The First Stop / The Deep Stops

by George Irvine

In determining where to start your decompression, the logic is very simple: you want to let gas escape from the tissues prior to bubbling. Once it bubbles, it will not escape. Rising up rapidly from depth is a good way to trap gas in tissues by forming bubbles which will then grow when you are higher in the water column. On the other hand, gas that bubbles into the blood is generally trapped by the lungs, but those with any kind of pulmonary or cardiac shunt are at risk if this occurs. If it occurs to fast, and or the bubbles grow too large, they can block the effective lung function and will damage the capillary beds of the lungs. From depth, you want to remove gas in solution form.

The best way to do this is to begin your decompression stops at 80% of your profile in atmospheres rounded up. For a ten atmosphere dive, the first stop is 8 atmospheres, or about 240 feet. At the same time, the traveling time between 300 and 240 should be at 30 feet per minute max, so it should take you two minutes to get to 240.

There is a fine line between getting rid of gas and adding gas at this end of the deco. All you are trying to do is buy time to get the gas coming out in solution, and there is a point of diminishing returns for stops in the lower end of the deco range. The maximum deep stop is 5 minutes, the minimum is 20 seconds (30 FPM ascent). The best way to assure your ascent is at the correct speed is to physically stop every ten feet. That will get you your 20 seconds per ten feet. The range of bottom times that determine the length of the deep stops is 0-150 minutes. For 0, you still have the 30 foot rate, for 150 minutes you max out at 5 minutes per stop. Anything beyond this is effective saturation and the maximum applies.

These deep stops are equally divided at all depths up to 65 percent of the profile. At that point you begin lengthening the stops. Between 65% and 45%, the steps slightly lengthen, but max out at 10 minutes. Between 45% and 35%, the max is 20 minutes, between 35 and 25%, the max is 30 minutes, subject to certain parameters.

Going back to the deepest stop, if you switched gases, and 80% is where you need to switch gases on a long dive, you are maximizing the effect. If you use a helium based gas you further improve the results. Air is unacceptable as a deco gas as it causes damage that can not be fixed by decompressing, and further complicates the decompression due to the body's immune response to damage and the stress of rigid red cells jamming through small capillaries.

When you approach a gas change, you should be coming off of back gas. For the first deep switch, this is obviously the case. Having been on a low ppo2 operating gas, you can afford to spike the ppo2 with a deco gas, whereas yo do not dare do that without breaking to back gas first. You do not use a full 1.6 ppo2 fro any part of deep decompression. The risk is too high. You don't want an oxygen reaction at depth as you will not have any chance of recovering from this, or surfacing and going back down. Be smart and rely on helium and gradient more than ppo2 for these steps. Clearly, a 1.4 or less is preferred for deep stops max, whereas shallower you can do the full 1.6 because you are able to break to a lower effective ppo2 shallow by using back gas. Some people stage a full face mask starting at these stops. JJ does this.

It takes a solid two minutes for gas to make its first pass through the body when you switch. The switch step should be the longest of the series that uses one gas. You are getting the best oxygen window for that gas at this point, and you just came from a low ppo2, and the gradient

is not that severe. As you move up, the steps do not need to be longer on the same gas. In fact, you are best served to do your last step before gas switch on back gas and to make it the shortest of the steps. Here you are relying on gradient and the toggle effect.

The toggling effect is simply alternating between higher and lower ppo2s in order to prevent the onset of lung tissue damage, swelling, adding of protective layers, and constriction of the blood vessels. The reduced ppo2, especially the closer it gets to normoxic, will prevent and reverse these effects (other than the damage if it is already done). Using the gradient at this juncture is the best way to rid gas.

As you get up into the shallower areas prior to going to oxygen, you should take a full back gas break - what I call a "cleanup break". For instance, on a sat dive to 300, I will do 20-30 minutes on back gas at 50 feet. Cleanup breaks are effectively being done on long dives prior to gas switch if you do your last step on a gas by going back to the backgas.

In the 40-30 foot range from a deep dive with a long deco, it is unnecessary to extend the 40 and 30 foot stops at all. In fact these one can be sharply reduced if you have no shunts. You are better served by bubbling the gas into the blood stream sat these depths, a far more efficient and rapid way to get rid of it. Bubbles trapped here can be fixed by going back down slightly, but doing it just right means that will not happen to a well-perfused diver For instance, on a sat dive to 300 that would call for 120-140 minutes at 40 feet on any deco program, I do 20 minutes and then move up.

Following each oxygen stint, you must break to back gas. If you were breathing oxygen dry, as in a habitat or trough, you must do a ten minute break before going back into the water. The ascent rate from your oxygen stop to the surface is one foot per minute for a long dive, a scaled down version of that for a short dive. The greatest case of bubbling off-gassing occurs in the move from 10 or 20 feet to the surface. You want that to occur under some pressure and to be controlled by the slow ascent, so that when you are up, you will not get the sudden rush of bubbles that could shunt or cause other problems.

For shorter dives, the deco gases are added from the top down. In other words, your shortest dive might have just oxygen as the only different deco gas. A longer dive of the same profile may add the 50% gas. Still longer times would add the 35% gas and so forth. You weigh the advantage of the gas to the problem of carrying it. The effective shortening of the deco is not in play here because a shorter dive hits the minimum deco rules, so yo have to do the time anyway. Longer dives demand the extra gases to stay efficient. Toggling and alternating are key to decompression. There is no way you can beat this by maintaining a high ppo2.