Unified Team Diving™

UTD Student and Diver Procedures

Photo by Jeanna Edgerton

Unified Team Diving™

v 1.1

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Forward

Welcome to the *UTD Student and Diver Procedures Manual*. This book outlines, in detail, each of the skills, procedures and protocols as set by Unified Team Diving and its teachings. This manual will help you – the recreational, technical, overhead, or rebreather diver or student – understand each procedure we consider critical to proper and safe diving, and will enable you to achieve your goal of being a strong, thinking diver.

The Student and Diver Procedures Manual offers a written explanation and documentation standardizing the various student and diver procedures and protocols. You will find the sections divided into –

- Normal Procedures
- Student Drill Procedures
- Emergency procedures
- Bulletins and Papers
- Checklists and Worksheets

UTD also publishes a series of videos to help you visualize the skill sets. Ultimately, our online classes and printed student class materials support our certification classes.

So go ahead, get started and enjoy. Unified Team Diving provides an online forum at www.unifiedteamdiving.com as a place to ask more questions and get answers from UTD instructors and others in the community. If you still have unanswered questions, feel free to email us at info@unifiedteamdiving.com.

Safe Diving,

Andrew Georgitsis and Jeff Seckendorf

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Preface

Background

By understanding UTD's roots and background, you will see our vision and the future of UTD Training, Adventures and Equipment. Looking back into the early 1990's, there was an equipment configuration style emerging from the North Florida cave diving community called "Hogarthian." At that time the community of technical, wreck, and cave divers was very small, yet very divided. There were many opinions on how to configure the equipment the "right" way, often implying everyone else was diving wrong. Even within the Northern Florida and U.S. east coast diving communities, there were many technical, wreck, and cave divers who were configuring in a variety of ways from "stuffed" long hoses, to independent doubles, to multiple regulator systems on a single stage tank, to a multitude of convoluted and difficult to comprehend systems.

The Hogarthian configuration, named after Bill "Hogarth" Main, emerged at about the same time as the internet chat forums and boards. This allowed the word to spread about a configuration that was minimalist, clean, simple, and well thought out. The system was soon adopted by a cave exploration team called Woodeville Karst Plain Project (WKPP). Their project director at that time, George Irvine III, started to instill the configuration into his team and diving protocols. His passion for exploration, his extreme dedication to WKPP, and his personality led him to become very ridged in his approach to applying the Hogarthian configuration and demanding a team approach to exploration of the Wakulla Springs cave system.

In an article published in the late 1990‘s in *Aquanaut Magazine*, a technical dive magazine, Irvine coined the term “DIR,” or “Doing It Right.” In this article he pushed the idea of not only utilizing a consistent, scalable, streamlined and minimalist configuration mimicked after the “Hogarthian” configuration and drove the idea that DIR was a complete team approach to conducting a dive. That included everything from a consistent equipment configuration, to the consistent selection of the gases, decompression strategy, skill set and so on. DIR was born.

As the scope of the WKPP cave pushes became more and more complicated, the need for the team to all be on the same page and also be the source of backup equipment became more obvious. This drew national and then international attention. WKPP was achieving what others could not by utilizing a “DIR” approach to the project and/or dives.

At the same time, some of the upper level WKPP members, together with lead push diver Jarrod Jablonski and UTD founder Andrew Georgitsis, developed a training organization to teach and solidify the “DIR” approach. This teaching methodology would consist of an equipment configuration (modeled after the Hogarthian style), a “foundational diving skill set” taken from cave diving, and “procedures and protocols” culled from the WKPP methodology. Ultimately this is what became taught as the “DIR” approach.

For 10 years, UTD founder Andrew Georgitsis was the training director for this organization, developing the standards and procedures, training protocols and the senior instructors. In 2006 Georgitsis broke away to develop and pursue his vision of the “Unified Team.” Although “DIR” has many tenants that are excellent and make a great foundation from which to build your diving skills, the extreme rigidity and

lack of expandability beyond open-circuit back gas doubles and deco/stage bottles became limiting. In 2008 Georgitsis and Jeff Seckendorf teamed up, and Unified Team Diving (UTD) was born.

UTD is a progressive training agency with roots in DIR. To that end, we continue to teach a very consistent “DIR” open circuit program, from our Open Water and Recreational 1 basic certification classes, through more advanced recreational diving, technical, trimix, cave, wreck, and rebreather.

