# Tec 45

## Other Delivery Content, Tec 45-1

### Study assignment: Tec 45 Handout 1

**Learning Objectives**

*By the end of this section, you should be able to answer these questions:*

1. *Why is the standard practice to use two multigas dive computers on the dive, and to plan with desk top decompression software?*
2. *Why are DSMBs replacing lift bags in many tec diving situations?*
3. *Why has failure of quick releases on harness shoulders proved not to be a serious issue? What would you do if it were to happen?*
4. *What is perhaps the most common weighting error in tec diving?*
5. *Why is backup buoyancy critical in most open water, open circuit technical diving?*
6. *What are the problems with trying to use a lift bag or DSMB as a backup buoyancy system?*
7. *What is the policy of virtually every lift bag and dry suit manufacturer with respect to backup buoyancy?*
8. *Why is the redundant (double bladder) BCD the most realistic approach to providing backup buoyancy control?*

A. The standard of practice in deep decompression tec diving is to use multigas dive computers during the dive, with decompression software for overall planning. You may use a single gas computer and/or depth gauge and timer with tables in this course, but this is the recommended approach. There are several reasons why:

   1. Multigas computers now handle up to seven gas mixes (including trimix), and also calculate CCR (closed circuit rebreather) diving, making them suited to your future as well as present tec diving.
   2. A multigas computer maximizes your options in an emergency, allowing you, for example, to switch to a lower oxygen gas (even back gas) should you lose or exhaust your primary deco gas.
      a. Some of the newest models allow you to enter entirely new gases during the dive and recalculate your decompression. This provides more options in an emergency.

3. Many multigas computers have PC interfaces, allowing you to adjust stop depths, conservatism factors, etc. Some let you choose the decompression model you prefer.
4. Multigas computers track your actual dive profile, adjusting your decompression requirements based on your actual dive. This makes it easier to adjust to circumstances. Example: You accidentally exceed your planned depth slightly; you leave the bottom sooner based on your computer so that your decompression time is the same as planned, keeping you within your gas plan.
5. With a multigas computer, you can choose to decompress based on a single gas and switch to a higher oxygen gas for added conservatism (as you learned to do as a Tec 40 diver). Should circumstances require (emergency), however, you can switch to accelerated decompression to get to the surface faster with less gas used.
6. You still use deco software to plan the dive – oxygen exposure, decompression and gas requirements. Use the computer within the dive you plan.
7. Multigas computers are more sophisticated than single gas, so they're more complex to use. But, they are not difficult to use and getting easier.

B. DSMBs (Delayed Surface Marker Buoys) are replacing lift bags in many tec diving situations.
1. DSMBs stand higher in the water, making them preferred for rough conditions.
2. DSMBs are more compact on your rig, making them popular when used as an emergency alert only.
3. DSMBs have no-spill designs (though several lift bags have these, too, now), so accidentally losing tension on the line isn't likely to result in a spilled buoy.
4. The highest capacity DSMBs are essentially tall, thin lift bags and work well for drift decompression.
5. Several types of DSMBs (and lift bags) have LP inflation ports that allow you to fill them with an LP inflator hose, away from your body or mouth, without using a second stage. This minimizes the chance of regulator freeze, as well as minimizing reel tangle issues.

C. At one time, some people thought failure of shoulder quick release buckles on tec harnesses would be a serious issue. This hasn't proven true.
   1. Quick release buckles are designed to withstand hundreds of kg/lbs direct stress. This explains why stress failure is virtually unheard of.
   2. Were the release to fail, you would only have to pass the lower part of the harness strap through the D-ring on the upper part and tie it.

D. Weighting
   1. Proper weighting and adequate backup buoyancy remain two areas commonly addressed inadequately in open circuit technical divers.
   2. Perhaps the most common weighting error in tec diving is *under weighting.*
      a. Proper weighting means you're able to maintain your final stop depth with nearly empty back cylinders and either no or near-empty deco cylinders – this is what would happen if you had a major problem forcing you into a long deco using your gas reserve, and/or decoing on back gas.
      b. If you were not weighted for this, you face a high DCS risk, because you would not be able to remain at stops.
      c. As an example, a properly weighted tec diver wearing high capacity doubles and two deco cylinders will be about 14 kg/30 lbs negatively buoyant at the start of a dive, and 4.5 kg/10 lbs or more negative at the end if dive goes as planned.
      d. In this example, inadequate weighting would mean that in an emergency situation, besides the original problem, you also have to deal with between 4.5 kg/10lbs and 14 kg/30 lbs positive buoyancy while trying to decompress.

