

(This forward is provided for information only and is not part of the draft addendum.)

## **FOREWORD**

**Draft Addendum 90.1ad – Publication Draft.** The purpose of this addendum is to present a number of proposed substantive changes for public review. These modifications are the result of change proposals made pursuant to the continuous maintenance procedures contained in the *Manual for Processing ASHRAE Standards*. Contained within Addendum 90.1ad is 90.1ad-1 through 90.1ad-18 and each of these changes is preceded by a rationale statement which is provided for information only. In approving the response to a public review comment on Addendum 90.1ad, the project committee withdrew part six of the addendum and as a result, has left the existing wording in Section 6.3.2.2.3 unchanged.

### **Addendum 90.1ad (I-P and SI Editions)**

---

#### **90.1ad-1**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

The Energy Policy Act of 1992 set the EER for air conditioners and heat pumps with capacity up to 240,000 Btu/hour without the 0.2 reduction, as the California Energy Commission had done earlier. Thus all air conditioners and heat pumps which depend on the 0.2 reduction for compliance are being sold illegally. There is no justification in setting a standard so low that it can be achieved by illegally inefficient equipment.

#### **Addendum 90.1ad-1**

#### **SECTION 6.2.1, TABLES 6.2.1A AND B:**

Make changes to the fourth footnote in Tables 6.2.1A and B which reads as follows: *“Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.”*

The less efficient values for EER should apply to the 10/29/2001 column only but not to the “Minimum Efficiency” column.

#### **90.1ad-2**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

Currently a significant efficiency requirement is contained in a footnote to the table. This requirement should be incorporated into the table for clarity and ease of use. This change was accepted by the project committee as an editorial change.

#### **Addendum 90.1ad-2**

#### **TABLE 6.2.1A:**

For all air conditioners with capacities greater than or equal to 65,000 Btu/h (air, water, and evaporatively cooled) incorporate the last footnote (which allows a 0.2 deduction from EERs and IPLVs for units with heating sections other than electric

resistance heat) into the table. This would require separate listings for air conditioners with electric resistance heating sections and other heating sections. The units listed with other heating sections would have EER and IPLV values 0.2 lower. This would expand the table by showing the different requirements depending upon the heating section type. For example, air cooled air conditioners from 65,000-135,000 Btu/h would have the following efficiencies:

Air conditioners, air cooled	Electric resistance heating section	Efficiency 10/29/2001 10.3
	Other heating section	Efficiency 10/29/2001 10.1

**(I-P Units)**

**Table 6.2.1A  
Unitary Air Conditioners and Condensing Units, Electrically Operated,  
Minimum Efficiency Requirements**

Equipment Type	Size Category	<a href="#">Heating Section Type</a>	Sub-Category or Rating Condition	Minimum Efficiency <sup>b</sup>	Test Procedure <sup>a</sup>
Air Conditioners, Air Cooled	<65,000 Btu/h <sup>dc</sup>	<a href="#">All</a>	Split System	10.0 SEER	ARI 210/240
			Single Package	9.7 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	10.3 EER <sup>e</sup>	ARI 340/360
		<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">10.1 EER</a>	
	≥135,000 Btu/h and <240,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	9.7 EER <sup>e</sup>	
		<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">9.5 EER</a>	
	≥240,000 Btu/h and <760,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	9.5 EER <sup>e</sup> 9.7 IPLV <sup>e</sup>	
		<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">9.3 EER</a> <a href="#">9.5 IPLV</a>	
≥760,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	9.2 EER <sup>e</sup> 9.4 IPLV <sup>e</sup>		
	<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">9.0 EER</a> <a href="#">9.2 IPLV</a>		
Air Conditioners, Water and Evaporatively Cooled	<65,000 Btu/h	<a href="#">All</a>	Split System and Single Package	12.1 EER	ARI 210/240
			Split System and Single Package	11.5 EER <sup>e</sup>	
	≥65,000 Btu/h and <135,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	11.5 EER <sup>e</sup>	ARI 340/360
		<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">11.3 EER</a>	
	≥135,000 Btu/h and <240,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	11.0 EER <sup>e</sup>	
		<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">10.8 EER</a>	
≥240,000 Btu/h	<a href="#">Electric Resistance (or None)</a>	Split System and Single Package	11.0 EER <sup>e</sup> 10.3 IPLV <sup>e</sup>		
	<a href="#">All other</a>	<a href="#">Split System and Single Package</a>	<a href="#">10.8 EER</a> <a href="#">10.1 IPLV</a>		
Condensing Units, Air Cooled	≥135,000 Btu/h	–		10.1 EER 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥135,000 Btu/h	–		13.1 EER 13.1 IPLV	

<sup>a</sup> Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

<sup>b</sup> IPLVs are only applicable to equipment with capacity modulation.