Our open water students learn the same team procedures, same emergency procedures, same gas planning and ascent procedures as our Trimix students. This means there is a consistent path to all training within the agency. There is no need for students to replace gear, or learn new protocols as they move though more advanced classes. Each class advances on the previous, adding to the students’ experience as they move to deeper and more complicated diving, such as overhead cave and wreck environments.

UTD then pioneered the integration of other diving disciplines into the “UTD/DIR approach,” including the MX Series mCCR Rebreather, a fully closed circuit manual rebreather, based on designs and disciplines learned, taught and propagated by Andrew Georgitsis and other WKPP members using pSCR rebreathers in exploration during the late 1990’s and early 2000’s. This is a UTD/DIR compatible configuration for a rebreather, allowing a mix of open circuit and closed circuit divers to seamlessly function as a team – gas planning, ascent strategy, and emergency procedures are all similar.

This question often arises: Why does UTD care about “mixed team” protocols? Simply put, this should be the cornerstone of any rebreather configuration and design. In other words, almost every emergency on a rebreather leads to an open circuit bailout therefore, by default, the team has to deal with the emergency and exit as a “mixed” team. Knowing, practicing, and ensuring the team understands the proper protocols and procedures of mixed-team diving is essential in these “emergency” bailout situations.

The integration of MX Rebreathers and the UTD/DIR open circuit configuration must be seamless, from equipment configuration to gas management, from deco procedures to skill set. So if it's good enough for an emergency, it surely is good enough to enjoy a dive together.

A second discipline UTD pioneered was the integration of side mount with UTD/DIR principles and protocols. With the explosion of side mount diving as a style, many divers want to take advantage of the benefits of side mount diving, not only in their advanced side mount cave diving, but in their general recreational, technical, wreck and even recreational cave diving.

Side mount diving in the past posed many barriers and issues in consistency within the team. UTD's research and development team, along with the UTD instructor corps, spent much time and effort developing a system that integrates perfectly with the traditional UTD/DIR back mount system – we call this the Z-System. Traditionally, side mount was not considered DIR, but with the UTD Z-System, side mount is now seamlessly compatible with either UTD/DIR and/or the MX rebreathers.

In other words, each of these disciplines is "DIR Compatible" and integrates perfectly with the other systems.

The Future

UTD will continue to advance consistent, team-focused training. We are expanding side mount training to integrate it fully into both overhead and open water environments, providing a full range of classes for all divers. The same is true for rebreather training.

At the same time we continue to stay true to our roots and offer a full range of open circuit back mount UTD/DIR classes. We continue to expand our courses and materials, ensuring that we keep the community consistent through our student and instructor materials – from the UTD Standards and Procedures to the UTD Instructor Playbook, from the videos to the Student and Diver Procedures Manual.

All of this is designed to educate and facilitate the instructor,

student, and diver who wants to apply UTD ethos to their diving.

Our community is our greatest asset. We are offering divers a place to train AND dive with like-minded people. So UTD Adventures – instructor-led trips around the world – is expanding to include regularly scheduled dives wherever there is a UTD instructor or divemaster. We are holding Cave Week three times each year, twice in Mexico and once in France, Wreck Week is the first week in October every year in the Red Sea, and we are expanding into more project/scientific dives that are available for all divers.

UTD Equipment is focused on our five Signature Series projects – Z-System Side Mount, MX-Series Rebreathers, Delta and Alpha Series Wings, Vision Lighting, and Solar Dry Suit Heating. Our plan is to maintain focus on these five areas.

So join us – online at www.unifiedteamdiving.com, in the water at www.utdadventures.com, and for gear at www.utdequipment.com.

We wish you great training, safe diving, and unlimited fun in the water.

Unified Team Diving
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Situational Awareness
Equipment Management

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Situational Awareness Check

The purpose of a situational awareness check is to take a mental note during the dive. We do this approximately every five minutes. This should be done 'on the fly,' without stopping your team. It is one of the most important things to learn to ensure you stay on top of all aspects of a dive – team, environment, and equipment. It is conducted as follows:

- Flow check (optional)
- Track bottom time and average depth
- Track gas consumption
- Monitor your team

Double check the environment for:
- Any object or condition that helps with navigation and return to entry
- Any changes in conditions - current, silt, visibility, etc.

