Choosing a Scuba Regulator

By Mike Ault, Copyright 2007

In my recent article about buoyancy compensation devices (BCDs) an attempt was made to demystify the selection of a buoyancy compensation device for the novice scuba diver. In this article I will try to explain the basic differences between scuba regulators and provide a basis for comparison between the various regulators available on the market today. Unfortunately there is not enough room in a single article for me to cover all of the available regulators, their various features and specifications.

Primary Regulators

When many scuba divers speak of their regulator they are usually speaking about the entire assembly consisting of the primary regulator, hoses, the secondary regulator, a backup regulator (sometimes called an octopus) and a gauge console that usually contains a depth gauge, a submersible pressure gauge (SPG) and maybe a dive computer and compass. In the DIR and technical diving arena the divers will usually break this set of components out and discuss each part as a different piece of gear, mixing and matching to get the best combination for the particular type of dive they may be planning. Often a technical or DIR diver will eschew the console setup completely and depend on a wrist-worn bottom timer and a small SPG only. Remember that as long as you are careful to match specifications and capabilities then you can mix and match consoles, gauges, computers, primary and secondary regulators.

Figure 1: Complete "Regulator" Assembly

The primary regulator is the one that all the hoses attach to and is tasked with converting the high tank pressure (3000+ PSI) air in the tank to 125-145 PSI low pressure air over the entire operating range of the system. The secondary regulator takes the 125-145 PSI low pressure air and delivers it to the diver at just above ambient (water or air) pressure.

When deciding what regulator is best for your needs you have to accurately define your needs as a starting point in the decision process. You need to determine what environments you will be diving in, for example if you are going to only dive within recreational limits and only in tropical (greater than 70 degree Fahrenheit) water you will not need as robust a regulator as a second diver who dives water in temperatures ranging from near freezing during winter ice dives to tropical temperatures during dive trips. So the first parameter will be temperature range of expected use.

Another factor determining the best regulator for you is to figure out if you will ever exceed the recreational diving envelope of depth (dive in excess of 130 FSW) if the answer is no, then you will not need as adjustable or high flow capable a regulator as a diver who frequently goes to 200 or more feet of depth.

DIN or A-Frame (yoke) connector is another choice in scuba regulators, the DIN, popular in Europe and technical/DIR diving allows higher pressures and offers a more secure attachment to the tank, also usually exhibiting a smaller footprint. The A-frame connector is a standard in the USA and in most tourist dive shops. So, if you plan on moving into technical or DIR type diving, a DIN regulator may be what you need, most have adapters to convert them into A-frame as needed. If you have no desire to dive with high pressure tanks and dive deep wrecks and caves, then a simple A-frame regulator may be your best bet.

Figure 2: DIN with adapter (Apeks DS4) and Yoke (Oceanic PX3) Primary Regulators

Note that this selection of DIN or A-frame will also drive what tanks you may purchase for your own use, as an example most sets of double tanks will have DIN type connectors, probably with A-frame adapters in place (if 200 bar connector is used) If you choose the higher pressure tanks (greater than 200 bar) you will have to have DIN regulators as generally speaking there aren't adapters for 300 bar fittings for the A-frame connector. A 200 bar adapter cannot be used in a 300 bar tank connector as the threads in a 300 bar connector are made deeper to prevent this from happening as a safety precaution

Figure 3: OMS 300 Bar-DIN and Dive-Rite 200 Bar-DIN Connectors

Primary regulators will usually be piston type and will come as either balanced (always deliver the same pressure above ambient) or unbalanced (deliver higher pressure, and consequently higher flow at greater depths. Primary regulators also come as environmentally sealed or not. The environmentally sealed primary regulators are for use in cold/extreme environments like ice diving.

Other regulator options include the number and placement of high pressure and low pressure ports. High pressure ports are used to feed pressure gauges or air integrated computer transmitters, low pressure ports provide for the secondary and backup regulators and the various inflator hoses (such as BCD and dry suit). The LP ports are sometimes designated as high flow (for secondary and backup regulators) and low flow (for inflator hoses.) The high pressure ports have a different hole and thread size than the low pressure ports and will usually be nearer the connection to the tank. Usually you will only need a single high pressure port for your pressure gage, however if you wish to use a transmitter for an integrated air dive computer and have the SPG for a backup then you will need two.

If you are a non-technical/DIR diver and don't dive dry suits then you will only need 3 low pressure ports, one for the BCD inflator, one for your secondary regulator and one for your backup regulator, this drops to 2 if you use a combined BCD fill/backup regulator and increases to 4 if you dive a dry suit and need a dry suit inflator as well as a BCD inflator.

Another option is whether the section of the primary stage that contains the ports rotates to allow adjustment of hose placement (called a turret type regulator like the Oceanic PX3 or DST series from Apeks) or not. Most technical or DIR divers prefer a ridged or non-turret regulator to eliminate a possible failure point. I have not heard of any joint failures at the turret on a regulator in nearly three-years of diving, but it never fails to err on the side of caution.

