

**TABLE 6.8.1A Electronically Operated Unitary Air Conditioners and Condensing Units—  
Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>		
Air conditioners, air cooled	<65,000 Btu/h <sup>c</sup>	All	Split system	13.0 SEER			
			Single package	13.0 SEER			
Through-the-wall (air cooled)	≤30,000 Btu/h <sup>c</sup>	All	Split system	12.0 SEER	AHRI 210/240		
			Single package	12.0 SEER			
Small-duct high-velocity (air cooled)	<65,000 Btu/h <sup>c</sup>	All	Split system	10.0 SEER			
Air conditioners, air cooled	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	11.2 EER	AHRI 340/360		
			11.4 IEER				
		All other	Split system and single package	11.0 EER			
			11.2 IEER				
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	11.0 EER			
			11.2 IEER				
		All other	Split system and single package	10.8 EER			
			11.0 IEER				
	≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	10.0 EER			
			10.1 IEER				
		All other	Split system and single package	9.8 EER			
			9.9 IEER				
≥760,000 Btu/h	Electric resistance (or none)	Split system and single package	9.7 EER				
		9.8 IEER					
	All other	Split system and single package	9.5 EER				
		9.6 IEER					
Air conditioners, water cooled	<65,000 Btu/h	All	Split system and single package	12.1 EER	AHRI 210/240		
			12.3 IEER				
	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	11.5 EER (before 6/1/2011)	AHRI 340/360		
				12.1 EER (as of 6/1/2001)			
		All other	Split system and single package	11.7 IEER (before 6/1/2011)			
				12.3 IEER (as of 6/1/2011)			
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	11.3 EER (before 6/1/2011)		AHRI 340/360	
				11.9 EER (as of 6/1/2011)			
		All other	Split system and single package	11.5 IEER (before 6/1/2011)			
				12.1 IEER (as of 6/1/2011)			
	≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	11.0 EER (before 6/1/2011)			AHRI 340/360
				12.5 EER (as of 6/1/2011)			
All other		Split system and single package	11.2 IEER (before 6/1/2011)				
			12.5 IEER (as of 6/1/2011)				
≥760,000 Btu/h	Electric resistance (or none)	Split system and single package	10.8 EER (before 6/1/2011)	AHRI 340/360			
			12.3 EER (before 6/1/2011)				
	All other	Split system and single package	11.0 IEER (before 6/1/2011)				
			12.5 IEER (before 6/1/2011)				
≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	11.0 EER (before 6/1/2011)		AHRI 340/360		
			12.4 EER (as of 6/1/2011)				
	All other	Split system and single package	11.1 IEER (before 6/1/2011)				
			12.6 IEER (as of 6/1/2011)				
≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	10.8 EER (before 6/1/2011)			AHRI 340/360	
			12.2 EER (as of 6/1/2011)				
	All other	Split system and single package	10.9 IEER (before 6/1/2011)				
			12.4 IEER (as of 6/1/2011)				

