



**BSR/ASHRAE/IES Addendum BS
to ANSI/ASHRAE/IES Standard 90.1-2016**

Public Review Draft

Proposed Addendum BS to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

**Second Public Review (February 2019)
(Draft Shows Proposed Independent Substantive
Changes to Previous Public Review Draft)**

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FOREWORD

This addendum updates table F-2 to reflect the new water heater requirements that were adopted by DOE for residential water heaters effective December 2015

This addendum also make updates to table 7.8 for water heaters to clarify requirements for products applications outside the US that are not covered by the DOE requirements that are referenced in the normative appendix F table F-2. For these non-US applications the efficiency requirements will be aligned with the DOE requirements in the normative appendix F-2

Also there are some editorial corrections made to table F-2 to move the pool heat pump water heater requirements to the table F-2 instead of listing them in a text requirement. Heat Pump water heaters are now rated the same as storage water heaters by DOE

This second public review ISC makes changes to the first public review to correct some errors and to improve the clarity of the addendum.

The following is a summary of the changes being made by the second public review ISC

1. Editorial corrections as identified by public review comment
2. Eliminate outside US requirements for residential water heaters and add a new footnote h to not require mandatory compliance with the US residential water heaters outside the US and recommend use of local requirements or if none exist then consideration of the DOE requirements listed in appendix F.
3. For instantaneous electric water heaters DOE requirements have an 80% and 77% thermal efficiency which are actually the efficiencies for gas instantaneous water heaters. These efficiencies are incorrect and most electric instantaneous water heaters have a thermal efficiencies closer to 98%. To not force a DOE rule at this time we will just list no requirements for the instantaneous electric water heaters knowing that the efficiency is inherent in the design.

[Note to Reviewers: This public review draft makes proposed independent substantive changes to the previous public review draft. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the previous draft are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed substantive changes.]

Addendum BS to 90.1-2016

Revise table 7.8 from the first public review as shown below IP

Table 7.8 Performance Requirements for Water-Heating Equipment—Minimum Efficiency Requirements

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Performance Required ^a	Test Procedure^{b,c}
Electric table-top water heaters	≤12 kW	≥20 gal and ≤120 gal and <4000 (Btu/h)/gal	For applications outside US ^g see footnote (h) Very-Small DP: $UEF = 0.6323 - (0.0058 \times V_r)$ Low-DP: $UEF = 0.9188 - (0.0031 \times V_r)$ Medium-DP: $UEF = 0.9577 - (0.0023 \times V_r)$ High-DP: $UEF = 0.9884 - (0.0016 \times V_r)$ For US Applications See footnote (g).	10 CFR 430 Appendix E
Electric Storage water heaters	≤12 kW ^e	Resistance and heat pump ≤55 gal <4000 (Btu/h)/gal ≥20 gal and ≤55 gall	For applications outside US ^g see footnote (h) Very-Small DP: $UEF = 0.8808 - (0.0008 \times V_r)$ Low-DP: $UEF = 0.9254 - (0.0003 \times V_r)$ Medium-DP: $UEF = 0.9307 - (0.0002 \times V_r)$ High-DP: $UEF = 0.9349 - (0.0001 \times V_r)$ For US Applications See footnote (g).	10 CFR 430 Appendix E
		Resistance and heat pump >55 gal <4000 (Btu/h)/gal ≥55 gal and ≤120 gal	For applications outside US ^g see footnote (h) Very-Small DP: $UEF = 1.9236 - (0.0011 \times V_r)$ Low-DP: $UEF = 2.0440 - (0.0011 \times V_r)$ Medium-DP: $UEF = 2.1171 - (0.0011 \times V_r)$ High-DP: $UEF = 2.2418 - (0.0011 \times V_r)$ For US Applications See footnote (g).	10 CFR 430 Appendix E
	>12 kW ^e	Resistance ≥20 gal <4000 Btu/h/gal	$SL \leq 0.3 + 27/V_m$ %/h	10 CFR 431.106
Electric instantaneous water heaters	≥12 kW ^e	≥4000 (Btu/h)/gal <2 gal	For applications outside US ^g see footnote (h) Very-Small DP: $UEF = 0.91$ Low-DP: $UEF = 0.91$ Medium-DP: $UEF = 0.91$ High-DP: $UEF = 0.92$ For US applications see footnote (g)	10 CFR 430 Appendix E
	>12 kW and ≤58.6 kW ^c	≥4000 (Btu/h)/gal ≤2 gal ≤180 °F	For applications outside US ^g Very Small DP: $UEF = 0.80$ Low DP: $UEF = 0.80$ Medium DP: $UEF = 0.80$ High DP: $UEF = 0.80$ For US applications see footnote (g)	10 CFR 430 Appendix E
	>58.6 kW ^c	≥4000 (Btu/h)/gal <10 gal	No requirement	10 CFR 431.106
		≥4000 (Btu/h)/gal ≥10 gal	No Requirement $SL \leq 0.3 + 27/V_{mT}$	
Gas storage water heaters	≤75,000 Btu/h	<4000 (Btu/h)/gal ≥20 gal and ≤55 gal	For applications outside US ^g see footnote (h) Very-Small DP: $UEF = 0.3456 - (0.0020 \times V_r)$ Low-DP: $UEF = 0.5982 - (0.0019 \times V_r)$ Medium-DP: $UEF = 0.6483 - (0.0017 \times V_r)$ High-DP: $UEF = 0.6920 - (0.0013 \times V_r)$ For US applications See footnote (g).	10 CFR 430 Appendix E

