Breathless Down Under

How inattentive divers get into air trouble

Two recent articles by Dr. Christopher J. Acott in the South Pacific Underwater Medical Society Journal *survey the results of a study of incidents in Australia and New Zealand in which divers ran out of air, as well as a test of divers' knowledge of equipment checkout procedures. Dr. Acott is with the Hyperbaric and Diving Medicine Unit, Department of Anesthesia and Intensive Care, Royal Adelaide Hospital, North Terrace, Adelaide, South Australia. Both this article and "How We Mess Up" on page 6 are adapted from Dr. Acott's articles.* In Depth *takes all responsibility for editorial changes in this article.*

Diving is an equipment-oriented sport in a dynamic environment; your safety depends on your knowledge of the risks. Although some diving accidents are unforeseeable, as many as 90 percent are due to diver error.

A diving incident is any error that impairs diving safety. Most errors are trivial and can be caught before they cause harm. Being human, we can't eliminate all errors, but we can minimize their effects — especially errors of omission, repetition, or substitution, or those that are caused by inadequate knowledge or skills or from failure to follow rules.

Of the reports we analyzed, 19.5 percent involved an out-of-air problem; 35 percent of these resulted in injury or death.

The factors contributing to the first 1,000 incidents in the

Danger Down East

Arguments against weight-integrated BCs

Dear Delmar,

In the latest issue of *In Depth* (March 1996) you responded to another reader's query about weight-integrated BCs by saying that you like them and prefer them to weight belts. I think there are two good reasons why these systems may not be appropriate for all divers or diving situations, and that there is a further caveat to their use.

Here in New England (where the underwater visibility is not always the greatest) it is not uncommon to get tangled in fishing or lobster-pot line, making it sometimes necessary to remove your BC (especially if it is the regulator first stage that is tangled) to free yourself (yes, your buddy should be able to do this for you, but I prefer to be able to do a self-rescue if possible, and your buddy might also be tangled). Solving the problem and putting the BC back on will be an extremely difficult task if removing your BC makes you 20–30 pounds buoyant.

Divers who need assistance getting in and out of the water should consider the burden these systems put on the people helping them. For many years I have been actively involved with the Moray Wheels, a dive club dedicated to promoting diving for people with physical disabilities (often with spinal cord injuries, but also amputees and people with diseases such as cerebral palsy or spina bifida). The usual practice is to get the disabled diver to the water's edge (or the stern platform of a boat) and bring their gear to them. A single unit weighing perhaps 70 pounds (30 pounds of lead is not unusual in our cold waters) is MUCH harder to move around than two separate pieces (BC/tank/regulator and weight belt) each weighing about half that.

As for the caveat: Anyone (no matter how able) using a weight-integrated BC should, for their own safety, make certain that their buddy (and anyone else in the dive group who will listen) knows exactly how to release the weights in an emergency. Personally, I prefer a weight belt — anyone can easily release that if, for some reason, I should become unconscious.

Peter Vernam
Nahant, MA

Excellent points to bring up, Peter. While the main advantages of weight-integrated BCs are enjoyed with tropical diving, they are not without merit in coldwater diving. To avoid ending up a dive shaped like a U from the 67 pounds strapped around my middle, I've split the difference: I wear a portion of the weight on my belt and the rest in the BC.

Delmar Mesa

study are ranked by frequency in the table. Knowledge- or rule-based errors predominate in the first ten contributing factors.

It was not just the inexperienced who ran out of air. More than 75 percent of the divers had an advanced certification, although the injury rate was higher among inexperienced divers.

Failure to check the pressure gauge occurred in 33 percent of the incidents. An inaccurate gauge was responsible for another 15 percent of the out-of-air incidents. Such incidents could be minimized by the use of audible alarms in both the tank valve and the pressure gauge, a thorough pre-dive gauge check, and recalibration of gauges during regulator servicing. Carrying a small spare (pony) cylinder might help; but would divers who fail to check their main air supply remember to check the spare? In 32 percent of the cases, the diver failed to make sure that the air supply was turned on or failed to check the pressure, the hoses, the mouthpiece, or the second stage.

Frequent use of the power inflator to maintain buoyancy — a fault of technique — was the cause of only five of the incidents. In three cases, divers could not read the pressure gauge because of either poor equipment design or limited vision. Vomiting underwater obstructed the air supply in three cases.

Our data showed that buddy-breathing ascents were unsafe in out-of-air situations. Even when the ascent rate was controlled, 30 percent of the buddy-breathing ascents resulted in death. An exhaling, non-breathing ascent was less likely to cause a fatality. Controlled octopus-breathing ascents were safest. ■

Causes and Contributing Factors in 1,000 Air Supply Incidents

Cause	Number of Incidents
Did not check contents gauge	55
Contents gauge inaccurate	25
Tank empty or depleted before dive	18
Air not turned on	12
Second-stage problem	12
First-stage failure	8
Inattention or increase in air consumption	6
Air hose rupture	5
Air frequently used to maintain buoyancy	5
Change tank size	5
Mouthpiece problem underwater	4
Vomiting obstructing mouth piece	3
Unable to read contents gauge	3
Air consumption/poor dive plan	3
Hookah air hose kinked	2
Scooter/inattention	1
Tank contaminated with silica	1

Contributing Factors	Number	Type of error
Error in judgment	249	1
Inexperience	224	1
Inattention	212	3
Poor dive planning	196	4
Failure to check	176	2
Haste	143	3
Insufficient training	129	4
Anxiety	124	5
Failure to understand equipment	109	1
Not familiar with diving conditions	109	1
Poor commumunication	96	2
Poor physical fitness	83	5
Weather conditions	78	5
Lack of a buddy check	64	2
Poor maintenance of equipment	51	5
Failure to understand the dive table	42	1
Inadequate supervision	40	5
Sea sickness	37	3
Lack of medical clearance to dive	34	5
Poor servicing of equipment	34	5
Drug or alcohol intake	25	5

(Error types: 1=knowledge based; 2=rule based; 3=skill based; 4=technical; 5=latent)

Type of Ascent	Numbers	Morbidity
Out-of-air ascent	168	57
Out-of-air/rapid ascent	89	52
Out-of-air/nonrapid ascent	79	5
Out-of-air/octopus/rapid ascent	21	9
Out-of-air/buddy/rapid ascent	14	7
Other rapid ascents	54	36
Out-of-air/octopus/nonrapid ascents	39	1
Out-of-air/buddy/nonrapid ascent	10	3
Nonrapid ascents	30	1