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Building Science
Adventures In Building Science

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Build Tight - Ventilate Right
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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>
<tr>
<td>Description</td>
<td>Rate @ 50</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Getting rid of big holes</td>
<td>3 ach@50</td>
</tr>
<tr>
<td>Getting rid of smaller holes</td>
<td>1.5 ach@50</td>
</tr>
<tr>
<td>Getting German</td>
<td>0.6 ach@50</td>
</tr>
</tbody>
</table>

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
Motorized damper

Outside Air

Exhaust fan
Ventilation Rates Are Based on Odor Control
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Health Science Basis for Ventilation Rates is Extremely Limited

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The Applicable Studies Focus on Dampness

Figure 1: Minimum ventilating rate history.
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 ft²
- 3 bedrooms
- 8 ft. ceiling
- Volume: 16,000 ft³

**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 | 62.2 - 2010 | 7.5 cfm/person | 50 cfm |
| .20 ach | 53 cfm | .35 ach | 90 cfm |
| .15 ach | 40 cfm | 62.2 - 2013 | 7.5 cfm/person | 90 cfm |

**Office**

**Occupant Density**

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

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

**Correctional Facility Cell**

**Occupant Density**

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

150 ft³ → 20 cfm/person  
300 ft³ → 12 cfm/person  

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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
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
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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
Clothes Dryers
Fireplaces
Approaches