E. Backup buoyancy is critical in most open water, open circuit technical diving because a diver is substantially negatively buoyant throughout the dive.
   1. Failure of the primary BCD without a backup leaves no alternative but to drop equipment (deco cylinders, weights, etc.). This can make the situation worse if the diver must discard deco gases to attain buoyancy.
   2. Discarding gear may result in too much buoyancy. If the diver is already in deco, the ability to decompress effectively becomes compromised, growing worse as the diver consumes gas.

3. There is a high likelihood of surfacing with omitted decompression if the diver cannot maintain stop depths, or lacks the required decompression gases, or both.
4. A dry suit *may* work as a backup buoyancy device.
   a. This is primarily an option when the dive will be relatively short and shallow, with short decompression – the gas requirement is low, so the diver is not substantially negatively buoyant (such as when using aluminum cylinders).
   b. Limited option – most dry suits will not hold more than small amount of excess gas. Beyond a certain point, it escapes through neck/wrist seals.
   c. Several manufacturers caution against inflating their dry suits to gain large amounts of buoyancy because of zipper failure issues.
   d. A large volume of expanding gas is harder to control in a dry suit.
   e. With deeper/longer tec dives, backup buoyancy control other than the dry suit is generally necessary.
5. Some have advocated using a lift bag or DSMB as a backup buoyancy device. This has several problems:
   a. DSMBs and lift bags are *not* designed as buoyancy devices and are difficult to control in that role.
      - They are even more difficult to control while trying to perform gas switches, handle a gas shutdown, etc.
      - Even if learned and practiced, it is not a skill one would expect a diver to perform reliably in a real failed BCD emergency over the course of a real decompression. If it has not been practiced at all, it would be especially difficult.
      - DSMBs/lift bags do not provide a realistic buoyancy system for positive buoyancy at the surface after completing decompression.
      - Using a DSMB/lift bag as back up buoyancy would require the diver to hold on to the bag while dealing with other tasks, or it would have to be clipped to the harness. Either would compromise safety.
   b. If the DSMB/lift bag is used for backup buoyancy, then it is not available to send to the surface.

c. Sending the DSMB/bag to the surface and hanging on the line for buoyancy is not a good option either.
   - In all but flat seas, this will cause the diver to rise and fall, compromising the quality of the decompression.
   - Once sent up, there is no way to adjust the bag's buoyancy.
   - It is not a technique that transfers well to other environments.
   - Stress on the line and reel is a major issue. For this to be reliable, the diver would need to carry much heavier line and a larger reel than most tec divers prefer.

d. Trying to use a lift bag or DSMB as a backup buoyancy system unnecessarily complicates an emergency situation, and provides inadequate benefit.

6. It's worth noting that no dry suit manufacturer and no lift bag manufacturer sanctions the use of their products as tec diving backup buoyancy devices. Some specifically warn against it.
7. The redundant (double bladder) BCD is the most realistic approach to providing backup buoyancy control.
   a. They are  designed for the job and endorsed by the manufacturers.
   b. They are used the same way as your primary BCD – a well practiced skill you use on every dive, exactly what you want in an emergency situation.
   c. They are applicable to virtually all dive environments.
   d. Other than a slightly higher investment, there are no meaningful drawbacks.
   e. They are the only real option for open water tec diving in a wet suit.

**Exercise, Other Delivery Content, Tec 45-1**

1. Multigas computers have become the standard of practice in tec diving because (choose all that apply)

❑ a. they handle multiple gases and CCR diving.
❑ b. they maximize your options in an emergency.
❑ c. their decompression models are newer than those in single gas computers.
❑ d. they are smaller than single gas computers.

2. DSMBs are replacing lift bags in many tec diving situations because (choose all that apply)

❑ a. they don't stick so far up into the wind.
❑ b. they are more compact on your rig.
❑ c. they have no-spill designs.
❑ d. some have special inflation systems.

3. It is unlikely that a quick release on your harness shoulder would fail, but if it did, you would only need to tie off the loose end.

❑ True
❑ False

4. Perhaps the most common weighting error in tec diving is

❑ a. under weighting.
❑ b. over weighting.
❑ c. neutral weighting.
❑ d. None of the above.

5. Backup buoyancy control is critical in open water, open circuit tec diving because if you're properly weighted and your primary BCD fails, you risk being unable to decompress adequately.

❑ True
❑ False

6. Problems with trying to use a lift bag or DSMB as a backup buoyancy system include (choose all that apply)

❑ a. it is a complex skill with low reliability for use under stress after disuse.
❑ b. it is difficult to conduct that skill and other complex skills at the same time.
❑ c. hanging from a floating DSMB/lift bag may compromise the quality of decompression.
❑ d. hanging from a floating DSMB/lift bag requires a heavier line/reel than tec divers like to use.