A situational awareness check helps us:

- Confirm positioning of all tank valves
- Calculate current gas consumption

- Adjust dive parameters on the fly based on in-water gas consumption, actual average depth, and ascent profiles or decompression strategy
- Assist navigation
- Adjust the dive parameters as needed

Ascents

Depending on the environment, we will determine the final shape of the ascent profile. Here is a general set of rules to help get started. In any ascent, the last stop should be conducted at 20'/6m, followed by a slow ascent of 3ft/1m per minute to the surface – we call this a 5-minute ascent drill in the UTD Essentials classes.

Recreational Minimum Deco Ascent Profile Overview

- Calculate 50% of the average depth of the dive or your current depth, whichever is deeper.
- Ascend at 30'/10m per minute to the calculated depth from above.
- Conduct a one minute stop for each remaining 10'/3m interval including the ascent to the following stop. This can be conducted as a 40 second stop and 20 seconds of movement to the next shallower interval.
- Continue until you reach the next strategy or the surface.
- This ascent profile is based on a one-hour surface interval. If the surface interval is less than one hour, double the three shallow stops, 2 ATA to the surface, or 30'/9m, 20'/6m, 10'3m.

Extended Decompression Dives
(longer than 15 min bottom time)

- Calculate 75% of the average depth of the dive or your current depth, whichever is deeper.
- Ascend at 30'/10m per minute to the calculated depth.
- Conduct a one (1) minute stop for each remaining 10'/3m interval including the ascent to the following stop. This can be conducted as a 40 second stop and 20 seconds of movement to the next shallower interval.
- Continue until you reach the next strategy.

Flow Checks

Flow checks are conducted at various points in the dive to confirm that all valves are in the correct position. Flow checks are mandatory in overhead environments.

Standard times to conduct a flow check:

- On the surface during pre dive - modified valve drill.
- Upon initial descent.
- Mid point or turn point in a dive.
- Anytime you feel the need due to bumping a valve or tanks.
- After valve failures.
- After any drill involving manipulating the valves.

Back Mount Flow Check

This procedure is similar to the modified valve drill in that it is normally completed to ensure the valves are all the way open and can be turned closed. So slightly turn the valve closed (less than one-quarter turn) and then turn it back to fully open. This includes single, double and all stages/deco bottles and the dry suit inflation bottle. We generally start from the right side and work towards the left and then down to the stages/deco and suit inflation, followed by SPG checks.

Check that the right valve is on and can be turned off, isolator is on and can be turned off, the left valve is on and can be turned off, and stages, deco's, and suit inflation bottles are pressurized and in the correct on or off positions. Finally, check back gas SPG.

Side Mount Flow Check

As in back mount, this should be done from right to left.

- Check the right valve is either open (turn valve slightly off and on) or closed - checking pressure.
- Check the left valve is closed (turn it on and off - checking pressure) or open as appropriate.
- Check that any other deco or stage/deco bottles are pressurized and closed or open as appropriate.

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Propulsion and Team Positioning

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Photo by Nick Ambrose

Propulsion

We aim to employ a variety of kicks in order to create precise maneuverability and maximize efficiency.

Generally most divers were taught a flutter kick to simply go forward. Some fins even proclaim to go the fastest forward. In reality, diving is about not only propelling forward, but maneuvering in a variety of environments.

The choice of fin is directly related to the efficiency and precision of the kick, so a discussion on fins is useful. Small bladed fins with stiff tips allow us to feel the tips and really control our position while allowing us to move away from the standard type of flutter kick. We find it inefficient to use the largest muscle in the body in order to drive water up and down – it burns the most energy, stirs up the bottom, promotes silting and potentially disturbs the environment. In addition, extending our legs straight out promotes a feet down / head up angle of trim.

These are the five propulsion methods we use:

- Frog kick
- Modified Frog
- Modified Flutter
- Backward
- Helicopter

Using these various kicks allow us to make almost no impact on the environment, as water is not forced down toward the bottom. The proper kick will also provide much better efficiency. Better efficiency means less effort, less effort means a lower gas consumption rate, and a lower consumption rate means a longer, calmer dive.

We typically use three kicks for forward propulsion – the frog kick, modified frog kick and modified flutter kick. For maneuvering and maintaining position while still protecting the environment, we use the backward kick and helicopter turn.

Frog Kick

Let's start with the frog kick. Because it is a very powerful kick requiring little effort, and it is good for the environment, the frog kick is the primary kick we use for forward propulsion. There are two simple steps to the frog kick for the diver in trim. First, from the 'glide' position simply 'slice' the sides of the fins/blades through the water to reduce drag. Next, the ankles turn the blades to create thrust. During the power stroke, picture yourself clapping your feet together. Though you're not actually touching the bottom of your feet/fins together that's the general movement. It's important to note that only the ankles, knees and groin are used for this kick. Your hips are NOT used and your knees will not drop below your hips.

