The HangLine

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Have Gas – Will Travel

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The diving industry maintains that a detailed and well-thought out dive plan should be constructed for each and every dive from the open water level to deep mixed gas, cave and Rebreather diving. This is very important because divers sometimes take their experience for granted, presume a dive will work out fine and overlook some or all of the steps of properly planning a dive. When things go wrong and your dive plan did not include a contingency to cover that problem, resolving it becomes more difficult. This can increase a diver's risk and stress levels exponentially. In the last edition of the HangLine we began the process of managing the different aspects of a dive.

This involved the selection of a dive site, your buddy, how deep you were going, what gases you were going to breath, how long you could stay and what stops you had to make. We will now conclude the different aspects of advanced dive planning by considering gas management rules, equipment selection, contingency planning and the environment. Gas management rules have got be one of the top debated issues within the technical community. In actual fact determining how much gas to bring with you is quite simple if you employ a responsible management attitude. First you must begin by determining your gas consumption rate. This needs to be done in an environment

Figure 1

Calculating Gas Management

Example;

During a twenty minute swim at 66FSW (3 ATA) a diver consumes 900 PSIG out of an 80 cubic foot cylinder. The pressure at 66FSW is 3 times greater than at the surface so it is logical that the diver's air consumption at that depth will be 3 times greater as well.

Calculations: If the diver consumed 900PSIG at 3ATA then he/she will consume 300PSIG at 1ATA (the surface)

900PSIG / 3ATA = 300PSIG

According to the math the diver will breath 300PSIG from the tank at the surface over a 20-minute period. What we now want to do is find out how much the diver breaths per minute. All you need to do is divide the total gas consumed over the 20-minute period by 20 and you will get the diver's SAC Rate per minute.

Calculations: 300PSIG / 20 minutes = 15 PSIG/Min
= SAC Rate

that is as close to the conditions that you will be diving in during actual technical dives. Usually I select 3ATA (66 FSW) and swim at a normal pace for a decent period of time (around 20 minutes). I record my starting and ending pressures and complete my calculations on the surface (see example in figure 1). Ultimately I will want to calculate how many PSIG I consume per minute on the surface - this is what is referred to as a SAC Rate or a Surface Air Consumption Rate.

Once calculated the SAC Rate can be applied to any depth during any dive as long as you maintain the same breathing rate and cylinder size. Technical divers will convert this value to a RMV or Respiratory Minute Volume which allows them to calculate their consumption rate on any size cylinder(s) because the units are based on volume rather than pressure which is subject to the cylinder configuration (see figure 2).

Once your RMV is calculated you can adjust your dive plan based on the amount of gas you can expect to use and the plan for the total amount of gas you need to bring. The caving community and efforts of great pioneers like Sheck Exley devised a standard that has now become the basis for all gas management rules - it is called the Rule of Thirds. Its premise is that a dive is turned after 1/3rd of the diver's gas is consumed. It allows a cave diver to use a third of his/her gas to swim into the cave, a third to swim out of the cave and a third for any problems that might occur during the dive. The rule is based on exiting the dive with at least one third of your gas left. To many it may appear conservative but when things go wrong, one third of your gas is not a lot to get you out of trouble. There have been some arguments that propose the rule should be modified accordingly for open water dives or dives that do not require a diver to return to the same point of entry. These issues are discussed in all technical training courses

Figure 2

Converting SAC to RMV

$$RMV = \frac{\text{SAC Rate}}{\text{(Tank Working Pressure/Tank Working Volume)}}$$

Applied to the above example;
RMV = 15 PSIG/MIN / (3000PSIG/80CUFT) = .4 CUFT/MIN

and do illustrate how complex managing a dive plan can get.

The management role does not stop there, next the diver needs to determine the size of tanks needed to hold enough gas required to complete the dive and decompression safely. Can he/she manage the tanks and what are the tank's buoyancy characteristics when empty? Have they been cleaned and properly labeled for the gas they will be filled with? And then the diver needs to start reviewing each piece of gear necessary to support the dive while not task loading him/herself (refer to Gadget Pandemonium: The Redundancy Dilemma, 2010-01 issue of HangLine). This entire subject represents a huge component of technical diver training and can be referred to as **Managing your Gas** and **Managing your Equipment**.

Our management skills will next be put to work taking care of all of the contingency plans that need to be sorted out. As the complexity of the dive increases so does the risk - we have already talked about this. **Managing the Risk** (and reducing it) involves **Managing the Contingencies** that will cover our behinds when things go wrong - or better yet preventing things from going wrong in the first place. With each extra piece of gear, each foot deeper we go, each foot farther into a cave or a wreck and with each extra minute of deco we accumulate we have to explore and consider all of the things that can go wrong and what we can do to prevent or resolve it.

How about Mother Nature herself? She is the one component of a dive we have the least control over and deserves the greatest amount of respect. **Managing the Environment** includes continuous updates and evaluations and asking ourselves whether any new developments have put the dive outside of our limitations. This is called **Managing the Environment** and requires a lot of research and experience.

As you can see planning a dive means managing a number of factors. At the technical level, divers will adjust their plan many times, balancing one limit against another before deciding on a final strategy. Experience, training and good judgement allows them to do this. A good Technical Diver will not compromise safety or increase the level of risk to make a dive possible, they will compensate and prepare for it - that's what managing is all about.

~Safe Diving