ANSI/ASHRAE/IES Addenda ce and cp to
ANSI/ASHRAE/IESNA Standard 90.1-2007

ASHRAE ADDENDA

Energy Standard for Buildings Except Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 26, 2010; by the ASHRAE Board of Directors on June 30, 2010; by the IES Board of Directors on June 23, 2010; and by the American National Standards Institute on July 1, 2010.

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ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

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In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This additional control requires that all spaces (unless exempted) have multilevel control capability (also commonly known as bi-level switching). A study by Heschong Mahone Group notes that energy savings varies between 8 - 22 percent for bi-level control depending on the space type. IES paper #34 by Rensselaer Polytechnic Institute (RPI), "Occupant Use of Manual Controls in Private Offices" notes that 74 percent of a sample reduced their lighting for savings of 9 percent. Another RPI study "Individual Lighting Control for Offices" claims savings from occupant lighting reduction is 35-42 percent.

Note: *Section 9.4.1.2 b) was modified by addendum x to 90.1-2007. This change is shown relative to that published addendum rather than to 90.1-2007.*

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ce to 90.1-2007

Modify the Standard as follows (I-P Units)

Modify 9.4.1.2 as follows:

9.4.1.2 Space Control. Each space enclosed by ceiling height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting All controlled lighting shall meet the following requirements:

a. The controlled lighting shall have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off.

Exception to 9.4.1.2 (a):

a. Lights in corridors, electrical/mechanical rooms, public lobbies, restrooms, stairways, and storage rooms
b. Spaces with only one luminaire with rated input power less than 100 W.
c. Spaces types with ~~allowed~~ lighting power ~~densities~~ allowance of less than 0.6 W/ft^2 (see table 9.6.1).

~~a.~~b. An *occupant sensor* or a timer switch shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space in

1. classrooms and lecture halls,
2. conference, meeting rooms, and training rooms,
3. employee lunch and break rooms~~.~~,
4. storage and supply rooms between 50 ft^{2}and 1000 ft^2,
5. rooms used for document copying and printing,
6. office spaces up to 250 ft^2,
7. restrooms
8. dressing, locker, and fitting rooms.

Exceptions to 9.4.1.2 (b~~a~~):

a. Spaces with multi-scene lighting control systems
b. Shop and laboratory classrooms
c. Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s)
d. Lighting required for 24-hour operation

~~b.~~c. For ~~all other spaces~~ spaces not included in 9.4.1.2(b), each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft^2 area for a space 10,000 ft^2 or less and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2. The occupant shall be able to override any time-of-day scheduled shutoff *control* for no more than two hours.

Modify the Standard as follows (SI Units)

Modify 9.4.1.2 as follows:

9.4.1.2 Space Control. Each space enclosed by ceiling height partitions shall have at least one *control device* to independently *control* the *general lighting* within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting. All controlled lighting shall meet the following requirements:

a. The controlled lighting shall have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off.

Exception to 9.4.1.2 (a):

a. Lights in corridors, electrical/mechanical rooms, public lobbies, restrooms, stairways, and storage rooms
b. Spaces with only one luminaire with rated input power less than 100 W.
c. Spaces types with ~~allowed~~ lighting power ~~densities~~ allowance of less than 6 W/m^2 (see table 9.6.1).

~~a.~~b. An *occupant sensor* shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space in

1. classrooms and lecture halls,
2. conference, meeting rooms, and training rooms,
3. employee lunch and break rooms~~.~~,
4. storage and supply rooms up to 15.24 m^2 and 304.8 m^2,
5. rooms used for document copying and printing,
6. office spaces up to 76.2 m^2,
7. restrooms

8. dressing, locker, and fitting rooms.

