Submit a comment

Proposed Change 2011

Code Reference(s):	**NBC20 Div.B 9.36.4.2. (first printing)** **NBC20 Div.B 9.36.8.10. (first printing)** **NECB20 Div.B 6.2.2.1. (first printing)**
Subject:	Service Water Heating Equipment Efficiency Table
Title:	Updated Performance Metric for Heat Pump Water Heaters
Description:	This proposed change updates the metric used to state the performance requirements for heat pump water heaters by replacing the energy factor (EF) metric with the uniform energy factor (UEF) metric.

This change could potentially affect the following topic areas:

- ☐ Division A
- ☐ Division C
- ☐ Building operations
- ☑ Small Buildings
- ☐ Fire Protection
- ☐ Accessibility
- ☐ Building Envelope
- ☐ Heating, Ventilating and Air Conditioning
- ☑ Division B
- ☑ Design and Construction
- ☑ Housing
- ☑ Large Buildings
- ☐ Occupant safety in use
- ☐ Structural Requirements
- ☑ Energy Efficiency
- ☐ Plumbing
- ☐ Construction and Demolition Sites

Problem

PCF 1804, "Updates to Referenced Documents," proposes to update CAN/CSA-C745, "Energy efficiency of electric storage tank water heaters and heat pump water heaters," to the 2020 edition. The new edition of the CSA standard lists the heat pump water heater performance requirements using the uniform energy factor (UEF) metric instead of the energy factor (EF) metric. Tables 9.36.4.2. and 9.36.8.10. of Division B of the National Building Code of Canada (NBC) and Table 6.2.2.1. of Division B of the National Energy Code of Canada for Buildings (NECB) both state the minimum service water heating equipment performance requirements for heat pump water heaters using the EF metric, and they should be updated to state the minimum performance requirements for this equipment using the UEF metric instead.

Failure to use the UEF metric when stating heat pump water heater performance requirements in the NECB and NBC would create issues for Code users and regulators when evaluating equipment performance and conformance with the Codes.

Justification

Stating the heat pump water heater performance requirements in the Codes using the same metric (i.e., UEF) as the referenced standard (i.e., CAN/CSA-C745) would facilitate conformance with the Code requirements.

This proposed change would make Code compliance easier, as the Codes would state the minimum performance requirements using the same metric as the labels on the equipment.

PROPOSED CHANGE

NBC20 Div.B 9.36.4.2. (first printing)

[9.36.4.2.] 9.36.4.2. Equipment Efficiency

[1] 1) *Service water heaters*, *boilers*, pool heaters and storage tanks shall comply with the performance requirements stated in Table 9.36.4.2. (See Note A-9.36.4.2.(1).)

[2] 2) Hot service water storage tanks not listed in Table 9.36.4.2. shall be covered with insulation having a minimum thermal resistance of 1.8 (m^2×K)/W.

Table [9.36.4.2.] 9.36.4.2.
Service Water Heating Equipment Performance Requirements
Forming Part of Sentences [9.36.4.2.] 9.36.4.2.([1] 1) and ([2] 2)

Type of Equipment	Input (1)	Performance Testing Standard	Performance Requirement (2)
Storage-Type Service Water Heaters			
Electric	≤ 12 kW (V_r > 50 L but ≤ 270 L)	CAN/CSA-C191	SL ≤ 35 + (0.20 V_r) (top inlet)
			SL ≤ 40 + (0.20 V_r) (bottom inlet)
	≤ 12 kW (V_r > 270 L but ≤ 454 L)		SL ≤ (0.472 V_r) – 38.5 (top inlet)
			SL ≤ (0.472 V_r) – 33.5 (bottom inlet)