<sup>c</sup> ~~Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than Electric Resistance heat.~~

<sup>dc</sup> Single-phase, air-cooled air-conditioners < 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

**(I-P Units)**

**Table 6.2.1B  
Unitary and Applied Heat Pumps, Electrically Operated,  
Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency <sup>b</sup>	Test Procedure <sup>a</sup>
Air Cooled (Cooling Mode)	<65,000 Btu/h <sup>dc</sup>	All	Split System	10.0 SEER	ARI 210/240
			Single Package	9.7 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or None) All other	Split System and Single Package	10.1 EER <sup>e</sup>	ARI 340/360
			Split System and Single Package	9.9 EER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or None) All other	Split System and Single Package	9.3 EER <sup>e</sup>	
			Split System and Single Package	9.1 EER	
≥240,000 Btu/h	Electric Resistance (or None) All other	Split System and Single Package	9.0 EER <sup>e</sup> 9.2 IPLV <sup>e</sup>		
		Split System and Single Package	8.8 EER 9.0 IPLV		
Water-Source (Cooling Mode)	<17,000 Btu/h	All	86°F Entering Water	11.2 EER	ARI/ISO-13256-1
	≥17,000 Btu/h and <65,000 Btu/h	All	86°F Entering Water	12.0 EER	ARI/ISO-13256-1
	≥65,000 Btu/h and <135,000 Btu/h	All	86°F Entering Water	12.0 EER	ARI/ISO-13256-1
Groundwater-Source (Cooling Mode)	<135,000 Btu/h	All	59°F Entering Water	16.2 EER	ARI/ISO-13256-1
Ground Source (Cooling Mode)	<135,000 Btu/h	All	77°F Entering Water	13.4 EER	ARI/ISO-13256-1
Air Cooled (Heating Mode)	<65,000 Btu/h <sup>dc</sup> (Cooling Capacity)	-	Split System	6.8 HSPF	ARI 210/240
			Single Package	6.6 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h (Cooling Capacity)	-	47°F db/43°F wb Outdoor Air	3.2 EER	ARI 340/360
≥135,000 Btu/h (Cooling Capacity)	-	47°F db/43°F wb Outdoor Air	3.1 EER		
Water-Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)	-	68°F Entering Water	4.2 EER	ARI/ISO-13256-1
Groundwater-Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)	-	50°F Entering Water	3.6 EER	ARI/ISO-13256-1
Ground Source (Heating Mode)	<135,000 Btu/h (Cooling Capacity)	-	32°F Entering Water	3.1 EER	ARI/ISO-13256-1

<sup>a</sup> Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

<sup>b</sup> IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.

<sup>c</sup> ~~Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than Electric Resistance heat.~~

<sup>dc</sup> Single-phase, air-cooled heat pumps < 65,000 Btu/h are regulated by NAECA. SEER and HSPF values are those set by NAECA

(SI Units)

**Table 6.2.1A**  
**Unitary Air Conditioners and Condensing Units, Electrically Operated,**  
**Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency <sup>b</sup>	Test Procedure <sup>a</sup>	
Air Conditioners, Air Cooled	<19kW <sup>dc</sup>	All	Split System	2.93 SCOP	ARI 210/240	
			Single Package	2.84 SCOP		
	≥19 kW and <40 kW	Electric Resistance (or None) All other	Split System and Single Package	3.02 COP <sup>c</sup>		
			Split System and Single Package	2.96 COP		
	≥40 kW and <70 kW	Electric Resistance (or None) All other	Split System and Single Package	2.84 COP <sup>c</sup>		ARI 340/360
			Split System and Single Package	2.78 COP		
≥70 kW and <223 kW	Electric Resistance (or None) All other	Split System and Single Package	2.78 COP <sup>c</sup> 2.84 IPLV <sup>c</sup>			
		Split System and Single Package	2.72 COP 2.78 IPLV			
≥223 kW	Electric Resistance (or None) All other	Split System and Single Package	2.70 COP <sup>c</sup> 2.75 IPLV <sup>c</sup>			
		Split System and Single Package	2.64 COP 2.69 IPLV			
Air Conditioners, Water and Evaporatively Cooled	<19 kW	All	Split System and Single Package	3.35 COP	ARI 210/240	
			Split System and Single Package	3.37 COP <sup>c</sup>		
	≥19 kW and <40 kW	Electric Resistance (or None) All other	Split System and Single Package	3.31 COP		
			Split System and Single Package	3.31 COP		
	≥40 kW and <70 kW	Electric Resistance (or None) All other	Split System and Single Package	3.22 COP <sup>c</sup>		ARI 340/360
			Split System and Single Package	3.16 COP		
≥70 kW	Electric Resistance (or None) All other	Split System and Single Package	2.70 COP <sup>c</sup> 3.02 IPLV <sup>c</sup>			
		Split System and Single Package	2.64 COP 2.96 IPLV			
Condensing Units, Air Cooled	≥40 kW	-		2.96 COP 3.28 IPLV	ARI 365	
				3.84 COP 3.84 IPLV		
Condensing Units, Water or Evaporatively Cooled	≥40 kW	-		3.84 COP 3.84 IPLV		