Exceptions to 9.4.1.2 (ba):

a. Spaces with multi-scene lighting control systems

b. Shop and laboratory classrooms

c. Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s)

d. Lighting required for 24-hour operation

b.c. For spaces not included in 9.4.1.2(b), each *control device* shall be activated either manually by an occupant or automatically by sensing an occupant. Each *control device* shall *control* a maximum of 2500 ft^2 area for a space 10,000 ft^2 or less and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2. The occupant shall be able

to override any time-of-day scheduled shutoff *control* for no more than two hours.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

Variable Refrigerant Flow (VRF) systems are variable-speed, multi-split air conditioners and heat pumps used in many buildings covered by ASHRAE 90.1. Some of the heat pump systems are capable of heat recovery operations, providing simultaneous heating and cooling. Although VRF systems were introduced in Japan and Europe more than 20 years ago, they are just beginning to penetrate the U.S. market. In the past five years, the U.S. demand for VRF systems has increased significantly, prompting the need to establish minimum energy efficiency requirements for these products.

This proposal establishes, for the first time in ASHRAE 90.1, efficiency requirements for VRF air conditioners and heat pumps, including heat pumps that use a water source for heat rejection. Including these values ensures that ASHRAE 90.1 is up-to-date, and recognizes a new technology.

The cooling EERs and heating COPs are proposed for a full range of product cooling capacities at standard rating conditions listed in AHRI Standard 1230, The AHRI standard was first published in November 2009 and contains test procedures for such equipment. In addition, AHRI is developing a certification program for this equipment and expects to launch it later in 2010. The proposed SEER, HSPF, EER, and COP levels are identical to the minimum efficiencies for conventional ducted air cooled air conditioners and applied heat pumps listed in ASHRAE 90.1. The only exception is for VRF Heat Pumps with Heat Recovery capability; the EER and IEER values will be 0.2 lower due to the pressure drop in the refrigerant system to achieve heat recovery operation. Higher IEER levels are being proposed as these products are primarily designed to operate in zoning applications and at part-load conditions. The first phase of IEER values is effective immediately, while the second phase will become effective on July 1, 2012.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum cp to 90.1-2007

Modify the Standard as follows (I-P Units)

Add definition for VRF systems in Section 3 as follows:

Variable Refrigerant Flow (VRF) System: An engineered direct expansion (DX) multi-split system incorporating at least one variable capacity compressor distributing refrigerant through a piping network to multiple indoor fan coil units each capable of individual zone temperature control, through integral zone temperature control devices and common communications network. Variable refrigerant flow utilizes three or more steps of control on common, inter-connecting piping.

Add the following to 6.4.1.1:

h. Table 6.8.1 K-Heat Transfer Equipment
i. Table 6.8.1 L- Variable Refrigerant Flow Air Conditioners
j. Table 6.8.1 M- Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps

Add Tables 6.8.1L and M

TABLE 6.8.1L Electrically Operated Variable Refrigerant Flow Air Conditioners—Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure

TABLE 6.8.1L Electrically Operated Variable Refrigerant Flow Air Conditioners—Minimum Efficiency Requirements

VRF Air Conditioners, Air Cooled	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.2 EER 12.5 IEER 13.1 IEER (as of 7/1/2012)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.0 EER 12.3 IEER 12.9 IEER (as of 7/1/2012)	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	10.0 EER 11.1 IEER 11.6 IEER (as of 7/1/2012)	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps— Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure
VRF Air Cooled, (cooling mode)	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.0 EER 12.3 IEER 12.9 IEER (as of 7/1/2012)	
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	10.8 EER 12.1 IEER 12.7 IEER (as of 7/1/2012)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	10.6 EER 11.8 IEER 12.3 IEER (as of 7/1/2012)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	10.4 EER 11.6 IEER 12.1 IEER (as of 7/1/2012)	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	9.5 EER 10.6 IEER 11.0 IEER (as of 7/1/2012)	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	9.3 EER 10.4 IEER 10.8 IEER (as of 7/1/2012)	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps— Minimum Efficiency Requirements

