Ratio Deco

Overview

Ratio deco is simply an “on the fly” system of applying a set of rules to develop a decompression strategy that will work for you in your range of diving. These rules are derived from a combination of the best of different theories, software profiles and ideologies, combined into one easy to use “on the fly” methodology. Ratio deco is applicable to any environment, consistent through your range of diving and most importantly simple to use by the diver, especially during the dive; if any changes occur to the planned depth or bottom time the deco can easily be adjusted quickly. The following discussion of ratio deco is a set of guidelines that is based on Standard Mixes, Deep Stops, Oxygen Windows, free phase gases and dissolved gases. The in water times for decompression are similar to a Buhlmann profile set to a conservative factor of 30/85 and/or a V-planner profile (RGBM/VPM-B) set to a conservative factor of +2. You will find, however, that the shape is very different from anything produced by a computer software model or by a computer strapped to your arm. The ratio deco shape takes into account the best theory and practical experience as we know it today. The rules have evolved and will continue to evolve slightly as we learn more and more about decompression.

Global Perspective

Background
Traditionally, the shape of deco was based on Haldanian or Neo-Haldanian principles. These create an ascent profile that quickly brings the diver as shallow as possible without exceeding the M-Value*, stopping only when you reach the M-Value*, leading the diver to ascend to shallow depths and then to stop for longer periods of time. This theory of decompression discounts the possibility of bubbles occuring at depth without exceeding the M-Value and therefore neglects any potential for growth of these or any pre-existing bubbles. These theories in principle assumed the diver would not bubble from a tissue compartment if they do not exceed the corresponding M-Value.

Unfourtunately these assumptions are not borne out in reality and researchers such as Buhlmann found pre-existing “micro bubbles” and that other bubbles do occur much deeper than once thought. Researchers such as Bruce Weinke and David Yount started to study bubble formation and develop decompression profiles that addressed these bubbles, their mechanics and their free phase growth. Also born was the concept of doing “Deep Stops” by Brian Hills to introduce slower ascent profiles that allow these bubbles to be transported back to the lungs before growing unmanagably large. Divers also started to use Buhlmann models with Gradient Factors that attempt to force the model to introduce stops at a greater depth. All of these approaches aim at the same goal: stop the diver much deeper than in traditional decompression, bring them up slower without penalizing for the deeper stops and then make the shallow stops much shorter than traditional. The decompression is effectively completed at depth and not at 10’(3m).

*M Value, specifies the maximum tolerable inert gas tension without producing decompression sickness symptoms.

