
The Good Format Tables

You're Diving What Tables? And Why?

Have you ever gone to a dive resort that imposed mystery dive profiles on guests? If you're like our editors, you're going to ask, "Why?" (or "Says who?") when the divemaster informs everybody that the first dive of the day will be "60 feet for 30 minutes." Even if you're accustomed to using tables instead of a dive computer, you're probably not going to be satisfied with a vague answer like "That's worked for us in the past" or "We have to get back for lunch." Most dive operators these days seem to have converted to dive computers, but some are still holding out. In this report, our West Coast Editor highlights a resort operation that permits multilevel diving but uses table-based profiles.

At St. George's Lodge in Belize, you'll probably be diving with Fred Good, the owner/divemaster. Fred plans multilevel dives using a modified version of the USN tables, rather than relying on the numbers scrolled by most dive computers for single-depth dives.

Of course, dive computers do adjust their times on the fly, but they don't really permit detailed pre-dive planning. They'll tell you what you have available on your next dive to 100 feet, for example, but they won't tell you in advance how much time you'll have at each level if you leave 100 feet after 10 minutes, ascend to 80 feet, spend 15 minutes there, and then go to 40 feet. [*Editor's note: The Suunto Solution can provide a pre-dive simulation this complex, but only before a first dive; the Scubapro DC-11 and its Dacor predecessor, the MicroBrain Pro Plus, can also simulate dives, but they are so complicated to use in this mode that few recreational divers make the effort. Notebook and office-sized computers can run simulation software, but few dive boats or traveling divers have these at their disposal.*]

Fred's system is similar to that promoted in the late 1970s by Dennis Graver, then training director at PADI, who was working with USN tables. In PADI's "Decompression in Depth" seminar proceedings, Dennis popularized the idea that a repetitive letter group meant essentially the same thing in terms of residual nitrogen, no matter how you got to that group. The Graver method was commonly used at the time by commercial divers to "step up" or "step across" the tables, though few recreational divers knew about it.

For instance, using the USN tables on a first dive, you got to be an "E" diver after 15 minutes at 100 feet. If you remained at 100 feet, you would have only 10 more minutes before running out of no-stop time (the USN limit is 25 minutes at 100 feet). On the other hand, if you hadn't gone to 100 feet at all, but had just descended to a maximum of 60 feet and stayed there for 25 minutes, you would also have become an "E" diver. You'd have another 35 minutes available to you because the USN no-stop limit at 60 feet is 60 minutes.

What Dennis promoted is to combine the two dives in the following fashion: After 15 minutes at 100 feet, you'd become an "E" diver. If you then ascended to 60 feet and kept that letter designation, you could stay there for another 25 minutes. At the end of the time, you'd be a "J" diver. Why not ascend to 40 feet, for example, keeping the "J" group? At 40 feet, a "J" diver would be one who (on a first dive) had spent 110 minutes there. The USN no-stop limit for 40 feet is 200 minutes. Why not spend the remaining 90 minutes at 40 feet for a total dive of 15 + 25 + 90 minutes? It was a lot like getting something for free. You went to 100 feet, and instead of 25 minutes, you had a 130-minute dive.

That's the simplified version. Graver actually recommended reducing some of the no-stop limits by a letter group or two, just in case. In theory, you unloaded some of the nitrogen you got on deeper segments of the dive while you were loafing around in the shallows. The same method could be used for repetitive dives, too, by entering the tables with the appropriate amount of residual nitrogen time that applied to the letter group following your surface interval.

This is similar to what Fred is currently doing, although he has added a healthy degree of conservatism by arbitrarily raising his letter group each time he changes depth levels,

by staying above the tabulated depth within a level (e.g., staying closer to the 50-foot end of the 50- to 60-foot depth range), and by not diving to the no-stop limits for any depth. Fred claims no detected hits so far on his profiles.

Although I dived Graver's method — as did many of my friends — for several years without mishap, I must point out that it has always been

controversial and I do not advocate such methods. In 1981, Karl E. Huggins and Lee Somers at the University of Michigan analyzed 101 multi-level, 30- to 60-minute dive profiles conducted strictly according to Graver's guidelines. All but one of the 101 sample dives produced nitrogen levels higher than 90% of the maximum that would have been allowed in at least one tissue group at full no-stop

limits. Fifty-five of these sample dives produced theoretical nitrogen levels higher than 96% of the maximum that would have been allowed by the USN model. Eight dives produced nitrogen levels equal to 100% or more of the allowed maximum. In other words, using the Graver method made it easy to violate the theoretical USN model.

As a result of this research, the University of Michigan issued some guidelines for cutting back even further on the no-stop times when "stepping up." A few years later, Karl published his own tables for multilevel diving. These tables — which were eventually incorporated into the Orca EDGE — were quite a bit more conservative than the USN tables.

One of the problems with the USN tables is that they can be confusing to learn, especially for new divers. The basic layout or format is user-hostile. There have been many attempts to improve on the layout over the years. The table layout on the previous page is Fred's design. It's a whole lot like Ralph Maruscak's Nu-Way tables that came out in 1970, but it incorporates the best visual features of the PADI (non-Wheel) Recreational Dive Planner. It's easier to use than a standard set of USN tables, which span several sheets. Nonetheless, Fred's tabled values are standard USN.

