Redundancy & Configuration

How many tanks do you need and where should you put them?

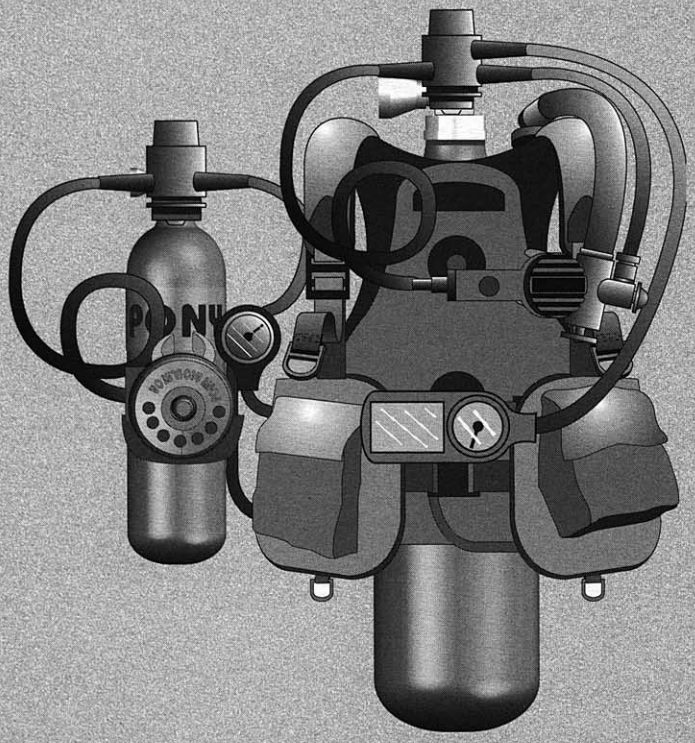
By analyzing diving accidents, evidence shows that many incidents could have been avoided if the diver had used sufficient and proper redundant equipment setup in a reliable configuration. At what point in our diving careers should we begin thinking about redundant equipment and stop relying on our dive partners for emergency gas supplies? Statistics prove that even in basic open water dives over half of the accidents involving gas-supply occurred when a buddy either did not know that a problem existed or was unable to help. There are even incidents where a buddy actually refused to give assistance. Emergency swimming ascents (ESAs) can be a valuable technique in these cases, but only if the ascent is controlled and constant exhalation is maintained. Most divers find ESAs possible only from shallower depths (60ft or less) and impossible in overhead environments. This is evidence enough that independent redundant back-up systems have a place in diving.

Should we all run out and bolt our tanks together? Not necessarily. One problem associated with redundant systems is the belief that the more gear a diver carries, the safer he will be. This problem is most commonly associated with beginning advanced divers, where the diver carries far to much equipment for the type of dive being conducted. When a diver carries too many cylinders, second stages, pressure gauges, reels, and lights, the possibility of equipment failure, equipment confusion, and equipment entanglement greatly increases. Divers must evaluate the type of dive being conducted and only carry the redundant equipment needed to provide an acceptable level of risk for each dive.

Because of the many variables and preferences that exist in setting up dive equipment, it should be noted that this article exists only to offer suggestions and give ideas for a basic blueprint on how equipment can be configured. Different geographic locations and dive profiles may mean that further modifications to equipment setup may be necessary to provide safety and reliability. The equipment configurations that follow are what many seasoned technical divers have successfully used many times on a variety of dives. Remember, in all cases, a failure on any gas-supply related equipment (i.e., tank valve, hose, or regulator assembly) will demand an immediate return to the surface or first decompression stop scheduled. (continued page 4)