Modified Frog Kick

The modified frog kick is a kick that is very useful in narrow environments where the wide strokes of the frog kick are too wide for the passage, or when you only need to make very slow forward progress. The modified frog kick is similar to the frog kick but the diver only uses his ankles for the loading and power strokes. Your knees are NOT used, nor are the groin muscles, only the ankles. Again, like the frog kick the hips are NOT used. This is a very small, efficient, and restful kick.

Modified Flutter Kick

The modified flutter kick is useful as a powerful forward kick in narrow areas, such as when having to maintain very tight wing on wing team positioning in poor visibility, or through a passage that might result in kicking the side walls using the full frog kick, or even just to take a break from frog kicking. The modified flutter varies from the flutter, or 'scissor' kick, in that the groin and hip remain stationary as they would in the prone position. During the power stroke, with the knee perpendicular to the body, the ankle is pointed so as to point the fin tip directly upward. Then flex the knee to 45º using the front side of the fin blade for propulsion. The recovery stroke involves relaxing the ankle which allows the fin to return to horizontal and minimize drag as the knee returns to the 90º position.

The Backward Kick

The backward kick is critical for the diver to maintain position in the team, maintain position in light current, and avoid having to 'push off' from the environment or other divers. For the loading stroke, picture touching the bottoms of your feet together. Though you won't actually touch them together, picturing it that way can help. Point the fin tips down and slowly extend them further aft. Make sure to keep your head up for balance and trim. For the power stroke, keeping your heels together, move your toes apart and then swing the blades OUT to create the most drag. The blades go out, not toward your head. Sweep the fins forward using the top and side of the fins for power. Be sure to keep your knees up. Then recover by extending your fins with your toes pointed straight back, being careful not to propel yourself forward. Then repeat.

The Helicopter Turn

The helicopter kick allows you to turn or change position

without have to make a wide, sweeping turn. The loading stroke simply has the ankle slice the fin through the water. For the power stroke, the outside ankle 'pushes' with the bottom of the fin, while the inside ankle 'pulls' with the top of the fin. In other words, one leg does a regular frog kick, while the other leg does a backward kick.

Team Positioning

Because we are part of a team, we need to pay attention to both our individual position and team position. In other words, where you position yourself affects the team, so consider the complete environment and where the other members of your team are when you decide where you will be at any given moment.

Remember, the goals of the team are:

- Safety
- Efficiency
- Ease
- Individual Awareness

So your individual goals should be:

- Awareness of all team members' positions
- Awareness of team members' fields of view and their ability to move
- Your ability to communicate, either with visual signals, touch contact, or light signals

Team Member Roles

Within the team, it's important to agree upon the roles and responsibilities before the dive. These will be reviewed during the Pre-Dive SADDDDD sequence, but a more involved discussion may be required prior to gearing up. Let's talk about the dive leader. While all members of the team are ex-

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Valve Drills

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UTD Standard Protocol Valve Drills
Single Tank Back Mount
Double Tank Back Mount
Double Tank Side Mount
MX Series Rebreathes

The valve drill is not designed to specifically mimic reality, it is a drill only. The main purpose of the valve drill is to ensure the diver can remain aware of their surroundings and be stable in one position, be horizontal and neutrally buoyant, and in proper trim while task loaded. Further, the goals are to be able to reach and manipulate the valves making sure there are no mobility issues, and ultimately create an association between each valve and its corresponding second stage.

Equipment

The valve drill will allow divers to become comfortable with the management of their breathing equipment and to understand the correlation between valves, first stages, and second

stages. It also develops the rote muscle memory of long hose use, switching regulators, using clips, dealing with lights and stages, as well as maintaining buoyancy control and positioning while task loading.

Team Skills

The valve drill is a team orientated drill. The idea is to create communication and awareness between team members. Overall awareness of the team, equipment and the environment are all equally important.

UTD Valve Drill Protocol - Single Tank Back-Mount

Team Communication Signal:
"YOU – WATCH ME – VALVE-DRILL"

Phase One – Get a Safe Source of Gas

- Conduct an air share with teammate.
- Clip-off long hose.

Phase Two – Shut Down Tank

- Left hand signals light once or twice to gain attention while shutting off tank valve.
- Purge long hose.
- Signal OK.

