Women and Diving - valid topic or dead horse
By Andrea Zaferes, Lifeguard Systems

It takes a new diver asking questions about diving and pregnancy, decompression sickness susceptibility, menstruation concerns and birth control pills, to make us remember that as long as there are women divers there will be women and diving issues that need to be discussed. Some of us who have sat through too many panels and have read too many repetitive articles on women and diving find ourselves saying enough is enough, stop the segregation. The issue of the above questions can not be ignored, nor can the fact that there are gender myths, stereotypes and realities of life in general that also emerge in diving. Sexism extends through all parts of life and needs to be dealt with accordingly where ever it occurs.

A good example of this are the relatively new agency marketing campaigns aimed at recruiting the older diver, which results in our teaching a generation of couples where there often are roles of dependence assumed by the wife. How many times have I heard, "my husband works out the dive profiles for us," "my husband decides where we will dive," and "I don't need a rescue class, I just sport dive, and besides my husband is a rescue diver." In all reality, the woman has the greatest need for a rescue class because the man has the higher chance of having a heart attack or other problem during the dive, and because the woman especially needs to learn rescue techniques that do not rely on brut strength or physical endurance.

Consider the following questions myself and fellow Lifeguard Systems Instructors receive and see how you would answer them.

"I just returned from a ten day diving vacation and found out I'm 2 months pregnant, should I consider aborting the fetus because it may have problems?"

"I'm taking a dive vacation by myself to the Red Sea, will I have any problems with the dive guides hassling me?"

"Can I fail this Instructor Candidate because he continually hits on every woman student during class time?"

"My husband and I often go off by ourselves to do shore dives. He is physically much bigger than I am and I'm worried that I would never be able to get him on shore if he ever had an accident in the water."

We need more data than are available to answer the first question. Two weeks ago I spoke at the Westchester Medical Center Diving Physiology Conference in NY, and was lucky enough to hear Dr. Kindwall speak. Pregnancy was one of the issues he addressed and made it clear that there were several well done studies demonstrating an increased risk of birth defects when the mother scuba dived during pregnancy.

We also need more data on a variety of physiological questions. For example, I've been told redundantly by respected physiologists that women do not have a higher risk of hypothermia. Well if you use the medical definition of hypothermia, less than 95 degree Fahrenheit core temperature, then sure that may be so, but if you us a definition of a loss in temperature that detrimentally affects a divers' physical abilities and judgment then I would disagree from an anecdotal basis. Our Instructors teach a minimum of 800 divers annually and for whatever reason, we almost always send one or two women out of the water due to cold before any men are sent out. Is it because women's suits don't function as well? Is it because they don't eat in the morning or because they are not as active in the water? Laboratories can not test all the dependent and independent variables found in real life. Whatever the cause, our Instructors feel it is an issue and we deal with it accordingly.

Dehydration is another important example of the need for caution when extrapolating laboratory data to real life. Noted physiologist Dr. Jolie Bookspan tells us in a May issue of Sea Breeze that men are possibly at higher risk for dehydration based on their physiology. But,what would happen if we applied a few real world variables? I believe that more women have difficulty urinating in the water or in their exposure suits than men, which may lead to more frequent voluntary dehydration if the boat does not have a head or if there is a long bottom time. Some women take diuretic premenstral medications. It is likely that as a group, women spend more hours in the sun, working on a tan than men. With these not studied factors, perhaps women are more likely to become dehydrated than men on a dive vacation.

The second question is a real concern for many destinations as well as in scuba classes around the world. The sexual and power dynamics between Instructors and their students should be discussed in every Instructor course. We have failed more than one male Candidate for consistently directing the majority of his attention to pretty women students and for making them feel uncomfortable by hitting on them during class time. Sure, we would fail a woman Candidate for doing the same thing, but that has not yet happened.

There has been more than one fatality of women who were coerced into an unsafe diving situation by male Instructors whose main concern was on satisfying their own desires. For my own experience, it took talking with other women and a general sense of anger to learn how to deal with the male dive leader who thinks you are there for his pleasure. Women's outrage of breast busting wet suits and other sexist ads is what changed the face of most companies' media campaigns. This outrage surfaced because of women talking about women's issues in diving. I think that just as in any part of life, there needs to be conscious raising in the realm of what is acceptable behavior between dive leaders and divers.

Women's panels and articles also helped tell manufacturers that we wanted wet suits and other gear to fit our bodies. I'm still waiting for a stock drysuit with torso and leg length measurements to fit a woman's measurements. There are many problems we could bring up ranging from the need for ankle weights which we find more women than men need to prevent lower back pain from floating legs and fins, to major problems we observe in dive instruction such as male Instructors letting some women students get away with not comfortably performing full mask clears etc., to avoid stress. There are fields of diving that women have barely broken into yet such as commercial, public safety and military diving, and that needs to be continually addressed until the numbers change.

Are there still women and diving issues? I say yes, just as there are women's issues in all parts of life.

Ascent rates and buoyancy control part I
Two seconds per foot
by Andrea Zaferes, Lifeguard Systems

July 30, 2002

Below please find a letter for Alert Diver re: Haldane Revisited by Dr. Bennett

The issue of ascent rates must be looked at from many angles. Dr. Bennett provided a very useful and well put scientific angle in Haldane Revisited that all divers should be made privy too – particularly dive leaders and those that write educational standards and procedures. I would like to address the diver skill angle of safety stops and ascent rates. The safety stop, as Dr. Bennett well explained is important for dropping “fast-tissue” tensions. It also is important for decreasing the risk of making rapid ascents in the last part of the ascent.

Can you relate to the following experience at any point in your dive career: one minute your gauge reads somewhere between 15-10 feet and then seconds later you are staring at the surface less than 2 feet away. “Wow, how did that happen?”

We tell divers that they should make safety stops and perform 30 ft/min (9 m/min) ascent rates but are we teaching them how and making sure that they can achieve them? We watch thousands of diver ascending annually with diver certifications ranging from entry level to course director and I can tell you that the answer to that question is a resounding “no.” The medical community is doing their part, but without diving educators and leaders to make sure research findings are put in practice then we all fail.

