envelope* UA (sum of *U*-factor times assembly area) is less than or equal to the total UA resulting from using the *U*-factors in Table N1102.1.2, (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table N1102.1. The UA calculation shall be done using a method consistent with the *ASHRAE Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

TABLE N1102.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>

CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>k</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE AND DEPTH	CRAWL SPACE <sup>e</sup> WALL R-VALUE
1	1.2	0.75	0.35 <sup>i</sup>	30	13	3/4	13	0	0	0
2	0.65 <sup>i</sup>	0.75	0.35 <sup>j</sup>	30	13	4/6	13	0	0	0
3	0.50 <sup>i</sup>	0.65	0.35 <sup>a,j</sup>	30	13	5/8	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13 + 5 <sup>b</sup>	13/17	30 <sup>f</sup>	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13 + 5 <sup>b</sup>	15/19	30 <sup>g</sup>	10/13	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	30 <sup>g</sup>	10/13	10, 4 ft	10/13

- a. *R*-values are minimums. *U*-factors and solar heat gain coefficient (SHGC) are maximums. R-19 batts compressed in to nominal 2 × 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.
- b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
- c. The first *R*-value applies to continuous insulation, the second to framing cavity insulation: either insulation meets the requirement.
- d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less, in zones 1 through 3 for heated slabs.
- e. There are no SHGC requirements in the Marine Zone.
- f. Basement wall insulation is not required in warm-humid locations as defined by Figure N1101.2 and Table N1101.2.
- g. Or insulation sufficient to fill the framing cavity, R-19 minimum.
- h. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-5 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.
- i. For impact-rated fenestration complying with Section R301.2.1.2, the maximum *U*-factor shall be 0.75 in zone 2 and 0.65 in zone 3.
- j. For impact-resistant fenestration complying with Section R301.2.1.2 of the *International Residential Code*, the maximum SHGC shall be 0.40.
- k. The second *R*-value applies when more than half the insulation is on the interior.

## N1102.2 Specific insulation requirements.

**N1102.2.1 Ceilings with attic spaces.** When Section N1102.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Section N1102.1.2 and the Total UA alternative in Section N1102.1.3.

**N1102.2.2 Ceilings without attic spaces.** Where Section N1102.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m<sup>2</sup>) of ceiling area. This reduction shall not apply to the *U*-factor alternative approach in Section N1102.1.2 and the Total UA alternative in Section N1102.1.3.

**N1102.2.3 Access hatches and doors.** Access doors from *conditioned spaces* to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all *equipment* which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the *attic* access is opened and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

**N1102.2.4 Mass walls.** Mass walls, for the purposes of this chapter, shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs.

**N1102.2.5 Steel-frame ceilings, walls and floors.** Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table N1102.2.5 or shall meet the *U*-factor requirements in Table N1102.1.2. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

**Exception:** In climate zones 1 and 2, the continuous insulation requirements in Table N1102.2.5 shall be permitted to be reduced to R-3 for steel frame wall assemblies with studs spaced at 24 inches (610 mm) on center.

**N1102.2.6 Floors.** Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

**N1102.2.7 Basement walls.** *Exterior walls* associated with conditioned basements shall be insulated from the top of the *basement wall* down to 10 feet (3048 mm) below *grade* or to the *basement floor*, whichever is less. Walls associated with unconditioned basements shall meet this requirement unless the floor overhead is insulated in accordance with Sections N1102.1 and N1102.2.6.

**N1102.2.8 Slab-on-grade floors.** Slab-on-grade floors with a floor surface less than 12 inches below *grade* shall be insulated in accordance with Table N1102.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below *grade* shall be extended the distance provided in Table N1102.1 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the *exterior wall*. Slab-edge insulation is not required in jurisdictions designated by the code official as having a very heavy termite infestation.

TABLE N1102.1.2  
EQUIVALENT *U*-FACTORS<sup>a</sup>

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT <i>U</i> -FACTOR	CEILING <i>U</i> -FACTOR	FRAME WALL <i>U</i> -FACTOR	MASS WALL <i>U</i> -FACTOR <sup>b</sup>	FLOOR <i>U</i> -FACTOR	BASEMENT WALL <i>U</i> -FACTOR	CRAWL SPACE WALL <i>U</i> -FACTOR
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.060	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.060	0.060	0.033	0.059	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.033	0.059	0.065

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in zone 1, 0.14 in zone 2, 0.12 in zone 3, 0.10 in zone 4 except Marine and the same as the frame wall *U*-factor in Marine zone 4 and in zones 5 through 8.

c. Basement wall *U*-factor of 0.360 in warm-humid climates as defined by Figure N1101.2 and Table N1101.2.

TABLE N1102.2.5  
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION (*R*-VALUE)

WOOD FRAME <i>R</i> -VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT <i>R</i> -VALUE <sup>a</sup>
<b>Steel Truss Ceilings<sup>a</sup></b>	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
<b>Steel Joist Ceilings<sup>b</sup></b>	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
<b>Steel Framed Wall</b>	
R-13	R-13 + 5 or R15 + 4 or R-21 + 3 or R-0 + 10
R-19	R-13 + 9 or R-19 + 8 or R-25 + 7
R-21	R-13 + 10 or R-19 + 9 or R-25 + 8
<b>Steel Joist Floor</b>	
R-13	R-19 in 2 × 6 R-19 + R-6 in 2 × 8 or 2 × 10
R-19	R-19 + R-6 in 2 × 6 R-19 + R-12 in 2 × 8 or 2 × 10

For SI: 1 inch = 25.4 mm.

- a. Cavity insulation *R*-value is listed first, followed by continuous insulation *R*-value.  
b. Insulation exceeding the height of the framing shall cover the framing.

**N1102.2.9 Crawl space walls.** As an alternative to insulating floors over crawl spaces, insulation of crawl space walls shall be permitted when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finished *grade* level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder. All joints of the vapor retarder shall overlap by 6 inches (152 mm) and be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches (152 mm) up the stem wall and shall be attached to the stem wall.

**N1102.2.10 Masonry veneer.** Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

**N1102.2.11 Thermally isolated sunroom insulation.** The minimum ceiling insulation *R*-values shall be R-19 in zones 1 through 4 and R-24 in zones 5 through 8. The minimum wall *R*-value shall be R-13 in all zones. New wall(s) separating the sunroom from *conditioned space* shall meet the *building thermal envelope* requirements.

### N1102.3 Fenestration.

**N1102.3.1 *U*-factor.** An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

**N1102.3.2 Glazed fenestration SHGC.** An area-weighted average of fenestration products more than 50 percent glazed shall be permitted to satisfy the solar heat gain coefficient (SHGC) requirements.

**N1102.3.3 Glazed fenestration exemption.** Up to 15 square feet (1.4 m<sup>2</sup>) of glazed fenestration per *dwelling unit* shall be permitted to be exempt from *U*-factor and SHGC requirements in Section N1102.1. This exemption shall not apply to the *U*-factor alternative approach in Section N1102.1.2 and the Total UA alternative in Section N1102.1.3.

**N1102.3.4 Opaque door exemption.** One side-hinged opaque door assembly up to 24 square feet (2.22 m<sup>2</sup>) in area is exempted from the *U*-factor requirement in Section N1102.1.1. This exemption shall not apply to the *U*-factor alternative approach in Section N1102.1.2 and the Total UA alternative in Section N1102.1.3.

**N1102.3.5 Thermally isolated sunroom *U*-factor.** For zones 4 through 8 the maximum fenestration *U*-factor shall be 0.50 and the maximum skylight *U*-factor shall be 0.75. New windows and doors separating the sunroom from *conditioned space* shall meet the *building thermal envelope* requirements.

**N1102.3.6 Replacement fenestration.** Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for *U*-factor and solar heat gain coefficient (SHGC) in Table N1102.1.

**N1102.4 Air leakage.**

**N1102.4.1 Building thermal envelope.** The *building thermal envelope* shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from *conditioned spaces*.
8. Behind tubs and showers on *exterior walls*.
9. Common walls between *dwelling units*.
10. Attic access openings.
11. Rim joists junction.
12. Other sources of infiltration.

**N1102.4.2 Air sealing and insulation.** Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options given by Section N1102.4.2.1 or N1102.4.2.2.

**N1102.4.2.1 Testing option.** Tested air leakage is less than 7 ACH when tested with a blower door at a pressure of 50 pascals (0.007 psi). Testing shall occur after rough in and after installation of penetrations of the building envelope, including penetrations for utilities, plumbing, electrical, ventilation and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace and stove doors shall be closed, but not sealed;
2. Dampers shall be closed, but not sealed; including exhaust, intake, makeup air, back draft, and flue dampers;
3. Interior doors shall be open;
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
5. Heating and cooling system(s) shall be turned off;
6. HVAC ducts shall not be sealed; and
7. Supply and return registers shall not be sealed.

**N1102.4.2.2 Visual inspection option.** The items listed in Table N1102.4.2, applicable to the method of construction, are field verified. Where required by the code official, an *approved* party independent from the installer

of the insulation, shall inspect the air barrier and insulation.

**N1102.4.3 Fireplaces.** New wood-burning fireplaces shall have gasketed doors and outdoor combustion air.

**N1102.4.4 Fenestration air leakage.** Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cubic foot per minute per square foot [1.5(L/s)/m<sup>2</sup>], and swinging doors no more than 0.5 cubic foot per minute per square foot [2.5(L/s)/m<sup>2</sup>], when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory, and listed and *labeled* by the manufacturer.

**Exception:** Site-built windows, skylights and doors.

**N1102.4.5 Recessed lighting.** Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as meeting ASTM E 283 when tested at 1.57 psi (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

## SECTION N1103 SYSTEMS

**N1103.1 Controls.** At least one thermostat shall be installed for each separate heating and cooling system.

**N1103.1.1 Programmable thermostat.** Where the primary heating system is a forced air furnace, at least one thermostat per *dwelling unit* shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55°F (13°C) or up to 85°F (29°C). The thermostat shall initially be programmed with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 78°F (26°C).

**N1103.1.2 Heat pump supplementary heat.** Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

### N1103.2 Ducts.

**N1103.2.1 Insulation.** Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

**Exception:** Ducts or portions thereof located completely inside the *building thermal envelope*.

**N1103.2.2 Sealing.** Ducts, air handlers, filter boxes and building cavities used as ducts shall be sealed. Joints and seams shall comply with Section M1601.4. Duct tightness shall be verified by either of the following:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 cfm (3.78 L/s) per 100 ft<sup>2</sup> (9.29

m<sup>2</sup>) of conditioned floor area or a total leakage less than or equal to 12 cfm (5.66 L/s) per 100 ft<sup>2</sup> (9.29 m<sup>2</sup>) of conditioned floor area when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler end closure. All register boots shall be taped or otherwise sealed during the test.