Phase Three – Turn on Tank

- Turn on tank.
- Unclip long hose.
- Purge long hose regulator to confirm a gas supply.
- Replace primary regulator long hose, return donated regulator.

- Teammate stows the long hose and switches back to primary.

Final Phase – Flow Check

- Check valve is all the way open (turn valve slightly off then on again - making sure it can move).
- Check SPG.
- Signal OK.

Key Points

- Maintain horizontal trim and a head-up position at all times.
- Keep aware of team, equipment and the environment.
- Maintain a quick flash of light once or twice, enough to get the team's attention, not a consistent flashing during shutdown. If a teammate loses his attention, pause the drill, flash again, than continue.
- Strive to clip and unclip long hose with one hand.
- Extend arms out front first before reaching up and behind for maximum mobility.
- Keep arm and elbow close to ear when reaching up and behind for maximum mobility (like combing your hair).
- Be aware of accidently venting gas from the dry suit when manipulating the left post.

UTD Valve Drill Protocol - Double Tank Back-Mount

Team Communication Signal:
"YOU – WATCH ME – VALVE-DRILL"

Phase One – Right Post

- Purge backup regulator to ensure it is functioning.

- Left hand signals light once or twice to gain attention while shutting down right post.
- Breathe right post down/switch to backup and clip off long hose.
- Turn on right post, purge clipped off long hose to confirm it's on.

Phase Two – Isolator

- Left hand signals light once or twice to gain attention while shutting off isolator.
- Turn isolator back on.

Phase Three – Left Post

- Purge long hose regulator to check it is on, unclip long hose.
- Switch light to right hand.
- Right hand signals light once or twice to gain attention while shutting down left post.
- Breathe left post down and switch light to left hand.
- Switch to long hose.
- Switch light to right hand.
- Turn on left post.
- Switch light back to left hand.
- Purge backup regulator.

Final Phase – The Flow Check

- Check right to left making sure all valves are open (turn valves slightly off, then on again).
- Check SPG.
- Check deco bottles.

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Ratio Deco

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Overview

Ratio Deco is a simple "on the fly" strategy of applying a set of rules to develop your "decompression strategy" that will minimize the risks and maximize the benefits of the dive for you and your team. No matter what your range, environment, or equipment (open circuit, semi closed circuit, or fully closed circuit), Ratio Deco will help you approach the decompression as a team with a consistent approach and strategy.

Most importantly, you and your teammates will understand the risks vs. benefits and how to best deal with the decompression, especially when something goes wrong. Your Ratio Deco strategy will be derived from a combination of different decompression theories, existing software profiles, past and present ideologies, and ultimately your experience with the profiles. All of these are then combined into one easy to use "on the fly" strategy.

Ratio Deco is applicable and consistent within any environment, throughout any range of diving, utilizing either open circuit or closed circuit. Most importantly, Ratio Deco is simple to use by both the diver and the team, especially during the dive. If any changes occur to the planned depth or bottom time, the deco can easily be adjusted.

The following discussion of Ratio Deco strategy is a starting point, with a set of guidelines that are based on UTD / DIR standard mixes, deep stops, oxygen windows, free phase gases and dissolved gases. Initially, you will want to take a small step away from relying on a computer-generated profile and/or wrist mounted computer, and practice using a very conservative Ratio Deco Strategy. Therefore, we encourage you to start by using the set of Ratio Deco rules and strategy outlined below. This will allow you to gain the experience and confidence in your deco schedules prior to deviating. You can then develop your own set of rules or tweaks.

You will find that these in-water times for decompression are very similar to a Neo-Bühlmann or Workman profile set to a conservative factor of GF low 30 and GF high 85 and/or a computer generated profile from V-planner (RGBM / VPM-B) set to a conservative factor of +2. However, you will find with Ratio Deco that deep stops are incluced and yeild a shape that is very different from anything produced by a computer software model or a computer strapped to your arm. The Ratio Deco strategy shape takes into account the best of various theories and practical experience as we know it today. The rules have evolved and will continue to evolve slightly as we learn more about decompression.

Global Perspective

Background

The first concept for a diver or team to understand is that a decompression profile or decompression strategy is not an exact science. It is not black and white. The times and stop depths are not precise, predictable, or even scientifically proven. DCS is very unpredictable – you can do everything perfectly and still suffer a symptomatic progressive DCS hit. Therefore, there is no perfect model or shape to decompression. Diving has the inherent risk of DCS and your approach and strategy to your diving, including your decompression, should weigh the risk vs. benefit, minimizing the risk and maximizing the benefit.

