CHAPTER

4 WATER RATING CALCULATION PROCEDURES

SECTION 401—WATER RATING INDEX

401.1 Determining the water rating index. The *water rating index* shall be determined in accordance with Sections 401.2 through 401.6. The *reference home* shall be configured in accordance with Sections 401.3 and 401.4. The *rated home* shall be configured in accordance with Sections 401.5 and 401.6. The number of *bedrooms* in the *rated home* shall be not less than one.

401.2 Calculating the water rating index. A *water rating index* shall be calculated in accordance with Equation 4-1.

Equation 4-1
$$WRI = \frac{\text{indoor and outdoor daily water use for the rated home}}{\text{indoor and outdoor daily water use for the referenced home}} \times 100$$

401.3 Determining daily indoor water use for the reference home. The indoor daily water use for the *reference home* shall be calculated in accordance with Equation 4-2.

Equation 4-2
$$refIN_{gpd} = refF_{gpd} + refW_{gpd} + refDW_{gpd} + refCW_{gpd} + refT_{gpd} + refSof_{gpd} + refOther$$

where:

$refIN_{gpd}$ = Indoor daily water use.

$refF_{gpd}$ = Daily fixture water use.

$refW_{gpd}$ = Daily wasted water use by hot water distribution systems.

$refDW_{gpd}$ = Daily dishwasher water use.

$refCW_{gpd}$ = Daily clothes washer water use.

$refT_{gpd}$ = Daily toilet water use.

$refSof_{gpd}$ = Daily water softener water use.

refOther = Daily total other or unidentified water use.

401.3.1 Determining daily fixture water use for the reference home. The daily fixture water use for the reference home shall be calculated in accordance with Equation 4-3.

Equation 4-3
$$refF_{gpd} = 14.6 + 10 \times Nbr$$

where:

$refF_{gpd}$ = Daily fixture water use.

Nbr = Number of *bedrooms* in the *rated home*.

401.3.2 Determining daily hot water waste for the reference home. The hot water waste for the *reference home* shall be calculated in accordance with Equation 4-4.

Equation 4-4
$$refW_{gpd} = 9.8 \times Nbr^{0.43}$$

where:

$refW_{gpd}$ = Daily wasted water use by hot water distribution systems.

Nbr = Number of bedrooms in the rated home.

401.3.3 Determining daily dishwasher water use for the reference home. The dishwasher water use for the *reference home* shall be calculated in accordance with Equation 4-5.

Equation 4-5
$$refDW_{gpd} = \frac{(88.4 + 34.9 \times Nbr) \times 8.16}{365} = 1.97 + 0.7802 \times Nbr$$

where:

$refDW_{gpd}$ = Daily dishwasher water use.

Nbr = Number of *bedrooms*.

(88.4 + 34.9 × *Nbr*) = Best fit regression equation for dishwasher cycles per year using data from the 2005 Residential Energy Consumption Survey.

8.16 = Gallons per cycle from the DOE Technical Support Document from the NAECA standard in effect in 2006.

401.3.4 Determining daily clothes washer water use for the reference home. The daily clothes washer water use for the *reference home* shall be calculated in accordance with Equation 4-6.

Equation 4-6 $$refCW_{gpd} = \frac{3.0 \times 11.4 \times ACY}{365}$$

where:

$refCW_{gpd}$ = Daily clothes washer water use.

3.0 = Reference washer capacity (CAPw) (in cubic feet).

11.4 = Reference integrated water factor (IWF) in (gallons per cycle, per cubic foot).

ACY = Adjusted cycles per year = (164 + 46.5 × *Nbr*)

Nbr = Number of *bedrooms*.

401.3.5 Determining daily toilet water use for the reference home. The daily toilet water use for the reference home shall be calculated in accordance with Equation 4-7.

Equation 4-7 $refT_{gpd} = refFPO \times refGPF \times Occ$

where:

$refT_{gpd}$ = Daily toilet water use.

refFPO = Flushes per person per day = 5.05.

refGPF = Gallons per flush for toilets = 1.6.

Occ = Number of occupants:

Occupants of a *dwelling* or *townhouse* = 1.09 + 0.54 × *Nbr*

Occupants of other than a *dwelling* or *townhouse* = 1.49 + 0.45 × *Nbr*

Nbr = Number of *bedrooms*.

401.3.6 Determining daily water softener use for the reference home. Where the *rated home* has a water softener and the water hardness at the *rated home's* location is greater than or equal to 180 ppm (180 mg/L), the daily water softener water use for the *reference home* shall be calculated in accordance with Equation 4-8. Where the *rated home* does not meet these conditions, the daily water softener water use shall equal zero.

Equation 4-8 $$refSof_{gpd} = \frac{\text{grains of hardness}}{\text{gallon of water}} \times \text{sum of indoor water uses in the reference home} \times \frac{5 \text{ gallons used}}{1{,}000 \text{ grains removed}}$$

where:

$refSof_{gpd}$ = Daily water softener water use.

401.3.7 Determining daily other water use for the reference home. The other daily water use for the *reference home* shall be determined in accordance with Equation 4-9.

Equation 4-9 $refOther = 5.93 \times Nbr$

where:

r*efOther* = Daily total other or unidentified water use.