<sup>a</sup> Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

<sup>b</sup> IPLVs are only applicable to equipment with capacity modulation.

<sup>c</sup> ~~Deduct 0.06 from the required COPs and IPLVs for units with a heating section other than Electric Resistance heat.~~

<sup>dc</sup> Single-phase, air-cooled air-conditioners < 19 kW are regulated by NAECA. SCOP values are those set by NAECA.

(SI Units)

**Table 6.2.1B**  
**Unitary and Applied Heat Pumps, Electrically Operated,**  
**Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency <sup>b</sup>	Test Procedure <sup>a</sup>
Air Cooled (Cooling Mode)	<19 kW <sup>de</sup>	All	Split System	2.93 SCOP <sub>c</sub>	ARI 210/240
			Single Package	2.84 SCOP <sub>c</sub>	
	≥19 kW and <40 kW	Electric Resistance (or None) All other	Split System and Single Package	2.96 COP <sub>c</sub> <sup>e</sup>	ARI 340/360
			Split System and Single Package	2.90 COP <sub>c</sub>	
	≥40 kW and <70 kW	Electric Resistance (or None) All other	Split System and Single Package	2.72 COP <sub>c</sub> <sup>e</sup>	ARI 340/360
			Split System and Single Package	2.66 COP <sub>c</sub>	
≥70 kW	Electric Resistance (or None) All other	Split System and Single Package	2.78 COP <sub>c</sub> <sup>e</sup> 2.70 IPLV <sup>e</sup>	ARI 340/360	
		Split System and Single Package	2.72 COP <sub>c</sub> 2.64 IPLV		
Water-Source (Cooling Mode)	<5 kW	All	30.0°C Entering Water	3.28 COP <sub>c</sub>	ARI/ISO-13256-1
	≥5 kW and <19 kW	All	30.0°C Entering Water	3.52 COP <sub>c</sub>	ARI/ISO-13256-1
	≥19 kW and <40 kW	All	30.0°C Entering Water	3.52 COP <sub>c</sub>	ARI/ISO-13256-1
Groundwater-Source (Cooling Mode)	<40 kW	All	15°C Entering Water	4.75 COP <sub>c</sub>	ARI/ISO-13256-1
Ground Source (Cooling Mode)	<40 kW	All	25°C Entering Water	3.93 COP <sub>c</sub>	ARI/ISO-13256-1
Air Cooled (Heating Mode)	<19 kW <sup>de</sup> (Cooling Capacity)	-	Split System	1.99 SCOP <sub>H</sub>	ARI 210/240
			Single Package	1.93 SCOP <sub>H</sub>	
	≥19 kW and <40 kW (Cooling Capacity)	-	8.3°C db/6.1°C wb Outdoor Air	3.2 COP <sub>H</sub>	ARI 340/360
≥40 kW (Cooling Capacity)	-	8.3°C db/6.1°C wb Outdoor Air	3.1 COP <sub>H</sub>		
Water-Source (Heating Mode)	<40 kW (Cooling Capacity)	-	20.0°C Entering Water	4.2 COP <sub>H</sub>	ARI/ISO-13256-1
Groundwater-Source (Heating Mode)	<40 kW (Cooling Capacity)	-	10°C Entering Water	3.6 COP <sub>H</sub>	ARI/ISO-13256-1
Ground Source (Heating Mode)	<40 kW (Cooling Capacity)	-	0.0°C Entering Water	3.1 COP <sub>H</sub>	ARI/ISO-13256-1

<sup>a</sup> Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

<sup>b</sup> IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.