2. Rough-in test: Total leakage shall be less than or equal to 6 cfm (2.83 L/s) per 100 ft<sup>2</sup> (9.29 m<sup>2</sup>) of conditioned floor area when tested at a pressure differential of 0.1 inch w.g. (25 Pa) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm (1.89 L/s) per 100 ft<sup>2</sup> (9.29 m<sup>2</sup>) of conditioned floor area.

**Exception:** Duct tightness test is not required if the air handler and all ducts are located within *conditioned space*.

**N1103.2.3 Building cavities.** Building framing cavities shall not be used as supply ducts.

**N1103.3 Mechanical system piping insulation.** Mechanical system piping capable of carrying fluids above 105°F (40°C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

**N1103.4 Circulating hot water systems.** All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or *readily accessible* manual switch that can turn off the hot water circulating pump when the system is not in use.

**N1103.5 Mechanical ventilation.** Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

TABLE N1102.4.2  
AIR BARRIER AND INSULATION INSPECTION

COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.
Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated and sealed to drywall. Exception—fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior wall	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

**N1103.6 Equipment sizing.** Heating and cooling *equipment* shall be sized as specified in Section M1401.3.

**N1103.7 Snow melt system controls.** Snow- and ice-melting systems supplied through energy service to the building shall include automatic controls capable of shutting off the system when the pavement temperature is above 50°F (10°C) and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F (5°C).

**N1103.8 Pools.** Pools shall be provided with energy conserving measures in accordance with Sections N1103.8.1 through N1103.8.3.

**N1103.8.1 Pool heaters.** All pool heaters shall be equipped with a *readily accessible* on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas or LPG shall not have continuously burning pilot lights.

**N1103.8.2 Time switches.** Time switches that can automatically turn off and on heaters and pumps according to a pre-set schedule shall be installed on swimming pool heaters and pumps.

**Exceptions:**

1. Where public health standards require 24-hour pump operation.
2. Where pumps are required to operate solar- and waste-heat-recovery pool heating systems.

**N1103.8.3 Pool covers.** Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F (32°C) shall have a pool cover with a minimum insulation value of R-12.

**SECTION N1104  
LIGHTING SYSTEMS**

**N1104.1 Lighting equipment.** A minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be *high-efficacy lamps*.

TABLE 503.2.10.1(1)  
FAN POWER LIMITATION

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \leq CFM_s * 0.0011$	$hp \leq CFM_s * 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \leq CFM_s * 0.00094 + A$	$bhp \leq CFM_s * 0.0013 + A$

where:

- CFM<sub>s</sub> = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.
- hp = The maximum combined motor nameplate horsepower.
- Bhp = The maximum combined fan brake horsepower.
- A = Sum of  $[PD \times CFM_o / 4131]$ .

where:

- PD = Each applicable pressure drop adjustment from Table 503.2.10.1(2) in. w.c.

TABLE 503.2.10.1(2)  
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
<b>Credits</b>	
Fully ducted return and/or exhaust air systems	0.5 in w.c.
Return and/or exhaust airflow control devices	0.5 in w.c.
Exhaust filters, scrubbers or other exhaust treatment.	The pressure drop of device calculated at fan system design condition.
Particulate filtration credit: MERV 9 thru 12	0.5 in w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 in w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition.
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.
Heat recovery device	Pressure drop of device at fan system design condition.
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions
Sound attenuation section	0.15 in w.c.
<b>Deductions</b>	
Fume hood exhaust exception (required if Section 503.2.10.1, Exception 3, is taken)	-1.0 in w.c.

**503.2.10.2 Motor nameplate horsepower.** For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower (bhp). The fan brake horsepower (bhp) shall be indicated on the design documents to allow for compliance verification by the *code official*.

**Exceptions:**

1. For fans less than 6 bhp, where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the bhp, selection of the next larger nameplate motor size is allowed.
2. For fans 6 bhp and larger, where the first available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.

**503.2.11 Heating outside a building.** Systems installed to provide heat outside a building shall be radiant systems.

Such heating systems shall be controlled by an occupancy sensing device or a timer switch, so that the system is automatically deenergized when no occupants are present.

**503.3 Simple HVAC systems and equipment (Prescriptive).**

This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), each serving one zone and controlled by a single thermostat in the zone served. It also applies to two-pipe heating systems serving one or more zones, where no cooling system is installed.

This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equipment and distribution systems that provide cooling or cooling and heating which are covered by Section 503.4.

**503.3.1 Economizers.** Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1).

**TABLE 505.5.2—continued  
INTERIOR LIGHTING POWER ALLOWANCES**

LIGHTING POWER DENSITY	
Building Area Type <sup>a</sup>	(W/ft <sup>2</sup> )
Transportation	1.0
Warehouse	0.8
Workshop	1.4

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m<sup>2</sup>.

- a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.
- b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

$$\text{Additional Interior Lighting Power Allowance} = 1000 \text{ watts} + (\text{Retail Area 1} \times 0.6 \text{ W/ft}^2) + (\text{Retail Area 2} \times 0.6 \text{ W/ft}^2) + (\text{Retail Area 3} \times 1.4 \text{ W/ft}^2) + (\text{Retail Area 4} \times 2.5 \text{ W/ft}^2).$$

where:

- Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.
- Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.
- Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.
- Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

**Exception:** Other merchandise categories are permitted to be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is *approved* by the authority having jurisdiction.

**505.6 Exterior lighting. (Mandatory).** When the power for exterior lighting is supplied through the energy service to the building, all exterior lighting, other than low-voltage landscape lighting, shall comply with Sections 505.6.1 and 505.6.2.

**Exception:** Where *approved* because of historical, safety, signage or emergency considerations.

**505.6.1 Exterior building grounds lighting.** All exterior building grounds luminaires that operate at greater than 100 watts shall contain lamps having a minimum efficacy of 60 lumens per watt unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions under Section 505.6.2.

**505.6.2 Exterior building lighting power.** The total exterior lighting power allowance for all exterior building applications is the sum of the base site allowance plus the individual allowances for areas that are to be illuminated and are permitted in Table 505.6.2(2) for the applicable lighting zone. Tradeoffs are allowed only among exterior lighting applications listed in Table 505.6.2(2), Tradable Surfaces section. The lighting zone for the building exterior is determined from Table 505.6.2(1) unless otherwise specified by the local jurisdiction. Exterior lighting for all applications (except those included in the exceptions to Section

505.6.2) shall comply with the requirements of Section 505.6.1.

**Exceptions:** Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

1. Specialized signal, directional and marker lighting associated with transportation;
2. Advertising signage or directional signage;
3. Integral to equipment or instrumentation and is installed by its manufacturer;
4. Theatrical purposes, including performance, stage, film production and video production;
5. Athletic playing areas;
6. Temporary lighting;
7. Industrial production, material handling, transportation sites and associated storage areas;
8. Theme elements in theme/amusement parks; and
9. Used to highlight features of public monuments and registered historic landmark structures or buildings.

**TABLE 505.6.2(1)  
EXTERIOR LIGHTING ZONES**

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

**505.7 Electrical energy consumption. (Mandatory).** In buildings having individual dwelling units, provisions shall be made to determine the electrical energy consumed by each tenant by separately metering individual dwelling units.

**SECTION 506  
TOTAL BUILDING PERFORMANCE**

**506.1 Scope.** This section establishes criteria for compliance using total building performance. The following systems and loads shall be included in determining the total building performance: heating systems, cooling systems, service water heating, fan systems, lighting power, receptacle loads and process loads.

**506.2 Mandatory requirements.** Compliance with this section requires that the criteria of Sections 502.4, 503.2, 504 and 505 be met.

## SIGNIFICANT “ENERGY” DIFFERENCES

### BETWEEN 2009 IECC AND 2009 IRC

CODE CHANGE NUMBER	TOPIC	IECC VERSION	IRC VERSION	RECOMMENDATION
EC11-07/08	Clarifies climate zones	Disapproved	Approved as submitted	Unnecessary to approve this change since it is incorporated in EC10, approved by both codes. No action required.
EC22	Revises fenestration SHGC in climate zones 1, 2, 3	Disapproved	Approved Public Comment #2 to reduce SHGC	Discrepancies for these zones only. Virginia is in Zone 4, which has no SHGC requirement. No action required.
EC6	“Above code” programs	Approved to add “mandatory” requirements as integral to any above code program	No change.	IRC already references “above code” programs, but has no distinction between mandatory and non-mandatory requirements. No action required. Bigger issues: Can Fairfax implement an above code program under the authority of the USBC? Does this provision violate the Dillon rule?
EC46	Ceiling insulation exemption	Approved to limit exemption to 20% of total ceiling area or 500 sq.ft. (whichever is less)	No change.	USBC would have to propose change to IRC N1102.2.2 to provide the exemption.

**Hodge, Vernon**

**From:** Rodgers, Emory  
**Sent:** Friday, November 07, 2008 12:58 PM  
**To:** Turchen, Stephen; Hodge, Vernon  
**Subject:** RE: UPCOMING MEETING OF WORK GROUP ON ENERGY CONSERVATION

Great and really does meeting is march 26<sup>th</sup> and sending out agenda January 30<sup>th</sup>. Agree on IECC and IRC and maybe VBCOA, VPMIA and my staff can do prior to the 26<sup>th</sup>. I didn't include EC 45, 46, 56 and 58 but will do and for EC91 and 99. Most IRC homes use the prescriptive route but commercial folks will sometimes use the performance methods. I did note the code change from Washington that disallowed gaming between ASHRE 90.1 and the IECC and these 6 changes are part of that disallowance of creative designers finding ways to game the requirements?

**From:** Turchen, Stephen [mailto:Stephen.Turchen@fairfaxcounty.gov]  
**Sent:** Friday, November 07, 2008 12:37 PM  
**To:** Rodgers, Emory  
**Subject:** RE: UPCOMING MEETING OF WORK GROUP ON ENERGY CONSERVATION

Emory ---

I reviewed your write-up of important IECC changes emanating from the recently completed code change cycle, as included in your proposed agenda for item #5, and offer the following input:

- EC16 was not approved, it was denied at the Final Action Hearing
- Only EC71 was approved (EC70 disapproved) at the FAH
- EC 79 was denied at the FAH
- EC136 (not EC132) was approved to limit fan HP on commercial HVAC equipment
- EC45, 46, 56, 58 may be of interest to the Work Group, as all of these proposals will affect how compliance trade-off calculations are performed
- EC60 provides an updated "laundry list" of air sealing locations
- EC91 significantly adjusts the equipment efficiencies for the "standard" (code-compliant) house when doing energy simulation analyses for residential buildings
- EC99 requires that energy simulation analyses for residential buildings be done in terms of energy cost or source energy use (no longer permits site energy use)

I have not attempted to correlate the analogous IRC issues with the outcomes of the IECC (change proposal "Part I" vs "Part II"), which will require a lot of time. I know that in many cases there are inconsistencies; e.g., IECC approved and IRC disapproved, IECC modified differently from mod approved for IRC, etc. I think the USBC would be well served by the Work Group's making the effort to "align" the provisions of the two codes in our recommendations.