Let us look just at the term 30 feet per minute. What does that mean? Can you walk at a rate of 30 feet per minute accurately? How about a rate of 45 feet/min or 70 feet per minute? How can you measure that while doing it? Can you tell when you are driving 45, 60, 60 mph without looking at your speedometer? It is fine for scientists to say 30 feet per minute, but it is not fine for dive instructors and leaders. We need to give divers a usable term such as two seconds per foot. Ahhh, now they can ascend by counting two seconds for every foot their hands move upwards on the anchor line, or they can look at their gauges and count “one-one-thousand, two-one-thousand” for every decreasing foot on the gauge during free ascents.

Never take what anyone says for face value. Go out and try it. Take a group of divers. Put their hands behind their backs (to hide their watches) and have them walk a length of 60 feet at “30 feet/min” and time them. Take another group and tell them “two seconds a foot” and see what happens. The divers in the latter group will go slower and be far closer to the rate we are looking for. Play with this in the water and see what happens. Also watch what happens when divers walk alone versus walking in a group. Peer pressure can be a powerful force.

Having usable, measurable ascent rate terminology arises, no pun intended, when divers do not have an ascent line. Any working dive guide will tell you that few divers can competently stop and hang at any depth, let alone shallow depths such as 15 feet. Why do so many divers end up popping up in the last 15 feet? One answer is because they let go of the ascent line and head for the boat after their safety stop. How many divers can perform a 2 second per foot ascent rate without a line? Not enough.

One of the main reasons for this is overweighting which starts in their first dive classes and is allowed to continue throughout their diving life. We teach already certified divers and we take an average of 6 lbs off these students as the first step towards developing neutral buoyancy. In the last two years we have seen a worsening overweighting problem and hear more often that divers were taught to ascend by inflating their BCD. Sends shivers down our spines. In the last year, for example, I have had at least thirty public safety diver students tell me that "we are rescue divers so we were taught to put lots of weight on so we can sink straight to the bottom." We are seeing an increase in divers who are overweighting themselves by ten or more lbs. That's scarier than a freshwater eel bumping you in zero visibility water.

What does overweighting have to do with ascent rates and safety stops? It is simple, every pound of lead is equal to about a pint of buoyancy. If you are 6 lbs over-weighted on the surface then you have to have 6 pints of air in your BCD just to be neutral at the surface. By the time you reach ten feet that air is compressing and you are dropping and you respond by adding more air into your BCD, after possibly unconsciously taking in and holding a large inhalation. By the time you reach 2 ATA (33 fsw) you have to have 12 pints of surface air in your BCD to compensate, and 18 pints at 3 ATA (66 fsw). This is in addition to the air you have to add for suit compression caused by increased pressure at depth.

With so much gas in their BCDs think about what happens every time divers rise or fall a little in the water column. If they rise six inches the air expands causing them to become positively buoyant. They respond by dumping air out of their BCDs, causing them to sink too far and fast, so they reflexively take in a large breath and hit the power inflator. My mentor Walt "Butch" Hendrick aptly named this the Great Compensation Chase. The more air you have in your BCD, the faster and further you will rise and fall with each change in body position. Hovering and slow free ascent rates become a significant challenge, and in shallow water can be a near impossibility for the average diver. In order to ascend at a 2 sec/ft rate and hover it is necessary to remain neutrally buoyant continuously. Let us see why this is so.

Place yourself in an over-weighted diver's fins at a 40 foot bottom. You may have fifteen or so extra surface equivalent pints of air in your BCD as you begin your free ascent. You raise your power inflator above your head and hit the exhaust button. You raise your other arm to protect your head with your hand, just like you were taught. You begin kicking. You keep on kicking. After a few seconds of noticing significantly decreased visibility you realize that your fin tips are kicking up the silt off the bottom. Many of you can relate to this experience at least once can't you? Don't worry you are, sadly, not alone.

Think about the obvious laws of physics. If you are negatively buoyant in a vertical position and are not kicking then where are you going? Down. No two blennies about it. So we all agree that if you are negatively buoyant you must kick continuously to make an ascent and the moment you stop kicking you will descend. The next question then is, is it possible to make a 2 sec/ft free ascent while kicking continuously? I am going to say not likely, but don't take my word for it, go to a pool, overweight by 6 lbs and try it. Continuous kicking will cause a too fast ascent.

Ascent rates and Buoyancy Control Part II
Two seconds per foot
by Andrea Zaferes, Lifeguard Systems

July 30, 2002

Now why do so many divers make negatively buoyant ascents? The reason is they were allowed to overweight and they were taught ascent procedures that made them negatively buoyant even if they were weighted neutrally. Try this. Weight yourself neutrally. To do this, at the surface vent all the air out of your BCD, cross your legs, stop moving, breathe normally, let your arms hang down naturally, and you should be hanging with your scalp at the water line. Descend by gently crossing your arms across your chest and tensing your arm muscles, or by gently raising an arm out of the water and making a slightly longer than normal exhalation. Once you are hanging vertically at 8-10 feet gently, slowly raise your arms above your head and see what happens. Lo and behold you will sink. Try it again and this time hold your gauge in one hand and your power inflator in the other. You should sink earlier and a little faster. Putting weight above your center of gravity, over your head, will make you negatively buoyant.

So think back to how you were taught to ascend? If you were neutral, then just the act of raising one, or worse, two arms above your head will make you negatively buoyant. Next we were taught to exhaust the air from our BCD at the start and during our ascent to prevent a rapid rise from BCD air volume expanding with decreased depth. If you had many pints of air to compensate for overweighting then what has to happen if you vent that air? You have to become negatively buoyant at a rate of 1 lb per pint of air lost. Are divers taught how to vent just the right enough air to remain neutral? Or are they taught to raise up both arms and vent? Answer honestly. It is no wonder that more divers are reverting to adding air back to their BCD to ascend – they literally cannot get off the bottom without kicking.

The solution, as was taught to me by Hendrick is to start out neutral. Learn how to plan dives and move efficiently throughout the dive so that you have plenty of air left in your tank at the end of the dive (700-1,000 for sport diving). Remember that if you drain your tank to 500 psi then you will have to overweight yourself by at least 2-3 lbs just to compensate for the loss of the air weight in your tank. You should not still be diving with so little air for many reasons.