<sup>e</sup> ~~Deduct 0.06 from the required COPs and IPLVs for units with a heating section other than Electric Resistance heat.~~

<sup>de</sup> Single-phase, air-cooled heat pumps < 19 kW are regulated by NAECA. SCOP and HSPF values are those set by NAECA

### **90.1ad-3**

(This rationale is provided for information only and is not part of the draft addendum)

### **RATIONALE:**

This is for clarity since the entire section deals only with zone controls.

### **Addendum 90.1ad-3**

#### **SECTION 6.2.3.1:**

6.2.3.1 should read “Zone Thermostatic Controls” not “Thermostat Controls”

### **90.1ad-4**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

The current wording is confusing and has loopholes. There are also two sets of damper requirements which are not consistent. The main section 6.2.3.2.4 now only applies to heating or cooling systems, not to ventilation-only systems such as toilet exhaust fans. The economizer section 6.3.1.1.4 references a 4” static pressure rating condition which is non-standard and hard to find data for in catalogs, and which is also much higher than real systems will operate.

This change puts all damper requirements in one section, uses a common rating condition, and makes leakage ratings a function of weather. Both motorized and gravity dampers (which are allowed by exception (a) to 6.2.3.2.4) are included. The damper cfm/ft<sup>2</sup> ratings are based on:

- Very low leakage (4 cfm/ft<sup>2</sup>): Ruskin CD-50, 60, and similar ultra low leak dampers. Some of the larger sizes of a CD-36 will also work. The CD-50/60 ultra low leak dampers are rated for 2 to 3 cfm/ft<sup>2</sup> but I made this 4 to be sure we are including the low-leak dampers available on exhaust fans and rooftop units.
- Middle leakage (10 cfm/ft<sup>2</sup>): Ruskin CD-36. Some of the larger sizes of a CD-35 with blade and jamb seals will also work.
- High leakage (20 cfm/ft<sup>2</sup>): Ruskin CD-35 with blade and jamb seals and BD2 backdraft dampers. The latter have leakage of 20 cfm/ft<sup>2</sup> for dampers 24” and larger, but are 40 cfm/ft<sup>2</sup> for smaller dampers, which is why the note is added.

**Note: Use of the brand name “Ruskin” is for example only and does not constitute an endorsement of the product.**

### **Addendum 90.1ad-4**

#### **SECTIONS 6.2.3.2.4 AND 6.3.1.1.4:**

Change title of 6.2.3.3:

6.2.3.3 Ventilation System Controls.

Move 6.2.3.2.4 to a subsection of 6.2.3.3 and delete last sentence:

**6.2.3.3.3 Shutoff Damper Controls.** [as written...]....

Add new section 6.2.3.3.4:

**6.2.3.3.4 Dampers.** Where outdoor air supply and exhaust air dampers are required by Section 6.2.3.2.3, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.2.3.3.4.

**IP Units**

Table 6.2.3.3.4  
Maximum Damper Leakage

Climate	Maximum Damper Leakage at 1.0 in w.g.cfm per ft <sup>2</sup> of damper area	
	Motorized	Non-motorized
HDD65 > 7200 or CDD50 > 7200	4	Not allowed
HDD65 < 2701 and CDD50 < 3601	20	20 <sup>(a)</sup>
All others	10	20 <sup>(a)</sup>
Notes: (a) Dampers smaller than 24" in either dimension may have leakage of 40 cfm/ft <sup>2</sup> .		

**SI Units**

Table 6.2.3.3.4  
Maximum Damper Leakage

Climate	Maximum Damper Leakage at 250 Pa L/s per m <sup>2</sup> of damper area	
	Motorized	Non-motorized
HDD18 > 4000 or CDD10 > 4000	20	Not allowed
HDD18 < 1501 and CDD10 < 2001	100	100 <sup>(a)</sup>
All others	50	100 <sup>(a)</sup>
Notes: (a) Dampers smaller than 0.6 m in either dimension may have leakage of 200 L/s per m <sup>2</sup> .		

Revise section 6.3.1.1.4:

**6.3.1.1.4 Dampers.** Both return air and outside air dampers shall meet the requirements of 6.2.3.3.4.

**90.1ad-5**

(This rationale is provided for information only and is not part of the draft addendum)

**RATIONALE:**

*The 500 cfm limit is not needed since 5000 cfm systems and smaller are exempt by exception a).*



## **Addendum 90.1ad-5**

**SECTION 6.2.3.2.5:** Change Exception b) to 6.2.3.2.5 to read:

- b) Exhaust airflow from a single isolation zone of less than 10% of the design airflow of the exhaust system to which it connects.