Type of Equipment	Input (1)	Performance Testing Standard	Performance Requirement (2)
	>12 kW	ANSI Z21.10.3/CSA 4.3 or DOE 10 CFR, Part 431, Subpart G, Appendix B	SL ≤ 0.30 +(102.2 V_s)
Heat pump water heaters	≤ 24 A and ≤ 250 V	CAN/CSA-C745	~~EF ≥ 2.1~~UEF ≥ 2.23
Gas-fired (3)	≤ 22 kW and first-hour rating < 68 L	CAN/CSA-P.3	UEF ≥ 0.3456 – (0.00053 V_s) (4)
	≤ 22 kW and first-hour rating ≥ 68 L but < 193 L		UEF ≥ 0.5982 – (0.00050 V_s) (4)
	≤ 22 kW and first-hour rating ≥ 193 L but < 284 L		UEF ≥ 0.6483 – (0.00045 V_s) (4)
	≤ 22 kW and first-hour rating ≥ 284 L		UEF ≥ 0.6920 – (0.00034 V_s) (4)
	> 22 kW but ≤ 30.5 kW and V_r ≤ 454 L		UEF ≥ 0.8107 – (0.00021 V_s) (4)
	> 22 kW	DOE 10 CFR, Part 431, Subpart G, Appendix A	E_t ≥ 90% and SL ≤ 0.84 [(1.25 Q) + (16.57 √V_r)]
Oil-fired	≤ 30.5 kW and first-hour rating < 68 L	CAN/CSA-B211 for EF or CAN/CSA-P.3 for UEF	EF ≥ 0.68 – (0.0005 V_r) or UEF ≥ 0.2509 – (0.00032 V_s)
	≤ 30.5 kW and first-hour rating ≥ 68 L but < 193 L		EF ≥ 0.68 – (0.0005 V_r) or UEF ≥ 0.5330 – (0.00042 V_s)
	≤ 30.5 kW and first-hour rating ≥ 193 L but < 284 L		EF ≥ 0.68 – (0.0005 V_r) or UEF ≥ 0.6078 – (0.00042 V_s)
	≤ 30.5 kW and first-hour rating ≥ 284 L		EF ≥ 0.68 – (0.0005 V_r) or UEF ≥ 0.6815 – (0.00037 V_s)

Type of Equipment	Input (1)	Performance Testing Standard	Performance Requirement (2)
	> 30.5 kW but ≤ 40.99 kW and V_r ≤ 454 L		UEF ≥ 0.6740 – (0.00035 V_s)
	> 40.99 kW	DOE 10 CFR, Part 431, Subpart G, Appendix A	E_t ≥ 80% and SL ≤ (1.25 Q) + (16.57 $\sqrt{V_r}$)
Tankless Service Water Heaters			
Gas-fired	< 58.56 kW, V_r ≤ 7.6 L and max. flow rate < 6.4 L/min	CAN/CSA-P.3	UEF ≥ 0.86
	< 58.56 kW, V_r ≤ 7.6 L and max. flow rate ≥ 6.4 L/min		UEF ≥ 0.87
	≥ 58.56 kW, V_r ≤ 37.85 L and input rate to V_r ratio ≥ 309 W/L	DOE 10 CFR, Part 431, Subpart G, Appendix C	E_t ≥ 94%
Oil-fired	≤ 61.5 kW (5)	DOE 10 CFR, Part 430, Subpart B, Appendix E	EF ≥ 0.59 – (0.0005 V_r)
	Other	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	E_t ≥ 80%
Electric	—	—	(6)
Combined space- and water-heating systems (combos)	≤ 87.9 kW if *boiler*-based	CAN/CSA-P.9	TPF = 0.80
	≤ 73.2 kW if based on *service water heater*		
Integrated mechanical systems	—	CSA P.10	OTPF = 0.85
Pool Heaters			
Gas-fired (3)	< 117.2 kW	ANSI Z21.56/CSA 4.7 or CSA P.6	E_t ≥ 82%
Oil-fired	—	CSA B140.12	E_t ≥ 78%

Notes to Table [9.36.4.2.] 9.36.4.2.:

(1) 1 kW = 3412 Btu/h

(2) The symbols and abbreviations used in this column have the following meanings:

EF	= energy factor
E_t	= thermal efficiency with a 38.9°C (70°F) water temperature difference
OTPF	= overall thermal performance factor
Q	= nameplate input rate, in kW
SL	= standby loss, in W
TPF	= thermal performance factor
UEF	= uniform energy factor
V_r	= rated nominal storage volume, in L
Vs	= measured storage volume, in L

(3) Includes propane.

(4) Industry and regulators are transitioning from using EF to UEF as the metric to evaluate *service water heater* performance. While this Code sets out performance requirements for gas-fired *storage-type service water heaters* within the scope of CAN/CSA-P.3 in terms of UEF, the "Energy Efficiency Regulations" set out performance standards for such *service water heaters* in terms of both EF and UEF.