Then, when it is time to ascend all you should have to do is get in a vertical position and “think up” and you should slowly begin to rise at 2 sec/ft. If you have to kick then you are not neutral. There should be minimal air in your BCD, especially if you are wearing only a thin wetsuit and are not diving below 100 feet. As you ascend bring your power inflator out forward at shoulder level and gently depress the exhaust button periodically. If you find yourself having to kick to stay in place or rise then you exhausted too much. You only want to vent enough air to keep you neutral at your solar plexus level. The higher the power inflator, the more air it will vent. If you vent just a few ounces too much you will become a few ounces negatively buoyant and the Great Compensation Chase will begin, although it will be manageable, as compared to errors in pint size volumes.

Practice hovering. At any point during the free ascent you or your buddy can signal “stop.” Stop for a few seconds and then continue with the ascent. It is particularly important to play this game in depths at 15 feet or shallower since that is where the greatest pressure changes occur.

Every diver should be capable of making 2 sec/ft ascents and hovering at any depth even if they always dive with an ascent/descent line. Always have practiced contingency plans. You cannot guarantee that you will always be able to reach or find that line so be prepared to make free, slow ascents and safety stops.

Being neutral from start to finish is the key. As one of course directors, George Safirowski, frequently points out, too many of today's divers are so unfamiliar with the feeling of being neutral because they always dive overweighted, that they feel uncomfortable and even nervous when they are properly weighted. They tell us that they feel out of control, they think they are rising when they are not. It takes time to be comfortable with feeling weightless, neutral, particularly if you have many hours negatively buoyant hours underwater in addition to all the years of being negatively buoyant on land.

Observe divers. Too many divers kick continuously as they progress forward throughout their dive, and during the few times that they do stop to look at something their hands and arms start sculling. Divers are not sharks, we will not die if we stop kicking, but sadly many divers will rise or fall if they stop kicking. They have learned to compensate for overweighting and poor buoyancy skills by kicking and sculling. If you want to really learn about this kicking compensation have an instructor take you in a pool and remove your fins in the deep end. Without sculling your hands, work on slowly rising and falling by just adjusting your body posture. If you gently raise your arms you will fall slowly. If you gently take your arms out and let your chest muscles relax "open" you will rise. Keep on breathing with normal inhalations and slightly gentler, slower exhalations. Do not use your lungs as elevators. Change your body posture and sometimes change your breathing by an ounce or two and that should be all you need to rise, fall, and stop. Practice hovering in a cross legged position, gently remove your mask, breathe, gently don the mask, breathe, and then gently clear the mask by exhaling just enough air to clear the mask not the pool (bubbles should not escape from the mask). This drill will make you a far safer diver for many different reasons.

Find an instructor who can move effortlessly and have that instructor trim you out. In the first buoyancy control class I taught with Hendrick 15 years ago I was amazed to learn that just the location of the weight on the belt can make as much as a four pound difference. I watched him take ten or more minutes per person, meticulously moving weight around on each student's belt and then remove pounds just by getting the weight in the right place for each person's body.

Make sure all your gear is secured to your body so that you and your gear are one. When you move your gear should move with you at the same time in the same way. Dangling gauges, octopuses are not only safety hazards, they ruin good buoyancy control, which incidentally means far more than just being able to hover and ascend slowly.

If your feet are positively buoyant then purchase ankle weights and adjust the amount of lead shot to make your feet stay where ever you put them. Hendrick, for example, has four pairs of ankle weights, with each pair weighted for different exposure suits (wet suit socks, wet suit boots, drysuits with thin socks, dry suit with thick booties).

Practice moving slowly and being neutral in the pool, teach your students to do this if you are an instructor, and divers will have a fighting chance in open water. Learn how to truly “be” in the water, and then hovering and 2 sec/ft ascents will become second nature. We greatly thank the scientists for figuring out what we need to do to be safe, and we thank industry leaders like those at DAN for communicating the information out to everyone. It is up to us to figure out how to make sure all divers are capable of performing these recommendations and standards.

For additional articles see www.teamlgs.com

Safe diving always,
Andrea

Renee, I got a bit carried away. I started out to just write a letter and 90 minutes later this is what came out. Let me know if you can use this. If yes, it can be cleaned up and I can send photos. It is a topic we speak on over and over and over again. I think it is something that is key to safety, so what better place than in Alert Diver.

Have a great day and please give my best to Dr. Bennett, Dan, and Betty.

Andrea teaches over 1500 police, fire, EMS, and sport-diver personnel annually worldwide, in everything from U/W vehicle extrication, instructor-level rescue, field neurological evaluations, to blackwater searching. She co-authored with Walt Hendrick such videos and books as Surface Ice Rescue, Scuba Instructor Readiness Series, Field Neurological Evaluations, Public Safety Dive Operations, Blackwater Contingency, Ice Diving Operations and Homicidal Drowning Investigation. Vice President of Lifeguard Systems & RIPTIDE, a course director, a noted public speaker, award winner, RIPTIDE e-zine editor, and the www.wateroperation.com on-line discussion group manager, she is one of the leading trainers in the water rescue and recovery industry today. Her main mission is to keep you alive and well. Send questions/comments az@teamlgs.com

Ascent rates and buoyancy control

By Andrea Zaferes, Lifeguard Systems

Often I write about topics that I know will be controversial to stir divers up into questioning, thinking, and challenging what they know, but this was not one of those times. Therefore it was a nice surprise that basic buoyancy control topics brought up lively discussion. We have been teaching this material for years and have never had controversial replies. So let's delve into it a little deeper.

One of the reasons I appreciate all the feedback is because it allows us to stress the importance of never taking anything for face value. Get in the water and try what the article discusses. Some of you disbelieved the information – great – get in and try it before making final decisions.

First though, understand that the term "buoyancy control" in the article refers to diver's movements in the water, not solely the application of Archimedes's Principle to the body and dive gear. That may have sparked some of the confusion. So yes, trim fits in that category of buoyancy control. What we care about is how we move, hover, and breathe underwater, so we integrate these three actions into the umbrella of "buoyancy control." Focus on the word "control."

Some readers had a hard time with the topic of how the placement of weight can affect buoyancy control. I just came back from an incredible week of diving in La Paz with a Nikonis V which is negatively buoyant enough to be a great tool for changing my location and posture in the water column. Hover vertically and gently raise the camera above your head, and you will gently sink. Hold the camera out forward and you can change to a horizontal position.

Hover horizontally and hold the camera out arms length in front of you with both hands. If you are wearing fins and booties that float one possible result is that as your body is tipped head downward by the camera, your legs will rise above where your body was laying horizontally. As your legs rise your booties will become slightly more buoyant and air will rise to the bottom of your BCD. If you are truly neutral that can make enough of a difference in shallow water to slowly cause your body to rise in the water column.