Overall shape

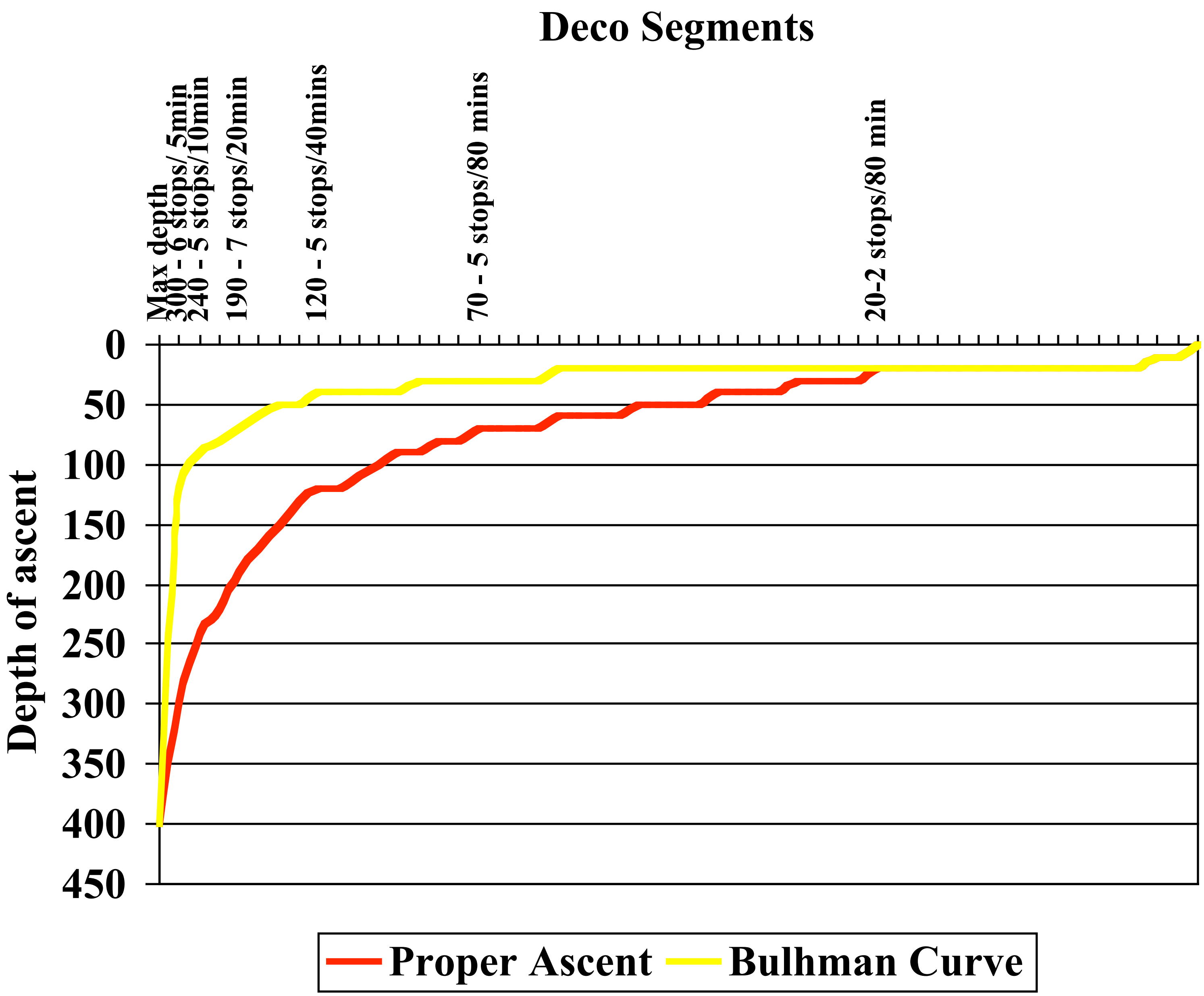
Overall shape of the decompression starting from the deeper deco stops to the shallower deco stops should be generally curved so that the proportion of time spent in each deco stop or segment of stops should be twice as long as the previous deco stop or segment. So for example if we had multiple stops per segment of decompression then each segment shallower should be twice as long as the previous segment. Let's say we had two (2) 10ft/3m deco stops per segment then we could say if:

Segment 1 – is the deepest segment and we needed a total of 2 minutes in that segment then we would do 1 min at each of the two 10ft/3m stops to total the 2 minutes in that segment.
Segment 2 – would now be 4 min (twice as long as previous, deeper segment) done over it's 2 stops, so each 10ft/3m stop is 2 minutes.
Segment 3 - 8 min (twice as long as segment 2) done over the 2 stops, so each 10ft/3m stop is 4 minutes.
Segment 4 – 16 min (twice as long as segment 3) done over the 2 stops, so each 10ft/3m stop is 8 minutes.
Segment 5 – normally this would be 32 minutes, done over 2 stops. If, however, there is only one stop (10ft/3m) left to go to the surface then to keep the shape we do16 minutes at the one stop.

Applying this approach to the Standard deco gases, we find that each gas typically covers about 5 stops with an average PPO2 of 1.2 atm, except for the oxygen bottle which covers approximately half as many stops and at a PPO2 of 1.6 atm.

Deco Gas	Depth Range	Number of Stops	Comment
12/60	300'/90m – 250'/75m	6 stops	Rarely used
15/55	240'/72m – 200'/60m	5 stops	Rarely used
21/35	190'/57m – 130'/39m	7 stops	Rarely used
35/30	120'/36m – 80'/24m	5 stops	
50% Nitrox	70'/21m – 30'/9m	5 stops	
Oxygen	20'/6m – 0'/0m	"2.5" stops	20'/6m stop + slow ascent