In other words, every time you dive, you get bent. Whether you are symptomatic or not, you essentially suffer some degree of DCS. How much is based on many factors – not only the gases you use, the profile, the times, and the stop depths, but also the condition within the human body. The human body is a living organism that is very dynamic and it deals with the introduction of foreign objects (gases, bubbles, pressure and so on) in a very unpredictable way.

Rather than believing you will not get bent if you follow your computer exactly, or if you print a black and white profile from your home computer and perfectly follow the exact stop times and depths, consider managing your decompression strategy properly so that you minimize your risk of being symptomatically bent (a DCS hit).

A second concept to move away from is that of a "best Mix," or exact bottom mix custom blended for a particular dive, depth, and time which leads to a requirement of exact stop times and depths – this is the basis of most decompression models.

However, these are statistical models generated mathematically by formula which do not exactly apply to a living organism such as the body. It can give you a basic premise, but it can't be exact. Your Ratio Deco strategy will be based on an average partial pressure of oxygen – PPO_2 – on the bottom of above 0.8 and below 1.2 depending on the length of your exposure.

If a dive has four hours of bottom time, it may not be prudent to expose yourself to a PPO_2 of 1.2, or worse yet 1.4, believing you are somehow offsetting the maximin amount of inert gas or nitrogen and reducing your risk of DCS. The more important fact is that you are exposing yourself to a much higher risk – oxygen toxicity (CNS and pulmonary). This is an example of how a computer decompression profile or program does not take into account "real" world diving weighing the risk vs. benefit to give you the best "Decompression Strategy."

For example, if we were going to plan a dive to 140'/42m, rather than calculating and using an exact mix to offset the most inert gas, in a Ratio Deco strategy we rather use a standardized mix of either 18/45, 21/35 or 25/25 for the dive. The appropriate choice would be based on first reducing the risk of oxygen exposure and toxicity, then the reduction of the production of CO_2 through gas density and narcosis, and then lastly reducing the risk of DCS.

If you are on open circuit or semi closed circuit, you would pick a standardized back gas or bottom gas that maintains your PPO_2 on the bottom above 0.8 and below 1.2. If you were on fully closed circuit, such as the MX Rebreather, rather than trying to maintain a perfect PPO_2 of 1.2, you would keep it above 0.8 and below 1.2 throughout the bottom portion of the dive by maintaining an average of 1.0. You would then pick the appropriate level of helium to reduce the gas density, breathing resistance, and narcosis, Finally you pick the decompression strategy.

Moving on to the decompression bottles and gas choices (amount and FO_2 in the mix), in open circuit, semi closed circuit, or open circuit "bailout" for fully closed circuit rebreather, you could choose from a range of standardized deco gases that meet various criteria. First and foremost, the first deco bottle choice must be based on the volume of bottom gas reserved to meet the UTD Rock Bottom requirements (see Rock Bottom Section).

Side Note: Keep in mind to reserve enough gas for two divers to air-share from the bottom to the next available source of gas, whether it be a stage bottle, deco bottle, and / or the surface.

For example, if you do a 200'/60m dive with just an oxygen bottle for decompression, the software might show a good decompression profile. However, you can clearly see that the required rock bottom "reserve gas" needed to get off the bottom, do all the deep stops and the mid range decompression stops, and then switch to oxygen at 20'/6m would be impossible, especially while two divers are air-sharing – you would not be able to carry that much back gas. Therefore, you would be served by introducing a deeper decompression bottle as well as the oxygen bottle. This would provide for a safer dive,

UTD Standardized Mixes

Bottom Mix/ Deco Mix	Working Depth/ Deco Range	MOD (Max PPO2)	END (Max Depth)	Mixing (Air Top)
Nitrox 32%	0 - 100'/30m	111'/33m	-	14% O2
Helitrox 25/25	90'/27m - 130'/39m	151'/46m	88'/26m	12% O2 25% He
Helitrox 21/35	100'/30m - 160'/48m	190'/57m	98'/29m	9% O2 35% He
Trimix 18/45	160'/48m - 200'/60m	220'/66m	94'/28m	8% O2 45% He
Trimix 15/55	200'/60m - 250'/75m	275'/83m	90'/27m	7% O2 55% He
Trimix 12/60	250'/75m - 300'/90m	352'/106m	100'/30m	5% O2 60% He
Trimix 10/70	300'/90m - 400'/120m	429'/130m	88'/26m	4% O2 70% He
Oxygen	20'/6m - 0'/0m	20'/6m	-	O2
Nitrox 50%	70'/21m - 30'/9m	70'/21m	-	36% O2
Helitrox 35/25	120'/36m - 80'/24m	120'/36m	80'/24m	25% O2 25% He
Helitrox 21/35	190'/57m - 130'/39m	190'/57m	98'/29m	9% O2 35% He
Trimix 18/45	240'/72m - 200'/60m	240'/72m	94'/28m	8% O2 45% He