(5) Consistent with the U.S. Congress "National Appliance Energy Conservation Act of 1987".

(6) No standard addresses the performance efficiency of electric tankless *service water heaters*; however, their efficiency typically approaches 100%.

[3] 3) Except for components that are required to be installed outdoors, service water heating equipment shall be installed in a *conditioned space*. (See Note A-9.36.4.2.(3).)

NBC20 Div.B 9.36.8.10. (first printing)

[9.36.8.10.] 9.36.8.10. Energy Conservation Measures for Service Water Heating Equipment

[1] 1) Service water heating equipment and components shall be designed and constructed in accordance with Subsection 9.36.4. and this Article.

[2] 2) Where service water heating equipment or techniques other than those described in Subsection 9.36.4. and this Article are used, the *building* shall be designed and constructed in accordance with the NECB.

[3] 3) Service water heating equipment that complies with one of the energy

conservation measures prescribed in Table 9.36.8.10. shall be credited with the corresponding energy conservation points stipulated therein.

Table [9.36.8.10.] 9.36.8.10.
Energy Conservation Measures and Points for Service Water Heating Equipment
Forming Part of Sentence [9.36.8.10.] 9.36.8.10.([3] 3)

Type of Equipment	**Energy Conservation Measures for Service Water Heating Equipment – Energy Efficiency, EF or UEF (1) (2)**	**Performance Testing Standard**	**Heating Degree-Days of *Building* Location, in Celsius Degree-Days**					
			Zone 4 < 3000	**Zone 5 3000 to 3999**	**Zone 6 4000 to 4999**	**Zone 7A 5000 to 5999**	**Zone 7B 6000 to 6999**	**Zone 8 ≥ 7000**
			Energy Conservation Points					
Gas- or oil-fired tankless condensing water heater	EF ≥ 0.95 or UEF ≥ 0.92	CAN/CSA-P.3	8.9	5.4	4.9	3.1	3.1	3.1
Gas- or oil-fired residential *storage-type service water heater*	EF ≥ 0.80 or UEF ≥ 0.83		8.9	5.4	4.9	3.1	3.1	3.1

Type of Equipment	Energy Conservation Measures for Service Water Heating Equipment – Energy Efficiency, EF or UEF (1) (2)	Performance Testing Standard	Heating Degree-Days of *Building* Location, in Celsius Degree-Days					
			Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
			Energy Conservation Points					
Gas- or oil-fired residential-duty commercial *storage-type service water heater*	UEF ≥ 0.79		4.6	2.7	2.4	1.5	1.5	1.5
	UEF ≥ 0.85		6.0	3.6	3.2	2.0	2.0	2.0
Heat pump water heater	~~EF ≥ 2.35~~UEF ≥ 2.44	CAN/CSA-C745	6.4	3.9	3.8	3.0	3.0	3.0

Notes to Table [9.36.8.10.] 9.36.8.10.:

(1) EF = energy factor
UEF = uniform energy factor

(2) Applies to *storage-type service water heaters* that heat potable water, including *storage-type service water heaters* used to generate heat in combined space- and water-heating systems.

NECB20 Div.B 6.2.2.1. (first printing)

[6.2.2.1.] 6.2.2.1. Equipment Efficiency

[1] 1) *Service water* heaters and pool heaters with the capacities listed in Table 6.2.2.1. shall comply with the performance requirements stated therein. (See Notes A-6.2.2.1.(1) and A-5.2.12.1.(1) and 6.2.2.1.(1).)

