CO2 Risk Management Summary

Carbon dioxide (CO2) makes up approximately 0.03% of the atmosphere, for a partial pressure at sea level of about 0.0003 atm or .03 kPA. At low concentrations, it is colorless, odorless, tasteless, and nontoxic, but in greater percentages or at high elevated partial pressures, it has an acid taste and can be toxic to humans.

Carbon dioxide is a waste product of the body's metabolic energy production process and is eliminated during the exhalation phase of respiration. For every liter of oxygen that it consumes, the human body produces almost a liter of carbon dioxide (CO2). The exact amount depends on the individual and varies according to diet, and can change dramatically when a diver is subjected to to increased workloads and exercise. CO2 also serves as the primary stimulus to breathing. That's why excessive hyperventilation prior to extended or deep breathhold diving is dangerous and insidious.

Hyperventilation reduces normal levels of CO2 and thus lowers the *urge to breathe* enabling the breathhold diver to momentarily extend his or her bottom time. If the oxygen partial pressure is reduced too far the result can be hypoxia, or "shallow water blackout". Essentially, the body's normal warning system is temporarily disabled and is slow in alerting the diver to his or her hypoxia crisis. Several champion free divers have fallen victim to this phenomenon and it is strongly advised that breathhold divers refrain from excessive hyperventilation techniques.

Another problem for scuba divers is CO2 retention. This can arise from poorly performing equipment and inadequate ventilation of the lungs for example, as a result of "skip breathing." Symptoms of carbon dioxide build up include headache, weakness, labored breathing, a feeling of air hunger,nausea, dizziness and confusion and eventually loss of consciousness at very high levels. Observable signs are typified by rapid breathing, clumsiness or foolish, incoherent actions and the slowing of response.

Some individuals are less sensitive to CO2 build up then others, and are often categorized as "CO2 retainers." Many diving physicians are sufficiently concerned about this abnormality in divers that they will recommend exclusion if a predisposition to CO2 retention is detected.

It is extremely important for divers to consider the effects of CO2 in planning their diving activities. Aside from the potential problem of CO2 toxicity itself, *elevated partial pressures of CO2 contribute to the onset and severity of both nitrogen narcosis and CNS oxygen toxicity.*

There are several ways in which divers can manage these risks. First, matching the performance of a regulator to the diver's operational needs is vital. Breathing resistance and exhalation should both be considered. Note that increased gas density with depth can overload a regulator inspite of glossy ad claims from manufacturers. Make sure your regulator is capable of delivering the performance required. Ask for the test results. Proper breathing techniques are also essential. Never "skip breathe." If your worried about conserving gas you should probably be carrying more. Slow deep ventilation cycles are recommended. And remember, don't to get out of breath.

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kPA*	Effect
0-4	Mild to moderate dyspnea
4-6	Dyspnea, anxiety
6-10	Impaired mental capability
11-15	Severely mental impairment, discomfort nausea
16-20	Loss of consciousness
> 20	Uncoordinated twitching and convulsions

* 1 kPA is equal to approximately 1/100 atm

Note, these values are below fatal levels.