## **90.1ad-7**

(This rationale is provided for information only and is not part of the draft addendum)

### **RATIONALE:**

The requirement for valves at hydronic heat pumps is in the wrong section. 6.3.2.2 addresses simultaneous heating and cooling. This section belongs in 6.3.4 since it addresses pumping energy. Also, the current wording does not make it clear what the valve is to do.

The revised wording:

- 1) puts the HHP valve requirement in the logical location.
- 2) Requires that the valve be interlocked to the compressor.
- 3) Deletes the 10 hp pump limitation since it is already in 6.3.4, the governing section for this new subsection.
- 4) Changes “shall” to “that” in 6.3.4.1, which is what it was in PRD#2 and incorrectly changed in the ISC. This section is supposed to require pump controls and capabilities for systems that happen to have control valves. It is not intended to require control valves. There are many systems that do not, such as condenser water systems serving chillers.

## **Addendum 90.1ad-7**

**SECTIONS 6.3.2.2.3, 6.3.4, 6.3.4.1, AND 6.3.4.4:**

Delete “, and” from 6.3.2.2.3 (b) and delete 6.3.2.2.3 (c):

Revise section 6.3.4 and 6.3.4.1:

**6.3.4 Hydronic System Design and Control.** HVAC hydronic systems having a total pump system power exceeding 10 hp (7.5 kW) shall meet provisions of 6.3.4.1 through 6.3.4.4.

**6.3.4.1 Hydronic Variable Flow Systems.** HVAC pumping systems that include control valves designed to modulate or step open and closed as a function of load shall be designed for variable fluid flow and be capable of reducing pump flow rates to 50% or less of the design flow rate.

Add section 6.3.4.4:

**6.3.4.4. Hydronic (Water Loop) Heat Pump Systems.** Each hydronic heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

## **90.1ad-8**

(This rationale is provided for information only and is not part of the draft addendum)

### **RATIONALE:**

This puts all the insulation requirements in a single section. With the current wording, the “General” section appears to apply to all duct and plenum construction, but it really applies to insulation only. It should be a “general” part of an insulation section, as proposed above.

In addition to this editorial change, the last clause of the second sentence of 6.2.4.1 is deleted. This section was not intended to apply to equipment regardless of “other standards” that may exist.

## **Addendum 90.1ad-8**

### **SECTIONS 6.2.4.1, 6.2.4.2, AND 6.2.4.5:**

Modify 6.2.4.1, 6.2.4.2, and 6.2.4.5 to read:

#### **6.2.4.1 Insulation**

**6.2.4.1.1 General.** Insulation required by this section shall be installed in accordance with industry accepted standards (see Appendix F). These requirements do not apply to HVAC equipment. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind but not limited to the following:

- (a) Insulation exposed to weather shall be suitable for outdoor service; e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.
- (b) Insulation covering chilled water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.

6.2.4.1.2 Duct and Plenum Insulation. **[as written...]**

6.2.4.1.3 Piping Insulation. **[as written...]**

Renumber 6.2.4.3 and 6.2.4.4 to:

#### **6.2.4.2 Ducts and Plenum Leakage**

##### **6.2.4.2.1 Duct Sealing**

##### **6.2.4.2.2 Duct Leakage Tests**

## **90.1ad-9**

(This rationale is provided for information only and is not part of the draft addendum)

### **RATIONALE:**

The buried duct application was inadvertently left out of Table 6.2.4.2B. The insulation requirements shown were developed using the same methodology as the rest of the table.

**Addendum 90.1ad-9**

**TABLE 6.2.4.2B:**

Add a “buried” column to Table 6.2.4.2B, as in Table 6.2.4.2A.

**Table 6.2.4.2B (I-P Units)  
Minimum Duct Insulation R-Value<sup>a</sup>  
Combined Heating and Cooling Ducts**

Envelope Criteria Table	Climate Zone		Duct Location						
	HDD65	CDD50	Exterior	Ventilated Attic	Unvented Attic w/ Backloaded Ceiling	Unvented Attic w/ Roof Insulation <sup>a</sup>	Unconditioned Space <sup>b</sup>	Indirectly Conditioned Space <sup>c</sup>	Buried
5-1	0-900	10801+	R-8	R-6	R-8	R-3.5	R-3.5	none	R-3.5
5-2	0-900	9001-10800	R-6	R-6	R-8	R-3.5	R-3.5	none	R-3.5
5-3	0-900	7201-9000	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-4	0-900	0-7200	R-6	R-3.5	R-6	R-3.5	R-1.9	none	R-3.5
5-5	901-1800	7201+	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-6	901-1800	5401-7200	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-7	901-1800	0-5400	R-3.5	R-3.5	R-6	R-1.9	R-1.9	none	R-1.9
5-8	1801-2700	5401+	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5

