The Inside Scoop on Hyperbaric Chambers

As a diver, you're undoubtedly familiar with the term "hyperbaric chamber," and it's likely you have seen photos of chambers or even had a tour of one. Did you know, however, that hyperbaric chambers come in different types and sizes and operate for many different purposes?

A hyperbaric chamber might be defined as any container that can be pressurized with air or other gases and holds pressures in excess of normal atmospheric pressure. If people go inside the chamber, the proper term to describe this type of device in the United States is a "pressure vessel for human occupancy."

Organizations such as the American Society of Mechanical Engineers (ASME) and the American Bureau of Shipping (ABS) have written standards for the construction of this type of apparatus for chambers built in the United States. As a professional diver, I have spent a good portion of my life in and around hyperbaric chambers of all descriptions. I have installed the plumbing on new chambers, have set up and operated chambers of all sizes (including saturation systems), and have treated divers (and been treated) for decompression sickness (DCS) in them. In terms of configuration, operation and creature comforts it provides, each chamber has its own unique personality. Although the world of hyperbaric chambers may seem complex, most chambers are actually simple.

Chamber Construction

In the late 1800s and for most of the 1900s, hyperbaric chambers were made almost exclusively from steel, because it was the only economical material that could safely hold the pressures found in most chambers. Today chambers are made from other materials, including acrylics and para-aramid fibers (like Kevlar(r)).

The plumbing that carries the breathing gases to and from most chambers is a mixture of copper and stainless steel tubing and brass pipe. Different types of valves control the flow of air, oxygen and nitrox to the chamber. Most chamber viewports are acrylic and are extremely thick. They are typically sealed with Orings, as are the chamber "doors," or hatches. Communications from inside the chamber to the operator(s) outside usually occurs through the use of an electronic communication box, more commonly referred to as a "com box" or "divers telephone." Commercial divers who dive using surface-supplied (umbilical) gear with full-face masks or helmets employ the same type of communications boxes.

Chambers may have either a "single-lock" device, with one compartment, or a "double lock," with two compartments. The advantage of a double-lock chamber is that people or equipment can "lock in" or "lock out" via the outer compartment, while the inner lock is maintained at a constant depth. This is especially important for treating persons with DCS since it allows doctors or other attendants to enter and leave the chamber without committing them to the entire length of treatment, which usually lasts six hours or longer. Almost all larger chambers have "medical locks," through which attendants pass medical supplies and food to the chamber's occupants. These are simple to operate, and they work by equalizing the chamber pressure with the space in the lock.

The typical chamber used in commercial diving is usually 54 or 60 inches in diameter with an overall length around 14 feet (4.3 meters). Clear acrylic chambers, like the ones found in many hospitals, are often large enough to accommodate only a single person lying down. If you're claustrophobic, this chamber can pose a challenge for you.

How Chambers Are Used

In military and commercial diving, hyperbaric chambers are routinely used for a procedure known as "surface decompression on oxygen" or "sur-d-O2." This technique calls for the diver to complete a series of stops in the water, then rapidly ascend to the surface and enter a decompression chamber within five minutes. Inside the chamber, the diver is recompressed, usually to an equivalent depth of 40 feet (12 meters), where he breathes pure oxygen for periods of 20 minutes, with five-minute breaks for air.

Surface decompression using oxygen is generally considered much safer than decompressing in the water. The diver's depth can be precisely controlled, there's less risk for the diver in the chamber than in the water, and the temperature of the chamber can also be controlled. Even though the diver is breathing pure oxygen at a depth that exceeds the maximum recommended depth for this gas, the diver in a dry environment and completely relaxed rarely experiences a problem.

Chambers that have been plumbed for commercial diving usually have an identical set of controls both inside and outside the chamber, although the topside controls will usually override the diver's controls. The rationale behind his plumbing philosophy is that in an emergency, divers can operate their own decompression. In the civilian world, not many chambers can be run from the inside. Military and commercial divers may also use a technique known as saturation diving, where the divers live in a saturation system, under pressure, for days at a time.

This system typically consists of several chambers bolted to each other, and a diving bell, which is also a hyperbaric chamber and can also be joined to the system. The system normally sits on the deck of a barge, ship or rig, anchored over the location where the divers will be working on the bottom. When it's time to go to work, the divers climb into the diving bell, which is sealed off from the system, and the system is sealed as well.

Once the inner-bell hatch is closed, it is lowered to the depth where the divers will work. When the pressure inside the bell is equal to the pressure outside the bell, the divers can open the hatch. Typically, one diver swims out to perform the job, while the other diver remains inside the bell to tend the first diver's hose and act as a safety diver in an emergency. The first diver will usually work for a maximum of four hours in the water and then trade places with his bellmate. It's not unusual for a bell "run" to last 10-12 hours from the time the bell leaves the deck until the divers lock back into the saturation system.