**TABLE 6.8.1A Electronically Operated Unitary Air Conditioners and Condensing Units—  
Minimum Efficiency Requirements (continued)**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>
Air conditioners, water cooled	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER (before 6/1/2011) 12.2 EER (as of 6/1/2011) 11.1 IEER (before 6/1/2011) 12.4 IEER (as of 6/1/2011)	AHRI 340/360
		All other	Split System and Single Package	10.8 EER (before 6/1/2011) 12.0 EER (as of 6/1/2011) 10.9 IEER (before 6/1/2011) 12.2 IEER (as of 6/1/2011)	
	< 65,000 Btu/h	All	Split System and Single Package	12.1 EER 12.3 IEER	AHRI 210/240
	≥ 65,000 Btu/h and < 135,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.5 EER (before 6/1/2011) 12.1 EER (as of 6/1/2011) 11.7 IEER (before 6/1/2011) 12.3 IEER (as of 6/1/2011)	
All other		Split System and Single Package	11.3 EER (before 6/1/2011) 11.9 EER (as of 6/1/2011) 11.5 IEER (before 6/1/2011) 12.1 IEER (as of 6/1/2011)		
Air conditioners, evaporatively cooled	≥ 135,000 Btu/h and < 240,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER (before 6/1/2011) 12.0 EER (as of 6/1/2011) 11.2 IEER (before 6/1/2011) 12.2 IEER (as of 6/1/2011)	AHRI 340/360
		All other	Split System and Single Package	10.8 EER (before 6/1/2011) 11.8 EER (as of 6/1/2011) 11.0 IEER (before 6/1/2011) 12.0 IEER (as of 6/1/2011)	
	≥ 240,000 Btu/h and < 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER (before 6/1/2011) 11.9 EER (as of 6/1/2011) 11.1 IEER (before 6/1/2011) 12.1 IEER (as of 6/1/2011)	
All other		Split System and Single Package	10.8 EER (before 6/1/2011) 12.2 EER (as of 6/1/2011) 10.9 IEER (before 6/1/2011) 11.9 IEER (as of 6/1/2011)		
	≥ 760,000 Btu/h	Electric Resistance (or None)	Split System and Single Package	11.0 EER (before 6/1/2011) 11.7 EER (as of 6/1/2011) 11.1 IEER (before 6/1/2011) 11.9 IEER (as of 6/1/2011)	
All other		Split System and Single Package	10.8 EER (before 6/1/2011) 11.5 EER (as of 6/1/2011) 10.9 IEER (before 6/1/2011) 11.7 IEER (as of 6/1/2011)		
Condensing units, air cooled	≥ 135,000 Btu/h	—	—	10.1 EER (before 6/1/2011) 10.5 EER (as of 6/1/2011) 11.4 IEER (before 6/1/2011) 11.8 IEER (as of 6/1/2011)	
Condensing units, water cooled	≥ 135,000 Btu/h	—	—	13.1 EER (before 6/1/2011) 13.5 EER (as of 6/1/2011) 13.6 IEER (before 6/1/2011) 14.0 IEER (as of 6/1/2011)	AHRI 365
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	—	—	13.1 EER (before 6/1/2011) 13.5 EER (as of 6/1/2011) 13.6 IEER (before 6/1/2011) 14.0 IEER (as of 6/1/2011)	

<sup>a</sup>PLVs and part-load rating conditions are only applicable to equipment with capacity modulation.

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

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

**TABLE 6.8.1B Electrically Operated Unitary and Applied Heat Pumps—  
Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>	
Air cooled (cooling mode)	<65,000 Btu/h <sup>c</sup>	All	Split system	13.0 SEER	AHRI 210/240	
			Single packaged	13.0 SEER		
Through-the-wall (air cooled)	≤30,000 Btu/h <sup>c</sup>	All	Split system	13.0 SEER		
			Single package	13.0 SEER		
Small-duct high-velocity (air cooled)	<65,000 Btu/h <sup>c</sup>	All	Split system	10.0 SEER		
Air cooled (cooling mode)	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	11.0 EER 11.2 IEER		AHRI 340/360
			All other	10.8 EER 11.0 IEER		
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	10.6 EER 10.7 IEER		
			All other	10.4 EER 10.5 IEER		
	≥240,000 Btu/h	Electric resistance (or none)	Split system and single package	9.5 EER 9.6 IEER		
			All other	9.3 EER 9.4 IEER		
Water source (cooling mode)	<17,000 Btu/h	All	86°F entering water	11.2 EER	ISO-13256-1	
	≥17,000 Btu/h and <65,000 Btu/h	All	86°F entering water	12.0 EER		
	≥65,000 Btu/h and <135,000 Btu/h	All	86°F entering water	12.0 EER		
Ground water source (cooling mode)	<135,000 Btu/h	All	59°F entering water	16.2 EER		
		All	77°F entering water	13.4 EER		
Water-source water to water (cooling mode)	<135,000 Btu/h	All	86°F entering water	10.6 EER	ISO-13256-2	
			59°F entering water	16.3 EER		
Ground water source Brine to water (cooling mode)	<135,000 Btu/h	All	77°F entering water	12.1 EER		