Finally, if you decide you want to mix and match primary and secondary regulators you need to know the IP pressure for the primary (usually between 125 and 145 PSI, or it may vary getting slightly higher with depth if the regulator is unbalanced.) You have to know the IP pressure to make sure you match a secondary or backup regulator that is compatible to the IP pressure. Of course, most LDS can adjust or tune the primary and secondary or backup regulators if the IP pressure falls outside of the compatible range at its factory setting.

Secondary Regulators

It is suggested that you find reviews of the regulators you are interested in. A good technical review will use a calibrated test device to show breathing effort at various depths for a primary/secondary combination of regulators. Usually the breathing effort is mostly attributed to the secondary regulator as long as the primary delivers adequate pressure and flow to the secondary.

Figure 3: Example Secondary Regulator, an Oceanic Alpha 8

Secondary regulators can be of the piston or diaphragm type and can offer adjustment knobs to adjust the release pressure (the pressure differential at which the diaphragm or piston opens) to allow easier breathing. Where an adjustable regulator is nice is when there may be extremes in depth for a given dive, where the adjustment for comfortable breathing at depth would result in a free-flowing regulator at the surface.

Secondary regulators also come in various types of materials from almost all plastic, to a combination of metal and plastic to all metal. Generally if you will be using a regulator for long periods of time, the lighter weight it is the easier it is to use since it reduces mouth and jaw fatigue. Placement of exhaust ports can also be an important consideration if you do underwater photography or videography. Side exhaust secondaries usually keep bubbles out of your visual path and are preferred for photography and videography. Some photographers even prefer the dual hose regulator that funnels the exhaust completely to the back of the head.

Backup or Octopus Secondary Regulators

Often times overlooked or treated as an afterthought, the backup or octopus regulator is also an important decision, after all, if you or your buddies secondary fails, the backup is how you will get air until you can surface or correct the problem. Generally there are three choices for a backup regulator:

1. Get a similar or identical regulator to the secondary
2. Get a lower performance regulator or one designed specifically as a backup
3. Use an integrated BCD fill/backup regulator

The benefit to using a regulator that is nearly or is identical to your primary regulator is that there won't be any difference between using it and your primary. In some cases, especially in an emergency, you won't get enough air from a lower performance or integrated backup due to the increased respiration rate you experience during these situations, this can lead to further stress and aggravate the emergency. The negative side to a high performance regulator as a backup is that it may tend to free-flow at the surface or at shallow depths.

Figure 4: A Bungeed Identical Backup Regulator (Oceanic Alpha 8)

The main benefit from use of a low performance backup is that a lower performance backup is less likely to free flow at the surface or at shallow depths.

Figure 5: A Dedicated, Lower performance Backup (Sherwood Octopus)

The only benefits from an integrated backup are that it frees one LP port on your primary regulator and reduces the number of hoses you need to route. There have been complaints of low-air volume delivery or wet breathing from an integrated backup (I have experienced both from one I used to have.)

Figure 6: Back-view of an Integrated Fill/Backup Regulator (Sherwood)

So What Regulator Is Right For Me?

Let's look at two divers, Joe and Mike. Joe dives 2-3 times per year in tropical locations. Joe is OW certified and not really interested in deep or technical diving. Joe doesn't take pictures underwater and has no desire to. Mike dives year round in cold and tropical water. Mike dives doubles and while not yet doing tech or DIR level diving is seriously considering it in the future. Mike is an amateur photographer and does do underwater photography.

Joe's primary regulator should be dependable, easily serviced, doesn't have to be used in extreme conditions, Joe will never use greater than 200 bar tanks. Joe's primary doesn't need to be diver adjusted and placement and number of ports isn't a serious consideration for Joe since he dives a standard secondary, octopus and console configuration. Joe will be happy with a non-sealed, non-turret or turret type, balanced A-frame (yoke) primary with a single HP and 3-4 LP ports, Joe's secondary doesn't need to be diver adjustable and port placement isn't a consideration. Joe probably won't notice the difference between a $500 and a $2000 regulator setup for the few times he dives per year (unless he happens to try out the advanced level divers regulator.)

Mike's primary regulator must be dependable and rugged, it should be easily serviced and has be useful in extreme conditions of pressure and temperature and may be exposed

to higher than 200 bar pressures. Mike's DIN primary regulator needs to be environmentally sealed, non-turret with 2 HP and 4 LP ports, with two of the LP ports providing high flow. The primary should probably be the unbalanced design to make breathing at depth easier. Mike's secondary should be adjustable with side exhaust and light weight. Mike's secondary should also be easy to take apart and put together, even underwater.

However, all the above being said, most divers will overbuy their primary and secondary regulators due to the gee-wiz factor. This overbuying is not necessarily a bad thing as a higher performance regulator will still do the trick for a Joe level diver as well as a Mike level diver.

So when you decide to take the plunge and purchase your own regulators, it is suggested you sit down and make a list of what features are important to you based on the type of diving you wish to do, then based on those features choose the regulator setup that best fulfills your needs within your expected price range.