I am also a bit confused about meeting dates for the Work Group. Your attachment has two dates: "January 30, 2009" at top and "March 26, 2009" as "meeting" date. Are we supposed to be meeting in Richmond on both dates? Just the March date?

I hope this helps a bit.

Steve  
 703-324-1653

\*\*\*\*\*

11/18/2008

---

**From:** Rodgers, Emory [mailto:Emory.Rodgers@dhcd.virginia.gov]  
**Sent:** Wednesday, November 05, 2008 2:02 PM  
**To:** Hodge, Vernon; Eubank, Paula; Wallace, Clinton; Tomberlin, Guy; Walz, Stephen (GOV); tommy.thompson@dmme.virginia.gov; Turchen, Stephen  
**Subject:**

I am sending the proposed agenda for the 2<sup>nd</sup> meeting of Work Group 1 on energy conservation to you for some feedback. Steve Turchen and Vernon Hodge might you look at the energy changes in #5 for the IECC and IRC-EC to see if I got it right on the code changes and subject matter. There were far more changes approved but I have only captured those that impact Zone 4 that covers all of Virginia, I hope.

I will be ordering some 2009 IECC, IRC-EC, IPC, IMC and IFGC ICC code books to assist the Work Group do its job. I believe there were some code changes in the 2009 IPC, IMC and IFGC that were approved that impact energy usage and am asking Guy and VMPIA to identify those code changes so we can discuss them and approved them as consensus to move forward for the proposed 2009 USBC regulations.

If you seen anything necessary to add please email me. If we can gain consensus at this 2<sup>nd</sup> meeting on 90% of the I-Codes changes and perhaps even a few of the voluntary standards and rating systems, then the 3<sup>rd</sup> meeting may enable us to wrap up the proposed 2009 USBC regulations for a required public hearing and tentative July adoption by the BHCD of the proposed regulations.

This is a very aggressive agenda and full of contentious items, but the goal of 15% or greater in energy savings for the 2009 USBC is achievable for this cycle. Comments by the end of November would be great.

**National Association of Home Builders  
Recommended State & Local Amendments to the  
2009 Edition of the International Energy Conservation  
Code (IECC)**

**Issue:** Ceilings without Attic Spaces

**2009 IECC Section:** Section 402.2.2 Ceilings without Attic Spaces

**Recommended Amendment:** Modify the Section as shown below (Delete text):

**402.2.2 Ceilings without attic spaces.** Where Section 402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m<sup>2</sup>) or 20% of the total insulated ceiling area, which ever is less. This reduction shall not apply to the U-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4

**Reason:**

This change limits the ceiling areas eligible for reduced R-value due to a framing cavity restriction. The code already has a limit (500 ft<sup>2</sup>). This additional limit adds a calculation to determine the second limit and therefore is more confusing than it is worth.

**Staff Contact:** Ken Sagan – [ksagan@nahb.com](mailto:ksagan@nahb.com) - 800-368-5242, ext. 8444

TABLE 402.1.3  
EQUIVALENT *U*-FACTORS<sup>a</sup>

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT <i>U</i> -FACTOR	CEILING <i>U</i> -FACTOR	FRAME WALL <i>U</i> -FACTOR	MASS WALL <i>U</i> -FACTOR <sup>b</sup>	FLOOR <i>U</i> -FACTOR	BASEMENT WALL <i>U</i> -FACTOR <sup>d</sup>	CRAWL SPACE WALL <i>U</i> -FACTOR <sup>c</sup>
1	1.20	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.65	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.50	0.65	0.035	0.082	0.141	0.047	0.091 <sup>c</sup>	0.136
4 except Marine	0.35	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.057	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.057	0.060	0.033	0.050	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.028	0.050	0.065

- a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
- b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Zone 1, 0.14 in Zone 2, 0.12 in Zone 3, 0.10 in Zone 4 except Marine, and the same as the frame wall *U*-factor in Marine Zone 4 and Zones 5 through 8.
- c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure 301.1 and Table 301.2.
- d. Foundation *U*-factor requirements shown in Table 402.1.3 include wall construction and interior air films but exclude soil conductivity and exterior air films. *U*-factors for determining code compliance in accordance with Section 402.1.4 (total UA alternative) of Section 405 (Simulated Performance Alternative) shall be modified to include soil conductivity and exterior air films.

**402.1.3 *U*-factor alternative.** An assembly with a *U*-factor equal to or less than that specified in Table 402.1.3 shall be permitted as an alternative to the *R*-value in Table 402.1.1.

**402.1.4 Total UA alternative.** If the total building thermal envelope UA (sum of *U*-factor times assembly area) is less than or equal to the total UA resulting from using the *U*-factors in Table 402.1.3 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table 402.1.1. The UA calculation shall be done using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

#### 402.2 Specific insulation requirements (Prescriptive).

**402.2.1 Ceilings with attic spaces.** When Section 402.1.1 would require R-38 in the ceiling, R-30 shall be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly, R-38 shall be deemed to satisfy the requirement for R-49 wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.

**402.2.2 Ceilings without attic spaces.** Where Section 402.1.1 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies shall be R-30. This reduction of insulation from the requirements of Section 402.1.1 shall be limited to 500 square feet (46 m<sup>2</sup>) or 20

percent of the total insulated ceiling area, whichever is less. This reduction shall not apply to the *U*-factor alternative approach in Section 402.1.3 and the total UA alternative in Section 402.1.4.

**402.2.3 Access hatches and doors.** Access doors from conditioned spaces to unconditioned spaces (e.g., attics and crawl spaces) shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed *R*-value of the loose fill insulation.

**402.2.4 Mass walls.** Mass walls for the purposes of this chapter shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick (other than brick veneer), earth (adobe, compressed earth block, rammed earth) and solid timber/logs.

**402.2.5 Steel-frame ceilings, walls, and floors.** Steel-frame ceilings, walls and floors shall meet the insulation requirements of Table 402.2.5 or shall meet the *U*-factor requirements in Table 402.1.3. The calculation of the *U*-factor for a steel-frame envelope assembly shall use a series-parallel path calculation method.

**Exception:** In Climate Zones 1 and 2, the continuous insulation requirements in Table 402.2.4 shall be permitted to be reduced to R-3 for steel frame wall assemblies with studs spaced at 24 inches (610 mm) on center.

# National Association of Home Builders Recommended State & Local Amendments to the 2009 Edition of the International Energy Conservation Code (IECC)

**Issue:** The Elimination of Equipment Trade-offs

**2009 IECC Section:** Table 404.5.2(1)

**Recommended Amendment:** Modify the Table as shown below (Delete text, add New Text)

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Heating systems <sup>a, b</sup>	<p><del>As proposed</del>  <u>Fuel type: same as proposed design</u>  <u>Efficiencies:</u>  <u>Electric: air-source heat pump with prevailing federal minimum efficiency</u>  <u>Nonelectric furnaces: natural gas furnace with prevailing federal minimum efficiency</u>  <u>Nonelectric boilers: natural gas boiler with prevailing federal minimum efficiency</u>            Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i></p>	<p>As proposed  <u>As proposed</u>  <u>As proposed</u></p>
Cooling systems <sup>c, d</sup>	<p><del>As proposed</del>  <u>Fuel type: Electric</u>  <u>Efficiency: in accordance with prevailing federal minimum standards</u>            Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i></p>	<p>As proposed  <u>As proposed</u>  <u>As proposed</u></p>
Service Water Heating <sup>e, f, g</sup>	<p><del>As proposed</del>  <u>Fuel type: same as proposed design</u>  <u>Efficiency: in accordance with prevailing Federal minimum standards</u>  <u>Use: gal/day = 30 + 10 × N<sub>br</sub></u>  <u>Tank temperature: 120°F</u>  <u>Use: same as proposed design</u></p>	<p>As proposed  <u>As proposed</u>  <u>Same as standard reference</u>  <u>Same as standard reference</u>  <u>gal/day = 30 + 10 × N<sub>br</sub></u></p>

**Reason:**

Replace code language from the 2006 IECC for the Heating systems, Cooling Systems and Service water heating Building Components in Table 404.5.2(1). By placing the 2006 language back into the code, builders and consumers have an opportunity to optimize a code compliance house design by using efficient equipment. The new language in the 2009 IECC discourages the use of high efficiency equipment which is often a more cost effective solution to achieve code compliance.

**Staff Contact:** Ken Sagan – [ksagan@nahb.com](mailto:ksagan@nahb.com) - 800-368-5242, ext. 8444

**TABLE 405.5.2(1)**  
**SPECIFICATIONS FOR THE STANDARD REFERENCE DESIGN AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame. Gross area: same as proposed <i>U</i> -factor: from Table 402.1.3 Solar absorptance = 0.75 Remittance = 0.90	As proposed As proposed As proposed As proposed As proposed
Basement and crawl space walls	Type: same as proposed Gross area: same as proposed <i>U</i> -factor: from Table 402.1.3, with insulation layer on interior side of walls.	As proposed As proposed As proposed
Above-grade floors	Type: wood frame Gross area: same as proposed <i>U</i> -factor: from Table 402.1.3	As proposed As proposed As proposed
Ceilings	Type: wood frame Gross area: same as proposed <i>U</i> -factor: from Table 402.1.3	As proposed As proposed As proposed
Roofs	Type: composition shingle on wood sheathing Gross area: same as proposed Solar absorptance = 0.75 Emittance = 0.90	As proposed As proposed As proposed As proposed
Attics	Type: vented with aperture = 1 ft <sup>2</sup> per 300 ft <sup>2</sup> ceiling area	As proposed
Foundations	Type: same as proposed foundation wall area above and below grade and soil characteristics: same as proposed.	As proposed As proposed
Doors	Area: 40 ft <sup>2</sup> Orientation: North <i>U</i> -factor: same as fenestration from Table 402.1.3.	As proposed As proposed As proposed
Glazing <sup>a</sup>	Total area <sup>b</sup> = (a) The proposed glazing area; where proposed glazing area is less than 15% of the conditioned floor area. (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area. Orientation: equally distributed to four cardinal compass orientations (N, E, S & W). <i>U</i> -factor: from Table 402.1.3 SHGC: From Table 402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used. Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85° External shading: none	As proposed  As proposed As proposed As proposed As proposed As proposed
Skylights	None	As proposed
Thermally isolated sunrooms	None	As proposed

(continued)