**TABLE 6.8.1B Electrically Operated Unitary and Applied Heat Pumps—  
Minimum Efficiency Requirements (continued)**

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>
Water source water-to-water (cooling mode)	<135,000 Btu/h	All	86°F entering water	10.6 EER	
Groundwater source water to water (cooling mode)	<135,000 Btu/h	All	59°F entering water	16.3 EER	ISO-13256-2
Ground source brine to water (cooling mode)	<135,000 Btu/h	All	77°F entering water	12.1 EER	
Air cooled (heating mode)	<65,000 Btu/h <sup>c</sup> (cooling capacity)	—	Split system	7.7 HSPF	AHRI 210/240
			Single package	7.7 HSPF	
Through-the-wall, (air cooled, heating mode)	≤30,000 Btu/h <sup>c</sup> (cooling capacity)	—	Split system	7.4 HSPF	AHRI 210/240
			Single package	7.4 HSPF	
Air cooled (heating mode)	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.3 COP	AHRI 340/360
			17°F db/15°F wb outdoor air	2.25 COP	
	≥135,000 Btu/h (cooling capacity)	47°F db/43°F wb outdoor air	3.2 COP		
		17°F db/15°F wb outdoor air	2.05 COP		
Water source (heating mode)	<135,000 Btu/h (cooling capacity)	—	68°F entering water	4.2 COP	
Ground water source (heating mode)	<135,000 Btu/h (cooling capacity)	—	50°F entering water	3.6 COP	ISO-13256-1
Ground source (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering water	3.1 COP	
Water source water to water (heating mode)	<135,000 Btu/h (cooling capacity)	—	68°F entering water	3.7 COP	ISO-13256-2
			50°F entering water	3.1 COP	
Ground source brine to water (heating mode)	<135,000 Btu/h (cooling capacity)	—	32°F entering water	2.5 COP	

<sup>a</sup>IPLVs and part-load rating conditions are only applicable to equipment with capacity modulation.

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

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

**TABLE 6.8.1C Water Chilling Packages—Efficiency Requirements<sup>a</sup>**

Equipment Type	Size Category	Path A	Path B	Test Procedure <sup>c</sup>
Air-Cooled Chillers	<150 tons	≥9.562 EER ≥12.500 IPLV	NA <sup>d</sup>	
	≥150 tons	≥9.562 EER ≥12.750 IPLV	NA <sup>d</sup>	
Air-Cooled without Condenser, Electrical Operated	All Capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		
Water-Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with water-cooled positive displacement efficiency requirements		
Water-Cooled, Electrically Operated, Positive Displacement	<75 tons	≤0.780 kW/ton ≤0.630 IPLV	≤0.800 kW/ton ≤0.600 IPLV	AHR1 550/590
	≥75 tons and <150 tons	≤0.775 kW/ton ≤0.615 IPLV	≤0.790 kW/ton ≤0.586 IPLV	
	≥150 tons and <300 tons	≤0.680 kW/ton ≤0.580 IPLV	≤0.718 kW/ton ≤0.540 IPLV	
	≥300 tons	≤0.620 kW/ton ≤0.540 IPLV	≤0.639 kW/ton ≤0.490 IPLV	
Water-Cooled, Electrically Operated, Centrifugal	<150 tons	≤0.634 kW/ton ≤0.596 IPLV	≤0.639 kW/ton ≤0.450 IPLV	
	≥150 tons and <300 tons	≤0.634 kW/ton ≤0.596 IPLV	≤0.639 kW/ton ≤0.450 IPLV	
	≥300 tons and <600 tons	≤0.576 kW/ton ≤0.549 IPLV	≤0.600 kW/ton ≤0.400 IPLV	
	≥600 tons	≤0.570 kW/ton ≤0.539 IPLV	≤0.590 kW/ton ≤0.400 IPLV	
Air-Cooled Absorption, Single Effect	All Capacities	≥0.600 COP	NA <sup>d</sup>	AHR1 560
Water-Cooled Absorption, Single Effect	All Capacities	≥0.700 COP	NA <sup>d</sup>	
Absorption Double-Effect, Indirect-Fired	All Capacities	≥1.000 COP ≥1.050 IPLV	NA <sup>d</sup>	
Absorption Double-Effect, Direct-Fired	All Capacities	≥1.000 COP ≥1.000 IPLV	NA <sup>d</sup>	