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Battlefield Calculations

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Introduction

Picture yourself on the road, driving to a dive site. Suddenly you notice a sign that reads, “Next Gas 65 Miles.” A quick glance at your gauge reveals that it is one-third full; do you need to stop now and fill your tank, or do you have enough to make it to the dive site?

To be able to answer confidently you need to know your car’s gas mileage and how much a full tank holds. The gas mileage may change with the terrain and how many scooters and tanks you’ve loaded into the back. With the right information you can do a quick calculation and know if you need to stop, even if you’re driving a rental, or a car you are not familiar with.

The same applies to diving. Once you get to the dive site you can do simple “battlefield calculations” to properly manage your breathing gas supply before and during the dive.

Battlefield calculations build on a basic understanding of the pressure in the water column and the pressure in your tanks to give you effective ways to do math on the boat, on shore, and even underwater to make diving safer and more fun.

We know that to some the word “math” is a “four-letter” word and for others as soon as you hear “calculations” you reach over for a calculator. STOP. Battlefield calculations are exactly that - meant to be done on the fly, quickly and easily, while underwater – no calculators, no scratch pad, no help from your mom – just study this chapter, get some practice, use your brain, and before you know, you’ll be doing math and calculations quickly and easily while underwater and “on the fly.” So reach over, grab a cup of your favorite coffee, get out your wetnotes, and let’s get cracking.

First and foremost, this is “scuba math”– it is not exact math. You cannot and will not be able to calculate every variable. Diving and the in-water environment is so dynamic we can allow for some room in the calculations. We will normally “error” on the side of conservative, but you cannot predict and account for everything. It is better to get a basic idea by doing a best “guesstimate” when planning, then double check the work while diving, updating “the plan” as we go, ultimately changing and accommodating it to the environment as we dive. This can be a very difficult concept for many divers and students who have a background in industries that require precision. It may take years to finally come to the conclusion that it is better to have a basic best guesstimate plan and update as the dive unfolds.

Gas Laws Reviewed

Basic gas laws involve three variables – pressure, volume, and temperature.

Boyle’s Law

Boyle’s law, published in 1662, shows that at constant temperature, the product of an ideal gas’s pressure and volume is always constant. If a container, with a fixed amount of molecules inside, is reduced in volume, more molecules will hit the sides of the container per unit of time, causing a greater pressure.

Boyle’s law affects many aspects of diving, including gas management reserves, consumption rates, etc...as well as just basic physiology.

Assuming temperature remains constant then the following holds true:

Pressure (ATA) = 1 / Volume

Better stated, the pressure is inversely proportional to volume. As pressure goes up (descending in the water), then the volume goes down. As pressure goes down (ascending) then volume increases proportionally.

This is very important to us as divers, because on any ascent, as pressure is reduced, teh volume is increased. Which means gas is expanding in our lungs, sinuses, inner and middle ears, BCD’s, dry suits, wet suits (in the neoprene), etc.

Dalton’s Law

Dalton’s law of partial pressures states that the total pressure of a mixture of gases is simply the sum of the partial pressures of the individual gases. Dalton’s Law is as follows:

Where PTotal is the total pressure of the atmosphere and PGas (PO_2, PN_2, PCO_2 , etc.) is the pressure of the gas mixture in the atmosphere.

Dalton’s law helps us calculate mixing gases and understanding how each of the gases within a total gas mixtue affects us.

$PTotal = PO_2 + PN_2 + PCO_2 + Pother$

In other words, when we dive, and we subject our bodies to increased pressure, we can look at the individual pressures of the gases we are breathing. If air is basically 21% oxygen and 79% nitrogen, and we double the pressure on our bodies by descending to two atmospheres (33’/10m) then the individual partial pressures double – the oxygen becomes .42 and the nitrogen becomes 1.68. Add the two partial pressures together and they equal ambient pressure. In this case the ambient pressure is 2.0 (two atmospheres, or 2 ATA).

