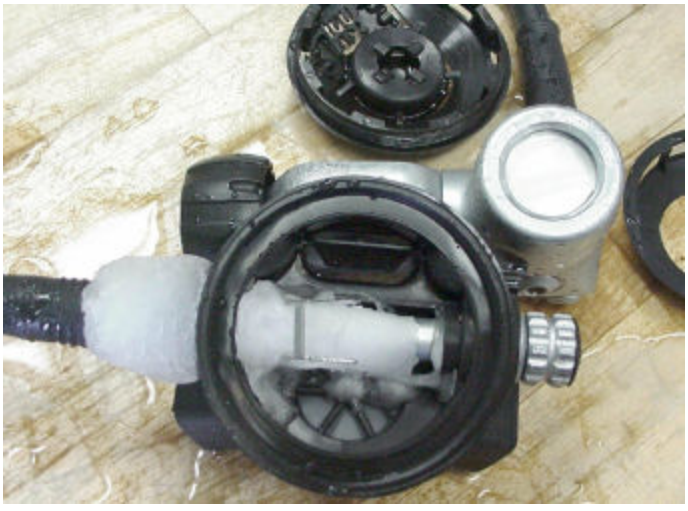
Cold Water Scuba Regulator Testing — U.S. Navy vs. EN 250

Under thick ice in the Ross Sea, near McMurdo, Antarctica.

When scuba diving under 3-m thick polar ice with no easy access to the surface, the last thing you want to worry about is a failure of your scuba regulator, the system that provides air on demand from the aluminum or steel bottle on your back.

However, cold water regulators do fail occasionally by free-flowing, uncontrollably releasing massive amounts of the diver's precious air supply. When they fail, the second stage regulators, the part held in a scuba diver's mouth, is often found to be full of ice.



The U.S. Navy uses scuba in polar regions where water temperature is typically -2° C (28° F). That water temperature is beyond cold; it is frigid. Accordingly, the Navy Experimental Diving Unit developed in 1995 a machine-based regulator testing protocol that most would consider extreme. However, that protocol has reliably reflected field diving experience in both Arctic and

Antarctic diving regions, for example, in Ny-Ålesund, Svalbard, or under the Ross Sea ice near McMurdo Station.

There are currently both philosophical and quantitative differences between European standards and the U.S. Navy standard for cold water regulator testing. Regulators submitted for a European CE mark for cold water diving must pass the testing requirements specified in European Normative Standard EN 250 January 2000 and EN 250 Annex A1 of May 2006. In EN 250 the water temperature requirement for cold water testing ranges from 2° C to 4° C. Oftentimes, regulators that pass the EN 250 standard do not even come close to passing U.S. Navy testing.

An iced up, highly modified Sherwood SRB3600 Maximus second stage regulator

The Navy's primary interest is in avoiding regulator free-flow under polar ice. The breathing effort, which is a focal point of the EN 250 standard, is of lesser importance. For instance, the 1991 Sherwood SRB3600 Maximus regulators long used by the U.S. Antarctic program have been highly modified and "detuned" to prevent free-flows. You cannot buy them off-the-shelf. Detuning means they are not as easy to breathe as stock regulators, but they also don't lose control of air flow to the diver; at least not very often. Here is a photo of one that did lose control.

NEDU performs a survival test on regulators, and any that pass the harshest test are then tested for ease of breathing. The so-called "freeze-up" evaluation breathes the regulator on a breathing machine with warmed (74 ±10°F; 23.3 ±5.6°C) and humidified air (simulating a diver's exhaled breath) at 198 feet sea water (~6 bar) in 29 ± 1°F (-1.7 ± 0.6°C) water. Testing is at a moderately high ventilation rate of 62.5 L/min maintained for 30 minutes. (In my experience a typical dive duration for a dry-suit equipped diver in Antarctica is 30-40 min.)

To represent polar sea water, the test water is salted to a salinity of 35-40 parts per thousand. The possible development of a "freeze up" of the regulator 2nd stage,

indicated by a sustained flow of bubbles from the exhaust port, is determined visually.

In contrast, the European standards call for slightly, but critically, warmer temperatures, and do not specify a duration for testing at an elevated respiratory flow rate. I have watched regulators performing normally under EN 250 test conditions (4° C), but free-flowing in water temperatures approaching 0° C. Those tests were run entirely by a non-U.S. Navy test facility, by non-U.S. personnel, using a U.K. produced breathing machine, with all testing being conducted in a European country. The differences in testing temperatures made a remarkable difference.

Haakon Hop of the Norwegian Polar Institute in Ny-Ålesund, Svalbard.

The NEDU testing results have been validated during field testing by scientific diving professionals under Arctic and Antarctic ice. The same regulators that excel in the NEDU protocol, also excel in the field. Conversely, those that fail NEDU testing fare poorly under the polar ice. For instance, a Norwegian biologist and his team exclusively use Poseidon regulators for their studies of sea life inhabiting the bottom of Arctic ice. (The hard hat in the photo is to protect cold skulls from jagged ice under the ice-pack.) Poseidon produces some of the few U.S. Navy approved cold-water regulators.

As is usual for a science diver in the U.S. Antarctic Program, a friend of mine had fully redundant regulators for his dive deep under Antarctic ice. He was fully prepared for one to fail. As he experienced both those regulator systems failing within seconds of each other, with massive free-flow, he might have been thinking of the words of Roberto "Bob" Palozzi spoken during an Arctic Diving Workshop run by the Smithsonian Scientific Diving program. Those words were: "It's better to finish your dive before you finish your gas…"

In both NEDU's and the Smithsonian's experience, any regulator can fail under polar ice. However, those which have successfully passed U.S. Navy testing are very

unlikely to do so.

A previous blog posting on the subject of Antarctic diving may also be of interest.

jclarke45 / August 2, 2012 / Diving, Science and Technology / Antarctica, Arctic, cold water diving, EN 250, Polar Diving Program, scuba regulators, Smithsonian Institution, U.S. Navy

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I value the article post.Much thanks again. Cool.

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