<sup>a</sup> The centrifugal chiller equipment requirements after adjustment per 6.4.1.2 do not apply to chillers where the design leaving evaporator temperature is < 36°F. The requirements do not apply to positive displacement chillers with design leaving fluid temperatures ≤ 32°F. The requirements do not apply to absorption chillers with design leaving fluid temperatures < 40°F.

<sup>b</sup> Compliance with this standard can be obtained by meeting the minimum requirements of Path A or Path B. However, both the full load and IPLV must be met to fulfill the requirements of Path A or Path B.

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

<sup>d</sup> NA means that this requirement is not applicable and cannot be used for compliance.

**TABLE 6.8.1D Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air-Conditioner Heat Pumps—Minimum Efficiency Requirements**

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure <sup>a</sup>
PTAC (cooling mode) standard size	All capacities	95°F db outdoor air	12.5 – (0.213 × Cap/1000) <sup>f</sup> EER (before 10/08/2012) 13.8 – (0.300 × Cap/1000) <sup>c</sup> EER (as of 10/08/2012)	
PTAC (cooling mode) nonstandard size <sup>b</sup>	All capacities	95°F db outdoor air	10.9 – (0.213 × Cap/1000) <sup>f</sup> EER	
PTHP (cooling mode) standard size	All capacities	95°F db outdoor air	12.3 – (0.213 × Cap/1000) <sup>f</sup> EER (before 10/08/2012) 14.0 – (0.300 × Cap/1000) <sup>c</sup> EER (as of 10/08/2012)	AHRI 310/380
PTHP (cooling mode) nonstandard size <sup>b</sup>	All capacities	95°F db outdoor air	10.8 – (0.213 × Cap/1000) <sup>f</sup> EER	
PTHP (heating mode) standard size	All capacities	—	3.2 – (0.026 × Cap/1000) <sup>f</sup> COP <sub>H</sub> (before 10/08/2012) 3.7 – (0.052 × Cap/1000) <sup>f</sup> COP <sub>H</sub> (as of 10/08/2012)	
PTHP (heating mode) nonstandard size <sup>b</sup>	All capacities	—	2.9 – (0.026 × Cap/1000) <sup>f</sup> COP <sub>H</sub>	
SPVAC (cooling mode)	<65,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	95°F db/75°F wb outdoor air	8.9EER	
	≥135,000 Btu/h and <240,000 Btu/h	95°F db/75°F wb outdoor air	8.6 EER	
SPVHP (cooling mode)	<65,000 Btu/h	95°F db/75°F wb outdoor air	9.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	95°F db/75°F wb outdoor air	8.9EER	AHRI 390
	≥135,000 Btu/h and <240,000 Btu/h	95°F db/75°F wb outdoor air	8.6 EER	
SPVHP (heating mode)	<65,000 Btu/h	47°F db/43°F wb outdoor air	3.0 COP	
	≥65,000 Btu/h and <135,000 Btu/h	47°F db/43°F wb outdoor air	3.0 COP	
	≥135,000 Btu/h and <240,000 Btu/h	47°F db/43°F wb outdoor air	2.9 COP	
Room air conditioners, with louvered sides	<6000 Btu/h	—	9.7 SEER	
	≥6000 Btu/h and <8000 Btu/h	—	9.7 SEER	
	≥8000 Btu/h and <14,000 Btu/h	—	9.8 EER	ANSI/AHAM RAC-1
	≥14,000 Btu/h and <20,000 Btu/h	—	9.7 SEER	
	≥20,000 Btu/h	—	8.5 EER	