		<p>>55 gal <4000 (Btu/h)/gal <u>>55 gal and ≤100 gal</u></p>	<p>For applications outside US^g <u>see footnote (h)</u> Very Small DP: $UEF = 0.6470 - (0.0006 \times V_r)$ Low DP: $UEF = 0.7689 - (0.0005 \times V_r)$ Medium DP: $UEF = 0.7897 - (0.0004 \times V_r)$ High DP: $UEF = 0.8072 - (0.0003 \times V_r)$</p> <p>For US applications See footnote (g).</p>	10 CFR 430 Appendix E
	>75,000 Btu/h and ≤105,000 Btu/h ^d	<p>≤120 gal <4000 (Btu/h)/gal ≤180 °F</p>	<p>For applications outside US^g Very Small DP: $UEF = 0.2674 - (0.0009 \times V_r)$ Low DP: $UEF = 0.5362 - (0.0012 \times V_r)$ Medium DP: $UEF = 0.6002 - (0.0011 \times V_r)$ High DP: $UEF = 0.6597 - (0.0009 \times V_r)$</p> <p>For applications outside US^g</p>	10 CFR 430 Appendix E
	>105,000 Btu/h ^{df}	<4000 (Btu/h)/gal	<p>80% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h</p>	<p>10 CFR 430 Appendix E 10 CFR 431.106</p>
Gas instantaneous water heaters	>50,000 Btu/h and ≤200,000 Btu/h	<p>≥4000 (Btu/h)/gal <2 gal</p>	<p>For applications outside US^g <u>see footnote (h)</u> Very Small DP: $UEF = 0.80$ Low DP: $UEF = 0.81$ Medium DP: $UEF = 0.81$ High DP: $UEF = 0.81$</p> <p>For US applications See footnote (g).</p>	10 CFR 430 Appendix E
	≥200,000 Btu/h ^{d,f}	<p>≥4000 (Btu/h)/gal and <10 gal</p>	80% E_t	<p>10 CFR 430 Appendix E 10 CFR 431.106</p>
	≥200,000 Btu/h ^f	<p>≥4000 (Btu/h)/gal and ≥10 gal</p>	<p>80% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h</p>	<p>10 CFR 430 Appendix E 10 CFR 431.106</p>
Oil storage water heaters	≤105,000 Btu/h	<p>≤50 gal <4000 (Btu/h)/gal</p>	<p>For applications outside US^g <u>see footnote (h)</u> Very Small DP: $UEF = 0.2509 - (0.0012 \times V_r)$ Low DP: $UEF = 0.5330 - (0.0016 \times V_r)$ Medium DP: $UEF = 0.6078 - (0.0016 \times V_r)$ High DP: $UEF = 0.6815 - (0.0014 \times V_r)$</p> <p>For US applications See footnote (g).</p>	10 CFR 430 Appendix E
	>105,000 Btu/h and ≤140,000 Btu/h ^e	<p>≤120 gal <4000 (Btu/h)/gal ≤180 °F</p>	<p>For applications outside US^g Very Small DP: $UEF = 0.2932 - (0.0015 \times V_r)$ Low DP: $UEF = 0.5596 - (0.0018 \times V_r)$ Medium DP: $UEF = 0.6194 - (0.0016 \times V_r)$ High DP: $UEF = 0.6740 - (0.0013 \times V_r)$</p> <p>For US applications See footnote (g).</p>	10 CFR 430 Appendix E
	>105,000 Btu/h ^e	<4000 (Btu/h)/gal	<p>80% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h</p>	10 CFR 431.106
Oil instantaneous water heaters	≤210,000 Btu/h	<p>≥4000 (Btu/h)/gal and <2 gal</p>	<p>80% E_t $EF \geq 0.59 - 0.0005 \times V$</p>	<p>Sections G.1 and G.2 of ANSI Z21.10.3 10 CFR 430 Appendix E as it appeared as of 1/1/2014</p>
	>210,000 Btu/h	<p>≥4000 (Btu/h)/gal and <10 gal</p>	80% E_t	10 CFR 431.106

