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Complete Support & Testing of Underwater Diving Equipment

Surface Supplied Emergency Breathing

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Emergency breathing is probably best defined as being able to breathe when your normal supply or breathing system has been interrupted or lost. The loss of your primary breathing supply can be sudden and dramatic, or it can sneak up slowly. Regardless, if you survive a loss of gas incident it can be a life altering experience that will change the way you dive from that point on.

Once the diver is in the emergency breathing mode all focus must shift to getting back on a normal supply or getting to a point of safety. In either case, the dive should be terminated unless the loss was momentary, is clearly identified, remedied, and it is certain that there is no damage to equipment that could threaten the safety of the diver and the diver still has enough EGS gas.

A loss of normal umbilical supply can be caused from a pinched or severed umbilical, umbilical obstruction, topside valve alignment error, topside component failure, or helmet component failure. Probably the two most common causes are a pinched umbilical or improper topside valve alignment. A sudden loss will usually come from one of two causes, a severed umbilical, or a pinched umbilical at / or close to the diver. All other losses will usually result in more gradual loss of umbilical pressure that will probably be noticed by the diver in the form of increased inhalation effort that gets progressively harder with each breath. The longer the umbilical, the greater the warning because the pressure drop will be slower. If the umbilical is pinched off within 10-20 feet of the diver, or the umbilical gets severed, there will probably be little or no warning until he tries to inhale at which point the diver will experience the loss during inhalation at which point there is no gas to inhale and none to vibrate the vocal cords, resulting in the inability to talk, scream, or yell to topside. This is where panic can get a foot hold fast because the diver only has 20-30 seconds at best before unconsciousness sets in. Here is where a fully functional emergency gas system becomes the most important thing in the diver's life.

Regardless of the type or brand helmet or full face mask used, it should always be used with a fully functional EGS system that can be activated quickly and easily. There is no excuse or reason for not having a EGS system. Companies and/or organizations that condone the practice of not using a fully functional EGS system for all dives do so against the recommendation of KMDSI and Dive Lab and may face serious liability issues in the event of an accident or death. A diver with empty lungs will pass out much sooner than a person with full lungs. History has shown that in almost all cases, divers that think they are tough enough to make it to the surface without a fully functional EGS during an out of gas experience are usually "Dead Wrong".

Kirby Morgan pioneered the side block / demand regulator system over 40 years ago and that basic design remains the most copied and the standard by which all others are judged. All KMDSI helmets have a side block that allows two separate sources of breathing gas to be attached. Both supply sources feed a common manifold system that allows gas to be sent to the demand regulator via the bent tube and at the same time directly into the helmet via the steady flow defogger valve. Some divers keep the EGS cylinder valve shut, thinking that they won't have to worry about EGS gas leakage if the EGS valve gets bumped and open slightly. Keeping the EGS cylinder valve shut is not recommended because the first stage regulator will flood with water. Flooding of the regulator will ruin it and in some cases the flooded regulator will extrude the yoke sealing o-ring when pressurized, resulting in a total loss of the EGS. In addition, diving with the EGS cylinder valve shut will require the diver turn on both the cylinder valve, and the side block EGS valve to get gas. For these reasons, it is recommended that the diver leave the side block EGS valve shut and the cylinder valve open. In addition the first stage must have a pressure relief valve connected to the low pressure port. In this line up, the EGS regulator and whip stay pressurized to the EGS valve on the side block allowing gas immediately if needed. This line up practice is standard for all US military surface-supplied diving, and is recognized internationally as the safest way to configure an open circuit EGS system.