**TABLE 6.8.1D Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air-Conditioner Heat Pumps—Minimum Efficiency Requirements (continued)**

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure <sup>a</sup>
	<8000 Btu/h		9.0 EER	
Room air conditioners, without louvered sides	≥8000 Btu/h and <20,000 Btu/h	—	8.5 EER	ANSI/AHAM RAC-1
	≥20,000 Btu/h		8.5 EER	
Room air-conditioner heat pumps with louvered sides	<20,000 Btu/h	—	9.0 EER	
	≥20,000 Btu/h		8.5 EER	
Room air-conditioner heat pumps without louvered sides	<14,000 Btu/h	—	8.5 EER	
	≥14,000 Btu/h		8.0 EER	
Room air conditioner, casement only	All capacities	—	8.7 EER	
Room air conditioner, casement-slider	All capacities	—	9.5 EER	

<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>Nonstandard size units must be factory labeled as follows: "MANUFACTURED FOR NONSTANDARD SIZE APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW STANDARD PROJECTS." Nonstandard size efficiencies apply only to units being installed in existing sleeves having an external wall opening of less than 16 in. high or less than 42 in. wide and having a cross-sectional area less than 670 in.<sup>2</sup>.

<sup>c</sup>Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

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

**TABLE 6.8.1E Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters**

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure <sup>a</sup>
Warm-Air Furnace, Gas-Fired	<225,000 Btu/h	Maximum capacity <sup>c</sup>	78% AFUE or 80% $E_t$ <sup>b,d</sup>	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥225,000 Btu/h	Maximum capacity <sup>c</sup>	80% $E_t$ <sup>d</sup>	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, Oil-Fired	<225,000 Btu/h	Maximum capacity <sup>c</sup>	78% AFUE or 80% $E_t$ <sup>b,d</sup>	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥225,000 Btu/h	Maximum capacity <sup>c</sup>	81% $E_t$ <sup>d</sup>	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum capacity <sup>c</sup>	80% $E_c$ <sup>e</sup>	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Gas-Fired	All capacities	Maximum capacity <sup>c</sup>	80% $E_c$ <sup>e,f</sup>	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All capacities	Maximum capacity <sup>c</sup>	80% $E_c$ <sup>e,f</sup>	Section 40, Combustion, UL 731

<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>Combination units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h) may comply with either rating.

<sup>c</sup>Compliance of multiple firing rate units shall be at the maximum firing rate.