	>210,000 Btu/h	≥4000 (Btu/h)/gal and ≥10 gal	78% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h	
Hot-water supply boilers, gas and oil ^f	≥300,000 Btu/h and <12,500,000 Btu/h	≥4000 (Btu/h)/gal and <10 gal	80% E_{tv}	10 CFR 430.106-4 31.106
Hot-water supply boilers, gas ^f	≥300,000 Btu/h and <12,500,000 Btu/h	≥4000 (Btu/h)/gal and ≥10 gal	80% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h	10 CFR 430.106-4 31.106
Hot-water supply boilers, oil	≥300,000 Btu/h and <12,500,000 Btu/h	≥4000 (Btu/h)/gal and ≥10 gal	78% E_t $SL \leq (Q/800 + 110\sqrt{V})$ Btu/h	Sections G.1 and G.2 of ANSI Z21.40.3 10 CFR 431.106
Pool heaters, oil and gas	All		82% E_t <u>For commercial pool heaters and for applications outside US^g</u> For US applications See footnote (g).	ASHRAE 146 10 CFR 430 Appendix P
Heat pump pool heaters	All	50°F db 44.2°F wb Outdoor air 80.0°F entering water	4.0 COP	AHRI 1160 10 CFR 430 Appendix P
Unfired storage tanks	All		R-12.5	(none)

^a Thermal efficiency (E_t) is a minimum requirement, while standby loss (SL) is a maximum Btu/h based on a 70°F temperature difference between stored water and ambient requirements. In the SL 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.

^b Section 12 contains a complete specification, including the year version, of the referenced test procedure.

^c Electric instantaneous water heaters with input capacity >12 kW and ≤58.6 kW must comply with the requirements for the >58.6 kW if the water heater either (1) has a storage volume >2 gallons; (2) is designed to provide outlet hot water at temperatures greater than 180 °F; or (3) uses 3-phase power.

^d Gas storage water heaters with input capacity >75,000 Btu/h and ≤105,000 Btu/h must comply with these the requirements for the >450,000 105,000 Btu/h category if the water heater either (1) has a storage volume >120 gallons; (2) is designed to provide outlet hot water at temperatures greater than 180 °F; or (3) uses 3-phase power.

