

## CARBON DIOXIDE IN YOUR SHELTER

In most emergencies a civil defense shelter is ventilated with outside air. This air exchange removes the moisture and metabolic heat given off by the shelter occupants, supplies oxygen to the occupants, and removes exhaled carbon dioxide. The most common mistake in shelter ventilation is provision of plenty of air for oxygen supply and carbon dioxide removal - but not enough air for cooling and moisture removal.

Your tolerance for heat is related to both temperature and humidity. If the combination of these two factors rises above the tolerable limit, you will be forced to vacate the shelter even though plenty of air for breathing may be available.

There are, however, certain instances in which the ventilation system of a shelter must be temporarily turned off. The most common of these is in the event of fire near the air inlets. A fire usually gives off large amounts of carbon monoxide which binds chemically to the hemoglobin (oxygen-carrying protein) in the blood and to the heme groups in other essential metabolic and respiratory proteins. Too much carbon monoxide inhalation is immediately fatal. Many people have been killed by fire-generated carbon monoxide leakage into shelters during war. (This often happens when buildings burn over or near the shelter.)

As soon as the ventilation system is turned off, temperature, moisture, and carbon dioxide begin to increase and oxygen begins to decrease in an occupied shelter. If the shelter is not too densely occupied and if the temperature and humidity begin at reasonable levels, then the first of these four changes which becomes life threatening is the rise in carbon dioxide. Oxygen depletion is the next serious threat.

At the Swiss standard of 88 cubic feet per person occupancy and with shelter occupants who remain inactive, carbon dioxide reaches the comfortably tolerable limit of 2.5% in about 3 hours. At 5 hours, the level is 4%. At 4% candles go out and nausea, disorientation, lethargy, panic and other negative symptoms become so severe that shelter occupants must either reactivate the ventilation system or leave the shelter. For a shelter with three times that occupancy rate (as in overcrowded American shelters, since so few are in existence), the times are 1 and 2 hours respectively.

Fires, however, usually emit dangerous levels of carbon monoxide for 5 to 10 hours (sometimes much more in the case of long-smoldering rubble).

A shelter volume of 150 cubic feet or more per occupant provides a margin of 6 to 10 hours and also more comfort during normal occupancy. However, any American shelter within reach of many people is likely to be overcrowded regardless of its size and planned occupancy, since so few shelters are available.