

[ Revisions here primarily result for review by many people as part of the IECC process. They include:

- adding footnote describing table top and grid enabled water heaters and
- adding footnote indicating to look in C404.2.1 for further requirements.
- Footnotes are reordered to be in order of occurrence
- Referenced standards are updated
- A few small changes to footnotes

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Table C404.2 Minimum Performance of Water-Heating Equipment

<u>Equipment Type</u>	<u>Size Category (input)</u>	<u>Subcategory or Rating Condition</u>	<u>Draw Pattern</u>	<u>Performance Required<sup>a,b</sup></u>	<u>Test Procedure<sup>b,c</sup></u>
Electric table-top water heaters <sup>sd</sup>	≤ 12 kW	≥ 20 gal ≤ 120 gal <sup>fc</sup>	Very small	UEF ≥ 0.6323 - (0.0058 × Vr)	DOE 10
			Low	UEF ≥ 0.9188 - (0.0031 × Vr)	C.F.R. Part 430 App. E
			Medium	UEF ≥ 0.9577 - (0.0023 × Vr)	
			High	UEF ≥ 0.9884 - (0.0016 × Vr)	
Electric storage water heaters <sup>sf,gt</sup> and resistance and heat pump	≤ 12 kW	≥ 20 gal ≤ 55 gal <sup>fc</sup>	Very small	UEF ≥ 0.8808 - (0.0008 × Vr)	DOE 10
			Low	UEF ≥ 0.9254 - (0.0003 × Vr)	C.F.R. Part 430 App. E
			Medium	UEF ≥ 0.9307 - (0.0002 × Vr)	
			High	UEF ≥ 0.9349 - (0.0001 × Vr)	
Electric storage water heaters <sup>sf,gt</sup>	≤ 12 kW	≥ 55 gal ≤ 120 gal <sup>fc</sup>	Very small	UEF ≥ 1.9236 - (0.0011 × Vr)	DOE 10
			Low	UEF ≥ 2.0440 - (0.0011 × Vr)	C.F.R. Part 430 App. E
			Medium	UEF ≥ 2.1171 - (0.0011 × Vr)	
			High	UEF ≥ 2.2418 - (0.0011 × Vr)	
				(0.3 + 27/Vm), %h	DOE 10 C.F.R. 431.106 App B.
Grid-enabled water heaters <sup>sh</sup>		≥ 75 gal <sup>fc</sup>	Very small	UEF ≥ 1.0136 - (0.0028 × Vr)	10 C.F.R. 430
			Low	UEF ≥ 0.9984 - (0.0014 × Vr)	Appendix E
			Medium	UEF ≥ 0.9853 - (0.0010 × Vr)	
			High	UEF ≥ 0.9720 - (0.0007 × Vr)	
Electric instantaneous water heater <sup>si</sup>	≤ 12 kW	≤ 2 gal <sup>fc</sup>	Very small	UEF ≥ 0.91	DOE 10
			Low	UEF ≥ 0.91	C.F.R. Part 430
			Medium	UEF ≥ 0.91	
			High	UEF ≥ 0.92	
	≥ 12 kW & ≤ 58.6 kW <sup>wj</sup>	≤ 2 gal ≤ 180F	All	UEF ≥ 0.80	DOE 10 C.F.R. Part 430
Gas storage water heaters <sup>sf</sup>	≤ 75,000 Btu/h	≥ 20 gal & ≤ 55 gal <sup>fc</sup>	Very small	UEF ≥ 0.3456 - (0.0020 × Vr)	DOE 10
			Low	UEF ≥ 0.5982 - (0.0019 × Vr)	C.F.R. Part 430 App. E
			Medium	UEF ≥ 0.6483 - (0.0017 × Vr)	
			High	UEF ≥ 0.6920 - (0.0013 × Vr)	
	≤ 75,000 Btu/h	≥ 55 gal & ≤ 100 gal <sup>fc</sup>	Very small Low	UEF ≥ 0.6470 - (0.0006 × Vr) UEF ≥ 0.7689 - (0.0005 × Vr)	DOE 10 C.F.R. Part