Look at the graph below. This shows a typical deco shape for a 400'/120m dive. A proper ascent, would start the decompression stops much deeper than the Buhlmann model specifies and our first segment runs from 300'/90m –250'-75m and let's say it is 5 min long. Then our next segment of deco would be from 240'/72m – 200'/60m and it is 10 min long. The next would then be 190'/57m – 130'/39m and 20 min long. The next segment is 120'/36m – 80'/24m and 40 min long. The next is 70'/21m – 30/9m and 80 min long and the last segment, 20'/6m to the surface, is half the number of stops, so it also lasts 80 min. Notice the considerable difference in shape from a standard Buhlmann curve, which places the first stop at 120'/36m



Therefore we could say that for Deco times:

O2 time = Nitrox 50 time
Nitrox 50 time = 2 * 120’/36m bottle time
120’/36m bottle time = 2 * 190’/57m bottle time
190’/57m bottle time = 2 * 240’/72m bottle time

Example:
If we wanted to do deco with the first stop at 190’/57m we would do:

190’/57m – 130’/39m = 7min
120’/36m – 80’/24m = 15min
70’/21m – 30’/9m = 30min
20’/6m = 30min

This is not meant to indicate the times for a particular profile, just to give a very general feel for the shape. You would then divide the time for each section over the number of stops depending on what shape you want within that section (see below).

The time for the O2 segment is found based on Bottom Time and average depth, then you work your way deeper to find the times for each of the deeper deco segments.

Example

150'/45m O2 segment = 1/2 * Bottom Time
220'/66m O2 segment = 1 * Bottom Time
270'/81m O2 segment = 1.2 * Bottom Time
300'/90m O2 Segment = 1.5 * Bottom Time
350'/105m O2 segment = 2.2 * Bottom Time
400'/120m O2 segment = 3 * Bottom Time

So if you did a 25 min dive at 220'/66m your deco times for each segment would be

O2 segment = 25min
70'/21m-30'/9m = 25min
120'/36m-80'/24m = 12min
190'/57m-130'/39m = 6 min

Depth Averaging

The easiest way is to break bottom part of the dive into 5 min segments. Average each 5 min segment. Take the deepest segment and the shallowest segment and add them together. Divide by 2. This will give an average for the dive. Now weight it for depth and time. Meaning if you spent more time deeper then weight towards that depth. If you spent more time shallower, then weight towards shallower.

Example: Dive on 21/35 using nitrox 50 for deco and the dive profile is 100'/30m for 5min then 150'/45m for 5 min then 160'/48m for 5 min then 140'/42m for 5min then 130'/39m for 5 min then 100'/30m for 5 min. Total 30 minutes you would do this:

So deepest is 160'/48m + shallowest 100'/30m = total of 260'/78m divide this by 2 to equal 140'/42m. About half the dive was spent shallower than this, and the other half at this depth or deeper, so we can use this average without adjusting to weight for depth. Using the average of 140'/42m, the deco would be 25min on nitrox 50 for a 30min bottom time.

A conservative approach to weighting is to average each of the bottom time segments pair wise, starting with the shallowest. In detail, find an average depth for each 5 min segment. Then, sum the depths of first two shallowest segments and divide by 2. Then use that average and sum it with the depth of next deepest segment and divide by two.

Then the sum that average with the next deepest depth and divide by 2. And so on until you have included all of the bottom time segments.

Example: Dive on 21/35 using nitrox 50 for deco and the dive profile is 100'/30m for 5min then 150'/45m for 5 min then 160'/48m for 5 min then 140'/42m for 5min then 130'/39m for 5 min then 100'/30m for 5 min. Total 30 minutes you would:

100'/30m plus 100'/30m = 200'/60m divided by 2 = 100'/30m
100'/30m plus 130'/39m = 230'/69m divided by 2 = 115'/35m
115'/35m plus 140'/42m = 255'/77m divided by 2 = 130'/39m
130'/39m plus 150'/45m = 280'/84m divided by 2 = 140'/42m
140'/42m plus 160'/48m = 300'/90m divided by 2 = 150'/45m

Using 150'/45m for 30min equals 30min deco.

This would give you the most conservative deco and the result does not depend on the order in which you conducted the dive. Deepest part first, last or in the middle.

Actual Deco profile based on Deco Planner with 30/85 GF is 24min for the above example.