VRF Water source (cooling mode)	<65,000 Btu/h	All	VRF Multi-split systems 86°F entering water	12.0 EER	AHRI 1230
	<65,000 Btu/h	All	VRF Multi-split systems with Heat Recovery 86°F entering water	11.8 EER	
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF Multi-split System 86°F entering water	12.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 86°F entering water	11.8 EER	
	≥135,000 Btu/h	All	VRF Multi-split System 86°F entering water	10.0 EER	
	≥135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 86°F entering water	9.8 EER	
VRF Groundwater source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System 59°F entering water	16.2 EER	AHRI 1230
	<135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 59°F entering water	16.0 EER	
	≥135,000 Btu/h	All	VRF Multi-split System 59°F entering water	13.8 EER	
	≥135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 59°F entering water	13.6 EER	
VRF Ground source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System 77°F entering water	13.4 EER	AHRI 1230
	<135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 77°F entering water	13.2 EER	
	≥135,000 Btu/h	All	VRF Multi-split System 77°F entering water	11.0 EER	
	≥135,000 Btu/h	All	VRF Multi-split System with Heat Recovery 77°F entering water	10.8 EER	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps— Minimum Efficiency Requirements

VRF Air Cooled (heating mode)	<65,000 Btu/h (cooling capacity)	- - -	VRF Multi-split System	7.7 HSPF	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)	- - -	VRF Multi-split system 47°F db/43°F wb outdoor air	3.3 COP	
			17°F db/15°F wb outdoor air	2.25 COP	
	≥135,000 Btu/h (cooling capacity)	- - -	VRF Multi-split System 47°F db/43°F wb outdoor air	3.2 COP	
			17°F db/15°F wb outdoor air	2.05 COP	
VRF Water source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68°F entering water	4.2 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68°F entering water	3.9 COP	
VRF Groundwater source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50°F entering water	3.6 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50°F entering water	3.3 COP	
VRF Ground source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32°F entering water	3.1 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32°F entering water	2.8 COP	

Add the following reference to Section 12 (under Air-Conditioning, Heating, and Refrigeration Institute)

Modify the Standard as follows (SI Units)

Add definition for VRF systems in Section 3 as follows:

Variable Refrigerant Flow (VRF) System. An engineered direct expansion (DX) multi-split system incorporating at

least one variable capacity compressor distributing refrigerant through a piping network to multiple indoor fan coil units each capable of individual zone temperature control, through integral zone temperature control devices and common communications network. Variable refrigerant flow utilizes three or more steps of control on common, inter-connecting piping.

Add the following to 6.4.1.1:

h. Table 6.8.1 K-Heat Transfer Equipment

i. Table 6.8.1 L- Variable Refrigerant Flow Air Conditioners

j. Table 6.8.1 M- Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps

Add Tables 6.8.1L and M)

TABLE 6.8.1L Electrically Operated Variable Refrigerant Flow Air Conditioners—Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure
VRF Air Conditioners, Air Cooled	<19 kW	All	VRF Multi-split System	3.81 SCOP	AHRI 1230
	≥19 kW and <40 kW	Electric Resistance (or none)	VRF Multi-split System	3.28 COP 3.66 ICOP 3.84 ICOP (as of 7/1/2012)	
	≥40 kW and <70 kW	Electric Resistance (or none)	VRF Multi-split System	3.22 COP 3.60 ICOP 3.78 ICOP (as of 7/1/2012)	
	≥70 kW	Electric Resistance (or none)	VRF Multi-split System	2.93 COP 3.25 ICOP 3.40 ICOP (as of 7/1/2012)	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps — Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps — Minimum Efficiency Requirements