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<u>Equipment Type</u>	<u>Size Category (input)</u>	<u>Subcategory or Rating Condition</u>	<u>Draw Pattern</u>	<u>Performance Required<sup>a,b</sup></u>	<u>Test Procedure<sup>b,c</sup></u>
			Medium	$UEF \geq 0.7897 - (0.0004 \times V_r)$	430 App. E
			High	$UEF \geq 0.8072 - (0.0003 \times V_r)$	
	$> 75,000$ Btu/h and $\leq 105,000$ Btu/h <sup>dk</sup>	$\leq 120$ gal $\leq 180$ F	Very small	$UEF > 0.2674 - 0.0009 \times V_r$	DOE 10
			Low	$UEF > 0.5362 - 0.0012 \times V_r$	C.F.R. Part
			Medium	$UEF > 0.6002 - 0.0011 \times V_r$	430 App. E
			High	$UEF > 0.6597 - 0.0009 \times V_r$	
	$> 105,000$ Btu/h <sup>df</sup>			$80\% E_f$	DOE 10
				$SL \leq (Q/800 + 110\sqrt{V}), \text{ Btu/h}$	C.F.R. 431.106
Gas instantaneous water heater <sup>hi</sup>	$> 50,000$ Btu/h and $\leq 200,000$ Btu/h	$\leq 2$ gal	Very small	$UEF > 0.80$	DOE 10
			Low	$UEF \geq 0.81$	C.F.R. Part
			Medium	$UEF > 0.81$	430 App. E
			High	$UEF > 0.81$	
	$\geq 200,000$ Btu/h <sup>df</sup>	$\leq 10$ gal <sup>fc</sup>		$80\% E_f$	DOE 10
					C.F.R. 431.106
	$\geq 200,000$ Btu/h <sup>f</sup>	$\geq 10$ gal		$80\% E_f$	DOE 10
				$SL \leq (Q/800 + 110\sqrt{V}), \text{ Btu/h}$	C.F.R. 431.106
Oil storage water heaters <sup>ef</sup>	$\leq 105,000$ Btu/h	$\leq 50$ gal <sup>fc</sup>	Very small	$UEF = 0.2509 - (0.0012 \times V_r)$	DOE 10
			Low	$UEF = 0.5330 - (0.0016 \times V_r)$	C.F.R. Part
			Medium	$UEF = 0.6078 - (0.0016 \times V_r)$	430
			High	$UEF = 0.6815 - (0.0014 \times V_r)$	
	$> 105,000$ Btu/h and $\leq 140,000$ Btu/h <sup>el</sup>	$\leq 120$ gal $\leq 180$ F	Very small	$UEF > 0.2932 - 0.0015 \times V_r$	DOE 10
			Low	$UEF > 0.5596 - 0.0018 \times V_r$	C.F.R. Part
			Medium	$UEF > 0.6194 - 0.0016 \times V_r$	430 App. E
			High	$UEF > 0.6740 - 0.0013 \times V_r$	
	$> 140,000$ Btu/h			$80\% E_f$	DOE 10
				$SL \leq (Q/800 + 110\sqrt{V}), \text{ Btu/h}$	C.F.R. 431.106
Oil instantaneous water heater <sup>hi</sup>	$\leq 210,000$ Btu/h	$\leq 2$ gal		$80\% E_f$	DOE 10
				$EF \geq 0.59 - 0.0005 \times V$	C.F.R. Part
					430 App. E
	$> 210,000$ Btu/h	$\leq 10$ gal		$80\% E_f$	DOE 10
					C.F.R. 431.106
	$> 210,000$ Btu/h	$\geq 10$ gal		$78\% E_f$	DOE 10
				$SL \leq (Q/800 + 110\sqrt{V}), \text{ Btu/h}$	C.F.R. 431.106
Hot water supply boilers, gas and oil <sup>hi</sup>	$\geq 300,000$ Btu/h and $\leq 12,500,000$ Btu/h	$\leq 10$ gal		$80\% E_f$	DOE 10
					C.F.R. 431.106
Hot water supply boilers, gas <sup>hi</sup>	$\geq 300,000$ Btu/h and $\leq 12,500,000$ Btu/h	$\geq 10$ gal		$80\% E_f$	DOE 10
				$SL \leq (Q/800 + 110\sqrt{V}), \text{ Btu/h}$	C.F.R. 431.106