Table [6.2.2.1.] 6.2.2.1.
Service Water Heating Equipment Performance Requirements
Forming Part of Sentences 5.2.12.4.(1), [6.2.2.1.] 6.2.2.1.([1] 1), 6.2.2.4.(2) and 6.2.2.5.(1)

Type of Equipment	Input Power	Rated Storage Capacity (V_r), L	Volume of Tank (V_s), L	Input/V_s, W/L	Performance Testing Standard	Rating Conditions (1)	Performance Requirement (2) (3)
Electric-Powered *Service Water* Heaters							
Storage-type (4)	≤ 12 kW	≥ 50 and ≤ 270	—	—	CAN/CSA-C191	Bottom inlet	SL ≤ 40 + (0.2 V_r)
						Top inlet	SL ≤ 35 + (0.2 V_r)
		> 270 and ≤ 454				Bottom inlet	SL ≤ (0.472 V_r) – 33.5
						Top inlet	SL ≤ (0.472 V_r) – 38.5
	> 12 kW	—	—	—	ANSI Z21.10.3/CSA 4.3 (5) or DOE 10 CFR, Part 431, Subpart G, Appendix B	ΔT = 44.4°C	SL ≤ 0.3 + 102.2/V_r
Storage-type, heat pump	≤ 24 A and ≤ 250 V	—	—	—	CAN/CSA-C745	—	~~EF ≥ 2.1~~UEF ≥ 2.23
Instantaneous	—	—	—	—	—	—	(6)
Fuel-Fired *Service Water* Heaters							

Type of Equipment	Input Power	Rated Storage Capacity (V_r), L	Volume of Tank (V_s), L	Input/V_s, W/L	Performance Testing Standard	Rating Conditions (1)	Performance Requirement (2) (3)
Gas-fired, storage-type (4) (7)	≤ 22 kW	—	≥ 76 and < 208	—	CAN/CSA-P.3	FHR < 68	UEF ≥ 0.3456 – (0.00053 V_s)
						68 ≤ FHR < 193	UEF ≥ 0.5982 – (0.00050 V_s)
						193 ≤ FHR < 284	UEF ≥ 0.6483 – (0.00045 V_s)
						FHR ≥ 284	UEF ≥ 0.6920 – (0.00034 V_s)
			≥ 208 and < 380			FHR < 68	UEF ≥ 0.6470 – (0.00016 V_s)
						68 ≤ FHR < 193	UEF ≥ 0.7689 – (0.00013 V_s)
						193 ≤ FHR < 284	UEF ≥ 0.7897 – (0.00011 V_s)
						FHR ≥ 284	UEF ≥ 0.8072 – (0.00008 V_s)
	> 22 kW and ≤ 30.5 kW	≤ 454	—	—	CAN/CSA-P.3	All values of FHR	UEF ≥ 0.8107 – (0.00021 V_s)
	All others	—	—	—	DOE 10 CFR, Part 431, Subpart G, Appendix A	ΔT = 50°C	E_t ≥ 90% SL ≤ 0.84 [(1.25 Q) + (16.57 √V_r)]

Type of Equipment	Input Power	Rated Storage Capacity (V_r), L	Volume of Tank (V_s), L	Input/V_s, W/L	Performance Testing Standard	Rating Conditions (1)	Performance Requirement (2) (3)
Gas-fired, instantaneous (4) (7) (8)	< 59 kW	≤ 7.6	—	≥ 310	CAN/CSA-P.3	< 6.4 L/min	UEF ≥ 0.86
						≥ 6.4 L/min	UEF ≥ 0.87
	All others	—			DOE 10 CFR, Part 431, Subpart G, Appendix C	—	E_t ≥ 94%
Oil-fired, storage-type (4)	≤ 30.5 kW	> 76	—	—	CAN/CSA-B211	—	EF ≥ 0.68 – (0.0005 V_r)
					CAN/CSA-P.3	FHR < 68	UEF ≥ 0.2509 – (0.00032 V_s)
						68 ≤ FHR < 193	UEF ≥ 0.5330 – (0.00042 V_s)
						193 ≤ FHR < 284	UEF ≥ 0.6078 – (0.00042 V_s)
						FHR ≥ 284	UEF ≥ 0.6815 – (0.00037 V_s)
	> 30.5 kW and ≤ 41 kW	≤ 454	—	< 310	CAN/CSA-P.3	All values of FHR	UEF ≥ 0.6740 – (0.00035 V_s)
	All others	—	—	—	DOE 10 CFR, Part 431, Subpart G, Appendix A	—	E_t ≥ 80% SL ≤ (1.25 Q) + (16.57 $\sqrt{V_r}$)

