

Government Asphyxiation

By Brian Dunaway

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Houston press has reported that Lowe's and Home Depot stores throughout Harris County have sold out of the plastic sheeting, duct tape, and other supplies recommended by the Office of Homeland Defense (OHD) in order for citizens to be better prepared in the event of an terrorist act. It's the same all over the nation.

This is a very serious health issue.

"Place a dry cleaning bag over your head and await further instructions." This may as well have been the instructions by the time they filtered down to Betty Sue in Omaha. But we all know Betty Sue doesn't have anything to worry about, does she? Well, she does if she follows the instructions from OHD.

The cause for most concern is the OHD plan for "What to do during a chemical or biological attack":

"Seek shelter in an internal room, preferably one without windows. Seal the room with duct tape and plastic sheeting. Ten square feet of floor space per person will provide sufficient air to prevent carbon dioxide build-up for up to five hours."

And Good Morning America's Home Improvement Editor, Ron Hazelton, assured his viewers:

"Don't worry about running out of air. Every ten square feet of floor space will last an adult about 5 hours. And don't leave the room until you get instructions from the Emergency Broadcast System to do so."

But notice the discrepancy in the phrases "to prevent carbon dioxide build-up" and "don't worry about running out of air." Hazelton is actually correct (probably accidentally) that the amount of oxygen corresponding to a ten square foot space is probably sufficient (though marginal) to sustain an adult for about five hours, but the critical issue is not oxygen consumption, but carbon dioxide generation and accumulation. The OHD statement is correct in identifying carbon dioxide accumulation as a concern, but its conclusions are surprising, to say the least.

Assuming an eight-foot ceiling (yielding eighty cubic feet per person) and a subject metabolic rate of 800 BTU/hr, after five hours the partial pressure of carbon dioxide (ppCO₂) would be ~67 mm Hg (if the initial ppCO₂ were zero). It cannot be understated: this is very high.

(Note: 800 BTU/hr (3.36 kcal/min) is not unreasonable for a very excited person in a hot and humid enclosure with elevated carbon dioxide (more on that in a moment). For this case, a bare (but irresponsible) minimum might be 600 BTU/hr (corresponding to a ppCO₂ level of 50 mm Hg after five hours). Consider that NASA Environmental Control and Life Support (ECLS) engineers typically assume a waking metabolic rate of 450 BTU/hr for moderate intravehicular activity, and this

is with very physically efficient subjects (astronauts) not using major muscle groups (e.g., legs) in microgravity.)

Keep in mind that the maximum operational limit for the Shuttle Orbiter is 7.6 mm Hg, and is actually lower for the International Space Station. The NASA Spacecraft Maximum Allowable Concentration (SMAC) for carbon dioxide is 10.0 mm Hg for a one-hour period. Similar values can be found among the literature of the various military branches.

The NASA Bioastronautics Data Book (Second Edition, pp. 48–49) indicates that after only 80 minutes, at a ppCO_2 level of ~ 18 mm Hg, the subject can experience "mental depression, headache, dizziness, nausea." At ~ 45 mm Hg (after 80 minutes), the subject experiences "marked deterioration leading to dizziness and stupor, with inability to take steps for self preservation. The final state is unconsciousness." (The level in our case would not reach 45 mm Hg after 80 minutes, but the threshold of the aforementioned symptoms would be at a much lower CO_2 level at the end of five hours.)

Industry literature is similar.

The W.E. Kuriger Associates web page titled "Carbon Dioxide Fact Book," states that,

Several studies have indicated that CO_2 does not seriously impact human health until levels reach approximately 15,000 ppm [7.5 mm Hg]. ... At extremely high levels, i.e., 30,000 ppm [15 mm Hg] (these concentrations are usually never reached in a standard home), the symptoms can include nausea, dizziness, mental depression, shaking, visual disturbances and vomiting. At extremely high levels, loss of consciousness may occur. ... Finally, CO_2 is an asphyxiate, a condition in which an extreme decrease in the amount of oxygen in the body, accompanied by an increase of carbon dioxide, leads to loss of consciousness or death.

Concentrations of 100,000 ppm [50 mm Hg] or more of CO_2 can produce unconsciousness or death.

And carbon dioxide is hardly the only physiological concern.

One would probably pass out from heat exhaustion before he passed out from exposure to high carbon dioxide concentrations.

It's probably not a bad assumption to consider the system adiabatic (no heat transfer — there would be very little heat transfer via conduction, which is the only mechanism for heat transfer to the environment in this scenario), and considering the thermal capacitance of the subject (the thermal capacitance of the surrounding air is only about 1% of that of the subject), suffice to say that the subject would have very serious core temperature problems long before five hours time (a three, four degree elevation per hour?)

And within about ten to fifteen minutes after being in this enclosure the air would become saturated, that is, 100% relative humidity (and condensate would start forming on the plastic). As the air temperature and humidity increases

(deteriorating the mechanisms for rejecting the subject's metabolic heat), and carbon dioxide levels increase, and as oxygen is depleted (at the end of five hours, at 800 BTU/hr the subject would be at an altitude equivalency of ~19,000 feet (0.47 atm.), at 600 BTU/hr ~14,000 feet (0.60 atm.)), his metabolic rate will increase, in turn increasing the metabolic heat and perspired and respired water vapor he generates, creating a vicious cycle.

And, of course, children and elderly can withstand much less of this kind of environment than adults.

Perhaps the worst aspect of the dissemination of this information is that the balance of the press, including network news broadcasters, didn't even mention a time limit at all.

Other aspects of the OHD statement are very odd — how many folks are wealthy enough to have an inside room with no windows (other than a closet, which would, according to their recommendations, only be sufficient for one person)?

And plastic sheeting? That's awfully vague. Surely there are permeability and robustness issues here. The Washington Post reported that in a local D.C. hardware store "plastic drop-cloths were being evaluated with one aim in mind: Would they work to seal a room?" Good question, but not likely.

Considering that only a very tiny proportion of the population (and obviously no one at the Office of Homeland Security) are trained to make these calculations and decisions, and remembering that a significant portion of the population doesn't know their "right hand from their left," may God bless them, the instructions from the OHD are cause for very serious concern.

So please give this wide circulation — there is a high likelihood that there are plenty of folks already out there sitting in an enclosure that they believe to be safe, unknowingly endangering the lives of themselves and their children.

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Brian Dunaway [[send him mail](#)] is a chemical engineer and a native Texan.

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