^e Oil storage water heaters with input capacity >105,000 Btu/h and ≤140,000 Btu/h must comply with these the requirements for the >140,000 Btu/h if the water heater either (1) has a storage volume >120 gallons; (2) is designed to provide outlet hot water at temperatures greater than 180 °F; or (3) uses 3-phase power.

^f Refer to Section 7.5.3 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.

^g In the U.S., the efficiency requirements for water Water heaters or gas pool heaters in this category or subcategory are specified by the U.S. Department of Energy. Those requirements and applicable test procedures are found in the Code of Federal Regulations 10 CFR Part 430 Water heaters or gas pool heaters in this category or subcategory are regulated as consumer products by the US Department of Energy defined in 10 CFR 430.

^h Where this standard is being applied to a building outside the United States and Canada and water heaters in this subcategory are being installed in that building, those water heaters shall meet the local efficiency requirements. If there are no local efficiency standards for residential water heaters, consideration should be given to using the U.S. DOE efficiency requirements shown in Table F-2 of Appendix F.

Informative Note: See Informative Appendix F for the U.S. Department of Energy efficiency requirements applicable to these water heaters and pool heaters for US applications.

Make the following changes to F2 from the first public review

F2 DOE Minimum Energy Efficiency Requirements for Water Heaters and Pool Heaters

These standards for Uniform Energy Factor became effective on December 29, 2017, and apply to products manufactured on or after that date and the thermal efficiency requirements for gas fired pool heaters manufactured on or after April 16, 2013 (Table F-2).

The following text from the first public review has not been changed and is only shown for clarity

F3 DOE Minimum Energy Efficiency Requirements for Pool Heaters

~~Gas-fired pool heaters manufactured on or after April 16, 2013, shall have a thermal efficiency not less than 82%.~~

Modify the first public review IP document as shown below

Table F-2 Minimum Energy Efficiency Requirements for Water Heaters and Pool Heaters

Source: 10 CFR Part 430, *Energy Conservation Program: Energy Conservation Standards for Water Heaters*

Product Class	Rated Storage Volume and input rating (if applicable)	Draw Pattern	Uniform Energy Factor (UEF) or thermal efficiency (E _t)	Test Procedure
Gas-fired storage water heater	≥20 gal and ≤55 gal	Very Small	$UEF = 0.3456 - (0.0020 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 0.5982 - (0.0019 \times Vr)$	
		Medium	$UEF = 0.6483 - (0.0017 \times Vr)$	
		High	$UEF = 0.6920 - (0.0013 \times Vr)$	
	>55 gal and ≤100 gal	Very Small	$UEF = 0.6470 - (0.0006 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 0.7689 - (0.0005 \times Vr)$	
		Medium	$UEF = 0.7897 - (0.0004 \times Vr)$	
		High	$UEF = 0.8072 - (0.0003 \times Vr)$	
Oil-fired storage water heater	≤50 gal	Very Small	$UEF = 0.2509 - (0.0012 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 0.5330 - (0.0016 \times Vr)$	
		Medium	$UEF = 0.6078 - (0.0016 \times Vr)$	
		High	$UEF = 0.6815 - (0.0014 \times Vr)$	
Electric Storage Water Heaters	≥20 gal and ≤55 gal	Very Small	$UEF = 0.8808 - (0.0008 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 0.9254 - (0.0003 \times Vr)$	
		Medium	$UEF = 0.9307 - (0.0002 \times Vr)$	
		High	$UEF = 0.9349 - (0.0001 \times Vr)$	
	>55 gal and ≤100 gal	Very Small	$UEF = 1.9236 - (0.0011 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 2.0440 - (0.0011 \times Vr)$	
		Medium	$UEF = 2.1171 - (0.0011 \times Vr)$	
		High	$UEF = 2.2418 - (0.0011 \times Vr)$	
Tabletop Water heater	≥20 gal and ≤120 gal	Very Small	$UEF = 0.6323 - (0.0058 \times Vr)$	10 CFR 430 Appendix E
		Low	$UEF = 0.9188 - (0.0031 \times Vr)$	
		Medium	$UEF = 0.9577 - (0.0023 \times Vr)$	
		High	$UEF = 0.9884 - (0.0016 \times Vr)$	
Instantaneous Gas Fired Water Heater	<2 gal and >50,000 Btu/h	Very Small	$UEF = 0.80$	10 CFR 430 Appendix E
		Low	$UEF = 0.81$	
		Medium	$UEF = 0.81$	
		High	$UEF = 0.81$	
Instantaneous Electric Water Heater	<2 gal	Very Small	$UEF = 0.91$	10 CFR 430 Appendix E
		Low	$UEF = 0.91$	
		Medium	$UEF = 0.91$	