<sup>d</sup> $E_t$  = thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

<sup>e</sup> $E_c$  = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

<sup>f</sup>As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

**TABLE 6.8.1F Gas- and Oil-Fired Boilers, Minimum Efficiency Requirements**

Equipment Type <sup>a</sup>	Subcategory or Rating Condition	Size Category (Input)	Minimum Efficiency <sup>b,c</sup>	Efficiency as of 3/2/2010 (Date 3 yrs after ASHRAE Board Approval)	Efficiency as of 3/2/2020 (Date 13 yrs after ASHRAE Board Approval)	Test Procedure
Boilers, hot water	Gas-fired	<300,000 Btu/h	80% AFUE	80% AFUE	80% AFUE	10 CFR Part 430
		≥300,000 Btu/h and ≤2,500,000 Btu/h <sup>d</sup>	75% $E_f$	80% $E_f$	80% $E_f$	10 CFR Part 431
		>2,500,000 Btu/h <sup>a</sup>	80% $E_c$	82% $E_c$	82% $E_c$	
	Oil-fired <sup>e</sup>	<300,000 Btu/h	80% AFUE	80% AFUE	80% AFUE	10 CFR Part 430
		≥300,000 Btu/h and ≤2,500,000 Btu/h <sup>d</sup>	78% $E_f$	82% $E_f$	82% $E_f$	10 CFR Part 431
		>2,500,000 Btu/h <sup>a</sup>	83% $E_c$	84% $E_c$	84% $E_c$	
Boilers, steam	Gas-fired	<300,000 Btu/h	75% AFUE	75% AFUE	75% AFUE	10 CFR Part 430
	Gas-fired— all, except natural draft	≥300,000 Btu/h and ≤2,500,000 Btu/h <sup>d</sup>	75% $E_f$	79% $E_f$	79% $E_f$	10 CFR Part 431
		>2,500,000 Btu/h <sup>a</sup>	80% $E_c$	79% $E_f$	79% $E_f$	
	Gas-fired— natural draft	≥300,000 Btu/h and ≤2,500,000 Btu/h <sup>d</sup>	75% $E_f$	77% $E_f$	79% $E_f$	10 CFR Part 431
		>2,500,000 Btu/h <sup>a</sup>	80% $E_c$	77% $E_f$	79% $E_f$	
	Oil-fired <sup>e</sup>	<300,000 Btu/h	80% AFUE	80% AFUE	80% AFUE	10 CFR Part 430
≥300,000 Btu/h and ≤2,500,000 Btu/h <sup>d</sup>		78% $E_f$	81% $E_f$	81% $E_f$	10 CFR Part 431	
>2,500,000 Btu/h <sup>a</sup>		83% $E_c$	81% $E_f$	81% $E_f$		

<sup>a</sup> These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

<sup>b</sup>  $E_f$  = combustion efficiency (100% less flue losses). See reference document for detailed information.

<sup>c</sup>  $E_c$  = thermal efficiency. See reference document for detailed information.

<sup>d</sup> Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.

<sup>e</sup> Includes oil-fired (residual).

**TABLE 6.8.1G Performance Requirements for Heat Rejection Equipment**

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required <sup>a,b,c,d</sup>	Test Procedure <sup>e</sup>
Propeller or axial fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 14.0 gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥ 7.0 gpm/hp	CTI ATC-105S and CTI STD-201
Air-cooled condensers	All	125°F condensing temperature R-22 test fluid 190°F entering gas temperature 15°F subcooling 95°F entering db	≥176,000 Btu/h-hp	AHRI 460

<sup>a</sup> For purposes of this table, *open-circuit cooling tower performance* is defined as the water flow rating of the tower at the thermal rating condition listed in Table 6.8.1G divided by the fan motor nameplate power.

<sup>b</sup> For purposes of this table, *closed-circuit cooling tower performance* is defined as the process water flow rating of the tower at the thermal rating condition listed in Table 6.8.1G divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

<sup>c</sup> For purposes of this table, *air-cooled condenser performance* is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

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

<sup>e</sup> The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections.

**TABLE 6.8.1H Heat Transfer Equipment**

Equipment Type	Subcategory	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>
Liquid-to-liquid heat exchangers	Plate type	NR	AHRI 400

<sup>a</sup> NR = No requirement

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

**TABLE 6.8.1I 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	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	AHRI 1230
				11.2 EER	
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	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 6.8.1J 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 11.0 EER 12.3 IEER 12.9 IEER (as of 7/1/2012)	AHRI 1230
	≥ 65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	10.8 EER 12.1 IEER 12.7 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	10.6 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	10.4 EER 11.6 IEER 12.1 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	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	9.3 EER 10.4 IEER 10.8 IEER (as of 7/1/2012)	
	≥ 240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System with Heat Recovery		
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	