Imperial Gas Planning Worksheet

Unified Team Diving

Step 1: Determining ascent

	Depth	Stop Time
Max Depth		----
50% of Max		
Total stop time		

Step 2: RB time

	Time
Emergency	
Time to 50%	
Total stop time	
Total RB time	**min**

Step 3: RB volume

Emergency SCR	cf per min
X Average ATA's	ATA
= DCR	cf per min
X 2 divers	cf per min
X RB time	min
RB VOLUME	**cf**

RB in psi

Rated Volume	cf
÷ Service pressure	psi
x 100	cf/100psi
= **Tank Factor**	cf/100psi

RB in PSI

RB Volume	cf
÷ Tank Factor	cf/100psi
= **RB psi**	psi

Step 4: Gas Plan

	Pressure
Start Pressure	psi
- RB psi	psi
"= Usable psi	psi
÷ Gas Plan	
= **OB psi**	psi

Start Pressure	psi
- OB psi	psi
= **Turn Pressure**	psi

Bonus: Bottom and Run Time:

SCR (normal)	cf/min
X Depth in ATA's	ATA's
= DCR	cf/min
÷ Tank Factor	cf/100 psi
"= PSI/min at depth	

OB psi	psi
÷ PSI/min at depth	psi/min
"= OB time	min
+ IB time	min
+ Ascent time	min
Run Time	min

Be sure to reference minimum deco limits (NDL) when deciding on final bottom time.

Metric Gas Planning Worksheet

Unified Team Diving

Step 1: Determining ascent

	Depth	Stop Time
Max Depth		----
50% of Max		
Total stop time		

Step 2: RB time

	Time
Emergency	
Time to 50%	
Total stop time	
Total RB time	**min**

Step 3: RB volume

Emergency SCR	L per min
X Average ATA's	ATA
= DCR	L per min
X 2 divers	L per min
X RB time	min
RB VOLUME	**L**

RB in Bar

RB Volume	L
÷ Tank Factor	L/Bar
"= **RB Bar"**	Bar

Step 4: Gas Plan

	Pressure
Start Pressure	
- RB Bar	
"= Usable bar"	
÷ Gas Plan	
"= **OB Bar"**	

Start Pressure	
- OB Bar	
= **Turn Pressure**	

Bonus: Bottom and Run Time:

SCR (normal)	L/min
X Depth in ATA's	ATA's
= DCR	L/min
÷ Tank Factor	L/Bar
"= Bar/min" at Depth	

OB Bar	
÷ Bar/min at depth	
"= OB time	
+ IB time	
+ Ascent time	
Run Time	

Be sure to reference minimum deco limits (NDL) when deciding on final bottom time.

Notes:

Unified Team Diving™

Conclusion

The Ten Covenants of Unified Team Diving


Photo by Jeanna Edgerton

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Over the years we have defined who we are as UTD Divers. The following ten covenants clearly define the way we dive, the way we think, and the way we act when in the water as a unified team.

We offer these covenants as a way for you to define your own diving, whether technical diving, working underwater as a scientific diver, or just out for an easy recreational dive.

1. **Unified Team Diving** – The team is your backup – gas, equipment and brain.

2. **The Thinking Team** – No team member relies on another person or piece of equipment to make the "sole" decisions. No "trust me" dives.

3. **Rock Bottom Gas Management** – Every diver carries enough gas to bring two divers to the next available gas source, either the surface, a deco bottle, or stage bottle.

4. **Standard Gases** – Dive the desired PPO_2 at the target average depth and keep the equivalent narcosis depth to 100’/30m or less. NO DEEP AIR.

5. **Consistent Modular Equipment Configuration** – Have an equipment configuration that is consistent, modular and scalable within the team for all types of diving and diving environments.

6. **Minimalist Approach** – Only take what you need for the dive.

7. **Holistic** – All components of the system are thought out, work together, and have a solid reason behind their use and placement.

8. **Streamlined and Accessible Equipment Configuration** – All components can be stowed, yet are convenient to access.

9. **Situational Awareness** – Manage the environment, equipment and team, giving equal attention to each, but never become fixated or inflexible. Head up, eyes open, and brain on.

10. **The Proper Training and Experience for the Dive** – Have the appropriate training to ensure consistent protocols and skills for the dive, and understand potential hazards. This will ensure the correct starting point to build experience.