Nbr = Number of *bedrooms* in the *rated home*.

401.4 Determining outdoor water use for the reference home. The annual *outdoor water use* (in thousands of gallons per year) for the *reference home* shall be calculated using Equation 4-10 or 4-11.

If the *rated home* has a *netET* of less than 12 inches per year (305 mm/year) OR the *rated home* has an *automatic irrigation system,* use Equation 4-10.

Equation 4-10 $$\left[\frac{exp(A)}{1 + exp(A)}\right] \times 1.18086 \times [2.0341 \times netET^{0.7154} \times Ref_{Irr\_Area}{}^{0.6227}] + pool_{use}$$

If the *rated home* has a *netET* of greater than 12 inches per year (305 mm/year) AND the *rated home* does NOT have an *automatic irrigation system*, use Equation 4-11.

Equation 4-11 $$\left[\frac{exp(B)}{1 + exp(B)}\right] \times 1.22257 \times [1.4223 + 0.6311 \times netET + 0.9376 \times Ref_{Irr\_Area}] + pool_{use}$$

IF

$$Rat_{Irr\_Area} < Ref_{Irr\_Area}$$

THEN

Equation 4-12 $Ref_{Out} = \text{Equation 4-10 or 4-11} \diagup \frac{\text{Equation 4-10(using } Rat_{Irr\_Area} \text{ and } ind_{Pool} = 0)}{\text{Equation 4-10(with } Ref_{Irr\_Area} \text{ and } ind_{Pool} = 0)}$

AND

The annual *outdoor water use* for the *reference home* shall never be lower than the result of Equation 4-11.

The *outdoor water use* for the *reference home* shall never be greater than the result of Equation 4-13.

Equation 4-13 $\left[\frac{exp(A)}{1 + exp(A)}\right] \times 1.18086 \times [2.0341 \times netET^{0.7154} \times Ref_{Irr\_Area}{}^{0.6227}] + pool_{use}$

where:

Ref_{Out} = Annual *outdoor water use* for the *reference home*.

exp(A) = Exponent of [1.4416 + 0.5069 × (Ref_{Irr_Area}/1,000)].

exp(B) = Exponent of [0.6911 + 0.00301 × *netET* × (Ref_{Irr_Area}/1,000)].

Ref_{Irr_Area} = The size of the *irrigated area* in the *reference home*, calculated in accordance with Section 401.4.2.

Rat_{Irr_Area} = The size of the *irrigated area* in the *rated home*.

netET = The annual historic sum of mean reference evapotranspiration minus the mean precipitation for all months that evapotranspiration exceeds precipitation.

ind_{Pool} = Indicator representing the presence or absence of a swimming pool in the *rated home*.

$pool_{use}$ = Calculated in accordance with Section 401.6 as Equation 4-28 (using ind_{Pool} = 1) minus Equation 4-28 (using ind_{Pool} = 0).

401.4.1 Determining outdoor daily water use for the reference home. Daily *outdoor water use* for the *reference home* shall be determined by multiplying the result of either Equation 4-10 or Equation 4-11, as appropriate, by 1,000 and dividing the product by 365. Where the *rated home* is not a *dwelling* or *townhouse*, the outdoor daily water use shall be allocated equally to each *dwelling unit*.

401.4.2 Determining irrigated area for the reference home. The *irrigated area* for the *reference home* shall be calculated in accordance with Equation 4-13 or 4-14.

Where the *rated home* is a *dwelling* or *townhouse* and the *lot size* of the *rated home* is less than 7,000 square feet (650 m^2), the *irrigated area* of the *reference home* shall be calculated in accordance with Equation 4-14.

Equation 4-14 $Ref_{Irr\_Area} = Lot_{Area} \times (0.002479 \times Lot_{Area}{}^{0.6157})$

Where the *rated home* is a *dwelling* or *townhouse* and the *lot size* of the *rated home* is greater than or equal to 7,000 square feet (650 m^2), the *irrigated area* of the *reference home* shall be calculated in accordance with Equation 4-15.

Equation 4-15 $Ref_{Irr\_Area} = Lot_{Area} \times 0.577$

where:

Ref_{Irr_Area} = The size of the landscape that receives supplemental water in the *reference home*.

Lot_{Area} = The size of the lot on which the *rated home* is being constructed.

Where the *rated home* is not a *dwelling* or *townhouse*, the *irrigated area* for the *reference home* shall be the same as the *irrigated area* for the *rated home*.

401.5 Determining daily indoor water use for the rated home. The daily indoor water use for the *rated home* shall be calculated in accordance with Equation 4-16.

Equation 4-16

$$Indoor_{gpd} = Shower_{gpd} + KitchF_{gpd} + LavF_{gpd} + Waste_{gpd} + CW_{gpd} + DW_{gpd} + Toilets_{gpd} + Soft_{gpd} + Other_{gpd} + EP_{gpd}$$

where:

$Indoor_{gpd}$ = Daily indoor water use.

$Shower_{gpd}$ = Daily shower water use.

$KitchF_{gpd}$ = Daily kitchen faucet water use.

$LavF_{gpd}$ = Daily lavatory faucet water use.