Build Tight - Ventilate Right
Build Tight - Ventilate Right
How Tight?
What’s Right?
Air Barrier Metrics

<table>
<thead>
<tr>
<th>Material</th>
<th>0.02 l/(s-m²) @ 75 Pa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly</td>
<td>0.20 l/(s-m²) @ 75 Pa</td>
</tr>
<tr>
<td>Enclosure</td>
<td>2.00 l/(s-m²) @ 75 Pa</td>
</tr>
<tr>
<td></td>
<td>0.35 cfm/ft² @ 50 Pa</td>
</tr>
<tr>
<td></td>
<td>0.25 cfm/ft² @ 50 Pa</td>
</tr>
<tr>
<td></td>
<td>0.15 cfm/ft² @ 50 Pa</td>
</tr>
</tbody>
</table>
Getting rid of big holes 3 ach@50
Getting rid of smaller holes 1.5 ach@50
Getting German 0.6 ach@50
Best

As Tight as Possible - with -
Balanced Ventilation
Energy Recovery
Distribution and Mixing
Source Control - Spot exhaust ventilation
  Filtration
Material selection
Worst

Leaky - with – Nothing
Spot Ventilation in Bathroom/Kitchen
Exhaust Ventilation – with – No Distribution
and No Mixing
Three Types of Controlled Ventilation Systems

Exhaust Ventilation
Supply Ventilation
Balanced Ventilation
Induced infiltration
Induced exfiltration
Ventilation Rates Are Based on Odor Control
Ventilation Rates Are Based on Odor Control
Health Science Basis for Ventilation Rates is Extremely Limited
Ventilation Rates Are Based on Odor Control

Health Science Basis for Ventilation Rates is Extremely Limited

Almost Nothing Cited Applies to Housing
Ventilation Rates Are Based on Odor Control
Health Science Basis for Ventilation Rates is Extremely Limited
Almost Nothing Cited Applies to Housing
The Applicable Studies Focus on Dampness
Figure 1: Minimum ventilating rate history.
Figure 2: Odor acceptance.
House

2,000 ft²
3 bedrooms
8 ft. ceiling
Volume: 16,000 ft³

.35 ach  93 cfm
.30 ach  80 cfm
.25 ach  67 cfm
.20 ach  53 cfm
.15 ach  40 cfm
# House

- 2,000 ft\(^2\)
- 3 bedrooms
- 8 ft. ceiling
- Volume: 16,000 ft\(^3\)

## Ventilation Rates

| .35 ach | 93 cfm | 62 - 73 | 5 cfm/person | 20 cfm |
| .30 ach | 80 cfm | 62 - 89 | 10 cfm/person | 40 cfm |
| .25 ach | 67 cfm | 62 - 89 | 15 cfm/person | 60 cfm |
| .20 ach | 53 cfm | .35 ach | 90 cfm |
| .15 ach | 40 cfm | 62.2 - 2010 | 7.5 cfm/person | 50 cfm |
|         |       | + 0.01 |             |
|         |       | 62.2 - 2013 | 7.5 cfm/person | 90 cfm |
|         |       |         | + 0.03 |
Office

Occupant Density

15/1000 ft² (67 ft²/person) 62 - 89
15 cfm/person

5/1000 ft² (200 ft²/person) 62.1 - 2007
17 cfm/person

Correctional Facility Cell

Occupant Density

20/1000 ft² (48 ft²/person) 62.1 – 2007
10 cfm/person
C.P. Yaglou
Harvard School of Public Health
1936
1955

150 ft$^3$ $\rightarrow$ 20 cfm/person

300 ft$^3$ $\rightarrow$ 12 cfm/person
C.P. Yaglou
Harvard School of Public Health
1936
1955

150 ft³ → 20 cfm/person 18.75 ft² 106 occupants
300 ft³ → 12 cfm/person 37.5 ft² 53 occupants

Experiment

470 ft³ → 59 ft²
200 ft³ → 25 ft²
100 ft³ → 12 ft²
Aubin, D., Won, D.Y., Schleibinger, H., 2010
Formaldehyde sample concentration versus PFT measured outside air exchange rate over the test day.
ASHRAE Standard 62.2 calls for 7.5 cfm per person plus 0.03 cfm per square foot of conditioned area.

Occupancy is deemed to be the number of bedrooms plus one.
ASHRAE Standard 62.2 calls for 7.5 cfm per person plus 0.03 cfm per square foot of conditioned area

Occupancy is deemed to be the number of bedrooms plus one

Outcome is often bad – part load humidity problems, dryness problems, energy problems
IRC 2015 and 2018 calls for 7.5 cfm per person plus 0.01 cfm per square foot of conditioned area.

Occupancy is deemed to be the number of bedrooms plus one.
3 Bedroom House – 2,500 ft²
30 cfm plus 75 cfm
105 cfm
3 Bedroom House – 2,500 ft²
30 cfm plus 25 cfm
55 cfm
The Cult of The Blower Door
Blower Door Can’t Get You The True ACH On A Short Term Basis – Hour, Day, Week
Don’t Know Where The Holes Are
Don’t Know The Type of Holes
Don’t Know The Pressure Across The Holes
Dilution Is Not The Solution To Indoor Pollution
Source Control
Dilution For People
Source Control For The Building
Recommended Range of Relative Humidity
Above 25 percent during winter
Below 70 percent during summer
Kitchen Exhaust Hoods
Move cabinets farther apart.

Hood wider than cook top and extended outboard past head space.

Move hood up to provide headroom.

Interlocked make-up air.
Clothes Dryers
Fireplaces
Approaches
Bedroom → Bedroom → Bath → Bath → Heat exchange ventilator

Exhaust air → Outside air → Exhaust air

Dehumidifier

Kitchen → PTHP → Interlocked kitchen hood → make-up air