5-9	1801-2700	0-5400	R-6	R-3.5	R-6	R-1.9	R-1.9	none	R-1.9
5-10	2701-3600	5401+	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-11	2701-3600	3601-5400	R-6	R-6	R-6	R-3.5	R-3.5	none	R-1.9
5-12	2701-3600	0-3600	R-3.5	R-3.5	R-3.5	R-1.9	R-1.9	none	R-1.9
5-13	3601-5400	3601+	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-14	3601-5400	1801-3600	R-6	R-3.5	R-6	R-1.9	R-3.5	none	R-1.9
5-15	3601-5400	0-1800	R-3.5	R-3.5	R-3.5	R-1.9	R-1.9	none	R-1.9
5-16	5401-7200	3601+	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5-17	5401-7200	1801-3600	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
5-18	5401-7200	0-1800	R-6	R-3.5	R-3.5	R-1.9	R-3.5	none	R-3.5
5-19	7201-9000	1801+	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
5-20	7201-9000	0-1800	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
5-21	9001-10800	1801+	R-8	R-6	R-6	R-1.9	R-6	none	R-3.5
5-22	9001-10800	0-1800	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
5-23	10801-12600	all	R-8	R-6	R-6	R-1.9	R-6	none	R-6
5-24	12601-16200	all	R-8	R-8	R-8	R-1.9	R-6	none	R-6
5-25	16201-19800	all	R-10	R-8	R-8	R-3.5	R-6	none	R-6
5-26	19801+	all	R-10	R-10	R-8	R-3.5	R-8	R-3.5	R-6

<sup>a</sup> Insulation R-values, measured in (h·ft<sup>2</sup>·°F)/Btu, are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of 6.2.4.2 or Section 5. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 75°F at the installed thickness.

<sup>b</sup> Includes crawl spaces, both ventilated and non-ventilated.

<sup>c</sup> Includes return air plenums with or without exposed roofs above.

**Table 6.2.4.2B (S-I Units)  
Minimum Duct Insulation R-Value<sup>a</sup>  
Combined Heating and Cooling Ducts**

Envelope Criteria Table	Climate Zone		Duct Location						
	HDD65	CDD50	Exterior	Ventilated Attic	Unvented Attic w/ Backloaded Ceiling	Unvented Attic w/ Roof Insulation <sup>a</sup>	Unconditioned Space <sup>b</sup>	Indirectly Conditioned Space <sup>c</sup>	Buried
5-1	0-500	6001+	R-1.41	R-1.06	R-1.41	R-0.62	R-0.62	none	R-0.62
5-2	0-500	5001-6000	R-1.06	R-1.06	R-1.41	R-0.62	R-0.62	none	R-0.62
5-3	0-500	4001-5000	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-4	0-500	0-4000	R-1.06	R-0.62	R-1.06	R-0.62	R-0.34	none	R-0.62
5-5	501-1000	4001+	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-6	501-1000	3001-4000	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-7	501-1000	0-3000	R-0.62	R-0.62	R-1.06	R-0.34	R-0.34	none	R-0.34
5-8	1001-1500	3001+	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-9	1001-1500	0-3000	R-1.06	R-0.62	R-1.06	R-0.34	R-0.34	none	R-0.34
5-10	1501-2000	3001+	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-11	1501-2000	2001-3000	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.34
5-12	1501-2000	0-2000	R-0.62	R-0.62	R-0.62	R-0.34	R-0.34	none	R-0.34
5-13	2001-3000	2001+	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-14	2001-3000	1001-2000	R-1.06	R-0.62	R-1.06	R-0.34	R-0.62	none	R-0.34
5-15	2001-3000	0-1000	R-0.62	R-0.62	R-0.62	R-0.34	R-0.34	none	R-0.34
5-16	3001-4000	2001+	R-1.06	R-1.06	R-1.06	R-0.62	R-0.62	none	R-0.62
5-17	3001-4000	1001-2000	R-1.06	R-1.06	R-1.06	R-0.34	R-0.62	none	R-0.62
5-18	3001-4000	0-1000	R-1.06	R-0.62	R-0.62	R-0.34	R-0.62	none	R-0.62
5-19	4001-5000	1001+	R-1.41	R-1.06	R-1.06	R-0.34	R-0.62	none	R-0.62
5-20	4001-5000	0-1000	R-1.06	R-1.06	R-1.06	R-0.34	R-0.62	none	R-0.62
5-21	5001-6000	1001+	R-1.41	R-1.06	R-1.06	R-0.34	R-1.06	none	R-0.62
5-22	5001-6000	0-1000	R-1.41	R-1.06	R-1.06	R-0.34	R-0.62	none	R-0.62
5-23	6001-7000	all	R-1.41	R-1.06	R-1.06	R-0.34	R-1.06	none	R-1.06
5-24	7001-9000	all	R-1.41	R-1.41	R-1.41	R-0.34	R-1.06	none	R-1.06
5-25	9001-11000	all	R-1.76	R-1.41	R-1.41	R-0.62	R-1.06	none	R-1.06
5-26	11001+	all	R-1.76	R-1.76	R-1.41	R-0.62	R-1.41	R-0.62	R-1.06