**TABLE 6.8.1J Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps—  
Minimum Efficiency Requirements (continued)**

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

**TABLE 6.8.1K Air Conditioners and Condensing Units Serving *Computers Rooms***

Equipment Type	Net Sensible Cooling Capacity <sup>a</sup>	Minimum SCOP-127 <sup>b</sup> Efficiency		Test Procedure
		Downflow units	Upflow units	
Air conditioners, air cooled	<65,000 Btu/h	2.20 / 2.09		ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99		
	≥ 240,000 Btu/h	1.90 / 1.79		
Air conditioners, water cooled	<65,000 Btu/h	2.60 / 2.49		ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.50 / 2.39		
	≥ 240,000 Btu/h	2.40 / 2.29		
Air conditioners, water cooled with fluid economizer	<65,000 Btu/h	2.55 / 2.44		ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.45 / 2.34		
	≥ 240,000 Btu/h	2.35 / 2.24		
Air conditioners, glycol cooled (rated at 40% propylene glycol)	<65,000 Btu/h	2.50 / 2.39		ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.15 / 2.04		
	≥ 240,000 Btu/h	2.10 / 1.99		
Air conditioners, glycol cooled (rated at 40% propylene glycol) with fluid economizer	<65,000 Btu/h	2.45 / 2.34		ANSI/ASHRAE 127
	≥ 65,000 Btu/h and < 240,000 Btu/h	2.10 / 1.99		
	≥ 240,000 Btu/h	2.05 / 1.94		

a. net sensible cooling capacity: The total gross cooling capacity less the latent cooling less the energy to the air movement system. (Total Gross - latent - Fan Power)

b. sensible coefficient of performance (SCOP-127): a ratio calculated by dividing the net sensible cooling capacity in watts by the total power input in watts (excluding re-heaters and humidifiers) at conditions defined in ASHRAE Standard 127. The net sensible cooling capacity is the gross sensible capacity minus the energy dissipated into the cooled space by the fan system.

**TABLE 6.8.2A Minimum Duct Insulation R-Value,<sup>a</sup> Cooling and Heating Only Supply Ducts and Return Ducts**

Climate Zone	Duct Location						
	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation <sup>a</sup>	Unconditioned Space <sup>b</sup>	Indirectly Conditioned Space <sup>c</sup>	Buried
<b>Heating-Only Ducts</b>							
1, 2	none	none	none	none	none	none	none
3	R-3.5	none	none	none	none	none	none
4	R-3.5	none	none	none	none	none	none
5	R-6	R-3.5	none	none	none	none	R-3.5
6	R-6	R-6	R-3.5	none	none	none	R-3.5
7	R-8	R-6	R-6	none	R-3.5	none	R-3.5
8	R-8	R-8	R-6	none	R-6	none	R-6
<b>Cooling-Only Ducts</b>							
1	R-6	R-6	R-8	R-3.5	R-3.5	none	R-3.5
2	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
3	R-6	R-6	R-6	R-3.5	R-1.9	none	none
4	R-3.5	R-3.5	R-6	R-1.9	R-1.9	none	none
5, 6	R-3.5	R-1.9	R-3.5	R-1.9	R-1.9	none	none
7, 8	R-1.9	R-1.9	R-1.9	R-1.9	R-1.9	none	none
<b>Return Ducts</b>							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none

<sup>a</sup>Insulation R-values, measured in (h·ft<sup>2</sup>·°F)/ft, 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 Section 6.4.4.2 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 crawlspaces, both ventilated and nonventilated.

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

**TABLE 6.8.2B Minimum Duct Insulation R-Value,<sup>a</sup> Combined Heating and Cooling Supply Ducts and Return Ducts**

Climate Zone	Duct Location						
	Exterior	Ventilated Attic	Unvented Attic Above Insulated Ceiling	Unvented Attic with Roof Insulation <sup>a</sup>	Unconditioned Space <sup>b</sup>	Indirectly Conditioned Space <sup>c</sup>	Buried
<b>Supply Ducts</b>							
1	R-6	R-6	R-8	R-3.5	R-3.5	none	R-3.5
2	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
3	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
4	R-6	R-6	R-6	R-3.5	R-3.5	none	R-3.5
5	R-6	R-6	R-6	R-1.9	R-3.5	none	R-3.5
6	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
7	R-8	R-6	R-6	R-1.9	R-3.5	none	R-3.5
8	R-8	R-8	R-8	R-1.9	R-6	none	R-6
<b>Return Ducts</b>							
1 to 8	R-3.5	R-3.5	R-3.5	none	none	none	none