Decompression Strategies:

Deep Stops – Strategy 1

First suggested by Brian Hills, deep stops are now accepted by all major agencies and promoted by DAN as an "add on" to standard safety stops to improve quality of decompression and increase safety and conservatism. The concept is to stop deeper, with the depth of the first stop based on max depth, allowing the fastest compartments to off gas while still at deeper depths. The first stop can be seen as the Max Stop depth from Deco Planner. This Max Stop Depth is the depth at which the first compartment starts to unload. These deep stops will also allow time for the blood to transport bubbles to the lungs. Length of stops should be long enough to be effective but not so long as to add significantly to time or gas required for the ascent. In other words they should not go beyond your deco time in the deep segment, calculated by ratios as above. The length of each deep stop, with a stop each 10ft/3m, can be calculated based on your bottom time (past N.D.L. time) and your depth as a percentage of your bottom depth. See the table below. Because they are conducted on backgas, there is no O2 window and because they are still fairly deep, Boyle's law tells us that there is little growth of the bubbles between each 10ft/3m stop, the shape of the deep stop times is generally linear and only doubles between the suggested segments from table below. If these stops are done using an O2 window (i.e. on a deco bottle) then the stops can be conducted using an S-Curve (see the O2 window section below). Deep stops are conducted until you intercept a Gas Switch or a Buhlmann (dissolved gas) Curve or the surface.

Deep Stop Table (Linear Shape)

Depth to Start stops	Min (N.D.L.)	30min more than N.D.L.	60min More Than N.D.L	90min More Than N.D.L	120min More Than N.D.L	Max 150min
75% Depth (80% ATA)		1	2	3	4	5
50% Depth (65% ATA)	1	3	5	7	9	10

As a side note: This table is based on the WKPP deep stop theory. In this theory, there is a minimum bottom time (N.D.L.) below which minimum deco applies and a Maximum bottom time of 150min or more, beyond which the maximum deco applies. The bottom times shown in the table above are the time beyond the N. D. L. time and the table suggests how much time to do for each of the deep stops (every 10ft/3m). This does not dictate how much overall time you do for deco.

Linear shape

To get a linear shape ascent profile for a certain segment take the total time for that segment and divide by the number of stops. Remember that the linear shape is generally only used in deep stops on back gas.

Example:
15min over 5 stops = 15/5 which is 3 min each stop

O2 Windows – Strategy 2

We introduce the use of Decompression gas (a deco bottle) when we want to open an O2 Window deeper and we want to (need to) reduce the amount of extra backgas we need to carry to cover the ascent and the deco even in an emergency (rock bottom). The Oxygen Window will help accelerate the decompression and therefore reduce the in-water decompression times. By opening an O2 window you can achieve the decompression deeper and faster therefore you do not have to press the gradient as much by ascending to a shallow depth, which has the consequences of both bubble growth and, in case the decompression in the shallows cannot be completed, not having done any decompression. The choice of which decompression gases to carry is based on the standard decompression gases for the above segments but also whether another bottle is necessary or not to reduce for the amount of extra bottom gas to carry to cover rock bottom. If this amount is too great and too much backgas is needed then you will introduce a deeper decompression bottle to reduce rock bottom to a manageable and safe level.

We shape the deco curve for a segment on a deco bottle to emphasis the Higher PPO2 stops allowing the O2 window to work effectively. We can then shorten the next shallower stops (the intermediate stops of that segment) as they are not as high a PPO2 and therefore are not as effective. We again lengthen the shallowest portion of the segment as you are now pressing the gradient and we also use the last stop in the segment to do back gas breaks, allowing the lungs to recuperate from the high PPO2 before we spike it again in the next segment. We call this shape an s-curve and use it for each Decompression gas except the O2 bottle.

S-Curves
Take the total time for the segment and divide it by the number of stops. This gives you the linear shape. Keep this value for the stop time of the shallowest stop. For the next two deeper stops, halve the stop time (rounding up), push the time taken from these stops to the remaining two (deepest) stops.

Example S-curve:
15min over 5 stops = 15/5 which is 3 min per stop (linear)
Shallowest stop = 3 min
Next deeper stop = 3/2 = 2min
Next deeper stop = 3/2 = 2min
Second to deepest stop = 3 + 1 min from the intermediate stop time = 4min
Deepest stop = 3 + 1 min from the intermediate stop time = 4min

So a 70'/21m– 30'/9m bottle for 15min would be

Linear is 15/5 = 3 per stop
30'/9m = 3min
40'12m = 3min
50'/15m = 3min
60'/18m = 3min
70'/21m = 3min

Changed to a S-Curve:

30'/9m = 3min
40'12m = 2min
50'/15m = 2min
60'/18m = 4min
70'/21m = 4min

Side note: try not to exceed a time ratio of 4:1 between sequential stops. For example, if one stop is 5 min the next should be at least 2 min, otherwise if the next was 1 min you would have a time ratio of 5:1, which is a little high.