Adding a pair of one pound ankle weights to a diver with positively buoyant feet can make enough difference in body posture and breathing that as much as five pounds can be comfortably removed from the belt. The same can be true for adding a one pound weight to the dorsal side near the bottom of an aluminum cylinder if the cylinder is allowed to go below 700 psi. Play with it, try it.

The location of weight on the belt can make a large difference for probably a variety indirect and direct of reasons. For example, place the weight asymmetrically so that the diver is pulled to one side. The diver will continually work to not be pulled over. This will increase air consumption, and the arm movements will most likely expand the chest, with the result that the diver will request more lead to stay down. Some people need the weight more dorsally, others ventrally. Correct placement of the weight can make as much as a 4 lb difference.

Another great skill to practice to learn how weight placement can make a significant difference is horizontal corkscrewing. Lay horizontal and while moving forward, slowly corkscrew without dropping or rising. What usually happens with first attempts is that when the diver is supine (tank down, face up) the diver will drop in the water column and may actually swim head first into the bottom. Advanced rescue and drysuit divers will also know that this position typically causes the diver to become “heavy”, “negatively buoyant.” The trick to corkscrewing at a static depth is to gently inhale as you begin, and right through the point of being supine, and then gently exhale as you rotate back face down. The added buoyancy of the inhalation will counteract the “negative buoyancy” of moving into the supine position.

Being able to corkscrew is not only fun but can be very useful. Consider an instructor who is helping a diver whose weight belt is opening. The instructor can hover in a supine position under the prone student to make the necessary adjustments. Photographers can get some great silhouette shots of marine life. Divers can watch small creatures on the under side of jutting out rocks, reefs, and wrecks. Cavern or cave divers can flip underneath their lines to see the ceilings without their regulator first stages snagging the line.

In regards to another issue, talking about buoyancy in pints is extremely useful because a pint or a ½ liter is something everyone who likes ice cream can visualize a pint. It is also useful because that is how many people talk about breathing. Few people can apply a 500 cc tidal volume to buoyancy control.

Pints have practical applications. For example, when weighting a diver have the diver put enough air in the BCD at the surface to be neutral. Then slowly exhaust all the air and estimate how many pints of air were exhausted. That will tell you how many pounds you can take off the diver’s belt. With a little practice this works exceedingly well.

The moral to the story is to get out and hands-on try what was presented in the material. Never take anything for face value and you will be much safer. Thanks again to Diver’s Alert Network for creating such a great educational forum.

Exposure suits part I

Personal Protection Equipment: Choosing an exposure suit for water operations.
By Andrea Zaferes and Walt "Butch" Hendrick
Lifeguard Systems, www.teamlgs.com

Contaminated water diving course: “bring your own wetsuit.”
When we read advertisements like this we cringe and then realize it’s time to write another article.

The one mission that must be successfully completed one hundred percent of the time is “when the operation is over you need to go home”. Proper personal protection equipment (PPPE) is vitally important to the success of that mission, with exposure suits being one of the most important pieces of PPPE for water operation personnel.
When choosing an exposure suit the first question to ask is what kind of water do you need protection from? Is the water contaminated, cold, full of debris, moving, or a combination of these variables? The next decision has to be what do you need the suit for? Will it be for public safety diving, swiftwater operations, surf rescue, boat or personal watercraft operations, or surface ice rescue? Other questions to ask include, what are the budget constraints, how many technicians and operations personnel need to be outfitted with suits, what is the turnover rate for team members, and how often will the suits be used?
Contamination is an important consideration that is often overlooked when the district’s water is not currently contaminated. Floods, run offs from heavy rains, biohazards from bodies, creosote from pilings, and petroleum products from submerged vehicles can turn clean water into a hazmat situation. Too often we hear technicians say that they do not need drysuits because they have warm water and they would overheat. Proper procedures can prevent heat exhaustion, but only hazmat tested drysuits can protect technicians from contamination related illnesses.
Cold can also be a misunderstood variable. Water conducts heat twenty-five times faster than air. We lose heat at the same rate in 42o F air as we do in 80o F water. Some divers consider a wetsuit effective protection for winter water operations because they do not become cold easily, but are they considering what happens when they have to first sit as a 90-percent ready diver and then as a back up diver, prior to serving as a primary diver? Even surface rescue personnel must be prepared for unusually long operations and atypical weather conditions.
Everyone reacts differently to cold exposure and should be dressed accordingly. What is good for one team member may be completely insufficient for another. A navy study of the effects of immersion found that a higher level of body fat reduced the rate of rectal temperature loss. A 110 lb person losing heat at the same rate as a 250 lb person will most likely have a lower core temperature than the larger person. A study of 8 Navy combat swimmers in 6o C water showed that “each diver appears to have a particular core temperature decline profile with respect to cold water exposure.
For example one diver may be perfectly comfortable using wetsuit gloves, while another will feel pain in 15 minutes while wearing an insulated dry glove. A previous cold injury can increase susceptibility to cold problems, even if the original injury was many years earlier. Individual differences between ability to withstand cold can be great and should not be ignored, especially in the “grin and bear it” atmosphere of police and fire personnel. Technicians and surface support should be observant of individual cold stress susceptibility of themselves and of their teammates. This means that if the team captain has been ice diving in wetsuits for twenty years without becoming cold that does not mean that wetsuits are acceptable for other team members.
A large percentage of outdoor drownings occur in water not designated for swimming, which

means that trees, rocks, garbage, and other debris can be a real concern. Divers often must search in low or zero visibility water, forcing them to be bottom dwellers searching by feel. Ice rescue technicians may come in contact with spider wire and fish hooks, while swift water technicians may be pushed into sharp rocks or branches from strainers.

Once enough information is gathered about environmental variables, the team's needs, and department budget constraints, the next decision is what kind of suit is necessary? Most noncommercial divers wear passive exposure suits, meaning that the suits do not provide a heat source to the wearer, rather they provide insulation between the wearer and the environment. Active exposure suits are more commonly found on commercial diving sites and typically involve hot water suits. Public safety personnel can manage with passive suits because their in-water times should be much shorter than those of commercial divers. Passive suits are self-contained and far less expensive than the actively-insulated suits that typically burden divers with an umbilical and the need for highly trained water and surface support personnel.