Pneumofathometer

The pneumofathometer (pneumo) hose and supply system is primarily used for tracking the diver's depth on the bottom and during ascent for decompression control. Besides accurately tracking, the pneumo can be used for filling lift bags, clearing silt, and as a last resort in some cases for emergency breathing. The practice of using the pneumo hose for emergency breathing has been around since the pnemeo was first employed in the 1940's. Emergency breathing with the pneumo works pretty well with free flow helmets like the old Mk-V and the like as long as they are used with a dry suit open to the helmet. The way the pneumo is used for emergency breathing with the free flow helmet and suit was pretty straight forward, the diver would simply insert the hose up under the wrist cuff or cut a hole with his knife in the sleeve to insert the pneumo and then notify topside with voice communications or line pull signals to open up the pneumo valve and allow air into the divers dress. Sounds pretty simple right? Well it was in the days of free flow helmet diving, but not so fast, today most surface supplied diving practices employ demand mode helmets. Demand mode helmets operate on a different principal than free flow helmets. Think carefully, then try to come up with a couple scenarios where you might have to use the pneumo to feed the diver with air with a demand mode helmet like the SL-17 or KM-

37 or any other demand mode helmet. You will find it does not make a whole lot of sense. I am not saying it cannot be done, but it's not something that can be relied on as a viable option and certainly not as a replacement for a proper emergency gas system (EGS). Yes it does work on the stage or ladder under controlled conditions at dive school during drill time when everyone knows what's coming, but other than that breathing on the pneumo hose is pretty much "Hollywood" and here is why.

Using the pneumo all started with "deep sea free flow heavy gear" (Copper Hard Hat). Here's a little background. In the old days compressors were powered by human pumping. There were small single man units, and larger two manned units. As time went on volume tanks were added to help smooth out gas delivery and allow the pumpers to take a break long enough to light up their pipes or cigars. The volume tank also worked as a condenser allowing the water to be drained off, keeping the air to the divers much drier. By the 1940's the man power was replaced by machinery power and compressors could put out more volume at higher pressures.

Now think about the pneumo thing for a minute, make a list of how and why you might ever have to use the pneumo hose for supplying the diver with breathing air. First of all, most diver air supply systems also have that same air supply feeding the pneumo so if you lost air to the umbilical you also lost it to the pneumo. If the diver lost air because the umbilical got severed, "guess what", the pneumo probably got severed "too!" Now, let's say only the diver's umbilical gas was lost and we still air to the pneumo, with heavy gear the pneumo could and would work because with heavy gear you had to use a dry suit that was open to the helmet. The suit had quite a bit of compliant volume (expandable volume). The compliant volume helped insulate the diver, allowed for variable buoyancy, but most importantly the suit provided compliant volume for breathing. In essence the suit became a big breathing bag. With heavy gear, the air control valve worked like a sink faucet valve, simply allowing the diver to open and close the valve as necessary to allow air into the helmet and into the suit which supplied the volume for breathing. The exhaust valve was also adjustable. If air was lost the diver closed off the exhaust valve and breathed off the suit, the suit held enough air volume to allow the diver to re-breath the suit air for at least 3-5 minutes before the oxygen dropped too low, and hypoxia set in. Because the diver could breathe in the suit, he could also talk to topside as long as the communications still worked or could use line pull signals. The standby diver could usually get to the stranded diver within 3-5 minutes and get his pneumo into the cuff of a stranded diver to supply him with air while he attached a spare gas hose. The pneumo in this case could supply enough air to keep CO2 levels from rising too fast providing the diver remains calm and did not try to exert too much energy. Keep in mind with free flow helmets even at very light work it will require at the very least 1 actual cubic foot minute (ACFM) of air at depth to flush enough CO2 from the diving rig to keep the Co2 from rising too fast and becoming toxic after as little as 10 minutes or so. Even though there is enough oxygen in the breathing gas, the CO2 level quickly rises and once the level gets to around 4-6 percent the diver will have serious problems. Still, the pneumo could in this case provide adequate ventilation for emergency breathing. Free Flow Heavy Gear is the best case for using the pneumo for emergency breathing. But guess what!, in the modern world of commercial diving, demand mode helmets like the Superlight make up at least 90 percent of what is used.

Unlike free flow systems, all demand mode helmets have little or no usable compliant volume in the neck dam area, which is not enough for even one moderate breath. Having a large compliant volume within a demand mode helmet will not allow the demand valve to work. The helmet must remain separated from the suit. No compliant volume translates into nothing to draw from if you try to use the pneumo hose. If you try to use the pneumo in a real world emergency with a demand mode helmets you will ”Probably Die", and here is why.