TABLE 405.5.2(1)—continued  
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Air exchange rate	Specific leakage area (SLA) <sup>d</sup> = 0.00036 assuming no energy recovery	For residences that are not tested, the same as the standard reference design. For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate <sup>e</sup> but not less than 0.35 ACH For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate <sup>e</sup> combined with the mechanical ventilation rate, $f$ which shall not be less than $0.01 \times CFA + 7.5 \times (N_{br} + 1)$ where: $CFA$ = conditioned floor area $N_{br}$ = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: $kWh/yr = 0.03942 \times CFA + 29.565 \times (N_{br} + 1)$ where: $CFA$ = conditioned floor area $N_{br}$ = number of bedrooms	As proposed
Internal gains	$IGain = 17,900 + 23.8 \times CFA + 4104 \times N_{br}$ (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area.	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element <sup>g, f</sup> but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air.	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table 402.1.3 located on the interior side of the walls	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed
Heating systems <sup>g, h</sup>	As proposed Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed
Cooling systems <sup>g, i</sup>	As proposed Capacity: sized in accordance with Section M1401.3 of the <i>International Residential Code</i>	As proposed
Service water heating <sup>g, i, j, k</sup>	As proposed Use: same as proposed design	As proposed $gal/day = 30 + (10 \times N_{br})$
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.88 shall be applied to both the heating and cooling system efficiencies for all systems other than tested duct systems. Duct insulation: From Section 403.2.1. For tested duct systems, the leakage rate shall be the applicable maximum rate from Section 403.2.2.	As tested or as specified in Table 405.5.2(2) if not tested
Thermostat	Type: Manual, cooling temperature setpoint = 75°F; Heating temperature setpoint = 72°F	Same as standard reference

(continued)

TABLE 405.5.2(1)—continued

For SI: 1 square foot = 0.93 m<sup>2</sup>; 1 British thermal unit = 1055 J; 1 pound per square foot = 4.88 kg/m<sup>2</sup>; 1 gallon (U.S.) = 3.785 L; °C = (°F-3)/1.8, 1 degree = 0.79 rad.

- a. Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight-transmitting opening is less than 50 percent of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.
- b. For residences with conditioned basements, R-2 and R-4 residences and townhouses, the following formula shall be used to determine glazing area:
 
$$AF = A_s \times FA \times F$$
 where:
  - AF = Total glazing area.
  - A<sub>s</sub> = Standard reference design total glazing area.
  - FA = (Above-grade thermal boundary gross wall area)/(above-grade boundary wall area + 0.5 × below-grade boundary wall area).
  - F = (Above-grade thermal boundary wall area)/(above-grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.
 and where:
  - Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
  - Above-grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
  - Below-grade boundary wall is any thermal boundary wall in soil contact.
  - Common wall area is the area of walls shared with an adjoining dwelling unit.
- c. For fenestrations facing within 15 degrees (0.26 rad) of true south that are directly coupled to thermal storage mass, the winter interior shade fraction shall be permitted to be increased to 0.95 in the proposed design.
- d. Where leakage area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where:
 
$$SLA = L/CFA$$
 where L and CFA are in the same units.
- e. Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2001 ASHRAE Handbook of Fundamentals, Chapter 26, page 26.21, Equation 40 (Sherman-Grimrud model) or the equivalent shall be used to determine the energy loads resulting from infiltration.
- f. The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2001 ASHRAE Handbook of Fundamentals, page 26.24 and the "Whole-house Ventilation" provisions of 2001 ASHRAE Handbook of Fundamentals, page 26.19 for intermittent mechanical ventilation.
- g. Thermal storage element shall mean a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase-change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees (0.26 rad) of true south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.
- h. For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.
- i. For a proposed design without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be used for the standard reference design.
- j. For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.
- k. For a proposed design with a nonstorage-type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

TABLE 405.5.2(2)  
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS<sup>a</sup>

DISTRIBUTION SYSTEM CONFIGURATION AND CONDITION:	FORCED AIR SYSTEMS	HYDRONIC SYSTEMS <sup>b</sup>
Distribution system components located in unconditioned space	—	0.95
Untested distribution systems entirely located in conditioned space <sup>c</sup>	0.88	1
"Ductless" systems <sup>d</sup>	1	—

- For SI: 1 cubic foot per minute = 0.47 L/s; 1 square foot = 0.093 m<sup>2</sup>; 1 pound per square inch = 6895 Pa; 1 inch water gauge = 1250 Pa.
- a. Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.
  - b. Hydronic systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced airflow to maintain space temperatures.
  - c. Entire system in conditioned space shall mean that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.
  - d. Ductless systems shall be allowed to have forced airflow across a coil but shall not have any ducted airflow external to the manufacturer's air handler enclosure.



**PUBLIC CODE CHANGE PROPOSAL FORM  
FOR PUBLIC PROPOSALS IN THE INTERNATIONAL  
CODES**

**2007/2008 CODE DEVELOPMENT CYCLE**

**CLOSING DATE: All Proposals Must Be Received by August 20, 2007**

The 2007/2008 Code Development Hearings are tentatively scheduled for February 18 – March 2, 2008, location TBD.

1) **Name:** Stephen Turchen **Date:** August 16, 2007  
**Jurisdiction/Company:** Fairfax County Department of Public works and Environmental Services  
**Submitted on Behalf of:** [same]  
**Address:** 12055 Government Center Parkway  
**City:** Farifax **State:** VA **Zip Code:** 22035  
**Phone:** 703-324-1653 **Ext.** **Fax:** 703-324-1614 **E-mail address:**  
Stephen.turchen@fairfaxcounty.gov

2) **Copyright Release:** In accordance with Council Policy #28 Code Development, all Code Change Proposals, Floor Modifications and Public Comments are required to include a copyright release. A copy of the copyright release form is included at the end of this form. Please follow the directions on the form. This form as well as an alternative release form can also be downloaded from the ICC website at [www.iccsafe.org](http://www.iccsafe.org). If you have previously executed the copyright release, please check the box below:

2007/2008 Cycle copyright release on file

3) Indicate appropriate International Code(s) associated with this Public Proposal – Please use Acronym:  
\_\_\_\_\_ IECC \_\_\_\_\_  
If you have also submitted a separate coordination change to another I-Code, please indicate the code:  
\_\_\_\_\_  
(See section below for list of names and acronyms for the International Codes).

**Section 202 General Definitions**

Add new text as follows:

**Building Entrance.** Any doorway, set of doors, turnstile, or other form of portal that is ordinarily used to gain access to the building or space by its users and occupants.

**Section 502.4.6 Vestibules**

Revise as follows:

502.4.6 Vestibules. Building entrances A door that separates conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not

necessary for the interior and exterior doors to open at the same time. Door swing and distance between vestibule doors shall conform to 2006 IBC Sec. 1008.1.2 and 1008.1.7. Vestibules shall not be made part of the conditioned space of the building to which they are attached.

**Exceptions:**

1. ~~Buildings in Climate Zones 1 or and 2 as indicated in Figure 301.1 and Table 301.1.~~
2. Doors not intended to be used as a building entrance door, such as doors to mechanical or electrical equipment rooms.
3. Doors opening directly from a sleeping unit or dwelling unit.
4. Doors that open directly from a space that is less than 3000 ft<sup>2</sup> (298 m<sup>2</sup>) in area. Spaces that are separated from the "3000 ft<sup>2</sup> space" by a door or moveable partition shall not be considered part of the "3000 ft<sup>2</sup> space" for purposes of area computation.
5. Revolving doors. Building entrances with revolving doors. Any side-hinged swinging door required in addition to the revolving door in accordance with the 2006 IBC shall not require a vestibule.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

**Supporting Statement**

The purpose of the proposal is to clarify the IECC provisions as they to apply to vestibules for commercial buildings.

In practice, since this provision first appeared in the 2003 IECC, it has been difficult to interpret the requirements of IECC Section 502.4.6 for determining when an airlock vestibule should be added to a commercial building. What doors should be considered for vestibules? When is the space to which the door connects of a size that would require a vestibule? Answering questions like these in a logical and uniform manner has implications for both building design (and cost) and code enforcement, as well as energy conservation.

The new definition in Section 202 helps to define the class of doors that are eligible for vestibules. Only doors that are "ordinarily used to gain access" should be considered. Many doors can be used to get into a building, such as those discussed in exception #2, but they are not the primary means of access. Doors that are primarily exit discharge doors at the end of dedicated corridors or located to provide additional means of egress from large rooms are similarly ineligible, as they will not be used for "ordinary access." The inclusion of the phrase "or space" in the proposed definition is intended to account for large individual tenant

spaces in strip malls or similar buildings which will have building entrance doors that open directly to the outdoors. In effect, the definition causes the designer or code official to answer the following simple question: Is this a door that will be used for significant pedestrian traffic into this building or space? If so, a vestibule will be required, unless one of the proposed exceptions applies.

Text on door swing and distance between vestibule doors was added to ensure conformity with the IBC requirements for means of egress doors. Any door qualifying as a "building entrance door" will with rare exception be an egress door for the building or space.

Text was added to the main paragraph of Sec. 502.4.6 to ensure that vestibules are not themselves separately conditioned. Vestibules will always be indirectly conditioned by the adjacent conditioned area of the building or space to which they are attached and the constant opening and closing of the interior door. The exterior door will always let in unconditioned outside air which the HVAC system will always be trying to condition, wasting energy unnecessarily, considering the short transit time of pedestrians in the vestibule. Providing this additional language will also clarify to designers that direct conditioning of vestibules is not required, another source of confusion in this area.

Exception 1 was deleted as there is no logical reason for excluding cooling-dominated climate zones from the vestibule requirement. Vestibules in these climate zones will help to prevent hot, humid air intrusion into the conditioned space, just as vestibules in heating zones will help to prevent the intrusion of cold outside air.

The addition to exception 4 will clarify how to compute the 3000 ft<sup>2</sup> area when applying this exception, another source of confusion. One must consider only that floor area, directly adjacent to the building entrance door, that is completely bounded by walls, doors of any kind, or moveable partitions. (A fixed opening into an adjacent space would add the area of that adjacent space to the area directly adjacent to the building entrance door for the purposes of this exception.)

The addition to exception 5 clarifies the revolving door exemption. The IBC requires a side-hinged swinging door within 10 feet of a revolving door (Sec. 1008.1.3.1). Does the swinging door now become another "building entrance door" that needs a vestibule? The logical answer is "No," as the revolving door is considered to be providing the acceptable air-lock entry into the building or space, even though people may, on occasion, use the swinging door to gain access.

The code change proposal will increase the cost of construction in those cases where vestibules are now clearly required, based on the revised language, but will decrease the cost of construction in those cases where the proposal provides enough information to determine that a vestibule is not in fact required for the building or space under consideration.



# ICC CODES - PUBLIC COMMENT FORM

FOR PUBLIC COMMENTS ON THE "2008 REPORT OF THE PUBLIC HEARINGS"

PLEASE SEE BACK OF FORM FOR PROCEDURES ON SUBMITTING PUBLIC COMMENTS. ALL SUBMITTALS MUST COMPLY WITH THESE PROCEDURES.