There are, however, battery powered heating units on the market that are designed to be worn under drysuits by divers who move very slowly looking for small search objects in low visibility water, for divers who stay in one place for periods of time conducting research, or for ice divers who sit through the 90-percent ready and back-up diver positions before acting as a primary diver. Active heaters can also be helpful for divers who feel the effects of cold quickly, such as some women and individuals with little body fat.

Passive suits fall into two main categories, wetsuits and drysuits. Wetsuits help keep divers warm by trapping and insulating a layer of water next to a wearer's skin. That layer is warmed by the diver's body heat. The wetsuit itself is a spongy material with thousands of gas bubbles inside, which are the insulation that traps body heat. Increased suit thickness will increase the degree of insulation. If the suit does not fit well then cold water will replace the warmed water and heat loss will occur.

Exposure suits part II

Personal Protection Equipment: Choosing an exposure suit for water operations.

By Andrea Zaferes and Walt "Butch" Hendrick

Lifeguard Systems, www.teamlgs.com

Drysuits, which can be made of several types of materials, encapsulate all parts of a diver's body but the face and sometimes the hands, where wrist and neck seals prevent water from entering the suit. Surrounded by a layer of air in the suit, the wearer therefore stays totally dry, and is able to wear warm, insulating underwear beneath the suit. To compensate for the compression of the air in the suit as the diver descends, diving drysuits have a power inflator much like that of a buoyancy compensator device (BCD) and an exhaust valve to release air during ascents.

Too often teams make the mistake of purchasing wetsuits instead of drysuits solely because of cost differences. With decreasing national and local water standards most water operation teams have contaminated water in their district. In the long run, an incorrect purchase of wetsuits will be more costly when they later end up sitting on a shelf after being replaced by drysuits. It is better to start out purchasing three good quality drysuits than it is to purchase six wetsuits, if drysuits are the better choice of PPPE.

Let us look at some of the benefits and disadvantages of wetsuits and drysuits to help make the decision of which best meets the needs of your team.

Wetsuits

Advantages Disadvantages

Relatively inexpensive to purchase Not sufficient for cold air or water temps.

Require little training to use Proper fit required for thermal protection

Relatively little maintenance required Offer no protection against contaminated water

Thin suits offer little protection from debris

Are damaged by common contaminates

Insulation decreases with increased depth due to suit compression

Can take many hours to dry – require heated environment to dry

After use, cannot quickly be put back in service in a vehicle

Take longer to don

Cannot be worn over clothing

Are less forgiving when wearers change their size and weight over time

Requires thin suits for warm water and thick suits for cold water.

Can cause serious evaporative heat loss when worn wet on land

Wearers are soaking wet on land after suit removal – heated shelters are required to rehab in colder climates

Will freeze when left wet in cold air temps

Cannot be easily patched on scene, and must be dried prior to applying a patch

No way to cool wearers wearing thick suits on land

Drysuits in general

Advantages Disadvantages

Offer excellent cold water thermal protection A quality suit can be costly

Undergarments and added air can be adjusted for all season use Require certification training to use

Some drysuits offer excellent protection from contaminates Require a little more maintenance

Can be more readily adapted for use by different sized individuals Except for full thickness neoprene suits, drysuits have no intrinsic positive buoyancy so a PFD is required when working on the surface without a BCD

Allow for rapid donning
Can be worn over street clothes
Air can be added to maintain insulation with increasing depth
The wearer remains dry
Adult diapers can be worn during longer operations
Can offer superior protection against punctures and other injuries from debris
Allow wearers to be cooled on hot days on land by venting with the inflator valve

EPDM Vulcanized rubber, hazmat-tested Drysuits
Advantages Disadvantages
Are intrinsically negatively buoyant so less lead is required to be neutral Are generally the most costly suits
The PPPE of choice for hazmat diving
Can be towel-dried in between dives to prevent freezing
Can be towel-dried and immediately put back into service after use
Easy to clean, even when exposed to many contaminates
Can be worn over street clothes
Can be quickly patched on scene, even after being wet

Wetsuits are not suitable for water colder than 50o F, so they are not appropriate for year-round use in colder climates. Wetsuits allow water to be next to a wearer's skin so they offer no protection whatsoever against contamination. Additionally, petroleum products and some other contaminates break down the neoprene rubber of the suit, causing it to disintegrate. The fabric covering wetsuits also tends to trap body tissues and fluids from corpse recoveries. Once wetsuits are contaminated, they are virtually impossible to clean. Hence, if wetsuits are used, they should be used with caution, and only in clean bodies of water.
A good drysuit with appropriate winter-weight undergarments and a layer of air, will keep the diver's skin and core temperatures at normal levels at normal ranges for the duration of an average ice dive. A hazmat tested drysuit will protect wearers from contamination if an appropriate breathing apparatus is used.
Drysuits, which can be made of several types of materials, encapsulate all parts of a diver's body but the face and sometimes the hands, where wrist and neck seals prevent water from entering the suit. Surrounded by a layer of air in the suit, the wearer therefore stays totally dry, and is able to wear warm, insulating underwear beneath the suit. To compensate for the compression of the air in the suit as the diver descends, diving drysuits have a power inflator much like that of a buoyancy compensator device (BCD) and an exhaust valve to release air during ascents.
Too often teams make the mistake of purchasing wetsuits instead of drysuits solely because of cost differences. With decreasing national and local water standards most water operation teams have contaminated water in their district. In the long run, an incorrect purchase of wetsuits will be more costly when they later end up sitting on a shelf after being replaced by drysuits. It is better to start out purchasing three good quality drysuits than it is to purchase six wetsuits, if drysuits are the better choice of PPPE.
Let us look at some of the benefits and disadvantages of wetsuits and drysuits to help make the decision of which best meets the needs of your team.
Wetsuits
Advantages Disadvantages
Relatively inexpensive to purchase Not sufficient for cold air or water temps.
Require little training to use Proper fit required for thermal protection
Relatively little maintenance required Offer no protection against contaminated water