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		High	$UEF = 0.92$	
Grid Enabled Water Heaters	>75 gal	Very Small	$UEF = 1.0136 - (0.0028 \times V_r)$	<u>10 CFR 430 Appendix E</u>
		Low	$UEF = 0.9984 - (0.0014 \times V_r)$	
		Medium	$UEF = 0.9853 - (0.0010 \times V_r)$	
		High	$UEF = 0.9720 - (0.0007 \times V_r)$	
Pool heater Gas			82% E_t	<u>10 CFR 430 Appendix P</u>

^a. V_r is the Rated Storage Volume (in gallons), as determined pursuant to 10 CFR 429.17.

^b. Standards for electric storage water heaters apply to both electric resistance water heaters and heat pump water heaters.

Make the follow revisions first public review SI table 7.8 as shown below

Table 7.8 Performance Requirements for Water-Heating Equipment—Minimum Efficiency Requirements

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Performance Required ^a	Test Procedure^{b,c}
Electric table-top water heaters	≤12 kW	≥76 L and ≤450 L <309.75 W/L	For applications outside US ^g -see footnote (h) Very Small DP: UEF = 0.6323 – (0.0220 × V _i) Low DP: UEF = 0.9188 – (0.0117 × V _i) Medium DP: UEF = 0.9577 – (0.0087 × V _i) High DP: UEF = 0.9884 – (0.0061 × V _i) For US Applications See footnote (g).	10 CFR 430 Appendix E
Electric Storage water heaters	≤12 kW ^e	Resistance and heat Pump ≤76 L/208 L <309.75 W/L	For applications outside US ^g -see footnote (h) Very Small DP: UEF = 0.8808 – (0.0030 × V _i) Low DP: UEF = 0.9254 – (0.0011 × V _i) Medium DP: UEF = 0.9307 – (0.0008 × V _i) High DP: UEF = 0.9349 – (0.0004 × V _i) For US Applications See footnote (g).	10 CFR 430 Appendix E
		Resistance and heat Pump ≥75.7L >208 L and <454 L <309.75 W/L	For applications outside US ^g -see footnote (h) Very Small DP: UEF = 1.9236 – (0.0011 × V _i) Low DP: UEF = 2.0440 – (0.0041 × V _i) Medium DP: UEF = 2.1171 – (0.0030 × V _i) High DP: UEF = 0.2.2418 – (0.0015 × V _i) For US Applications See footnote (g).	10 CFR 430 Appendix E
	>12 kW ^e	Resistance ≥76 L and ≤450 L <310 W/L<309.75 W/L	SL≤0.3 + 27/V _m %/h	10 CFR 431.106
Electric instantaneous water heaters	≥12 kW ^e	≥309.75 W/L <7.6 L	For applications outside US ^g -see footnote (h) Very Small DP: UEF = 0.91 Low DP: UEF = 0.91 Medium DP: UEF = 0.91 High DP: UEF = 0.92 For US applications see footnote (g)	10 CFR 430 Appendix E
		≥309.75 W/L ≤7.6 L ≤82 °C	For applications outside US ^g Very Small DP: UEF = 0.80 Low DP: UEF = 0.80 Medium DP: UEF = 0.80 High DP: UEF = 0.80 For US applications see footnote (g)	10 CFR 430 Appendix E
	>12 kW and ≤58.6 kW ^c	≥309.75 W/L <38 L	80% E _i no requirements	10 CFR 431.106
		≥309.75 W/L ≥38 L	77% E _i no requirements SL ≤ 0.3 + 27/V _m , %/h	
Gas storage water heaters	≤22 kWh	≤208 L <309.75 W/L ≥75.7 L and ≤208 L	For applications outside US ^g -see footnote (h) ^h Very Small DP: UEF = 0.3456 – (0.0076 × V _i) Low DP: UEF = 0.5982 – (0.0072 × V _i) Medium DP: UEF = 0.6483 – (0.0064 × V _i) High DP: UEF = 0.6920 – (0.0049 × V _i) For US applications See footnote (g).	10 CFR 430 Appendix E
		≤208 L <309.75 W/L	For applications outside US ^g -see footnote (h) Very Small DP: UEF = 0.6470 – (0.0023 × V _i) Low DP: UEF = 0.7689 – (0.0019 × V _i) Medium DP: UEF = 0.7897 – (0.0015 × V _i)	10 CFR 430 Appendix E