**CLOSING DATE: All Comments Must Be Received by June 9, 2008.** The 2008 Final Action Hearings will be held September 17-23, 2008 in Minneapolis, Minnesota

1) Please type or print clearly: Public comments will be returned if they contain unreadable information.

Name:	Stephen Turchen				Date:	June 6, 2009	
Jurisdiction/Company:	Fairfax County Department of Public Works, Fairfax County, Virginia						
Submitted on Behalf of:	N/A						
Address:	12055 Government Center Parkway						
City:	Fairfax	State:	VA	Zip +4:	22035-5504		
Phone:	703-324-1653	Ext:	N/A	Fax:	703-324-1614		
e-mail:	Stephen.turchen@fairfaxcounty.gov						

2) Copyright Release: In accordance with Council Policy #28 Code Development, all Code Change Proposals, Floor Modifications and Public Comments are required to include a copyright release. A copy of the copyright release form is included at the end of this form. Please follow the directions on the form. This form as well as an alternative release form can also be downloaded from the ICC website at [www.iccsafe.org](http://www.iccsafe.org). If you have previously executed the copyright release, please check the box below:

2007/2008 Cycle copyright release on file

3) Code Change Proposal Number:

Indicate the Code Change Proposal Number that is being addressed by this Public Comment: EC127-07/08

4) Public Comment: The Final Action requested on this Code Change Proposal is: (Check Box)

Approved as Submitted (AS):
  Approved as Modified by this Public Comment (AMPC):
  Approved as Modified by the Code Committee as Published in the ROH (AM):
  Approved as Modified by Assembly Floor Action as Published in the ROH (AMF):
  Disapproved (D):

5) Proposed Modification (AMPC only):

See the attached sheet.

Modification Continued (Attach additional sheets as necessary)

6) Reason (State the reason and justification to support the Public Comment. Include a bibliography of any substantiating material. It is the responsibility of the commenter to make the material available at the Final Action Hearing):

See the attached sheet.

Reason Continued (Attach additional sheets as necessary)

PLEASE USE SEPARATE FORM FOR EACH PUBLIC COMMENT  
 SUBMITTAL AS A DOCUMENT ATTACHED TO AN EMAIL IS PREFERRED  
 SEE BACK OF FORM FOR DIRECTIONS ON WHERE TO SEND PUBLIC COMMENTS

## Section 202 General Definitions

Add new definition as follows:

**Building Entrance.** Any doorway, set of doors, turnstile, or other form of portal that is ~~ordinarily used to gain a primary means of gaining~~ access to the building or space by its users and occupants.

## Section 502.4.6 Vestibules

Revise as follows:

502.4.6 Vestibules. Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Door swing and distance between vestibule doors shall conform to 2006 IBC Sec. 1008.1.2 and 1008.1.7. Vestibules shall not be made part of the conditioned space of the building to which they are attached, unless required to prevent freezing of water pipes or floor surfaces within the vestibule.

### Exceptions:

1. Doors not intended to be used as a building entrance, such as doors to mechanical or electrical equipment rooms.
2. Doors opening directly from a sleeping unit or dwelling unit.
3. Doors that open directly from a space that is less than 3000 ft<sup>2</sup> (298 m<sup>2</sup>) in area. Spaces that are separated from the "3000 ft<sup>2</sup> space" by a door or moveable partition shall not be considered part of the "3000 ft<sup>2</sup> space" for purposes of area computation, if the door or partition is self-closing.
4. Building entrances with revolving doors. Any side-hinged swinging door required in addition to the revolving door in accordance with the 2006 IBC shall not require a vestibule.
5. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

### Reason

The purpose of the proposal and this public comment is to clarify when a vestibule is required in a commercial building.

One of the stated reasons for disapproval of the original proposal is "different needed ways in and out of buildings" would be prohibited. It is unclear why any door into or out of a building would be prohibited by the proposed change. The slightly modified definition in Section 202 identifies those doors that should be considered for vestibules: the ones that are "the primary means of gaining access" to the building. Many doors can be used to get into a building, but they are not the primary means of access. Doors that are exit discharge doors at the end of dedicated corridors or located to provide additional means of egress from large rooms are examples of doors that would not require vestibules under the proposed change, as they will not be used for primary access into the building. In effect, the definition causes the designer or code official to answer the following simple question: Is this a door that will be used for significant pedestrian traffic into this building or space? If so, a vestibule will be required, unless one of the proposed exceptions applies. Other doors become part of the building's design; they simply do not require vestibules. Note that there is nothing in the

proposed language of Sec. 502.4.6 that would prevent someone from installing a vestibule at a door where the section would not otherwise require a vestibule.

Text was originally added to the main paragraph of Sec. 502.4.6 to ensure that vestibules are not themselves separately conditioned. However, the Committee felt that sometimes the vestibule should be conditioned, such as “to prevent ice build-up.” A change was added to the original proposal language to permit heating if freeze protection of pipes or floor surfaces was considered a problem in some locales. Freeze protection should not be a significant issue for vestibules, as they will always be indirectly conditioned by the adjacent (heated) area of the building or space to which they are attached and the conditioning of that space via the IECC compliant building envelope. (Freeze protection of piping systems is addressed in the International Plumbing Code, Section 305.6.)

The addition to exception 3 should further clarify how to compute the 3000 ft<sup>2</sup> area when applying this exception. One must consider only that floor area, directly adjacent to the building entrance door, which is completely bounded by walls, doors of any kind, or moveable partitions. The added language is intended to ensure that a door or partition bounding the space directly adjacent to the building entrance door must be self-closing. If not, then the additional floor area beyond that door or partition can become part of the “3000 ft<sup>2</sup>” area that still requires the installation of a vestibule at the building entrance.

**502.4.7 Vestibules.** A door that separates *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time.

**Exceptions:**

1. Buildings in climate Zones 1 and 2 as indicated in Figure 301.1 and Table 301.1.
2. Doors not intended to be used as a building *entrance door*, such as doors to mechanical or electrical equipment rooms.
3. Doors opening directly from a *sleeping unit* or dwelling unit.
4. Doors that open directly from a space less than 3,000 square feet (298 m<sup>2</sup>) in area.
5. Revolving doors.
6. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.

**502.4.8 Recessed lighting.** Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and *labeled* as meeting ASTM E 283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the *conditioned space* to the ceiling cavity. All recessed luminaires shall be sealed with a gasket or caulk between the housing and interior wall or ceiling covering.

**SECTION 503  
BUILDING MECHANICAL SYSTEMS**

**503.1 General.** Mechanical systems and equipment serving the building heating, cooling or ventilating needs shall comply with Section 503.2 (referred to as the mandatory provisions) and either:

1. Section 503.3 (Simple systems), or
2. Section 503.4 (Complex systems).

**503.2 Provisions applicable to all mechanical systems (Mandatory).**

**503.2.1 Calculation of heating and cooling loads.** Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.

**503.2.2 Equipment and system sizing.** Equipment and system sizing. Heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance

with Section 503.2.1. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

**Exceptions:**

1. Required standby equipment and systems provided with controls and devices that allow such systems or equipment to operate automatically only when the primary equipment is not operating.
2. Multiple units of the same equipment type with combined capacities exceeding the design load and provided with controls that have the capability to sequence the operation of each unit based on load.

**503.2.3 HVAC equipment performance requirements.**

Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(4), 503.2.3(5), 503.2.3(6) and 503.2.3(7) when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through certification under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

**Exception:** Water-cooled centrifugal water-chilling packages listed in Table 503.2.3(7) not designed for operation at ARHI Standard 550/590 test conditions of 44°F (7°C) leaving chilled water temperature and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s.kW) condenser water flow shall have maximum full load and NPLV ratings adjusted using the following equations:

$$\text{Adjusted maximum full load kW/ton rating} = [\text{full load kW/ton from Table 503.2.3(7)}] / K_{\text{adj}}$$

$$\text{Adjusted maximum NPLV rating} = [\text{IPLV from Table 503.2.3(7)}] / K_{\text{adj}}$$

where:

$$K_{\text{adj}} = 6.174722 - 0.303668(X) + 0.00629466(X)^2 - 0.000045780(X)^3$$

$$X = DT_{\text{std}} + \text{LIFT}$$

$$DT_{\text{std}} = \{24 + [\text{full load kW/ton from Table 503.2.3(7)}] \times 6.83\} / \text{Flow}$$

$$\text{Flow} = \text{Condenser water flow (GPM)} / \text{Cooling Full Load Capacity (tons)}$$

$$\text{LIFT} = \text{CEWT} - \text{CLWT} (\text{°F})$$

$$\text{CEWT} = \text{Full Load Condenser Entering Water Temperature (°F)}$$

$$\text{CLWT} = \text{Full Load Leaving Chilled Water Temperature (°F)}$$

least 25 percent of the duct area have been tested and that all tested sections meet the requirements of this section.

**503.2.8 Piping insulation.** All piping serving as part of a heating or cooling system shall be thermally insulated in accordance with Table 503.2.8.

**Exceptions:**

1. Factory-installed piping within HVAC equipment tested and rated in accordance with a test procedure referenced by this code.
2. Factory-installed piping within room fan-coils and unit ventilators tested and rated according to AHRI 440 (except that the sampling and variation provisions of Section 6.5 shall not apply) and 840, respectively.
3. Piping that conveys fluids that have a design operating temperature range between 55°F (13°C) and 105°F (41°C).
4. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electric power.
5. Runout piping not exceeding 4 feet (1219 mm) in length and 1 inch (25 mm) in diameter between the control valve and HVAC coil.

**TABLE 503.2.8  
MINIMUM PIPE INSULATION  
(thickness in inches)**

FLUID	NOMINAL PIPE DIAMETER	
	≤ 1.5"	> 1.5"
Steam	1½	3
Hot water	1½	2
Chilled water, brine or refrigerant	1½	1½

For SI: 1 inch = 25.4 mm.

- a. Based on insulation having a conductivity (*k*) not exceeding 0.27 Btu per inch/h · ft<sup>2</sup> · °F.
- b. For insulation with a thermal conductivity not equal to 0.27 Btu · inch/h · ft<sup>2</sup> · °F at a mean temperature of 75°F, the minimum required pipe thickness is adjusted using the following equation;

$$T = r[(1 + tr)^{k/0.27} - 1]$$

where:

- T* = Adjusted insulation thickness (in).
- r* = Actual pipe radius (in).
- t* = Insulation thickness from applicable cell in table (in).
- K* = New thermal conductivity at 75°F (Btu · in/hr · ft<sup>2</sup> · °F).
- k* = 0.27 Btu · in/hr · ft<sup>2</sup> · °F.

**503.2.9 HVAC system completion.** Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.

**503.2.9.1 Air system balancing.** Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 horsepower (hp) (7.4 kW) and larger.

**503.2.9.2 Hydronic system balancing.** Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.

**503.2.9.3 Manuals.** The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:

1. Equipment capacity (input and output) and required maintenance actions.
2. Equipment operation and maintenance manuals.
3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.
4. A complete written narrative of how each system is intended to operate.