Cylinder and Regulator Configuration

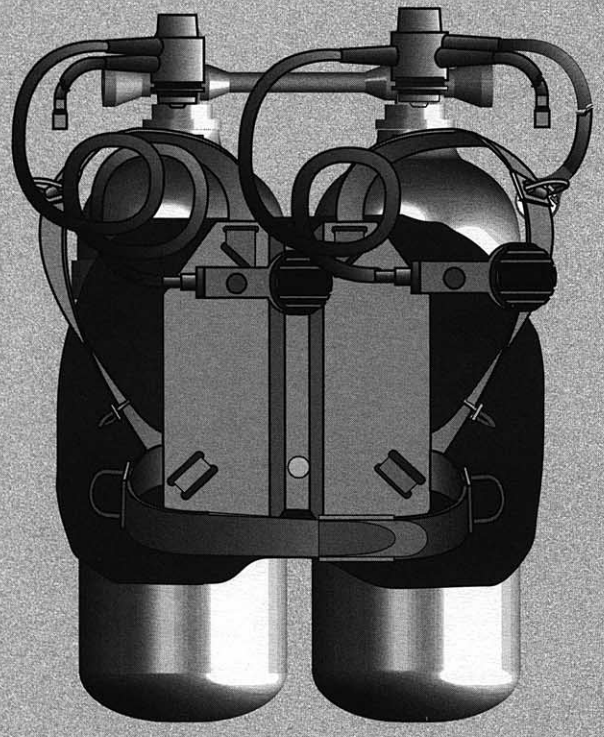
Recreational Diving
Single With Pony Tank



APPLICATIONS

Mainly used in deeper recreational diving at depths from 70-130 ft. This configuration provides an excellent fully redundant gas supply system for use in emergencies. The gas in the pony tank should not be planned for use at depth, nor should it be planned for use during decompression. This configuration provides solo divers or divers who loose track of their buddy with a safety net that they would not otherwise have. Follow appropriate gas management rules that apply to the type of diving being conducted.

Extended Range Diving
Standard Doubles



APPLICATIONS

Mainly used in overhead environments (i.e., caves, ice diving and wreck penetrations). This configuration typically provides enough gas volume for dives down to approximately 200 feet for 10-15 minutes, taking into account decompression requirements. The actual bottom time at depth will vary depending on air consumption, cylinder volume, and type of dive being conducted. This is also an excellent configuration for extended nitrox dives at shallower depths. Follow appropriate gas management rules that apply to the type of diving being conducted.

CYLINDER CONFIGURATION

Single—Use a 72 to 121 cubic foot cylinder. The main cylinder and pony can be banded together using one of several products made specifically for banding a pony to a larger cylinder (see your dive shop for details). These banding systems are easily removable for connecting the pony to several different cylinders during a multi-dive trip.

Pony—Use a 13 to 30 cubic foot cylinder for out of air emergencies only. Divers who accidently find themselves in obligated decompression can also use the pony for additional gas supply if needed (this is an emergency). The pony should not be planned for use in this manner since the main cylinder doesn't typically hold enough volume to carry the diver should the pony fail in some way. The pony is usually attached on the right side of the diver. The pony cylinder valve should be turned ON throughout the dive.

REGULATOR CONFIGURATION

Single—A standard two-stage, single-hose regulator with only one second stage is used on the main cylinder. This is your primary regulator. A high pressure hose with gauge console is attached and configured on the divers left side. A standard low pressure inflator hose is used for the buoyancy compensator.

Pony—The pony regulator is another standard two-stage, single-hose regulator with one first stage, one second stage, and a high pressure hose with pressure gauge only. No inflator hoses are attached to the pony. The pony's high pressure hose with pressure gauge is typically configured on the divers left side near the gauge console from the main cylinder. If the two gauges are similar in appearance they should be clearly marked with a high contrast label (i.e., black type on a white label) to minimize the possibility of confusion at depth.

CYLINDER CONFIGURATION

Matched cylinders are required for proper weight distribution. Use 72 to 121 cubic foot cylinders. Cylinders are banded together using steel bands and a standard valve manifold connects the gas supply between the tanks. An isolator valve manifold can also be used. Both valves on the manifold are turned on throughout the dive. In the event of a failure in any part of one of the regulators, such as a blown hose, the manifold valve connected to that regulator can be turned off preventing loss of gas. In this case all gas contained in both cylinders is still available through the remaining functional regulator. This event demands an immediate return to the surface or first scheduled decompression stop.