<sup>a</sup> Insulation R-values, measured in (m<sup>2</sup>-K/W), are for the insulation as installed and do not include film resistance. The required minimum thicknesses do not consider water vapor transmission and possible surface condensation. Where exterior walls are used as plenum walls, wall insulation shall be as required by the most restrictive condition of 6.2.4.2 or Section 5. Insulation resistance measured on a horizontal plane in accordance with ASTM C518 at a mean temperature of 23.9°C at the installed thickness.

<sup>b</sup> Includes crawl spaces, both ventilated and non-ventilated.

<sup>c</sup> Includes return air plenums with or without exposed roofs above.

(This rationale is provided for information only and is not part of the draft addendum)

**RATIONALE:**

The building owner may be a consortium, a person living outside the country, etc.

**Addenda 90.1ad-10**

**SECTIONS 6.2.5.1, 6.2.5.2, AND 6.2.5.3.1:**

Modify 6.2.5.1 and 6.2.5.2:

**6.2.5.1 Drawings.** Construction documents shall require that within 90 days after the date of system acceptance, record drawings of the actual installation be provided to the building owner or the designated representative of the building owner. Record drawings shall include as a minimum the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system including sizes, and the terminal air or water design flow rates.

**6.2.5.2 Manuals.** Construction documents shall require an operating manual and maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. The manuals shall be in accordance with industry accepted standards (see Appendix F) and shall include, at a minimum, the following:

Modify 6.2.5.3.1:

Construction documents shall require a written balance report be provided to the owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 ft<sup>2</sup> (460 m<sup>2</sup>).

**90.1ad-11**

(This rationale is provided for information only and is not part of the draft addendum)

**RATIONALE:**

This phrase is covered in Exception (a).

**Addendum 90.1ad-11**

**SECTION 6.3.1:** Revise to read:

**6.3.1 Economizers.** Each cooling system including a fan shall include either an air or water economizer meeting the requirements of 6.3.1.1 through 6.3.1.4.

**90.1ad-12**

(This rationale is provided for information only and is not part of the draft addendum)

**RATIONALE:**

To be sure it is clear how EERs are determined and to what equipment this table applies.

**Addendum 90.1ad-12**

**TABLE**

**6.1.3:** Add ARI rating standard references to the Table 6.1.3.

**Table 6.1.3 (I-P Units)  
Eliminate Required Economizer by Increasing Cooling Efficiency**

Unitary Systems with Heat Pump Heating							
System Size (kBtu/h)	Mandatory Minimum EER	Cooling Degree-Days (CDD50)					
		0 - 3600	3601 - 5400	5401 - 7200	7201 - 9000	9001 - 10800	
Minimum Cooling Efficiency Required (EER) <sup>a</sup>							<a href="#">Test Procedure<sup>=</sup></a>
≥65 and <135	10.1	N/A <sup>b</sup>	12.1	11.6	11.1	10.7	<a href="#">ARI 210/240</a>
≥135 and ≤240	9.3	N/A <sup>b</sup>	11.3	10.8	10.4	9.9	<a href="#">ARI 340/360</a>
>240 and <760	9.0	N/A <sup>b</sup>	10.9	10.5	10.0	9.6	
Other Unitary Systems							
System Size (kBtu/h)	Mandatory Minimum EER	Cooling Degree-Days (CDD50)					
		0 - 3600	3601 - 5400	5401 - 7200	7201 - 9000	9001 - 10800	
Minimum Cooling Efficiency Required (EER) <sup>a</sup>							<a href="#">Test Procedure<sup>=</sup></a>
≥65 and <135	10.3	N/A <sup>b</sup>	12.5	12.0	11.5	11.0	<a href="#">ARI 210/240</a>
≥135 and ≤240	9.7	N/A <sup>b</sup>	11.5	11.1	10.6	10.1	<a href="#">ARI 340/360</a>
>240 and <760	9.5	N/A <sup>b</sup>	11.2	10.7	10.3	9.9	
<sup>a</sup> Each EER shown below should be reduced by 0.2 for units with a heating section other than electric resistance heat. <sup>b</sup> Elimination of required economizer is not allowed. <sup>=</sup> <a href="#">Section 12 contains complete specification of the referenced test procedure, including the referenced year version of the test procedure</a>							