Thin suits offer little protection from debris
Are damaged by common contaminates
Insulation decreases with increased depth due to suit compression
Can take many hours to dry – require heated environment to dry
After use, cannot quickly be put back in service in a vehicle
Take longer to don
Cannot be worn over clothing
Are less forgiving when wearers change their size and weight over time
Requires thin suits for warm water and thick suits for cold water.
Can cause serious evaporative heat loss when worn wet on land
Wearers are soaking wet on land after suit removal – heated shelters are required to rehab in colder climates
Will freeze when left wet in cold air temps
Cannot be easily patched on scene, and must be dried prior to applying a patch
No way to cool wearers wearing thick suits on land

Drysuits in general
Advantages Disadvantages
Offer excellent cold water thermal protection A quality suit can be costly
Undergarments and added air can be adjusted for all season use Require certification training to use
Some drysuits offer excellent protection from contaminates Require a little more maintenance
Can be more readily adapted for use by different sized individuals Except for full thickness neoprene suits, drysuits have no intrinsic positive buoyancy so a PFD is required when working on the surface without a BCD
Allow for rapid donning
Can be worn over street clothes
Air can be added to maintain insulation with increasing depth
The wearer remains dry
Adult diapers can be worn during longer operations
Can offer superior protection against punctures and other injuries from debris
Allow wearers to be cooled on hot days on land by venting with the inflator valve

EPDM Vulcanized rubber, hazmat-tested Drysuits
Advantages Disadvantages
Are intrinsically negatively buoyant so less lead is required to be neutral Are generally the most costly suits
The PPPE of choice for hazmat diving
Can be towel-dried in between dives to prevent freezing
Can be towel-dried and immediately put back into service after use
Easy to clean, even when exposed to many contaminates
Can be worn over street clothes
Can be quickly patched on scene, even after being wet

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Exposure Suits part III

Personal Protection Equipment: Choosing an exposure suit for water operations.
By Andrea Zaferes and Walt "Butch" Hendrick
Lifeguard Systems, www.teamlgs.com

A good drysuit with appropriate winter-weight undergarments and a layer of air, will keep the diver's skin and core temperatures at normal levels at normal ranges for the duration of an average ice dive. A hazmat tested drysuit will protect wearers from contamination if an appropriate breathing apparatus is used.
As we can see, drysuits are the best choice for teams who work in cold or dirty water. If drysuits are chosen, then the next decision making process is choosing the right drysuit for the teams needs. Divers have the most stringent needs when it comes to drysuits, so we will address the needs of public safety divers first. Several of the needs of surface personnel and divers are the same when it comes to drysuits, so surface personnel will find the following information useful as well.

Side Bar
The myths of drysuit diving
Many divers and dive teams have false beliefs about drysuits that prevent them from taking advantage of the benefits of drysuits. Below are several such myths, followed by the reasons that they are untrue.
Myth #1: Drysuits require more weight than five or seven millimeter drysuits. In reality, a properly-weighted drysuit may require the same or even less weight than a thick wetsuit. The key is to first stretch fully upwards and downwards, and then burp excess air from the suit by kneeling with the left knee up, while holding the neck seal away from the skin with the left hand and pushing the exhaust valve with the right hand. The result will be that the suit sits properly and contains minimal air.
Myth #2: Drysuits are more restrictive to movement than wetsuits. A properly-fitting drysuit should allow full range of motion. Additionally, because they do not need to fit as tightly as wetsuits, drysuits can be more comfortable and less restricting.
Myth #3: To vent a drysuit that is self-inflating, pull the neck or wrist seals out to allow air to escape. While this procedure certainly sounds good, reaching through a hood or wrist seals while wearing gloves is not so easy. Instead, if your inflator is stuck, first disconnect the hose, then dump air through the arm-mounted exhaust valve as you flare out to slow your ascent and continue breathing normally..
Myth #4: Drysuit divers do not need to wear buoyancy compensators (BCD's). While this procedure was commonplace years ago, it has been discarded. Drysuit divers should wear BCDs to allow them sufficient flotation on the surface with a flooded suit, to allow for neutral buoyancy when carrying a recovered victim, and to compensate for depth-caused buoyancy changes.
Myth #6: Use the drysuit to control buoyancy rather than the BCD . There are many reasons why such a practice is a safety hazard, including increased risks of carotid sinus reflex, free-flowing suit inflator valves, inverted ascents, uncontrolled ascents, and poor buoyancy control.
Myth #6: A flooded drysuit will cause a diver to sink. Water weighs the same whether it is in or outside of the suit. A diver only becomes negatively buoyant in a flooded suit if the diver is over-weighted and if the diver was using the drysuit, rather than the BCD, to control buoyancy. In reality, the only dangers of a flooded drysuit are contamination and

hypothermia.
Myth #7: Divers do not need a drysuit course and certification to dive in a drysuit. Drysuits are a unique piece of equipment that require training and practice to use safely. Lack of training can result in dangerous overweighting, carotid sinus reflex, uncontrolled ascents, drowning, and decompression illness. Mandatory drysuit certification is a diving industry standard that must be met.

What to look for in a diving drysuit
Fit: There are a variety of drysuits on the market, but one key factor to all of them is fit. Drysuits that are too big require more air internally to fill the excess space, which increases the amount of weight needed to dive and decreases overall mobility. Suits that fit too tightly do not allow wearers to add enough air in the suits, which can result in restrictive compression in areas such as elbows, knees, shoulders, and spine. Such restriction can cause a serious lack of mobility and loss of circulation in the extremities.
Fit the suit with the thickest undergarments that may ever be worn, then bend down with hands reaching for the floor to make sure the torso is long enough. Stand straight with arms raised to the sky and make sure the crotch is not too low, which would mean that the torso is too long and possibly the legs are too short. If such is the case, fin kicking and walking will be more difficult.
With arms raised forward, make sure that the end of the suit material at the wrist does not extend beyond the wrist bone. Squat down to make sure that the legs are long enough. Lay supine on the floor holding the crotch in place and have someone pull on the boots. If the boots come fully off your feet then the legs are too long. If the suit legs are too long, then fin loss can occur in the case of accidental suit inflation with body inversion.
With the warmest undergarments on, the suit should fit well to every part of your body.
Material: Full thickness neoprene offers the most intrinsic insulation but it has several important drawbacks. It requires significantly more weight and significantly more time to dry, cannot be repaired wet on the scene, is more bulky to store, takes many hours to dry, is not acceptable for contaminated water, and is more difficult to clean. An advantage of full thickness neoprene suits is that they are usually less expensive than other drysuits.