<sup>a</sup>Insulation R-values, measured in (h·ft<sup>2</sup>·°F)/ft, 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 Section 6.4.4.2 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 crawlspaces, both ventilated and nonventilated.

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

**TABLE 6.8.3A Minimum Pipe Insulation Thickness  
Heating and Hot Water Systems<sup>a,b,c,d</sup>  
(Steam, Steam Condensate, Hot Water Heating and Domestic Water Systems)**

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (in)				
	Conductivity Btu·in./(h·ft <sup>2</sup> ·°F)	Mean Rating Temperature, °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness (in)				
>350 °F	0.32–0.34	250	4.5	5.0	5.0	5.0	5.0
251°F–350°F	0.29–0.32	200	3.0	4.0	4.5	4.5	4.5
201°F–250°F	0.27–0.30	150	2.5	2.5	2.5	3.0	3.0
141°F–200°F	0.25–0.29	125	1.5	1.5	2.0	2.0	2.0
105°F–140°F	0.22–0.28	100	1.0	1.0	1.5	1.5	1.5

- a For insulation outside the stated conductivity range, the minimum thickness ( $T$ ) shall be determined as follows:  $T = r\{(1 + 16r)^{K/k} - 1\}$  where  $T$  = minimum insulation thickness (in.),  $r$  = actual outside radius of pipe (in.),  $t$  = insulation thickness listed in this table for applicable fluid temperature and pipe size,  $K$  = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./h·ft<sup>2</sup>·°F), and  $k$  = the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- b These thicknesses are based on energy efficiency considerations only. Additional insulation is sometimes required relative to safety issues/surface temperature.
- c For piping smaller than 1/2" and located in partitions within conditioned spaces, reduction of these thicknesses by 1" shall be permitted (before thickness adjustment required in footnote a) but not to thicknesses below 1".
- d For direct-buried heating and hot water system piping, reduction of these thicknesses by 1.5" shall be permitted (before thickness adjustment required in footnote a) but not to thicknesses below 1".
- e The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown in the table.

**TABLE 6.8.3B Minimum Pipe Insulation Thickness  
Cooling Systems (Chilled Water, Brine, and Refrigerant)<sup>a,b,c</sup>**

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (in)				
	Conductivity Btu·in./(h·ft <sup>2</sup> ·°F)	Mean Rating Temperature, °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
			Insulation Thickness (in)				
40°F–60°F	0.21–0.27	75	0.5	0.5	1.0	1.0	1.0
<40°F	0.20–0.26	50	0.5	1.0	1.0	1.0	1.5

- a For insulation outside the stated conductivity range, the minimum thickness ( $T$ ) shall be determined as follows:  $T = r\{(1 + 16r)^{K/k} - 1\}$  where  $T$  = minimum insulation thickness (in.),  $r$  = actual outside radius of pipe (in.),  $t$  = insulation thickness listed in this table for applicable fluid temperature and pipe size,  $K$  = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu·in./h·ft<sup>2</sup>·°F), and  $k$  = the upper value of the conductivity range listed in this table for the applicable fluid temperature.
- b These thicknesses are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.
- c For direct-buried cooling system piping, insulation is not required.
- d The table is based on steel pipe. Non-metallic pipes schedule 80 thickness or less shall use the table values. For other non-metallic pipes having thermal resistance greater than that of steel pipe, reduced insulation thicknesses are permitted if documentation is provided showing that the pipe with the proposed insulation has no more heat transfer per foot than a steel pipe of the same size with the insulation thickness shown in the table.