<u>Equipment Type</u>	<u>Size Category (input)</u>	<u>Subcategory or Rating Condition</u>	<u>Draw Pattern</u>	<u>Performance Required<sup>a,b</sup></u>	<u>Test Procedure<sup>b,c</sup></u>
Hot water supply boilers, oil <sup>hi</sup>	≥ 300,000 Btu/h and < 12,500,000 Btu/h	≥ 10 gal		78% $E_f$ $SL < (Q/800 + 110\sqrt{V})$ , Btu/h	DOE 10 C.F.R. Part 431.106
Pool heaters, gas <sup>c</sup>	All			82% $E_f$	DOE 10 C.F.R. Part 430 App. P
Heat pump pool heaters	All	50°F db 44.2°F wb outdoor air 80.0°F entering water		4.0 COP	DOE 10 C.F.R. Part 430 App. P
Unfired storage tanks	All			Minimum insulation requirement R-12.5 (h-ft <sup>2</sup> -°F)/Btu	(none)

<sup>a</sup> Thermal efficiency ( $E_f$ ) is a minimum requirement, while standby loss is a maximum requirement. In the standby loss equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h.  $V_m$  is the measured volume in the tank in gallons. Standby loss for electric water heaters is in terms of %/h and denoted by the term "S," and standby loss for gas and oil water heaters is in terms of Btu/h and denoted by the term "SL." Draw pattern (DP) refers to the water draw profile in the Uniform Energy Factor (UEF) test. UEF and Energy Factor (EF) are minimum requirements. In the UEF standard equations,  $V_r$  refers to the rated volume in gallons.

[C404.2 option 1](#)

<sup>b</sup> Refer to Section C404.2.1 and C404.2.2 for additional requirements for service water heating system equipment.

[C404.2 option 2](#)

<sup>b</sup> Refer to Section C404.2.1 for additional requirements for service water heat system equipment.

<sup>b,c</sup> Chapter 6 contains a complete specification, including the year version, of the referenced test procedure.

<sup>d</sup> A tabletop water heater is a storage water heater that is enclosed in a rectangular cabinet with a flat top surface not more than three feet (0.91 m) in height and has a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.

<sup>e</sup> Water heaters or gas pool heaters in this category are regulated as consumer products by the USDOE as defined in 10 C.F.R. Part 430 and do not need to be checked for code compliance. Numbers in table are for reference or to use for over-code performance determinations.

<sup>f</sup> ~~Table top and s~~Storage water heaters have a ratio of input capacity (Btu/h) to tank volume (gal) < 4000.

<sup>g</sup> There are no minimum efficiency requirements for electric heat pump water heaters greater than 12 kW or for gas heat pump water heaters.

<sup>h</sup> A grid-enabled water heater is an electric resistance water heater that meets all of the following:

1. Has a rated storage tank volume of more than 75 gallons.

2. Is manufactured on or after April 16, 2015.

3. Is equipped at the point of manufacture with an activation lock.

4. Bears a permanent label applied by the manufacturer that complies with all of the following:

4.1 Is made of material not adversely affected by water.

4.2 Is attached by means of non-water soluble adhesive.

4.3 Advises purchasers and end-users of the intended and appropriate use of the product with the following notice printed in 16.5

point Arial Narrow Bold font: "IMPORTANT INFORMATION: This water heater is intended only for use as a part of an electric thermal storage or demand response program. It will not provide adequate hot water unless enrolled in such a program and activated by your utility company or another program operator. Confirm the availability of a program in your local area before purchasing or installing this product."