Type of Equipment	Input Power	Rated Storage Capacity (V_r), L	Volume of Tank (V_s), L	Input/V_s, W/L	Performance Testing Standard	Rating Conditions (1)	Performance Requirement (2) (3)
Oil-fired, instantaneous (4)	≤ 61.5 kW	—	—	—	DOE 10 CFR, Part 430, Subpart B, Appendix E	—	EF ≥ 0.59 – (0.0005 V_r)
	All others	—	< 37.8	≥ 310	DOE 10 CFR, Part 431, Subpart G, Appendix A	—	E_t ≥ 80%
			≥ 37.8			ΔT = 50°C	E_t ≥ 78% SL ≤ (1.25 Q) + (16.57 √V_r)
Solar Thermal *Service Water* Heaters							
With electric back-up	All capacities	—	—	—	ICC 900/SRCC 300	See standard	SEF ≥ 1.4
With gas-fired back-up (7)							SEF ≥ 0.9
Pool Heaters							
Gas-fired (7)	< 117.2 kW	—	—	—	ANSI Z21.56/CSA 4.7 or CSA P.6	See standard	E_t ≥ 82%
Oil-fired	—				CSA B140.12		E_t ≥ 78%
Heat pump	All values	—	—	—	AHRI 1160 (I-P)	Outdoor air 10°C db / 6.8°C wb 26.7°C entering water	4.0 COP

Notes to Table [6.2.2.1.] 6.2.2.1.:

(1) The symbols and abbreviations used in this column have the following meanings:

db	= dry-bulb outdoor air temperature
FHR	= first-hour rating: the amount of hot service water supplied within the first hour, in L
ΔT	= difference in temperature of water from inlet versus water from outlet of water heater
wb	= wet-bulb outdoor air temperature

(2) The symbols and abbreviations used in this column have the following meanings:

COP	= *coefficient of performance*
E_t	= *thermal efficiency* with a 38.9°C (70°F) water temperature difference
EF	= *energy factor*
Q	= rated input, in kW
SEF	= solar *energy factor*: a normalized ratio of energy output over energy consumption (only electricity or fuel input) over a 24-h period
SL	= *standby losses*, in %/h or in W, depending on which testing standard is used
UEF	= uniform *energy factor*
V_r	= rated volume, as specified by the manufacturer
V_s	= volume of tank, as measured in accordance with the listed test standard, in L

(3) Where more than one performance requirement applies to a given type/capacity/size combination, the equipment must comply with at least one of them.

(4) Components or equipment regulated in the "Energy Efficiency Regulations" at the time of publication of the Code (see Article 1.1.1.3. of Division A).

(5) When testing an electric *storage-type service water heater* for *standby losses* using the test procedure described in the referenced standard, the electrical supply voltage shall be maintained within ±1% of the centre of the voltage range specified on the water heater nameplate. Also, when needed for calculations, the *thermal efficiency* (E_t) shall be 98%.

(6) No standards address the performance efficiency of electric instantaneous *service water* heaters; however, their efficiency typically approaches 100%.

(7) Includes propane.

(8) See also Article 6.2.2.3.

Impact analysis

This proposed change is not expected to result in additional costs for Code users, who would benefit from the Codes using the same performance metric as the referenced document.

Enforcement implications

This proposed change could be enforced by the existing Code enforcement infrastructure without requiring additional resources. This proposed change would make enforcement easier, as the two Codes would state the minimum performance requirements using the same performance metric as the labels on the equipment.

Who is affected

Designers, engineers, architects, manufacturers, builders, specification writers and building officials.

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

NBC20 Div.B 9.36.4.2. (first printing)

[9.36.4.2.] 9.36.4.2. ([1] 1) [F96,F98-OE1.1]

[9.36.4.2.] 9.36.4.2. ([2] 2) [F93,F96-OE1.1]

[9.36.4.2.] 9.36.4.2. ([3] 3) [F98-OE1.1]

NBC20 Div.B 9.36.8.10. (first printing)

[9.36.8.10.] 9.36.8.10. ([1] 1) no attributions

[9.36.8.10.] 9.36.8.10. ([2] 2) no attributions

[9.36.8.10.] 9.36.8.10. ([3] 3) [F96-OE1.1]

NECB20 Div.B 6.2.2.1. (first printing)

[6.2.2.1.] 6.2.2.1. ([1] 1) [F96,F98-OE1.1]