The principle behind saturation diving is that after 24 hours under pressure, a diver becomes "saturated" with any inert gas in the breathing mix, and his decompression will be the same whether he has been under pressure for a day, a week or a month. Since most saturation diving takes place at depths in excess of 165 feet (50 meters), the inert gas used in the mixture is helium, which does not produce the same narcotic effect as nitrogen.

Of course, military and commercial divers can get DCS, too, and hyperbaric chambers are used to treat them, just as sport divers are treated. Another big difference between civilian versus commercial and military diving operations is accessibility: Many commercial and military vessels will have a chamber on site so that a diver can be treated quickly for any type of diving accident. Since treating a diving accident is a medical procedure, in almost all cases a hyperbaric physician will prescribe the diver's course of treatment. Hyperbaric chambers are also used for conducting research in diving physiology and for testing dive equipment. Such chambers are usually at the extremes of size.

They may be very large, such as the one at the U.S. Navy's Ocean Simulation Facility in Panama City, Fla., or they may be just large enough to accoaccommodate a piece of equipment like a diving helmet, regulator or dive computer. Small, one-man chambers are also used for evacuating victims of scuba diving accidents from remote locations to facilities where more extensive medical attention can be provided. Usually small enough and light enough, they can be transported on a helicopter or aircraft. They are also usually designed to either mate to a larger chamber, or they may be small enough to allow them to be placed inside a larger one; this allows the injured person to be kept under pressure continuously.

The Hyperbaric Experience

Making a "dive" inside a hyperbaric chamber is very much like being inside a large scuba tank. Just as in your scuba tank, the chamber will heat up as the pressure inside it increases, and it will cool off as the pressure is vented.

When you make a dive inside a chamber, you will need to equalize the pressure in your ears, just as you do when you dive underwater. Anything that you take inside, such as a watch, must be capable of withstanding the pressure.

If you have the opportunity to make a chamber dive just for the experience, and not because you need treatment, remember that if the dive is long enough and deep enough, you can get "the bends" as a result of your dive, just as you can on any open-water dive.

Hyperbaric Chamber Operations Require Skill and Maintenance

Being inside a hyperbaric chamber is relatively safe, but be aware of these risks: improper operation of the chamber, structural failure and fires A fire requires a source of ignition, something to burn and sufficient oxygen to support combustion. Because of this, chamber operators are extremely careful about the kinds of fabrics allowed inside.

Additionally, all have chamber passengers remove their shoes before entering, avoiding tracking in flammable oils. Since chambers are built to demanding standards, structural failures are rare. However, if a chamber is old and has been poorly maintained, or is damaged by external forces, it could end up depressurizing very rapidly. In this situation, explosive decompression can result, a serious or even fatal event. While most operators are well trained, even the best operator can make a mistake. If you or a buddy requires recompression in an unfamiliar place, take a look at the overall condition of the facilities: Is it clean and orderly? Does anything appear to need attention or repairs? If you have questions, were they answered to your satisfaction? If you have any doubts about the facility you are at, call DAN.

Chambers in Perspective

For many reasons, hyperbaric chambers are essential to diving. Let's hope you'll never need one, but it's good to understand what they are, how they work and why they are important. DAN Recompression Chamber Assistance Program (RCAP) Begins 18th Year of Service to the Recompression Chambers

Through its ongoing program of chamber assistance, DAN maintains contact with about 30 chambers in the DAN America region. These chambers may request assistance under DAN's Recompression Chamber Assistance Program (RCAP).

The program begins its 18th year of service to the recompression chamber community. Joel Dovenbarger, DAN America Vice President for Medical Services, said through communication with the chambers, DAN identifies general needs and targets specific needs of individual chambers. "We hear directly from the chambers, help them set priorities and find out how DAN can best assist them," Dovenbarger said.

"This year the RCAP will focus on educational programs and will place patient monitors at chambers that currently don't have a way to monitor heart rate, respiration and oxygen saturation while treating divers.

"DAN will also conduct site assessments to help chamber personnel upgrade their facilities or, if needed, make improvements."

Through RCAP DAN assists chambers through grants for maintenance, repair and new equipment and continuing medical education forums or medical conferences for chamber personnel. This emphasizes the importance of RCAP. Things the chambers cannot always afford, RCAP can provide. DAN's Recompression Chamber Assistance Program was established in 1993 to support recompression chambers and medical staff with financial assistance and training. The program has sought to ensure that high-quality recompression treatment is available to divers throughout the DAN America region.

To learn more about RCAP, visit http://www.daneurope.org/web/guest/rcapp1.

About the Author

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