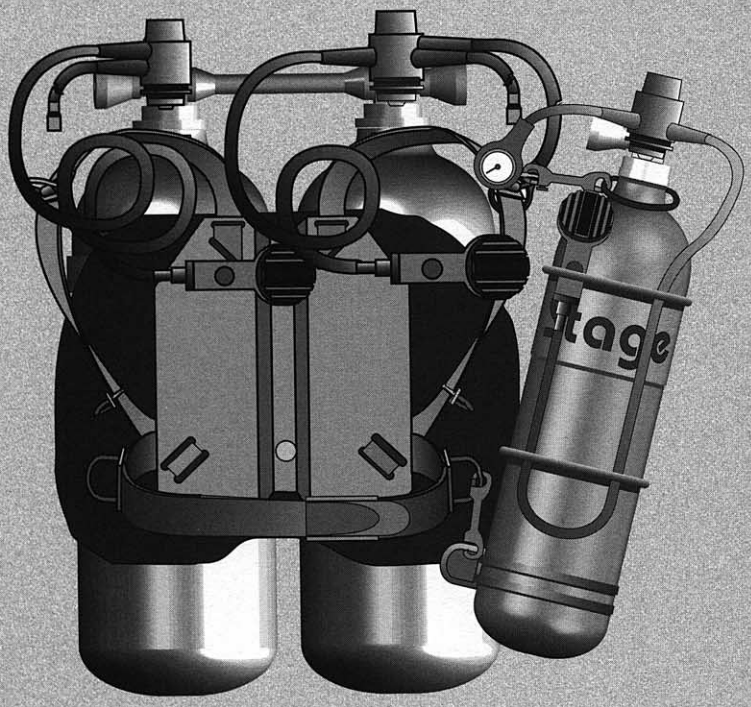
REGULATOR CONFIGURATION

Two independent regulators for full redundancy are used in this configuration. Regulator configuration can differ according to your training and type of diving. Two first stages are required for connection to each of the two valves on the manifold. A primary second stage with a longer hose (5-7 ft.) is typically connected to the valve closest to the divers right shoulder. The primary second stage can then be used in an emergency air sharing situation with two divers exiting single file in confined spaces. Another second stage and a high pressure hose with gauges is connected to the valve closest to the divers left shoulder. A low pressure inflator hose is connected to each first stage for BCD/Wings and drysuit inflation. All regulator second stages should be easily reachable, and all hoses should be streamlined to prevent entanglement.

(continued page 6)

Cylinder and Regulator Configuration (continued)

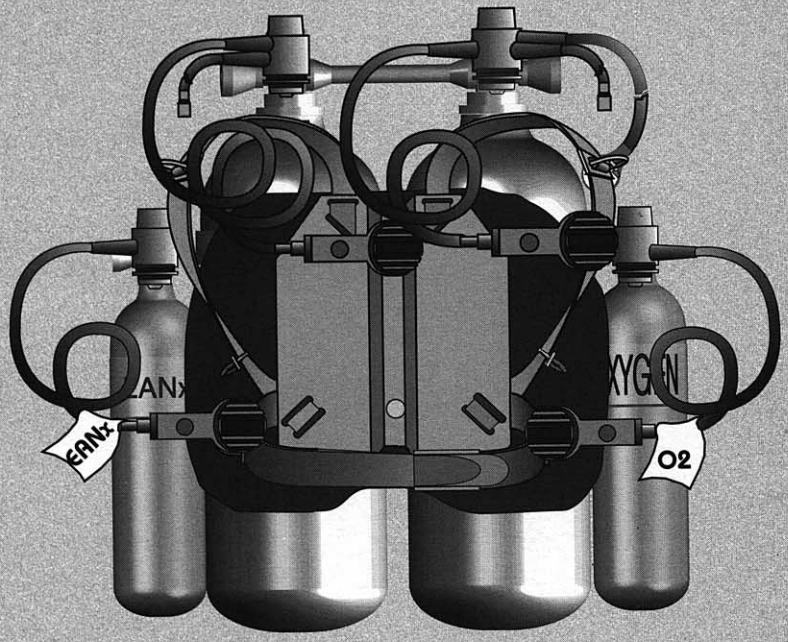
Cave Configuration
Doubles With Stage Tank



