Appendix X – Adjustments to Primary Ventilation Fan Flow Rate, including Infiltration Credit and ASHRAE Standard 62.2-2010, Appendix A (calculation for alternative compliance for existing homes using a single fan)

Calculation of the Infiltration Credit:

The infiltration credit that can be used to reduce the required installed fan flow requires a series of calculations. These calculations can be reduced to a few inputs using certain assumptions. This section provides this reduced equation for infiltration and shows how to use this to determine the credit for infiltration. For a more detailed step-by-step discussion see the end of this appendix.

1) The infiltration rate at operating conditions, measured in CFM, can be estimated as

$$I_{CFM} = 0.0508 * w * S * Q_{50}$$

In this equation:

S is a factor accounting for the height of the building, determined from Table X-1
Q_{50} is the blower door test result in CFM50 (cubic feet per minute at 50 Pa)
w is the weather factor from ASHRAE Standard 136

Table X-1. S factors for various building heights

Number of stories	1	1.5	2	2.5	3
S	1	1.13	1.23	1.32	1.39

2) The default infiltration rate I_d from ASHRAE Standard 62.2, measured in CFM, is

$$I_d = 0.02 * A_{floor}$$

3) If I_{CFM} is greater than I_d, then the infiltration credit I_{cred} can be calculated as

$$I_{cred} = \frac{1}{2}\left(I_{CFM} - I_d\right)$$

Use of ASHRAE Standard 62.2-2010, Appendix A

ASHRAE Standard 62.2-2010, includes an appendix that details an alternative compliance method intended for existing homes that did not meet the ASHRAE 62.2 local exhaust requirements when built. The strategy is to evaluate how much local exhaust deficit there is in each room that should have local exhaust, based on intermittent fan requirements, and increase the continuous primary fan flow rate to account for this deficit. This section provides guidance on how to determine the increase to the primary fan flow rate to comply with ASHRAE 62.2-2010.

Per ASHRAE 62.2-2010

- each bathroom should have a 50 CFM fan if used intermittently
- each kitchen should have a 100 CFM fan if used intermittently

For each of these rooms that does not meet these requirements

1. Calculate the deficit – if there is a fan that exhausts to outside but it does not have the required flow, the deficit is only the difference between the required flow and the measured flow
2. Reduce the deficit by 20 CFM for each of these rooms that has an operable window.
3. Sum up all of the individual deficits
4. Divide by 4
5. Add the result to the required primary fan flow rate

<u>Example #1:</u>

- Kitchen has no exhaust to outside but an operable window
- Bathroom #1 has no exhaust but an operable window
- Bathroom #2 has a fan that moves only 32 CFM

Deficit for kitchen is 100-20 = 80 CFM (20 CFM credit for operable window)
Deficit for bathroom #1 is 50-20 = 30 CFM (20 CFM credit for operable window)
Deficit for bathroom #2 is 50-32 = 18 CFM

Sum of deficits is 80+30+18 CFM = 128 CFM

Increase required primary fan flow rate by 128/4 = 32 CFM

<u>Example #2:</u>

- Kitchen has a fan to outside that moves only 60 CFM and an operable window
- Bathroom #1 has a fan that moves only 20 CFM
- Bathroom #2 has a fan that moves only 32 CFM

Deficit for kitchen is 100-60-20 = 20 CFM (20 CFM credit for operable window)
Deficit for bathroom #1 is 50-20 = 30 CFM
Deficit for bathroom #2 is 50-32 = 18 CFM

Sum of deficits is 20+30+18 CFM = 68 CFM

Increase required primary fan flow rate by 68/4 = 17 CFM

Detailed Step-by-Step Process for Determining Infiltration Credit

The infiltration credit using only a blower door result, three house characteristics (floor area, volume, number of above-grade stories), and a factor used to account for local weather.

The calculations that are required are for the equivalent leakage area (*ELA*), normalized leakage (*NL*), and Infiltration (*I*) at normal operating conditions.

1) Calculation of ELA

$$ELA = \frac{Q_{50}}{50^n} \Delta P^n \sqrt{\frac{\rho}{2\Delta P}}$$

Where Q_{50} = blower door leakage at 50 Pa (ft^3/min @ 50 Pa (or CFM50))
n = house leakage curve exponent
ΔP = reference pressure difference between inside and outside (Pa)
ρ = density

By assuming that $n = 0.65$ (experimental average value for residential buildings), $\Delta P = 4$ Pa (typical reference value for ELA), and the density is a constant of 1.2 kg/m^3, the ELA can be rewritten as, and by converting all metric units to consistent inch-pound (I-P) units:

$ELA = 0.000381 * Q_{50}$ (with *Q50* measured as CFM50, *ELA* has units of ft^2)

2) Calculation of NL

$$NL = \frac{1000 * ELA}{A_{floor}} \left(\frac{H}{H_0} \right)^{0.3}$$

Where A_{floor} = floor area of the house (ft^2)
H = height of the building above grade (ft)
H_0 = reference height of one story = 8 ft

The normalized leakage was developed assuming that the volume is 8 feet multiplied by the floor area. Using this assumption, substituting for *ELA*, and by assuming that the height of one story above grade is 8 ft, the *NL* can be rewritten as:

$$NL = \frac{3.048 * Q_{50}}{V} (stories)^{0.3}$$

where V = volume of the house (ft^3)

3) Calculation of Infiltration at normal operating conditions

$$I = NL * w$$

Where w = a weather factor specific to a geographic location

In this equation I is in air changes per hour (ACH). The weather factor can be found in a table in ASHRAE Standard 136.

Once the infiltration I is determined, it can be converted to cubic feet per minute (CFM) using the volume of the house.

$$I_{CFM} = \frac{I * V}{60}$$

Where I_{CFM} = infiltration in cubic feet per minute
60 = conversion from hours to minutes

The infiltration rate at operating conditions, measured in CFM, can then be estimated as

$$I_{CFM} = 0.0508 * w * (stories)^{0.3} * Q_{50}$$

4) Calculation of ASHRAE Standard 62.2 default infiltration rate

The default infiltration rate I_d from ASHRAE Standard 62.2, measured in CFM, is

$$I_d = 0.02 * A_{floor}$$

5) Determination of infiltration credit, to be credited against required primary ventilation fan flow

If I_{CFM} is greater than I_d, then the infiltration credit I_{cred} can be calculated as

$$I_{cred} = \frac{1}{2}\left(I_{CFM} - I_d\right)$$