			High DP: $UEF = 0.8072 - (0.0011 \times V_r)$ For US applications See footnote (g).	
	>22 kW and 82 <u>31</u> kW ^d	<309.75 W/L 7.6 <u>4.54</u> L ≤82 °C	Very Small DP: $UEF = 0.2674 - (0.0009 \times V_r)$ Low DP: $UEF = 0.5362 - (0.0012 \times V_r)$ Medium DP: $UEF = 0.6002 - (0.0011 \times V_r)$ High DP: $UEF = 0.6597 - (0.0009 \times V_r)$	10 CFR 430 Appendix E
	> 82 <u>31</u> kW ^f	<309.75 W/L	80% E_t SL ≤ (Q/0.234800 + 208.20.0166√V) kWh	40 CFR 430 Appendix E <u>10 CFR 431.106</u>
Gas instantaneous water heaters	>14.6 kW and ≤ 58.6 kW	≥309.75 W/L <7.57 L	For applications outside US ^g - <u>see footnote (h)</u> Very Small DP: $UEF = 0.80$ Low DP: $UEF = 0.81$ Medium DP: $UEF = 0.81$ High DP: $UEF = 0.81$ For US applications See footnote (g).	10 CFR 430 Appendix E
	≥ 58.6 kW ^{d,f}	≥309.75 W/L and <37.8 L	80% E_t	40 CFR 430 Appendix E <u>10 CFR 431.106</u>
	≥58.6 kW ^{d,f}	≥309.75 W/L and ≤ 37.8 L	SL ≤ (Q/0.234800 + 208.20.0166√V) kW	
Oil storage water heaters	< 44.6 <u>30.8</u> kW	< 309.75 W/L ≤189 L	For applications outside US ^g - <u>see footnote (h)</u> Very Small DP: $UEF = 0.2509 - (0.0045 \times V_r)$ Low DP: $UEF = 0.5330 - (0.0061 \times V_r)$ Medium DP: $UEF = 0.6078 - (0.0061 \times V_r)$ High DP: $UEF = 0.6815 - (0.0053 \times V_r)$ For US applications See footnote (g).	10 CFR 430 Appendix E
	> 8.75 <u>30.8</u> kW and ≤ 44.7 <u>41</u> kW ^e	<309.75 W/L ≤7.6 L ≤82 °C	Very Small DP: $UEF = 0.2932 - (0.0015 \times V_r)$ Low DP: $UEF = 0.5596 - (0.0018 \times V_r)$ Medium DP: $UEF = 0.6194 - (0.0016 \times V_r)$ High DP: $UEF = 0.6740 - (0.0013 \times V_r)$	10 CFR 430 Appendix E
	> 44.7 <u>41</u> kW ^e	<309.75 W/L	80% E_t SL ≤ (Q/0.234800 + 208.20.0166√V) kW	10 CFR 431.106
Oil instantaneous water heaters	<44 <u>61</u> kW	≥309.75 W/L and <7.6 L	80% E_t EF ≥ 0.59 - 0.0005 x V	Sections G.1 and G.2 of ANSI Z21.10.3 <u>10 CFR 430 as it appeared as of 1/1/2014</u>
	>61 kW	≥309.75 W/L and <7.6 <u>37.8</u> L	80% E_t	10 CFR 431.106
	>61 kW	≥309.75 W/L and ≥7.6 <u>37.8</u> L	78% E_t SL ≤ (Q/0.234800 + 208.20.0166√V) kW	
Hot-water supply boilers, gas and oil ^f	≥88 kW <3663 kW	≥309.75 W/L and <7.6 <u>37.8</u> L	80% E_t	10 CFR 430.406 <u>431.106</u>
Hot-water supply boilers, gas ^f	≥88 kW <3663 kW	≥309.75 W/L and ≥7.6 <u>37.8</u> L	80% E_t SL ≤ (Q/0.234800 + 208.20.0166√V) kW	10 CFR 430.406- <u>431.106</u>
Hot-water supply boilers, oil	≥88 kW and <3663 kW	≥309.75 W/L ≥7.6 <u>37.8</u> L	78% E_t SL ≤ (Q/0.234800 + 208.20.0166√V) kW	Sections G.1 and G.2 of ANSI Z21.10.3