APPLICATIONS

Mainly used in deep, extended range, and overhead environments (i.e., caves) with heavier anticipated decompression requirements. The stage is sometimes used as a bailout bottle for emergencies. All cylinders should be clearly labeled with the exact gas mixture and operating depth. Follow appropriate gas management rules that apply to the type of diving being conducted.

Wreck and Ice Configuration
Doubles With Multiple Stage Tanks



APPLICATIONS

Mainly used in wreck and ice diving with heavier anticipated decompression requirements. The cylinders in this configuration are filled with a combination of travel gas, bottom mix, and decompression gases. The specific gas configuration varies depending on personal preference and the specific dive requirements. One stage cylinder is typically filled with 100% O2 for shallow decompression (ppO2<1.6ATA). All cylinders should be clearly labeled with the exact gas mixture and operating depth. Follow appropriate gas management rules that apply to the type of diving being conducted and the specific gases being used.

CYLINDER CONFIGURATION

Doubles—Matched cylinders are required for proper weight distribution. Use 72 to 121 cubic foot cylinders. Cylinders are banded together using steel bands and a standard valve manifold connects the gas supply between the tanks. An isolator valve manifold can also be used.

Stage—Use a 13 to 121 cubic foot cylinder for extended bottom times or decompression gases. The stage is usually clipped on the left side of the diver. In cave diving the stage cylinder is usually dropped and clipped to the guideline when one-third of the gas volume is used. It is picked up on the return and a second third is used on the exit (rule of thirds). Any dropped stage cylinders should be turned off to prevent loss of gas.

REGULATOR CONFIGURATION

Doubles—Doubles regulator configuration is the same as with the standard doubles (see page 5). Note that some cave divers prefer to configure the regulator with the longer hose as an octopus for emergencies, and some prefer to use it as their primary regulator, There is logic to support both approaches.

Stage—The stage regulator is a single independent regulator with one first stage, one second stage, and a high pressure hose with pressure gauge only. No inflator hoses are attached to the stage. Stage cylinder regulators should be clearly marked with a high contrast label (i.e., black type on a white label) to minimize the possibility of confusion at depth. Heavy rubber bands can be stretched around stage cylinders for stowing stage regulators and hoses to streamline the configuration.

CYLINDER CONFIGURATION

Doubles—Matched cylinders are required for proper weight distribution. Use 72 to 121 cubic foot cylinders. Cylinders are banded together using steel bands and a standard valve manifold connects the gas supply between the tanks. An isolator valve manifold can also be used.

Stage—Use 13 to 121 cubic foot cylinders for extended bottom times or decompression gases. The stages are commonly banded in a balanced symmetrical configuration. Stage tanks are carried by the diver throughout the entire dive because of the risk of becoming separated from the decompression line due to strong currents or becoming lost.

REGULATOR CONFIGURATION

Doubles—Doubles regulator configuration for wreck and ice diving is the same as with the standard doubles (see page 5). Note that some wreck and ice divers prefer to configure the regulator with the longer hose as an octopus for emergencies, and some prefer to use it as their primary regulator, There is logic to support both approaches.

Stage—The stage regulator is a single independent regulator with one first stage, one second stage, and a high pressure hose with pressure gauge only. No inflator hoses are attached to the stage. All cylinder regulators (doubles and stage) should be clearly marked with a high contrast label (i.e., black type on a white label) to minimize the possibility of confusion at depth.