**503.2.10 Air system design and control.** Each HVAC system having a total fan system motor nameplate horsepower (hp) exceeding 5 horsepower (hp) shall meet the provisions of Sections 503.2.10.1 through 503.2.10.2.

**503.2.10.1 Allowable fan floor horsepower.** Each HVAC system at fan system design conditions shall not exceed the allowable fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) as shown in Table 503.2.10.1(1). This includes supply fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability.

**Exceptions:**

1. Hospital and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp or less.
3. Fans exhausting air from fume hoods. (Note: If this exception is taken, no related exhaust side credits shall be taken from Table 503.2.10.1(2) and the Fume Exhaust Exception Deduction must be taken from Table 503.2.10.1(2).)



[Home](#) | [Contact Us](#) | [Sponsor/Advertise](#)

[Join/Renew](#) | [My ACCA](#) | [Online Store](#) | [Consumer Info](#)



**Air Conditioning Contractors of America®**  
*Making life more comfortable for contractors and their customers.*

Search

<a href="#">About ACCA</a>	<a href="#">Business Services</a>	<a href="#">Technical Services</a>	<a href="#">News &amp; Publications</a>	<a href="#">Education &amp; Certification</a>	<a href="#">Outreach &amp; Advocacy</a>
----------------------------	-----------------------------------	------------------------------------	---	---	---

**Technical Services**

- » [Ask the Experts](#)
- » [HVAC System Design](#)
  - » [Recommended Values](#)
  - » [Articles & Presentations](#)
  - » [Speed-Sheet](#)
  - » [Version Comparisons](#)
  - » [ACCA-approved Software](#)
  - » [System Design Training](#)
  - » [Certified Instructors](#)
  - » [Instructor Training](#)
- » [Technical Bulletins](#)
- » [Quality Installation](#)
- » [ACCA Standards](#)
- » [Building Codes](#)
- » [ENERGY STAR](#)
- » [Articles & Presentations](#)
- » [ACCA Online Store](#)
- » [My ACCA](#)

\* This symbol identifies a resource that is for ACCA members only.

HVAC Industry Marketplace



**ACCA System Design**

The ACCA System Design Process is the industry standard for the proper design and installation of central HVAC systems. Our process is based on years of experience and the accurate application of specific methods, from system concept to testing the final installation.

**Not logged in.**  
 Please login for full access to our site. Or **join today** for instant access!

ACCA's Technical Manuals are the bedrock of air conditioning in America. ACCA procedures are required by many building codes and regional laws, and incorporated in many software programs (check here to see which ones).

**To purchase ACCA manuals and software,** be sure to check out our online store.

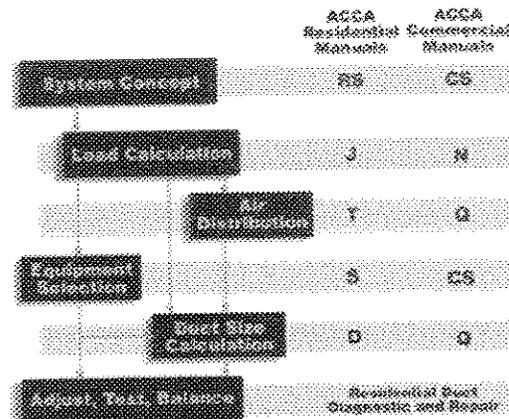
» **Recommended Values**  
 Learn about recommended values for occupant comfort and health from ACCA manuals.

» **Articles & Presentations**  
 These publicly-accessible articles help explain certain aspects of load calculation and system design.

» **Speed-Sheets for Manual J and Manual N**  
 Download the Speed-Sheets, spreadsheet programs that can be used in conjunction with Manual J-8 Abridged Edition (for residential load calculation) or Manual N 5th Edition (for light commercial load calculation).

» **Version Comparisons**  
 Which Manual J or Manual N is right for you?

**ACCA System Design Process**



**Hodge, Vernon**

**From:** Rodgers, Emory  
**Sent:** Thursday, October 02, 2008 8:01 AM  
**To:** Wallace, Clinton; Hodge, Vernon  
**Subject:** RE: Water Reclamation and Reuse Regulation (9VAC25-740)

Please send this onto Valerie as we do need to meet with them for our 2009 USBC regulations getting underway in March of 2009. Also send onto VBCOA and VPMIA with copies to Bill Dupler, Steve Shapario and Guy Tomberlin. The IAMPO letter and these regulations need to go onto ICC and their PMG director that Bill can give you the name. Make sure all noted parties get the copies of the attachments and save the regulation for our 2009 USBC as there are areas where we need coordination and agreement.

The 2009 USBC will have a code change on gray water, reclaimed water and maybe rainwater harvesting all the subject of legislation in 2008 and now in the Virginia Housing Commission where DEQ, VDH and DHCD gave presentations on how to move the ball down the field into allowing use as being energy and green sustainability matters. The USBC has an appendix on gray water that DEQ/SWCB need to review as it and with changes will be presented for our 2009 USBC regulations.

We will want Valerie or a designated DEQ person to join our work group and will want VDH present too. The 2008 DEQ/SWCB regulation has much to offer and I can understand the limited uses for reclaimed water at this time and separation from gray water. I think we and our building officials and building owners probably agree on the distinction and the issue with color of the piping needs to be different for gray and reclaimed water or for that matter rainwater harvesting that can be easily worked out. I am not sure what ICC uses for the pipe coloring scheme. I hope ICC contacts the 3 organizations noted in the letter to IAMPO as the ICC IPC is the most widely used plumbing code.

Just a brief review of the regulations raises some coordination issues and future harmonization or a MOA between DEQ and DHCD on the demarcation of their regulations and our state building code to avoid statutory and regulatory conflicts or more importantly for the end users to understand clearly what are the total impacts and to avoid costly permitting, inspections, plan reviews and other duplicative regulations. I didn't see any or the areas being noted that cannot be coordinated and harmonized by future regulations or by a MOA.

1. Agree DEQ and DHCD or VDH need to make sure the pipe coloring system is the same from the plants, in the public way and private property and inside the buildings.
2. Most of the definitions fit into the ones used in the ICC International Plumbing Code.
3. Generally, DEQ, VDH and DHCD MOA's have made the demarcation points for septic systems, wells, etc at the building line or where the end user obtains the services at a main. I note this because DEQ permits are required and there is a "maybe" for the end user that would be the building owner where the USBC has been the enforcement regulation by state law for construction of buildings and systems. For example the USBC has in the IPC backflow protection and waterless urinals are now used and local building departments have approved gray water systems for irrigation and flushing of toilets but not potable uses that is consistent with these SWCB 2008 regulations. I think when we do the 2009 USBC we can link most of these 2008 regulations into a harmonized set of regulations from the two boards/agencies.
4. In 9VAC25-740-50 exclusions and then prohibition there is need for discussions and better understanding on the intent and possible expansions of these sections. It appears at first glance the USBC should be referenced as are other state agencies and laws to make clear the distinctions for enforcers and the end users/designers. Because of the green/sustainability/energy advocacies some of the prohibitions may need to be revised such as the use in residential of gray water/rainwater harvesting/reclaimed water for non-potable uses the same as commercial which by our USBC includes institutions, assembly buildings, educational facilities, doctors offices and businesses. I suspect one reason for starting in a more restrictive vein is children or pets drinking from toilets.
5. Backflow devices are and have been for some time required by the USBC plumbing code at the equipment and appliances such as boilers, fire lines and various type dispensers and industrial equipment. Water purveyors work with the local building departments with some also requiring the main line to have a device or in some cases not to do so since the USBC requires them at the connection. Point is to make clear for purposes of uniformity the goal of safe potable water is provided but not at unreasonable costs, duplication and permitting/inspection processes. I think there are in-place many workable relationships so end users aren't confused nor are the enforcers.

10/2/2008

Like the technical parts, but leave it up to our plumbing code experts to review and comment.

Thanks to DEQ for moving us down the field on this highly visible matter.

---

**From:** Wallace, Clinton  
**Sent:** Thu 10/2/2008 6:35 AM  
**To:** Rodgers, Emory; Hodge, Vernon  
**Subject:** FW: Water Reclamation and Reuse Regulation (9VAC25-740)

FYI, I spoke with this Ms. Rourke yesterday. She wanted us to be aware of a recently adopted Virginia regulation concerning water reclamation and reuse. She did not want to create a conflict with are building/plumbing code.

Clinton Wallace  
State Building Codes Administrator  
Division of Building and Fire Regulation  
Department of Housing and Community Development  
Commonwealth of Virginia  
804-371-7161 Office  
804-371-7092 Fax  
clinton.wallace@dhcd.virginia.gov

---

**From:** Rourke, Valerie [mailto:varourke@deq.virginia.gov]  
**Sent:** Wednesday, October 01, 2008 4:32 PM  
**To:** Wallace, Clinton  
**Subject:** Water Reclamation and Reuse Regulation (9VAC25-740)

Hello Mr. Wallace.

I appreciated the opportunity to discuss with you the issue of the proposed IAMPO code for gray water pipe coloring and possible conflict with Virginia's recently adopted Water Reclamation and Reuse Regulation (9VAC25-740). Specifications for reclaimed water distribution systems, including pipe coloring and labeling are located under 9VAC25-740-110.B (see attached). Although the use of reclaimed water is prohibited in domestic or residential dwellings, or a building with a domestic or residential unit, it may be used in commercial buildings for toilet flushing and fire suppression.

For your information, I have also attached a copy of correspondence from the WaterReuse Association, the WEF and the AWWA to IAPMO regarding the proposed code for gray water pipe coloring. The letter goes into more detail about the issues of concern.

If you or your staff have any questions regarding the Water Reclamation and Reuse Regulation, please feel free to contact me.

Sincerely,

Valerie Rourke

<<Water Recl. & Reuse Regulation 10-1-08.pdf>>

<<Joint Letter to IAPMO 09-24-08.pdf>>

*Valerie A. Rourke (Note P.O.Box & zip change)*

10/2/2008

## APPENDIX C

# GRAY WATER RECYCLING SYSTEMS

*The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.*

**Note:** Section 301.3 of this code requires all plumbing fixtures that receive water or waste to discharge to the sanitary drainage system of the structure. In order to allow for the utilization of a gray water system, Section 301.3 should be revised to read as follows:

**301.3 Connections to drainage system.** All plumbing fixtures, drains, appurtenances and appliances used to receive or discharge liquid wastes or sewage shall be directly connected to the sanitary drainage system of the building or premises, in accordance with the requirements of this code. This section shall not be construed to prevent indirect waste systems required by Chapter 8.

**Exception:** Bathtubs, showers, lavatories, clothes washers and laundry trays shall not be required to discharge to the sanitary drainage system where such fixtures discharge to an *approved* gray water system for flushing of water closets and urinals or for subsurface landscape irrigation.