				10 CFR 431.106
Pool heaters, oil and gas	All		82% E_t For applications outside US ^g For US applications See footnote (g).	ASHRAE 146 10 CFR 430 Appendix P
Heat pump pool heaters	All	10°C db 5.55°C wb Outdoor air 26.7°C entering water	4.0 COP	AHRI 1160 10 CFR 430 Appendix P
Unfired storage tanks	All		R-2.2	(none)

^a Thermal efficiency (E_t) is a minimum requirement, while standby loss (SL) is a maximum Btu/h based on a 38.9°C temperature difference between stored water and ambient requirements. In the SL standby loss equations, V is the rated volume in gallons/Liters and Q is the nameplate input rate in Btu/kW. 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 kW and denoted by the term "SL". V_m is the measured volume in the tank in gallons/Liters. 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/Liters.

^b Section 12 contains a complete specification, including the year version, of the referenced test procedure.

^c Electric instantaneous water heaters with input capacity >12 kW and ≤58.6 kW must comply with the requirements if the water heater for the >56 kW either (1) has a storage volume >7.6 L; (2) is designed to provide outlet hot water at temperatures greater than 480 °F/82 °C; or (3) uses 3-phase power.

^d Gas storage water heaters with input capacity >22 kW Btu/h and ≤31 kW must comply with the requirements for the >30.7 kW, if the water heater either (1) has a storage volume >454 L; (2) is designed to provide outlet hot water at temperatures greater than 82 °C; or (3) uses 3-phase power

^e Oil storage water heaters with input capacity >31 kW Btu/h and ≤41 kW must comply with these the requirements for the > 41 kW if the water heater either (1) has a storage volume >454 L; (2) is designed to provide outlet hot water at temperatures greater than 82 °C; or (3) uses 3-phase power

^f Refer to Section 7.5.3 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.

^g In the U.S., the efficiency requirements for water heaters or gas pool heaters in this category or subcategory are specified by the U.S. Department of Energy. Those requirements and applicable test procedures are found in the Code of Federal Regulations 10 CFR Part 430 Water heaters or gas pool heaters in this category or subcategory are regulated as consumer products by the US Department of Energy defined in 10 CFR 430.