- <sup>iii</sup> Instantaneous water heaters and hot water supply boilers have an input capacity (Btu/h) divided by storage volume (gal)  $\geq$  4000 Btu/h-gal.
- <sup>iv</sup> Electric instantaneous water heaters with input capacity  $\geq$  12 kW and  $\leq$  58.6 kW that have either (1) a storage volume  $\geq$  2 gal; or (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power has no efficiency standard.
- <sup>v</sup> Gas storage water heaters with input capacity  $\geq$  75,000 Btu/h and  $\leq$  105,000 Btu/h must comply with the requirements for the  $\geq$  105,000 Btu/h if the water heater either (1) has a storage volume  $\geq$  120 gal; (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power.
- <sup>vi</sup> Oil storage water heaters with input capacity  $\geq$  105,000 Btu/h and  $\leq$  140,000 Btu/h must comply with the requirements for the  $\geq$  140,000 Btu/h if the water heater either (1) has a storage volume  $\geq$  120 gal; (2) is designed to provide outlet hot water at temperatures greater than 180°F; or (3) uses three-phase power.

Chapter 6

<b>AHRI</b>	Air Conditioning, Heating, and Refrigeration Institute 4100 North Fairfax Drive, Suite 200 Arlington, VA 22203	
Standard reference number	Title	Referenced in code section number
<del>1160</del> 2014	<del>Performance Rating of Heat Pump Pool Heaters</del>	..... <del>Table C404.2, C404.11.1</del>
<b>ANSI</b>	American National Standards Institute 25 West 43rd Street Fourth Floor New York, NY 10036	
Standard reference number	Title	Referenced in code section number
<del>Z21.10.3/CSA 4.3 — ( (11) ) 17</del>	<del>Gas Water Heaters, Volume III—Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating Tank and Instantaneous</del>	..... <del>Table C404.2</del>
Z21.47/CSA 2.3— ( (42) ) 16	Gas-fired Central Furnaces	Table C403.3.2 ( (44) ) (5)
Z83.8/CSA 2.6— ( (09) ) 16	Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-fired Duct Furnaces	Table C403.3.2 ( (44) ) (5)
<b>APSP</b>	The Association of Pool and Spa Professionals 2111 Eisenhower Avenue Alexandria, VA 22314	
Standard reference number	Title	Referenced in code

		section number
14— ( <del>2014</del> ) 2019	American National Standards for Portable Electric Spa Efficiency	C404.12
<b>ASABE</b>	American Society of Agricultural and Biological Engineers 2950 Niles Road St. Joseph, MI 49085	
<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in code section number</u>
S640—2017	Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)	C405.3
<b>ASHRAE</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329-2305	
ISO/AHRI/ASHRAE <del>146—2011</del>	<del>Testing and Rating Pool Heaters</del>	<del>Table C404.2</del>
<b>DOE</b>	U.S. Department of Energy c/o Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402-9325	
<u>Standard reference number</u>	<u>Title</u>	<u>Referenced in code section number</u>
10 C.F.R., Part 430—2015	Energy Conservation Program for Consumer Products: Test Procedures and Certification and Enforcement Requirement for Plumbing Products; and Certification and Enforcement Requirements for Residential Appliances; Final Rule	Table C403.3.2 ( ( <del>4</del> ) ) (1), Table C403.3.2 ( ( <del>5</del> ) ) (2), <u>Table C403.3.2(5)</u> , <u>Table C403.3.2(6)</u> , <u>Table C403.3.2(14)</u> , Table C404.2
( (10 C.F.R., Part 430, Subpart B, Appendix N— 2015	<del>Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers</del>	<del>(202)</del>
10 C.F.R., Part 431—2015	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards; Final Rules	Table C403.3.2 ( ( <del>5</del> ) ) (6), C403.8.4, C403.11, Table ( ( <del>C406.2(5)</del> ) ) C403.11, C403.11.2, C405.7, Table C405.7, C405.8, Table C405.8(1), Table C405.8(2), Table C405.8(3) Table C404.2

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**Commented [MK2]:** Needs to be current or we need a separate reference for C404.2