### SECTION C101 GENERAL

**C101.1 Scope.** The provisions of this appendix shall govern the materials, design, construction and installation of gray water systems for flushing of water closets and urinals and for subsurface landscape irrigation (see Figures 1 and 2).

**C101.2 Definition.** The following term shall have the meaning shown herein.

**GRAY WATER.** Waste discharged from lavatories, bathtubs, showers, clothes washers and laundry trays.

**C101.3 Permits.** Permits shall be required in accordance with Section 106.

**C101.4 Installation.** In addition to the provisions of Section C101, systems for flushing of water closets and urinals shall comply with Section C102 and systems for subsurface landscape irrigation shall comply with Section C103. Except as provided for in Appendix C, all systems shall comply with the provisions of the *International Plumbing Code*.

**C101.5 Materials.** Above-ground drain, waste and vent piping for gray water systems shall conform to one of the standards listed in Table 702.1. Gray water underground building drainage and vent pipe shall conform to one of the standards listed in Table 702.2.

**C101.6 Tests.** Drain, waste and vent piping for gray water systems shall be tested in accordance with Section 312.

**C101.7 Inspections.** Gray water systems shall be inspected in accordance with Section 107.

**C101.8 Potable water connections.** Only connections in accordance with Section C102.3 shall be made between a gray water recycling system and a potable water system.

**C101.9 Waste water connections.** Gray water recycling systems shall receive only the waste discharge of bathtubs, showers, lavatories, clothes washers or laundry trays.

**C101.10 Collection reservoir.** Gray water shall be collected in an *approved* reservoir constructed of durable, nonabsorbent and corrosion-resistant materials. The reservoir shall be a closed and gas-tight vessel. *Access* openings shall be provided to allow inspection and cleaning of the reservoir interior.

**C101.11 Filtration.** Gray water entering the reservoir shall pass through an *approved* filter such as a media, sand or diatomaceous earth filter.

**C101.11.1 Required valve.** A full-open valve shall be installed downstream of the last fixture connection to the gray water discharge pipe before entering the required filter.

**C101.12 Overflow.** The collection reservoir shall be equipped with an overflow pipe having the same or larger diameter as the influent pipe for the gray water. The overflow pipe shall be trapped and shall be indirectly connected to the sanitary drainage system.

**C101.13 Drain.** A drain shall be located at the lowest point of the collection reservoir and shall be indirectly connected to the sanitary drainage system. The drain shall be the same diameter as the overflow pipe required in Section C101.12.

**C101.14 Vent required.** The reservoir shall be provided with a vent sized in accordance with Chapter 9 and based on the diameter of the reservoir influent pipe.

### SECTION C102 SYSTEMS FOR FLUSHING WATER CLOSETS AND URINALS

**C102.1 Collection reservoir.** The holding capacity of the reservoir shall be a minimum of twice the volume of water required to meet the daily flushing requirements of the fixtures supplied with gray water, but not less than 50 gallons (189 L). The reservoir shall be sized to limit the retention time of gray water to a maximum of 72 hours.

**C102.2 Disinfection.** Gray water shall be disinfected by an *approved* method that employs one or more disinfectants such as chlorine, iodine or ozone that are recommended for use with the pipes, fittings and equipment by the manufacturer of the pipes, fittings and equipment.

**C102.3 Makeup water.** Potable water shall be supplied as a source of makeup water for the gray water system. The potable water supply shall be protected against backflow in accordance with Section 608. There shall be a full-open valve located on the makeup water supply line to the collection reservoir.

**C102.4 Coloring.** The gray water shall be dyed blue or green with a food grade vegetable dye before such water is supplied to the fixtures.

**C102.5 Materials.** Distribution piping shall conform to one of the standards listed in Table 605.3.

**C102.6 Identification.** Distribution piping and reservoirs shall be identified as containing nonpotable water. Piping identification shall be in accordance with Section 608.8.

## SECTION C103

### SUBSURFACE LANDSCAPE IRRIGATION SYSTEMS

**C103.1 Collection reservoir.** Reservoirs shall be sized to limit the retention time of gray water to a maximum of 24 hours.

**C103.1.1 Identification.** The reservoir shall be identified as containing nonpotable water.

**C103.2 Valves required.** A check valve and a full-open valve located on the discharge side of the check valve shall be installed on the effluent pipe of the collection reservoir.

**C103.3 Makeup water.** Makeup water shall not be required for subsurface landscape irrigation systems. Where makeup water is provided, the installation shall be in accordance with Section C102.3.

**C103.4 Disinfection.** Disinfection shall not be required for gray water used for subsurface landscape irrigation systems.

**C103.5 Coloring.** Gray water used for subsurface landscape irrigation systems shall not be required to be dyed.

**C103.6 Estimating gray water discharge.** The system shall be sized in accordance with the gallons-per-day-per-occupant number based on the type of fixtures connected to the gray water system. The discharge shall be calculated by the following equation:

$$C = A \times B$$

$A$  = Number of occupants:

Residential—Number of occupants shall be determined by the actual number of occupants, but not less than two occupants for one bedroom and one occupant for each additional bedroom.

Commercial—Number of occupants shall be determined by the *International Building Code*®.

$B$  = Estimated flow demands for each occupant:

Residential—25 gallons per day (94.6 Lpd) per occupant for showers, bathtubs and lavatories and 15 gallons per day (56.7 Lpd) per occupant for clothes washers or laundry trays.

Commercial—Based on type of fixture or water use records minus the discharge of fixtures other than those discharging gray water.

$C$  = Estimated gray water discharge based on the total number of occupants.

**C103.7 Percolation tests.** The permeability of the soil in the proposed absorption system shall be determined by percolation tests or permeability evaluation.

**C103.7.1 Percolation tests and procedures.** At least three percolation tests in each system area shall be conducted. The holes shall be spaced uniformly in relation to the bottom depth of the proposed absorption system. More percolation tests shall be made where necessary, depending on system design.

**C103.7.1.1 Percolation test hole.** The test hole shall be dug or bored. The test hole shall have vertical sides and a horizontal dimension of 4 inches to 8 inches (102 mm to 203 mm). The bottom and sides of the hole shall be scratched with a sharp-pointed instrument to expose the natural soil. All loose material shall be removed from the hole and the bottom shall be covered with 2 inches (51 mm) of gravel or coarse sand.

**C103.7.1.2 Test procedure, sandy soils.** The hole shall be filled with clear water to a minimum of 12 inches (305 mm) above the bottom of the hole for tests in sandy soils. The time for this amount of water to seep away shall be determined, and this procedure shall be repeated if the water from the second filling of the hole seeps away in 10 minutes or less. The test shall proceed as follows: Water shall be added to a point not more than 6 inches (152 mm) above the gravel or coarse sand. Thereupon, from a fixed reference point, water levels shall be measured at 10-minute intervals for a period of 1 hour. Where 6 inches (152 mm) of water seeps away in less than 10 minutes, a shorter interval between measurements shall be used, but in no case shall the water depth exceed 6 inches (152 mm). Where 6 inches (152 mm) of water seeps away in less than 2 minutes, the test shall be stopped and a rate of less than 3 minutes per inch (7.2 s/mm) shall be reported. The final water level drop shall be used to calculate the percolation rate. Soils not meeting the above requirements shall be tested in accordance with Section C103.7.1.3.

**C103.7.1.3 Test procedure, other soils.** The hole shall be filled with clear water, and a minimum water depth of 12 inches (305 mm) shall be maintained above the bottom of the hole for a 4-hour period by refilling whenever necessary or by use of an automatic siphon. Water remaining in the hole after 4 hours shall not be removed. Thereafter, the soil shall be allowed to swell not less than 16 hours or more than 30 hours. Immediately after the soil swelling period, the measurements for determining the percolation rate shall be made as follows: Any soil sloughed into the hole shall be removed and the water level shall be adjusted to 6 inches (152 mm) above the gravel or coarse sand. Thereupon, from a fixed reference point, the water level shall be measured at 30-minute intervals for a period of 4 hours, unless two successive water level drops do not vary by more than  $\frac{1}{16}$  inch (1.59 mm). At least three water level drops shall be observed and recorded. The hole shall be filled with clear water to a point not more than 6 inches (152 mm) above the gravel or coarse sand whenever it becomes nearly empty. Adjustments of the water level shall not be made during the three measurement periods except to the limits of the last measured water level drop. When the first 6 inches (152 mm) of water seeps away in less than 30 minutes,

the time interval between measurements shall be 10 minutes and the test run for 1 hour. The water depth shall not exceed 5 inches (127 mm) at any time during the measurement period. The drop that occurs during the final measurement period shall be used in calculating the percolation rate.

**C103.7.1.4 Mechanical test equipment.** Mechanical percolation test equipment shall be of an *approved* type.

**C103.7.2 Permeability evaluation.** Soil shall be evaluated for estimated percolation based on structure and texture in accordance with accepted soil evaluation practices. Borings shall be made in accordance with Section C103.7.1 for evaluating the soil.

**C103.8 Subsurface landscape irrigation site location.** The surface grade of all soil absorption systems shall be located at a point lower than the surface grade of any water well or reservoir on the same or adjoining property. Where this is not possible, the site shall be located so surface water drainage from the site is not directed toward a well or reservoir. The soil absorption system shall be located with a minimum horizontal distance between various elements as indicated in Table C103.8. Private sewage disposal systems in compacted areas, such as parking lots and driveways, are prohibited. Surface water shall be diverted away from any soil absorption site on the same or neighboring lots.

**TABLE C103.8**  
**LOCATION OF GRAY WATER SYSTEM**

ELEMENT	MINIMUM HORIZONTAL DISTANCE	
	HOLDING TANK (feet)	IRRIGATION DISPOSAL FIELD (feet)
Buildings	5	2
Property line adjoining private property	5	5
Water wells	50	100
Streams and lakes	50	50
Seepage pits	5	5
Septic tanks	0	5
Water service	5	5
Public water main	10	10

For SI: 1 foot = 304.8 mm.

**C103.9 Installation.** Absorption systems shall be installed in accordance with Sections C103.9.1 through C103.9.5 to provide landscape irrigation without surfacing of gray water.

**C103.9.1 Absorption area.** The total absorption area required shall be computed from the estimated daily gray water discharge and the design-loading rate based on the percolation rate for the site. The required absorption area equals the estimated gray water discharge divided by the design-loading rate from Table C103.9.1.

**TABLE C 103.9.1**  
**DESIGN LOADING RATE**

PERCOLATION RATE (minutes per inch)	DESIGN LOADING FACTOR (gallons per square foot per day)
0 to less than 10	1.2
10 to less than 30	0.8
30 to less than 45	0.72
45 to 60	0.4

For SI: 1 minute per inch = min/25.4 mm,  
1 gallon per square foot = 40.7 L/m<sup>2</sup>.