Exposure suit part IV

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Cuffs and seals: Heavy duty latex seals are especially important for cold or contaminated water, since both can increases the chance of latex tearing. Latex will tear easier than neoprene, but it can be toweled dry and is better for contaminated water diving. Cuff ring systems are recommended because a torn wrist seal can be replaced in less than a minute. If a wrist seal is torn and there is no cuff ring, then the suit will have to be sent out for a costly repair. Although cuff rings cost more in the initial investment, they can save the department significant money in the long run. Cuff ring systems also allow a greater variety of wearers to share the same suit.

If several users share a suit then the neck seal should be cut to fit the largest neck. Wearers with smaller diameter necks should first don custom made neoprene neck collar to increase their neck diameters. The suit neck seal then sits on top of the neoprene neck collar.

Drysuit undergarments: Divers typically under, rather than over, dress when it comes to undergarments. Always be prepared to be comfortable for twice as long as the planned dive time. Divers may need to remain as back-up or 90-percent ready divers for times longer than expected. If divers become overheated before serving as primary divers they can be placed in the water or they can be vented. To vent, have the diver pull the neck seal away from the neck while the tender hits the suit inflator button for ten to twenty seconds. This technique uses minimal air, but significantly decreases the temperature in the suit's torso.

Make sure the underwear fits. If it is too tight it can restrict movement and blood flow. Even underwear that is too big can cause movement restrictions. For example, if the torso is too long, the crotch area may end up too low, making it difficult to kick well. Too large undergarments can bunch up in joint areas causing restrictions.

Avoid underwear with a great deal of compressibility, which will result in unnecessary and possibly hazardous buoyancy changes for depths below 2 ATA. Pile-type underwear for example will greatly compress with depth, making the diver heavier. The diver responds by adding air to the BCD or drysuit which makes buoyancy control more difficult and the chances of rapid ascents more likely. Another consideration is that undergarments lose their insulation value as they compress.

Choose underwear material that will work when wet to avoid divers becoming chilled if they exert themselves and perspire or if the suit leaks. Polar fleece and wool works very well. An acrilian pile undergarment was tested under an immersion coverall during immersion for one hour in 2.5o C water. Subjects without the undergarments lost 13.1 o C of mean skin temperature while the protected subjects only had a loss of 9.9 o C. Avoid anything cotton because once cotton is wet or damp, divers will quickly chill.

If a team faces cold winters and the budget only allows the purchase of one set of undergarments, then we recommend purchasing the warmest undergarments that the manufacturer offers. In warmer seasons divers can wear less expensive fleece sweatshirts and sweatpants, but it is hard to find replacements for artic-capable undergarments in the winter.

Hoods: We can lose more than thirty percent of our heat from our heads, yet hoods are the first PPPE most people opt to not use when the water is warm. The reason given for ditching hoods is almost always lack of comfort. Hoods are important not only for thermal protection but for protection from contaminates and debris. Another consideration is that cold water passing over the ears can result in vertigo, which can be potentially hazardous.

For hoods to be comfortable they must fit properly. If a hood is too tight it will be restrictive and uncomfortable, if it is too large it will offer less thermal protection as water enters and moves around the head. Drysuit hoods are constructed either of neoprene, EPDM vulcanized rubber, or latex. The latter two hoods do not offer intrinsic thermal protection and thus require an undergarment such a skull cap or preferably a firefighter Nomex hood. But the latter two hoods can be towel-dried which is important for preventing evaporative heat loss between dives.

EPDM rubber hoods offer the greatest protection against contaminates and hence should be chosen if divers must enter contaminated water.

EPDM rubber hoods and especially latex hoods require a fabric undergarment even in warm water to allow for ear equalization. Latex can create a seal over the outer ear canal that can result in serious injury if a skull cap is not worn.

Hoods can fill with air if full face masks are used, which is especially true for positive pressure masks. Neoprene and latex hoods stretch, so they can hold larger amounts of air than EPDM rubber hoods. Every pint of air is equal to a pound of buoyancy so an extra pint of air in a hood can be an uncomfortable nuisance. Hood vents placed at the top and back of the head will prevent this “cone-head” problem. Commercially made diaphragm hood vents are recommended for latex hoods. Neoprene hoods can be purchased with vents or can have homemade vents made by cutting a small “x” in a stretched-out section of the hood with a sharp, heated knife tip.

Exposure Suits part V

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Gloves: Hands must be protected from cold, debris, and contaminates. Kevlar covered neoprene gloves are best for searching in debris-covered bottoms in clean, warm water. Dry gloves are required for cold and contaminated water. Cold hands can easily loose enough dexterity to make it impossible to perform effective searches and self rescue procedures such as weight-belt ditching and entanglement management, and can make victim handling a challenge.

Dexterity can also be lost when gloves are very thick or when they constructed as mittens or three fingered gloves. Dry gloves with proper insulation offer superior thermal protection than wet gloves, which allows the use of five fingered dry gloves even in cold water. Dry gloves come either lined or unlined. Fleece lined gloves are comfortable and warm but take a long time to dry should they flood. Unlined gloves allow the wearer to change liners between dives and wear the appropriate thickness liner for the water temperature. Kevlar liners or over-gloves can be used if searches are conducted in areas with sharp debris.

Boots: Attached hard sole boots are preferred over attached latex booties that require the donning of an over-boot. The latter system takes longer to don and requires the drying of these separate boots before they can be stored in service. Attached EPDM rubber boots are simply towel-dried. The disadvantage of attached boots is that they are less accommodating when several wearers with different size feet share a suit. The latex bootie system allows each wearer to have their own pair of over-boots. Attached boots are required for contaminated water diving. Some boots have a small protruding lip off the Achilles' heel to decrease the chance of a fin strap from slipping off, which is a nice feature.

Other features: Sometimes a department chooses one suit over another based on cost. This is rarely a good idea for safety reasons and because sometimes there are hidden costs. Questions to ask include does the suit come with a good maintenance and repair kit that can cause upwards of $40 or $50 when sold separately. Are suspenders included in the given cost? Suspenders will help prevent unnecessary strain on the suit's zipper and prevent wrist seals from dragging on the ground. Does the cost include a skull cap for under the hood? What is the suit warranty? What size customizations are offered? Is a carry bag included?