Dissolved Gas – Driving the gradient – Strategy 3
When we ascend we are using the reduction in ambient pressure to create a gradient between the ambient and the gas in our tissues. The larger the difference in pressure, the larger the gradient, and the more we offgas. The problem is if we drive it too much then we might form a bubble in the tissue which will become a problem as it expands later in the deco. So we "drive the gradient" (ascend shallower) when we are not using a O2 window and we are not deep (where forming these bubbles can lead to real trouble). In other words, we can push the gradient when we are on backgas or otherwise have no O2 window and are at shallower depth. In this case, we follow a more exponential deco curve; the time at each stop should be longer than the previous stop. This accounts for the increasing gradient for some tissues and for bubble growth according to Boyle's law,

which will be significant at these depths. In summary when we are on Backgas or generally at low PPO2 we offgas by driving the pressure gradient between the dissolved gas and the ambient. We do this by creating a exponential curve.

Exponential shape
Take the total time for the segment and divide it by the number of stops. This gives you the linear shape. Keep the stop time of the middle stop at this value. The next stops deeper should be half this time, then half again (rounding up). The time taken from the deepest stops should be added to the shallow stops to create an exponential shape. The shape can also resemble a Fibonacci sequence of stop times.

Fibonacci Sequence
21
13
8
5
3
2
1
1

Here is an example:
15min over 5 stops on backgas from 50' to 10' = 15/5 which is 3 min per stop (linear)
Middle stop = 3min (keep this time)
Deeper stop = 3/2 = 2min (rounding up)
Deepest stop = 2/1 = 1min

Second shallowest stop = 3 + 3min (time taken from two deepest stops) = 6 min
Shallowest stop = 3 min

So 50'/15m–surface in 15min would be as follows.

Linear is 15/5 = 3 per stop
10'/3m = 3min
20'/6m = 3min
30'/9m = 3min
40'/12m = 3min
50'/15m = 3min

Changed to a Exponential curve:
10'/3m = 3min
20'/6m = 6min
30'/9 m = 3min
40'/12m = 2min

50’/15m = 1min

Side note: Notice how we have reversed the 20’/6m and the 10’/3m stops. We try to get most of the deco done at the 20’/6m mark where we are still somewhat insulated from the surface conditions and then transition slowly up to the surface. The 3min stop at 10’/3m is really a slow ascent from 20’/6m to the surface rather than a hard stop at that depth.

Minimum Deco

The concept of N.D.L. derives from the idea that one does not “require” deco and therefore it is a No Deco Limit dive and the diver can return directly to the surface without any decompression stops. This concept makes some sense in the context of a dissolved gas theory. If the Buhlmann curve (maximum M-Value) is not reached before getting to the surface, then the diver is not required to make a deco stop at 10’/3m or deeper and is allowed to surface directly from depth. This type of model does not take into consideration the fact that a diver always experiences some bubbles in their system and that these need to be addressed, even after a short bottom time (for which the Buhlmann model would allow a direct ascent to the surface). The diver should make some decompression stops to address these bubbles and/or micro bubbles. These stops are termed Minimum Deco and should be conducted starting at 50% of max depth of the dive. The diver will start their ascent at the normal rate of 30’/10m per min until they reach this 50% mark, where they will slow their ascent rate to 10’/3m per min. A good way to practice this is to make a stop for 30 seconds at the stop depth and then spend 30 seconds ascending to the next stop. The diver should continue this slowed ascent rate (10’/3m per min) until they finish the 20’/6m stop. From 20’/6m you do a gradual 3min ascent to the surface to release the pressure slowly where it is changing the most. We use this concept both when conducting what is thought of as an traditional N.D.L. dive (See N.D.L. table below) and if we do a bailout (less than 5min bottom time) when we are deeper than 130’/39m.