VRF Air Cooled, (cooling mode)	<19 kW	All	VRF Multi-split System	3.81 $SCOP_C$	AHRI 1230
	≥19 kW and <40 kW	Electric Resistance (or none)	VRF Multi-split System	3.22 COP_C 3.60 ICOP 3.78 ICOP (as of 7/1/2012)	
	≥19 kW and <40 kW	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	3.16 COP_C 3.55 ICOP 3.72 ICOP (as of 7/1/2012)	
	≥40 kW Btu/h and <70 kW	Electric Resistance (or none)	VRF Multi-split System	3.11 COP_C 3.46 ICOP 3.60 ICOP (as of 7/1/2012)	
	≥40 kW and <70 kW	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	3.05 COP_C 3.40 ICOP 3.55 ICOP (as of 7/1/2012)	
	≥70 kW	Electric Resistance (or none)	VRF Multi-split System	2.78 COP_C 3.11 ICOP 3.22 ICOP (as of 7/1/2012)	
	≥70 kW	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery	2.73 COP_C 3.05 ICOP 3.16 ICOP (as of 7/1/2012)	
VRF Water source (cooling mode)	<19 kW	All	VRF Multi-split systems 30°C entering water	3.52 COP_C	AHRI 1230
	<19 kW	All	VRF Multi-split systems with Heat Recovery 30°C entering water	3.46 COP_C	
	≥19 kW and <40 kW	All	VRF Multi-split System 30°C entering water	3.52 COP_C	
	≥19 kW and <40 kW	All	VRF Multi-split System with Heat Recovery 30°C entering water	3.46 COP_C	
	≥40 kW	All	VRF Multi-split System 30°C entering water	2.93 COP_C	
	≥40 kW	All	VRF Multi-split System with Heat Recovery 30°C entering water	2.87 COP_C	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps — Minimum Efficiency Requirements

VRF Groundwater source (cooling mode)	<40 kW	All	VRF Multi-split System 15°C entering water	4.75 COP_C	AHRI 1230
	<40 kW	All	VRF Multi-split System with Heat Recovery 15°C entering water	4.69 COP_C	
	≥40 kW	All	VRF Multi-split System 15°C entering water	4.04 COP_C	
	≥40 kW	All	VRF Multi-split System with Heat Recovery 15°C entering water	3.98 COP_C	

TABLE 6.8.1M Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps — Minimum Efficiency Requirements

VRF Ground source (cooling mode)	<40 kW	All	VRF Multi-split System 25°C entering water	3.93 COP_C	AHRI 1230
	<40 kW	All	VRF Multi-split System with Heat Recovery 25°C entering water	3.87 COP_C	
	≥40 kW	All	VRF Multi-split System 25°C entering water	3.22 COP_C	
	≥40 kW	All	VRF Multi-split System with Heat Recovery 25°C entering water	3.16 COP_C	
VRF Air Cooled (heating mode)	<19 kW (cooling capacity)	- - -	VRF Multi-split System	2.25 $SCOP_H$	AHRI 1230
	≥19 kW and <40 kW (cooling capacity)	- - -	VRF Multi-split system 8.3°C db/6.1°C wb outdoor air	3.3 COP_H	
			-8.3°C db/ -9.4°C wb outdoor air	2.25 COP_H	
	≥40 kW (cooling capacity)	- - -	VRF Multi-split System 8.3°C db/6.1°C wb outdoor air	3.2 COP_H	
			-8.3°C db/ -9.4°C wb outdoor air	2.05 COP_H	
VRF Water source (heating mode)	<40 kW (cooling capacity)	---	VRF Multi-split System 20°C entering water	4.2 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	---	VRF Multi-split System 20°C entering water	3.9 COP_H	
VRF Groundwater source (heating mode)	<40 kW (cooling capacity)	---	VRF Multi-split System 10°C entering water	3.6 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	---	VRF Multi-split System 10°C entering water	3.3 COP_H	
VRF Ground source (heating mode)	<40 kW (cooling capacity)	---	VRF Multi-split System 0°C entering water	3.1 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	---	VRF Multi-split System 0°C entering water	2.8 COP_H	

Add the following reference to Section 12 (under Air-Conditioning, Heating, and Refrigeration Institute)

AHRI 1230-2010	Performance Rating of Variable Refrigerant Flow (VRF) Multi-split Air-Conditioning and Heat Pump Equipment

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.