Fred has drawn in a "water-line" to indicate which calculations take place above and which below the water, and has shown both residual nitrogen and remaining (available) no-stop times. He's also added times and depths for first stops, rather than requiring these to be looked up in a different table, Navy-style. On the whole, the layout is an improvement

Safety Margins, Attorneys, and Arm-Waving

Are the Good Tables a leap forward, a step backward, or a retention of field-proven schedules? Well, it depends on whom you ask. The USN tables were not originally intended for multilevel diving per Graver, Huggins, or Good. There is a published USN procedure for table-based multilevel diving, and it uses times and procedures that are very different from its standard single-depth tables. Most newer recreational diving tables *are* going in the direction of being more conservative than the USN tables, though the rationale for this may be more legalistic than physiological. Some of the specific changes — such as NAUI's conversion of bottom times to total dive times including ascent — seem to have been derived by rectal extraction, though they're probably pulling in the right direction.

When somebody gets bent, it's been a common legal defense for a dive operator to be able to cite use of the USN tables as the de facto standard of the industry. Many nonmilitary institutional diving operations have had excellent luck with the USN tables, when dived exactly as designed. Dive comput-

ers that can provide more dive time than the USN tables have already been dragged into court, with attention focused on their deviations from the USN standard.

Owner's manuals for dive computers also advise purchasers to add safety margins. How close should a computer be taken to its no-stop limits? Nobody really knows. In theory, the no-stop limit should be safe for most divers, but accidents do happen. Computer divers — including this publication's editors — routinely add random safety margins, just because. Ask any EDGE diver if he pushes the limit, and you'll often hear something like, "I keep at least two pixels away from the line." Users of more modern computers often cut back a couple of minutes from the no-stop limits, or don't let their accumulated dive time exceed their available no-stop time at any given depth, or use some other arbitrary formula. No doubt it's an excellent idea to build in a safety factor, but it's still impossible to relate these safety factors to the actual likelihood of getting bent.

over most other versions of the USN tables and could probably be used for any tables whose residual nitrogen calculations are based on letter groups. Of interest to nitrox divers, Fred plans to produce a multiple set of tables using this “Good Format” for mixes for each 1% increment between 15% and 40%.

The Bottom Line

If someone else is dictating your bottom time, you need to know how they are determining it and decide if you are comfortable with that. I am ambivalent on tables in general, and the USN tables in particular. I dived USN tables professionally for over 10 years and never saw a hit, even using Graver’s method for multilevel diving, so I’m comfortable with USN times. However, I’m coming up on my 49th birthday and have gradually backed off on my profiles over the last couple of years as a result of the research showing a definite link between age and “bendability.” If I were

diving USN tables, I’d be staying well away from the no-stop limits or adding to stop times by at least one depth level and one time interval on stop-required profiles. This kind of conservatism would put me pretty close to the Canadian DCIEM tables or the Huggins tables.

The arrangement of the numbers isn’t really important to me at this stage in my career, but might be for a newer diver. Fred’s tables are, indeed, a convenient rearrangement of the USN tables with a very clear layout. If I were still teaching students, I’d be tempted to give them a try to see if they were easier to learn than other arrangements.

Fred must feel that the USN limits are too generous for multilevel diving, since he adds his own arbitrary safety factors during dive operations at St. George’s Lodge. I’d rather see him revise his tables and procedures to show the times and

procedures he actually feels comfortable with, instead of reprinting the original limits. On the other hand, Fred obviously believes in allowing the end user to append his own safety factors.

I must admit to an anti-table bias in general. I’m convinced that on a per-dive basis dive computers are safer and a great deal more flexible than any set of tables in the industry, USN included. I haven’t dived lately with anyone using tables — though I did hang out with a Wheel user in Papua New Guinea several years ago — and can’t imagine going back to using tables myself. Being able to pre-plan a multilevel dive (as Good can with tables) seems much less advantageous than being able to alter a dive profile on the fly (as I can with my dive computer).

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Barracuda Reef

Illuminated by a Dive Light

Barracuda Reef is a name that holds a variety of emotional content for experienced aficionados of Cozumel diving. Depending on who you’re listening to, diving that particular site north of town (unlike all the others on the island, which are south) is anything from foolhardy madness to the best dive anywhere. Whatever the opinion, adrenaline is always part of it. This is high-adventure diving. The editor of

this publication has said that he always feels ambivalent when he hears of diving Barracuda Reef. He has, after all, had to delete from his subscription list the names of more than one experienced diver who braved the often treacherous currents that give the reef its reputation (and at least part of its appeal), never to be seen again.

The current in Cozumel (usually northerly, parallel to

the coast) each day whisks thousands of divers miles along a smorgasbord of world-famous reefs, from Maracaibo to Villa Blanca Wall. Just north of town, however, the island makes a right turn, but the reef and the current don’t — they go straight on, away from shore. Next stop: Cuba. The currents are often turbulent, inconsistent, different at the surface and at depth, very strong, and always unpredictable.

Why would anyone want to dive such a site? For all the reasons that people want to dive, except perhaps for relaxation. Barracuda Reef is one of the best dives in the world; with so few divers, it is absolutely