Example: If we dive to 100’/30m for less than 20 minutes, then we:
Ascend from 100’/30 – 50’/15 at the standard ascent rate of 30’/10m per min
Stop at 50’/15m for 1 min
40’/12m for 1 min
30’/9m for 1 min
20’/6m for 1 min
Take 3 min to ascend to the surface

Note: Keep in mind that the ascent time between stop depths is included in that 1 min

O2 deco

O2 is your friend and your enemy. We use pure O2 at the 20’/6m stop to open an Oxygen window and accelerate the decompression, which especially addresses the slow tissues. At this point in the dive the majority of the decompression should be completed and the O2 stop is essentially cleaning up the slow tissues. One should conduct short exposures to the high PPO2’s as it is considered much safer and more effective than breathing O2 continuously for long periods of time. O2 causes effects such as pulmonary toxicity, in which the blood vessels in the lungs dilate (Open excessively) causing an increase in fluid pressure and inflammation of the lungs. This fluid pushes through the blood/lung barrier and accumulates in the air sacs reducing the surface area available for gas exchange. The fluid interferes with the surfactant (coating on the Alveoli) thereby reducing the efficiency of gas transfer across the blood/lung barrier. The inflammation increases the physical thickness of the lung tissue, also slowing gas exchange. O2 Toxicity also causes vasoconstriction in the extremities, greatly reducing the off-gassing of the surrounding tissue. Remember, the very reason we are breathing O2 is to offgas these slow tissues. All these problematic effects can be reduced by short exposures to the O2.

Generally we try to cycle the O2 time so that we use on the O2 for 12min and then do a 6 min break (off) the O2 (This is a backgas break using the lowest PPO2 and highest helium gas). The time actually on the O2 and the backgas breaks are all included in your stop time. The reason for the backgas break is to allow the lungs to recover and to limit vasoconstriction in the extremities. We only do a backgas break if we are going to cycle back onto the O2 and if we are doing long exposures to O2. Otherwise, for short O2 times such as 15 or 20 min there is no reason to do 12 min on and then 6 min off. Just do the 15 or 20 min on the O2, including the ascent, which reduces the PPO2 anyway. The ascent from 20'/6m to the surface is a critical part of the ascent and should be done extremely slowly. The time to ascend from 20' should be at least 20% of the O2 stop time. This ascent can be done on the O2 since the depth change is lowering your PPO2 and you will not be cycling back on to the O2 for any further exposure.

Example: 15min O2 stop

Do 12 min at 20'/6m and then 3 min ascent to the surface all on O2. There is no reason for a backgas break as you are ascending and lowering the PPO2 and are not cycling back on to the O2.

30 min O2 stop
Do 12 on, then 6 off, then 12 on O2, 6 min of it up to the surface.

Choosing the Deco bottles & mixes
The choice of which deco gas(es) to carry is based on the following set of criteria. The first is that each gas is a standard deco mix for one of the deco segments listed above and it provides an O2 window to accelerate the deco. This will reduce in water decompression times and reduce the risk exposure to the environment. Another important consideration is the amount of backgas a diver needs to reserve in order to do the dive plus the ascent plus the deco. This backgas should be enough for two divers to airshare during the exit and the ascent and the deco. Therefore the deco gas is not only chosen to accelerate the decompression, but also to provide extra gas supply deeper so that the divers need not carry unreasonably large amounts of backgas. Very quickly this amount of gas becomes excessive for even the largest tanks and an alternative gas needs to be available deeper anyways. You need an additional bottle, and it is better to make it

a Deco bottle rather than a stage bottle as you also get the benefit of accelerating the deco exposure.

The deco bottle size should be as small as possible while meeting the need and the deco should be kept within reasonable time limits. One should consider that if this deco gas is lost the diver will need to double the decompression time and do the deco on the backgas. Therefore rather than use a larger cumbersome bottle to cover a longer decompression time spanning two of the deco segments outlined above (e.g. 70'-30' and 20'-0') one might consider using two bottles of smaller size and different mixes to cover each segment and therefore have redundancy and backgas enough to cover loss of one of the deco bottles.

0' – 100'/30m – for bottom times that would cause deco times of longer than 20mins (on backgas) we generally introduce the O2 bottle to accelerate the deco at 20'/6m and reduce the backgas requirements for airsharing the whole 20+ mins of deco. That would mean 40+ mins of backgas, which could well exceed the limits of the backgas redundancy.