**Same change for the SI edition.**

**90.1ad-13**

(This rationale is provided for information only and is not part of the draft addendum)

**RATIONALE:**

Having this statement makes this standard a de facto ventilation standard. Ventilation standards establish minimum rates; it was not the intent of Standard 90.1 to do so. Also, section 6.1.2 is the wrong reference (6.1.3 was probably the intent) but section 6.2 of Standard 62 is also a way of determining minimum rates. Finally, the design minimum outdoor air rate may be larger than the minimum required by Standard 62 in some cases (e.g. if there is a lot of exhaust air.)

**Addendum 90.1ad-13**

**SECTION 6.3.1.1.3:** Revise to read:

**6.3.1.1.3 High Limit Shutoff.** All air economizers shall be capable of automatically reducing outside air intake to the design minimum outdoor air quantity when outside air intake will no longer reduce cooling energy usage. High limit shutoff control types for specific climates shall be chosen from Table 6.3.1.1.3A. High limit shutoff control settings for these control types shall be those listed in Table 6.3.1.1.3B.

### **90.1ad-14**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

This change basically reverts back to 90.1-1989 language. The current language is actually too tough. It makes cold air systems basically impossible due to the temperature limits in exception 2. It also requires fan-powered VAV boxes in many cases since the reheat minimums are so low, but depending on the local utility rates, if gas heat is used, the fan energy from the fan-powered boxes can use more energy cost than the reduced reheat energy cost.

### **Addendum 90.1ad-14**

#### **SECTION 6.3.2.1 EXCEPTION a):**

Revise 6.3.2.1 Exception a) to read:

- (a) *Zones* for which the volume of air that is reheated, recooled, or mixed is no greater than the larger of the following:
1. The volume of outside air required to meet the ventilation requirements of 6.1.3 of *ASHRAE Standard 62* for the *zone*.
  2. 0.4 cfm/ft<sup>2</sup> (2 L/s·m<sup>2</sup>) of the *zone* conditioned floor area.
  3. 30% of the zone design peak supply rate.
  4. 300 cfm (140 L/s). This exception is for zones whose peak flow rate totals no more than 10% of the total fan system flow rate.
  5. Any higher rate that can be demonstrated, to the satisfaction of the authority having jurisdiction, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake in accordance with the multiple space requirements defined in *ASHRAE Standard 62*.

### **90.1ad-15**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

To make it clear that zone reset control is being provided, and also to not limit the location of the sensor when reset is provided – it may be anywhere.

### **Addendum 90.1ad-15**

#### **SECTION 6.3.3.2.2:**

Revise 6.3.3.2.2 to read:



**6.3.3.2.2 Static Pressure Sensor Location.** Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than 1/3 the total design fan static pressure, except for systems with zone reset control complying with 6.3.3.2.3. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure that static pressure can be maintained in each.

### **90.1ad-16**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

For clarity.

### **Addendum 90.1ad-16**

**EXCEPTION TO 6.3.5.1:** Revise to read:

**Exception to 6.3.5.1:** Heat rejection devices whose energy usage is included in the equipment efficiency ratings listed in Tables 6.2.1A through 6.2.1D.

### **90.1ad-17**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

Making a list like this simplifies compliance and handles a very large majority of applications.

### **Addendum 90.1ad-17**

**SECTION 6.3.3.2.1:**

Revise to read:

**6.3.3.2.1 Part-Load Fan Power Limitation.** Individual VAV fans with motors 30 hp (22 kW) and larger shall meet one of the following:

- (a) The fan shall be driven by a mechanical or electrical variable\_speed drive.
- (b) The fan shall be a vane-axial fan with variable pitch blades.
- (c) The fan shall have other controls and devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure set point equals 1/3 of the total design static pressure, based on manufacturer's certified fan data.

### **90.1ad-18**

(This rationale is provided for information only and is not part of the draft addendum)

#### **RATIONALE:**

Residences do not have 7-day week schedules in general.

## **Addendum 90.1ad-18**

**SECTION 6.2.3.2.1:** Add the following exception:

**Exception to 6.2.3.2.1:** Residential occupancies may use controls that can start and stop the system under two different time schedules per week.