^h Where this standard is being applied to a building outside the United States and Canada and water heaters in this subcategory are being installed in that building, those water heaters shall meet the local efficiency requirements. If there are no local efficiency standards for residential water heaters, consideration should be given to using the U.S. DOE efficiency requirements shown in Table F-2 of Appendix F.

Informative Note: See Informative Appendix F for the U.S. Department of Energy efficiency requirements applicable to these water heaters and pool heaters for US applications.

Make the following changes to the first public review SI table F-2

Table F-2 Minimum Energy Efficiency Requirements for Water Heaters and Pool Heaters

Source: 10 CFR Part 430, *Energy Conservation Program: Energy Conservation Standards for Water Heating Pumps Heaters*)

Product Class	Rated Storage Volume and input rating (if applicable)	Draw Pattern	Uniform Energy Factor (UEF) or Thermal Efficiency (E _t)	Test Procedure
Gas-fired storage water heater	≥75.7 L and ≤208 L	Very Small	$UEF = 0.3456 - (0.007605 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.5982 - (0.007205 \times V_r)$	
		Medium	$UEF = 0.6483 - (0.006404 \times V_r)$	
		High	$UEF = 0.6920 - (0.004903 \times V_r)$	
	>208 L and ≤378 L	Very Small	$UEF = 0.6470 - (0.002302 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.7689 - (0.004901 \times V_r)$	
		Medium	$UEF = 0.7897 - (0.004501 \times V_r)$	
		High	$UEF = 0.8072 - (0.004401 \times V_r)$	
Oil-fired storage water heater	≤189 L	Very Small	$UEF = 0.2509 - (0.004503 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.5330 - (0.006404 \times V_r)$	
		Medium	$UEF = 0.6078 - (0.006404 \times V_r)$	
		High	$UEF = 0.6815 - (0.005304 \times V_r)$	
Electric Storage Water Heaters	≥75.7 L and ≤208 L	Very Small	$UEF = 0.8808 - (0.003902 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.9254 - (0.004401 \times V_r)$	
		Medium	$UEF = 0.9307 - (0.009801 \times V_r)$	
		High	$UEF = 0.9349 - (0.009403 \times V_r)$	
	>75.7 L and ≤378 L	Very Small	$UEF = 1.9236 - (0.0044 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 2.0440 - (0.00410 \times V_r)$	
		Medium	$UEF = 2.1171 - (0.0030 \times V_r)$	
		High	$UEF = 2.2418 - (0.00450 \times V_r)$	
Tabletop Water heater	≥75.7 L and ≤454 L	Very Small	$UEF = 0.6323 - (0.0015 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.9188 - (0.0008 \times V_r)$	
		Medium	$UEF = 0.9577 - (0.0006 \times V_r)$	
		High	$UEF = 0.9884 - (0.0004 \times V_r)$	
Instantaneous Gas Fired water heater	<7.57 L and >14.6 kW	Very low	$UEF = 0.80$	10 CFR 430 Appendix E
		Low	$UEF = 0.81$	
		Medium	$UEF = 0.81$	
		High	$UEF = 0.81$	
Instantaneous Electric water heater	<7.57 L	Very low	$UEF = 0.91$	10 CFR 430 Appendix E
		Low	$UEF = 0.91$	
		Medium	$UEF = 0.91$	
		High	$UEF = 0.92$	
Grid Enabled Water Heaters	>284 L	Very low	$UEF = 1.0136 - (0.002807 \times V_r)$	10 CFR 430 Appendix E
		Low	$UEF = 0.9984 - (0.004404 \times V_r)$	
		Medium	$UEF = 0.9853 - (0.004903 \times V_r)$	
		High	$UEF = 0.9720 - (0.00072 \times V_r)$	
Pool heater Gas			82% E _t	10 CFR 430 Appendix P

^a V_r is the Rated Storage Volume (in L), as determined pursuant to 10 CFR 429.17.

^b Standards for electric storage water heaters apply to both electric resistance water heaters and heat pump water heaters.