100'/30 – 170'/51m - Shorter bottom times that produce a deco of 30min or less on Nitrox 50 we choose to use only a smaller Nitrox 50 bottle (70'/21m). A smaller balanced AL40 is the perfect bottle. It is small and easy to carry and will provide enough for a planned deco upto 30 min from 70'/21m – 0'/0m. By inserting this bottle the diver need only carry enough backgas bailout for two divers airsharing to ascend from depth to 70'/21m rather than all the way to let's say an O2 bottle. If the bottom times forces a deco time exceeding 30 min then we should rather add an O2 bottle than carry a larger nitrox 50 bottle to cover this longer decompression time. This O2 bottle will provide the extra gas needed to complete the longer decompression time, but also covers us if we lose the Nitrox 50 bottle. In the event a diver loses one of the bottles, the diver will only need to double the deco time for the segment covered by that bottle. They would need to do that doubled deco time on backgas and should reserve enough for this event. Rock bottom should normally cover the loss of at least one of the deco bottles, but if only one larger bottle were carried this might not be enough and additional backgas would need to be reserved. They will then proceed on up to the next bottle. So if the diver loses the Nitrox 50 bottle, the 70'/21m – 30'/9m stops will be doubled on backgas and the diver will still have the O2 bottle at 20'/6m to go to. If only the O2 bottle is lost, the diver can continue on nitrox 50 and switch to backgas when necessary. On the other hand, if the diver had only one large Nitrox 50 bottle and they were to lose it on let's say a 40min deco they would have to do 80 min on backgas. This is too much time for a reasonable amount of reserved backgas to cover.

180'/54m – 240'/72m - Shorter bottom times that produce a deco of 50min or less on Nitrox 50 and O2 we choose to use only two smaller Nitrox 50 and O2 bottles. These smaller balanced AL40's are the perfect bottles. They are small and easy to carry and will provide for a planned deco upto 30 min from 70'/21m – 30'/9m and upto 50 min at 20'/6m. By carrying these bottles the diver need only carry enough backgas bailout for divers to ascend from depth to 70'/21m rather than all the way to let's say an O2 bottle. If the bottom time forces the deco time to exceed 50 min then we should rather add a 120'/36m bottle than carry a larger nitrox 50/O2 bottle to cover this longer decompression time. This 120'/36m bottle will improve the deep stops effectiveness from 120'/36m – 80'/21m and provide the extra gas needed to complete the longer decompression time. The diver will not have to carry so much backgas as to get to the 70'/21m bottle but rather only enough to reach the 120'/36m bottle. Remember that the overall shape of the decompression is such that if we need to do 30min of Nitrox 50 then we need to do at least 15min from 120/36m to 80'/24m and therefore if we are doing this on backgas we will need enough gas for two divers airsharing to do this*. In other words, you need 30min of backgas (15min for each diver) just to cover the 120'/36m – 80'/21m range. This is too much backgas to reserve, so it is imperative at this point to add the 120'/36m bottle.

* Note: This is the correct deep stop profile creating the ideal decompression schedule. If you are pressed or up against a wall (such as an airsharing episode) then you can accelerate these deep stops to get up to the 70'/21m bottle.

In the event the diver loses one of the bottles, the diver will only need to double the deco time for the segment covered by that bottle. They would need to do that doubled deco time on the backgas and should have reserve enough for this possibility. Again, rock bottom should cover the loss of at least one of the deco bottles. They will then proceed on up to the next bottle. So if the diver loses the 120'/36m bottle, the 120'/36m – 80'/24m stops will be done on backgas and the diver will still have the Nitrox 50 and O2 bottle to go to. If the diver was to carry only larger Nitrox 50 and O2 bottles and put more deco time in that range, and they were to lose one they would not have the reserved backgas to cover the deco.

240'/72m – 300'/90m – For shorter bottom times that produce a deco of less than 70mins on three bottles (120'/36m, 70'/21m, and 20'/6m) we chose to use only three smaller bottles of 35/25, nitrox 50 and O2. If deco time exceeds this, then we add the 190'/57m bottle (21/35) for the same reasons as discussed above.