7. Several manufacturers endorse the use of the lift bags/DSMBs are emergency backup buoyancy devices.

❑ True

❑ False

8. The redundant (double bladder) BCD is the most realistic approach to providing backup buoyancy control because (choose all that apply)

❑ a. they were designed specifically for this purpose.

❑ b. you use them exactly like you use your primary BCD – a practiced skill.

❑ c. it is applicable to almost all dive environments.

❑ d. other than a slightly higher cost, it has no meaningful drawbacks.

How did you do?

1. a, b. 2. b, c, d. 3. True. 4. a. 5. True. 6. a, b, c, d. 7. False. 8. a, b, c, d.

## Other Delivery Content, Tec 45-2

### Study assignment: Tec 45 Handout 2

**Learning Objectives**

*By the end of this section, you should be able to answer this question:*

*1. Why may you set a multigas computer for gas blends you don't plan to use on a dive?*

L. More on using multigas computers in emergency situations

1. You do not have to use a gas just because you set your multigas dive computer for it.
2. Dive computers that support a large number of gases can be set for gases you don't plan to use, but that would be available for use in an emergency. This gives you more gas options in the event of an emergency.
   a. Example: Deco gases used by another team that will be diving along with your team may be different from your team's, but available for sharing.
   b. Example: Air is readily available in many dive environments, so support divers could bring it for decompression use if nothing else were quickly obtainable.
3. The main drawback to having your multigas computer set for gases you don't plan to use is that you have to be sure you don't select one of the contingency gases by accident.
4. Some of the newest computers will allow you to enter a new gas during the dive should you need to do so in an emergency situation. The computer can then calculate your decompression accordingly.

Exercise, Other Delivery Content, Tec 45-2

1. You might set a multigas computer for gas blends you don't plan to use during a dive so your computer can calculate your decompression with them in an emergency situation.

❑ True

❑ False

How did you do?

1. True.

## Other Delivery Content, Tec 45-3

### Study assignment: Tec 45 Handout 3

**Learning Objectives**

*By the end of this section, you should be able to answer this question:*

*1. What are your two options for conducting deep stops?*

*2. What is the current thinking regarding deep stops?*

*3. What approach to deep stops seems to be the most prudent?*

G. More on deep stops

1. There are two primary options for conducting deep stops.
    a. The first is to use a conventional dissolved gas decompression model and then add deep stops as discussed previously and in the *Tec Deep Diver Manual*.
    b. The second is to use a decompression model that inherently stops you deeper than other models. Most “bubble” models fit into this category.
2. Although deep stops had a lot of anecdotal support at one time, the current thinking based on US Navy Experimental Diving Unit research is that they may not be as beneficial as once thought.
    a. The USN compared a bubble model and conventional dissolved gas model on manned test dives. Dives were to the same depth for the same duration with the same decompression time distributed over a deep stops (bubble) schedule and a conventional (dissolved gas) schedule.
    b. The tests were terminated due to an unacceptable DCS rate in subjects decompressed with the bubble schedule.
3. Other data are less conclusive.
    a. Some no stop diving tests find a minor benefit to deep stops.
    b. Many divers have been using bubble models without difficulties.
    c. Deep stops and bubble models are common practices widely used in the tec community, again, without widespread problems.

4. The prudent approach to deep stops at the moment seems to be:
   a. Use a conventional dissolved gas model and add deep stops as you learned. The deep stops will lengthen your shallower stops.
   b. If you wish to use a decompression bubble model, choose one that is well supported by human test data.
   c. Whatever model you use, stay well within limits and pad your decompression to make it conservative. Don't be in a hurry to leave your last stop – extend it beyond the required time.
   d. Stay up to date on the latest findings in decompression research. Know your sources – just because someone says something on an internet forum doesn't make it true.

**Exercise, Other Delivery Content, Tec 45-3**

1. Your two options for deep stops include (choose all that apply)

❑ a. using a deep stops bubble model.
❑ b. adding deep stops to a bubble model.
❑ c. using a conventional dissolved gas model.
❑ d. adding deep stops to a conventional dissolved gas model.

2. The current thinking on deep stops is

❑ a. they are unquestionably beneficial.
❑ b. they are unquestionably without benefit.
❑ c. there is some doubt about whether they're as beneficial as once thought.

3. To use deep stops prudently (choose all that apply)

❑ a. use a conventional model, add deep stops and complete the extra deco they add.
❑ b. if you use a bubble model, use one well supported with human test data.
❑ c. use any model conservatively.
❑ d. stay informed about the latest findings in decompression theory.

How did you do?

1. a, d. 2. c. 3. a, b, c, d.