In summary, our experience with thousands of public safety divers around the word has shown that a hazmat tested, EPDM vulcanized rubber suit with a heavy duty back-mounted zipper, heavy duty wrist seals, attached hard sole boots with anti-slip soles, a swivel inflator valve, a domed exhaust valve, a good maintenance and repair kit, and suspenders, best meets the needs of most dive teams.

Surface Ice Rescue Technicians

Drysuits are mandatory for surface ice rescue technicians. The difference between a diving and surface drysuit is that the latter does not have inflator or exhaust valves, they are usually limited to neoprene or some type of nylon or bilaminate shell suit, they do not have true neck seals, and they are usually less costly than diving drysuits. Diving drysuits can be worn for surface ice operations but keep in mind that unless they are constructed of material that is buoyant enough to keep a flooded suit wearer on the surface, then a PFD must be worn over the suit. A second consideration is that diving drysuit inflator valves are located on the chest, so they could become damaged as rescuers work prone on the ice. An advantage of using diving drysuits is that they generally offer the wearer a far greater ability to move efficiently

and effectively in the water. Surface ice rescue drysuits were not designed for swimming and should not be used for such.
The water operation community is lead by a group of self-proclaimed experts who do not have any mandatory national standards or qualifications to be held to. Some of these experts design water operation equipment that too often reflects a lack of common sense and a poor understanding of what happens in actual water operations. Exposure suits manufactured for surface ice rescue technicians clearly demonstrate this problem.
Let’s look at some points that are apparently not as obvious as one would think. If a team is called to perform an actual ice rescue, then that tells the team that the ice was too thin to support the victim(s). We are then given a choice of who to put on the ice as rescue technicians – thin, lightweight, fast rescuers, or large, heavy, and possibly not fast rescuers? Hmmm, that will take some thought wont it. Who should we keep on shore to pull lines which can take quite a lot of strength if there are few responders - thin, smaller people, or larger folks? Hmmm. Ah, the answer must be to put the larger people on the ice because that is who most surface ice rescue suits are designed for. There are three main ice rescue suit manufacturers in the U.S., and two of the three make suits in one or two sizes, namely large and huge.
When we put physically fit, lightweight, thin rescuers in these large suits they can be rendered useless by the suits. Feet come out of boots when kicking, hands come out of gloves because sleeves are too long, suits flood, and airways are obstructed as the hoods come up to their eyeballs. One manufacturer who thought this through is Bayleysuit™ who offers suits in small and medium sizes, in addition to large and huge. Bravo Bayleysuit.

Exposure suits part VI

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Bayleysuit™ also did not make the airway obstruction error that other manufacturers have made. The first surface ice rescue suits were person-overboard suits, affectionately called “Gumbie suits” because of the foot shape. These suits were designed to keep people alive in rough, cold water as they waited for help to arrive, and had face flaps to protect the mouth and nose from waves and spray. These people lay there floating in the water, doing their best not to exert themselves. Does this sound like what ice rescue technicians do? No.
We wonder if manufacturers who include zippers or face flaps that completely cover the wearer’s mouth and nose with rubber or other nonporous material have ever attempted to cross 300 feet of realistically thin ice that breaks underneath them every so often. And have they done this under the stress of reaching drowning victim(s) as quickly as possible? The answer has to be no, because if they did they would realize that they would be quickly ripping off that face flap or yanking down that zipper to avoid going into respiratory distress. Proper procedures keep ice rescue technician airways dry. Face flaps serve to prevent technicians from getting the air that they need to do the job safely. They also serve to make it difficult or impossible to use voice or whistle communication to the victim or shore personnel. So what do we do about this? Write and call manufacturers and tell them what you want. Take a proactive approach, after all it is your safety that is at stake.

Features to look for in surface ice rescue suits include:
• Come in sizes to fit smaller rescuers.
• Avoid zippers or face flaps that cover the wearer’s mouth and nose. Face flaps can be cut back. Zippers that come up too high are more of a problem.
• Built in dry gloves, hood, and hard sole, nonskid boots.
• Velcro wrist straps are useful to keep hands in suit gloves if the suit sleeves are too long for the wearer.
• If the suit has a built in chest harness, make sure it is not secured only by a flap of neoprene sewn directly into the suit, and that it can be adjusted for the wearer’s size. If neither is the case then we recommend removing the built in harness and donning a well made water operation harness over the suit.
• Look for good seams, especially in the crotch area, to decrease the chance of cold water leaking into the suit.
• Mounted hood lights are a good idea for night time or low visibility operations.
• Five fingered gloves require less training and practice than do three fingered mittens.
• Built in or attached wrist ice awls can be very useful.
• Nylon shell suits with closed cell foam liners provide better protection from cold, and provide more mobility and comfort when worn by surface personnel on boats and shore than do neoprene suits.

There are two types of surface ice rescue suits on the market today – neoprene and nylon shell suits. Full thickness neoprene suits have intrinsic buoyancy while some of the other suits require a PFD to be worn. Neoprene ice suits tend to cost less but may not be as comfortable, and take longer to dry. Nylon shell suits can come with closed cell foam liners to provide warmth and buoyancy. These suits dry much faster than neoprene suits, and easier to repair in the field. Their liners can be removed allowing for easier cleaning. The shell suit is better suited to a larger variety of year round water operations. Mustang™ makes the most popular

shell suit called the Ice Commander.
No matter what type of ice rescue suit is used, undergarments should be capable of keeping wearer's warm even when wet. We recommend storing fleece socks and glove liners in the suit storage bag. Avoid wearing cotton.

Moving Water Operations

Increased water speed results in greater convective heat loss. Water that would normally seem warm when still, can quickly incapacitate someone when its speed picks up. NFPA Document 1670 defines swift water as anything moving at or faster than 1 knot. Ice rescue suits are not designed for, and should not be used in, swiftwater. Swiftwater technicians require suits that allow for unrestricted swimming skills should technicians end up in the water. Also, because ice rescue suits do not have true neck seals they can easily flood in swift water, further incapacitating rescuers.
Shell drysuits, with true neck seals, helmets and swiftwater PFD's are usually the PPPE of choice. Hard sole built in boots may not be the best choice because they may not allow wearers to kick effectively.
Surf operations pose the problem of rescuers who need to be able to get under waves for their own survival. Surf technicians may also need to surface dive to recover a drowned victim. This means they cannot wear exposure suits that are too positively buoyant to prevent voluntary submersion. They also need a suit that affords very strong swimming skills, hence restrictive suits are not an option.