Using it in Practice

0'/0m – 100'/30m

Min Deco Air Table:
0 - 130'/36m (Exponential Shape)

Note: EAD = 20% (20'/6m) for 32 nitrox or 30/30 TriOx

Depth	N.D.L. Time	Set point		
40'/12m	170	100'/30m	20min N.D.L.	
50'/15m	60	+ 10'/3m deeper	Less 5 min from N.D.L	
60'/18m	50	- 10'/3m shallow	Plus 5 min to the N.D.L	
70'/21m	35			
80'/24m	30	Extended Deco:	DT = (BT - Min deco time) + normal Min deco ascent time	
90'/27m	25	Bottom Time:		
100'/30m	20	Min Deco Time:		- minus
110'/33m	15		-----------	
120'/36m	10	Extra DT time		
130'/39m	5	Min Deco time:		+ add

		Total Deco Time:		(Exponential Shape)

* Notes:
Only add the Normal Min Deco ascent times when exceeding the N.D.L. by 20min or less.

Adding an O2 bottle will half the total time, do it from 20'/6m, do deep stops for the deeper stops.

Repetitive dives: To be conservative, double shallow stops (30'/9m - 20'/6m - 10'/3m).
Minimum Surface interval: 60 mins

100’/30m – 170’/51m

Ratio
Deco: **1:1 @ 100'/30m - 170'/51m**
Use Only 21/35 or 18/45 with Nitrox 50 for deco

Set Point
150'/45m 1 : 1

BT	DT
10	10
15	15
20	20
25	25
30	30
35	35
40	40

Adjustments on the Fly

+ 10'/3m	+ 5 min
- 10'/3m	- 5 min
Lost Deco Gas	Double Deco time

Do 1/2 Deco time @ 20'/6m and 10'/3m = 2 stops — Emphasize 20'/6m stop
Do 1/2 Deco time @ 70'/21 - 30'/9m = 5 stops — Do an S curve for Nitrox 50%

* Notes:
Repetitive Dive: to be conservative, double shallow stops (30'/9m - 20'/6m - 10'/3m)
Minimum surface interval: 60 mins
If you add O2 as well as Nitrox 50, do not adjust

180’/54m – 240’/72m

Ratio Deco:	**1:2 @ 150'/45m - 240'/72m for 18/45 or 15/55**			
			with Nitrox 50 and O2 for deco	
Set Point				
220'/66m	1	: 2		
	BT	DT	**Adjustments on the fly**	
	10	20		
	15	30	+ 10'/3m + 5 min	
	20	40	- 10'/3m - 5 min	
	25	50		
	30	60	Lost Deco Gas Double Deco time	
	35	70		
	40	80		
	Do 1/2 Deco time on O2 @ 20'/6m			Min 20% ascend time to surface
	Do 1/2 Deco time @ 70'/21m - 30'/9m = 5 stops			Do a S curve for Nitrox 50%
	Notes:			
	Do 1/2 of nitrox 50 time in 120’/36m-80’ range			
	O2 is always 12 min on O2 and 6 min off or Up			
	Always Backgas Break before gas switch (included in time)			

240'/72m – 300'/90m

Ratio Deco: **1:3 @ 240'/72m - 300'/90m for 15/55 or 10/70**

with TriOx 35/25, Nitrox 50 and O2 for deco

Set Point 270'/81m

Set Point 270'/81m	1	: 3	
	BT	DT	**Adjustments on the fly**
	10	30	
	15	45	+ 10'/3m + 5 min
	20	60	- 10'/3m - 5 min
	25	75	
	30	90	Lost Deco Gas Double Deco time
	35	105	
	40	120	

Do 0.4 (40%) Deco time on O2 @ 20'/6m   20% of the time ascent to the surface
Do 0.4 (40%) Deco time @ 70'/21 - 30'/9m = 5 stops Do a S curve for Nitrox 50%
Do 0.2 (20%) Deco time @ 120'/36m - 80'/24m = 5 stops Do a S curve for TriOx 35/25

Notes:

O2 is always 12 min on O2 and 6 min off or Up
Always Backgas Break before gas switch (included in time) 80'/24m and 30'/9m
Do half of 120'/36m bottle time in 190'/57m-130'/39m range.
If you add 190'/57m bottle do not adjust times, this will only increase the effectiveness of deep stops