Scenario: Super Diver is using his SL-17B with a wet suit and decided he did not need a EGS system because he was only diving in 40 feet of water. Topside lowers a 1000 lb concrete clump to the bottom and it settles on right on top of the divers umbilical about 10 feet from him. The diver inhales and suddenly feels the high inhalation resistance, he immediately exhales and tries to inhale again and realizes that not only is there no air but his lungs are empty. At that very moment, the divers need for air is “great” and if he could suddenly inhale he would demand (suck) air much faster than a little old ¼” pneumo hose could deliver. In disbelief the diver tries one more time and only manages to suck water into the helmet thru the neck dam he finally confirms what he already knew, “There is No Air!” WOW” “what’s a diver to do”? Well, lets look at the options, he can’t tell topside because he has nothing in his lungs to make the vocal cords wiggle. He can’t resort to line pull signals without getting to the free end of the umbilical on the other side of the clump. Taking the helmet off is not an option yet. The diver then makes the decision, and charges over the clump, grabs the umbilical, and starts frantically jerking in the hope the tender will figure out what happened. Now even if the diver was to stick the pneumo under the neck dam how would topside know to give him air? It’s only been 10 seconds since the diver lost air, but because his lungs are empty the diver is really hurting, and now in a full blown panic. He involuntarily inhales, and draws water up into the helmet from the neck dam again while at the same time he inhales water causing him to choke, now the helmet is about half full of water and the water is sloshing around, the water in helmet is cold and makes his head feel like a lead weight. Another 5 seconds pass and he realizes he cannot hold his breath because he does not have any breath to hold. Think about it! There is a big difference between holding your breath with a lung full air, and holding your breath with no air in your lungs. At this point with the helmet is now full of water, the diver frantically rips at the yoke clamp and latch catch, and gets the helmet off. It’s only been 25 seconds since the last exhale but seems like an eternity. With the helmet off, he has now increased his weight by about 28 lbs because that’s what the helmet weighs when void of air and full of water. He grabs the umbilical and starts to climb and then he feels something is holding him, he suddenly realizes! the snap shackle!! Oh no!! , another 5 seconds passes as he fumbles with the shackle, adrenaline is pumping, his head is pounding, he starts ripping at the snap shackle, then suddenly everything feels fine and things become surreal as he drifts back and lays on the clump next to his helmet. It’s only been 33 seconds. Meanwhile, topside, amidst the noise of the crane and compressor the tender realizes that there must be something wrong with the communication box because they cannot hear the diver breathing. Topside makes several attempts to communicate and the same time the tender tries line pull signals. The tender suddenly realizes there is no bubbles!. It’s now been 50 seconds.

The supervisor orders air to the pneumo, and the standby into the water. The standby diver was really quick, he finished getting dressed in 20 seconds and made it to the diver in 1 minute. Once there, he noticed Super Diver with his helmet lying next to him. The standby diver ordered up on the clump and was able to clear the umbilical within 30 seconds it then took another minute to re-shackle the diver and tie the helmet off to keep it from tangling, then another 2 minutes to get the diver to the surface because the standby was trying to maintain an airway on Super Diver to keep him from emboli zing. After hitting the surface it took another minute for up and over on deck. All in all it's been about 6 minutes since Super Diver took his last breath, to now laying on his back having CPR. What do you think his chances are? The above times would be about as short as possible and in the real world it would probably take a lot longer.

Now look at the same scenario with a fully functional, properly configured EGS system. When Super Diver's umbilical got pinched and the he could not inhale, he immediately opened the EGS valve on the side block and took a couple deep breaths to come off the adrenaline rush, notified topside he was on EGS, because he lost gas. In short order topside figured out about the pinched umbilical, picked up the clump, and had Super Diver clear the umbilical, shut the EGS then test the normal supply, and resume breathing on normal supply. After that, the dive was terminated and Super Diver surface normally as directed by topside. All this took less than 2 minutes. Is using the pneumo viable? You make the call!