**C103.9.2 Seepage trench excavations.** Seepage trench excavations shall be a minimum of 1 foot (304 mm) to a maximum of 5 feet (1524 mm) wide. Trench excavations shall be spaced a minimum of 2 feet (610 mm) apart. The soil absorption area of a seepage trench shall be computed by using the bottom of the trench area (width) multiplied by the length of pipe. Individual seepage trenches shall be a maximum of 100 feet (30 480 mm) in *developed length*.

**C103.9.3 Seepage bed excavations.** Seepage bed excavations shall be a minimum of 5 feet (1524 mm) wide and have more than one distribution pipe. The absorption area of a seepage bed shall be computed by using the bottom of the trench area. Distribution piping in a seepage bed shall be uniformly spaced a maximum of 5 feet (1524 mm) and a minimum of 3 feet (914 mm) apart, and a maximum of 3 feet (914 mm) and a minimum of 1 foot (305 mm) from the side-wall or headwall.

**C103.9.4 Excavation and construction.** The bottom of a trench or bed excavation shall be level. Seepage trenches or beds shall not be excavated where the soil is so wet that such material rolled between the hands forms a soil wire. All smeared or compacted soil surfaces in the sidewalls or bottom of seepage trench or bed excavations shall be scarified to the depth of smearing or compaction and the loose material removed. Where rain falls on an open excavation, the soil shall be left until sufficiently dry so a soil wire will not form when soil from the excavation bottom is rolled between the hands. The bottom area shall then be scarified and loose material removed.

**C103.9.5 Aggregate and backfill.** A minimum of 6 inches of aggregate ranging in size from 1/2 to 2 1/2 inches (12.7 mm to 64 mm) shall be laid into the trench below the distribution piping elevation. The aggregate shall be evenly distributed a minimum of 2 inches (51 mm) over the top of the distribution pipe. The aggregate shall be covered with *approved* synthetic materials or 9 inches (229 mm) of uncompacted marsh hay or straw. Building paper shall not be used to cover the aggregate. A minimum of 9 inches (229 mm) of soil backfill shall be provided above the covering.

**C103.10 Distribution piping.** Distribution piping shall be not less than 3 inches (76 mm) in diameter. Materials shall comply with Table C103.10. The top of the distribution pipe shall be not less than 8 inches (203 mm) below the original surface. The

slope of the distribution pipes shall be a minimum of 2 inches (51 mm) and a maximum of 4 inches (102 mm) per 100 feet (30 480 mm).

**TABLE C103.10  
DISTRIBUTION PIPE**

MATERIAL	STANDARD
Polyethylene (PE) plastic pipe	ASTM F 405
Polyvinyl chloride (PVC) plastic pipe	ASTM D 2729
Polyvinyl chloride (PVC) plastic pipe with pipe stiffness of PS 35 and PS 50	ASTM F 1488

**C103.11 Joints.** Joints in distribution pipe shall be made in accordance with Section 705 of this code.

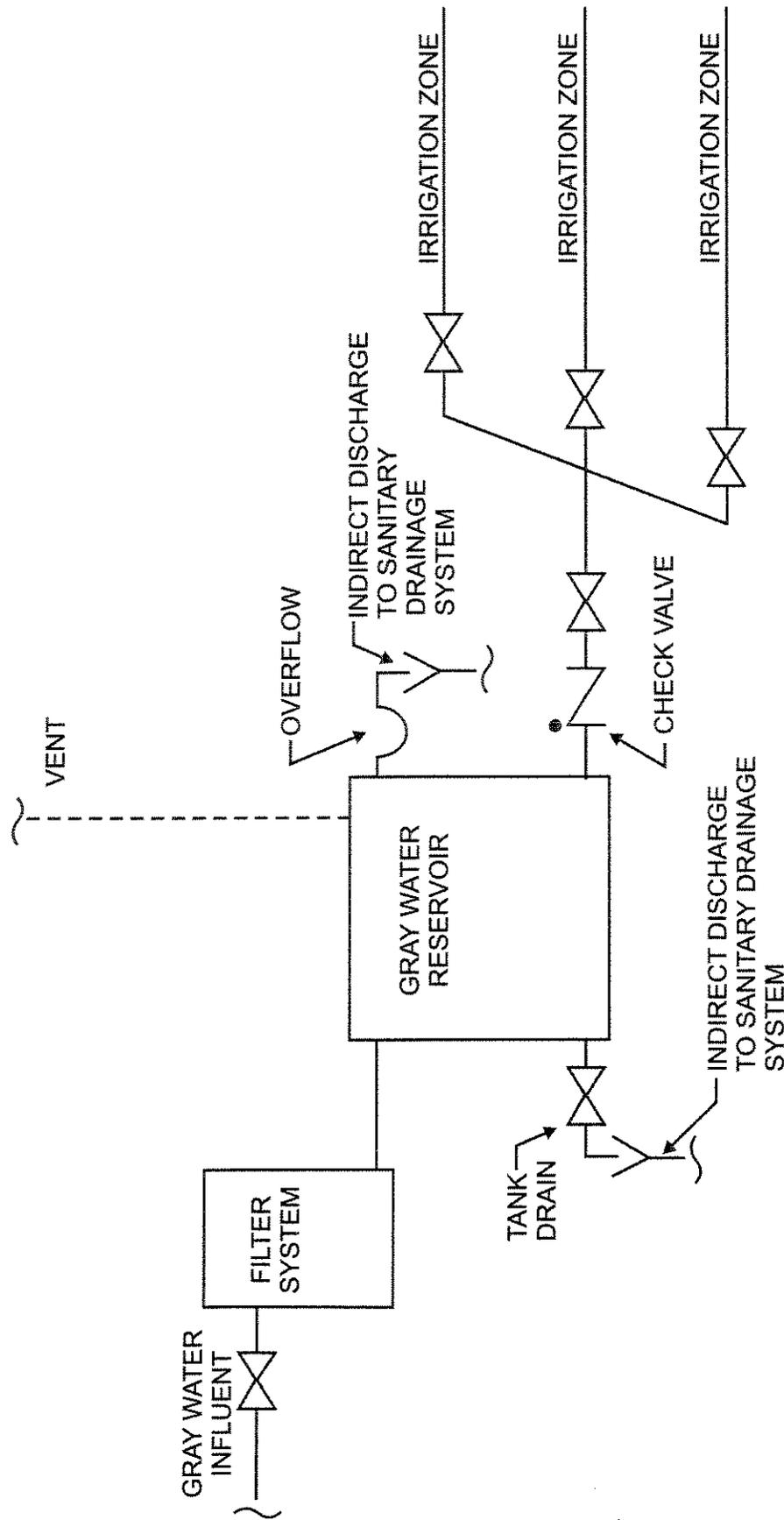


FIGURE 1  
GRAY WATER RECYCLING SYSTEM FOR SUBSURFACE LANDSCAPE IRRIGATION

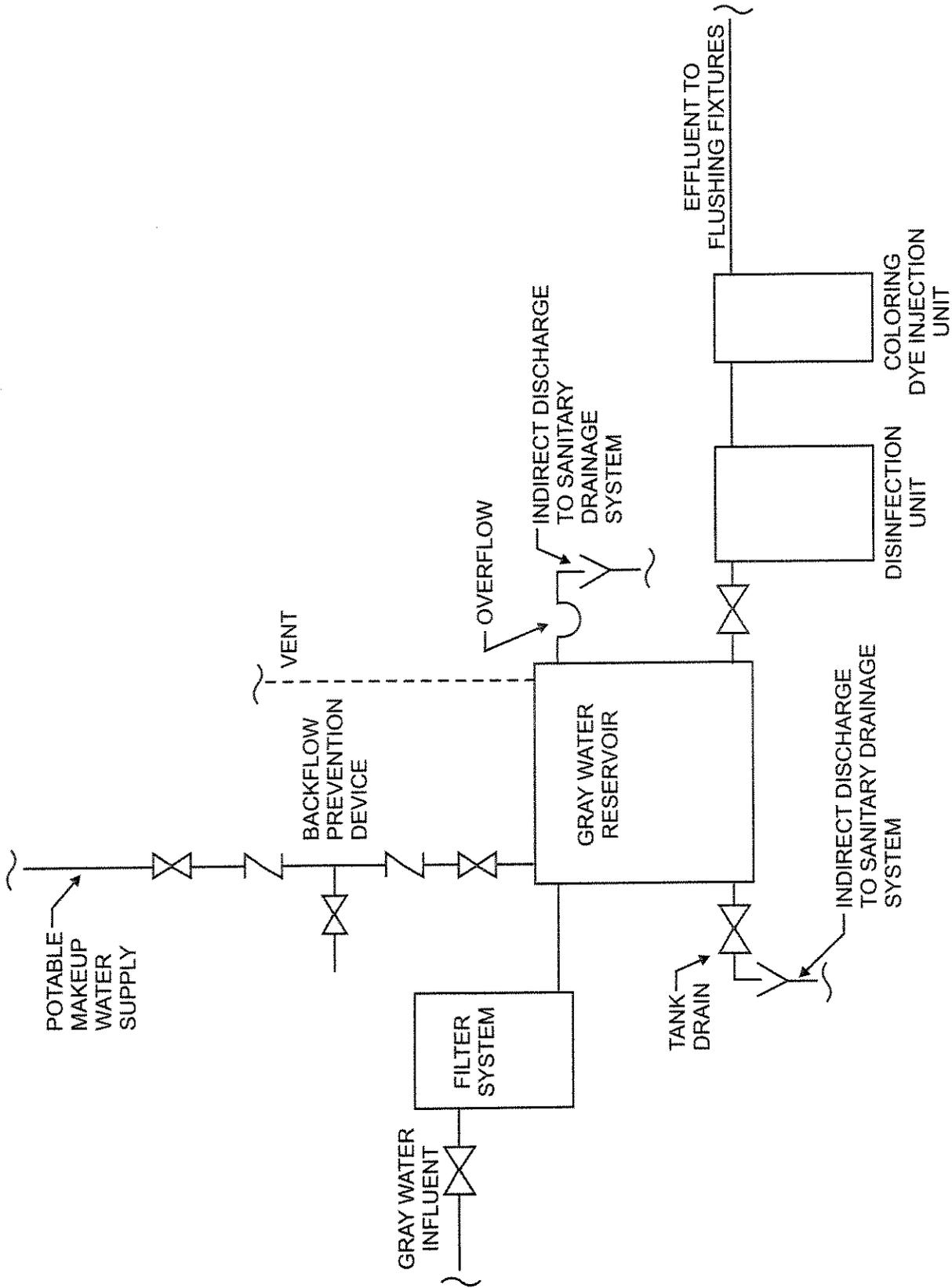


FIGURE 2  
GRAY WATER RECYCLING SYSTEM FOR FLUSHING WATER CLOSETS AND URINALS