APPENDIX I-2  Calculating CO2 Concentrations in a Zone

NOTE: Calculation of ventilation rate per person required based on CO2 generation with an estimate of occupant activity level and maximum zone CO2 concentration of 450 ppm over outdoor.

A mass balance equation for the outdoor air flow rate needed to maintain the steady-state concentration below a given limit is:

\[ \text{Vo} = \frac{\text{N}}{(\text{Cs} - \text{Co})} \]

Where:
- \( \text{Vo} \) = outdoor air flow rate per person
- \( \text{N} \) = generation rate per person
- \( \text{Cs} \) = CO2 concentration in the space
- \( \text{Co} \) = CO2 concentration in the outdoor air

The formula can be further simplified, given that the guideline limit is 450 ppm over outdoor:

\[ \text{Cs} - \text{Co} = 450 \text{ ppm} \]

Reference: ASHRAE 62-2001, Appendix C and Figure C-2

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>N (cfm)</th>
<th>L/min</th>
<th>mets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated, office</td>
<td>0.0109</td>
<td>0.31</td>
<td>1</td>
</tr>
<tr>
<td>Light machine</td>
<td>0.0177</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>Heavy work</td>
<td>0.0353</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

\[ \text{N (cfm)} = \text{L/min} \times 0.0353 \] (conversion from metric to English units)

mets = metabolic rate
## APPENDIX I-2 Calculating CO2 Concentrations in a Zone

### TABLE 2

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Vo (cfm)</th>
<th>N (cfm)</th>
<th>Cs - Co (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seated, office</td>
<td>24.3</td>
<td>0.0109</td>
<td>0.00045</td>
</tr>
<tr>
<td>Light machine</td>
<td>39.2</td>
<td>0.0177</td>
<td>0.00045</td>
</tr>
<tr>
<td>Heavy work</td>
<td>78.4</td>
<td>0.0353</td>
<td>0.00045</td>
</tr>
</tbody>
</table>

450 ppm = 450 / 1,000,000 = .000450

### INSTRUCTIONS

**Calculator Key**
- GRAY - Do Not Change
- BLUE - Calculated by model, Do Not Overwrite
- YELLOW - User input required (Replace the sample data shown with actual)

1. Determine Co2 generation rate based on activity level of occupants in the space. Use the graph of mets vs. CO2 generation in ASHRAE 62-2001. Figure C-2.
   In the above example, the "mets" level (metabolic rate) is chosen for three activity levels and corresponding L.min of CO2 generation is read off the Carbon Dioxide Production Line.

2. Enter the level in the L/min column of **Table 1** and the corresponding cfm per person will be calculated in the N (cfm) column.

3. Enter the N (cfm per person) in **Table 2** (Ventilation Rate Required, CFM per person)
   The required ventilation rate, per person (Vo) will be calculated.

**NOTE:**
For large areas such as gymnasiums, use an average activity level for required CFM per person.
Control of measured CO2 levels with occupancy sensors can reduce overall ventilation.