HYPOXIA IN THE HORNET

What We Know, And What We're Doing

By Lt. Greg Ostrander

An FA-18B pilot flying at high altitude experienced hypoxia after 30 minutes in flight. The aviator (flying in the rear cockpit) experienced disorientation, tingling, discolored skin, and extreme fatigue. He told the other pilot they needed to descend, and they headed down. After a few minutes at 8,000 feet, the pilot's symptoms subsided, and they uneventfully returned to base. All effects of the hypoxic experience were gone in 10 to 15 minutes on deck. Here's the kicker: The pilot had on his mask the whole time, and the cabin altitude was between 14,000 and 18,000 feet.

What was the cause? If you said "contaminated LOX," you'd be wrong. The cause was a leaking oxygen valve in the rear cockpit. The faulty valve had drawn cabin air into the pilot's hose and significantly reduced the delivery pressure. Also, the pilot's personal mask was changed out before the flight because of a comm problem; the mask he used didn't fit him as well.

This incident illustrates recent FA-18 problems with hypoxia. Each incident may have many possible causal factors, but no single causal factor seems to be prevalent (this holds true for LOX or OBOGS jets). However, analysis indicates some common threads are emerging.

NavAir, the Naval Air Warfare Center, the Naval Survival Training Institute, and the Naval Safety Center are working to identify the reasons behind hypoxia events and to provide fixes.

What We Know

In the past, most hypoxia incidents in fleet aircraft were caused by material failures or cabin pressurization problems. In TacAir, occasionally there would be LOX contamination, OBOGS degrades, or aircrew inappropriately flying with their masks off. In the Hornet, recent problems have been more varied and more frequent—14 incidents reported in the last 12 months alone. Three fatal Class-A flight mishaps attributable to hypoxia have occurred since 2001.

Summary of the Problems

- Problems with maintenance and material failures have included burst hoses, kinked hoses, mask/hose separations, cabin pressurization/ECS failures, loose fittings, and systemic leaks. Corrective actions have been taken to prevent most of these problems from recurring.
- Aircrew (with OBOGS) continue to expe-

rience mask-on hypoxia and are recognizing their symptoms and taking corrective action. However, some aircrew are not following the emergency procedure for hypoxia, they are omitting steps or do them out of order.

• Three incidents have occurred at low altitudes (less that 10,000 feet), where hypoxia should not be a problem. The OBOGS system may have been contaminated, or, aircrew waiting to take off may have inhaled large amounts of exhaust gases. Also, fatigue, dehydration, or anemia may have been factors.

• Oxygen paradox occurs when reoxygenation after hypoxia causes a temporary worsening of symptoms, causing aircrew to consider taking off their masks—which can be catastrophic. Oxygen paradox is discussed in more detail in adjoining articles.

• The intense workload and high-altitude flying in TacAir make mask-off flying a bigger risk. Hornet pilots have taken off their masks to drink water or to wipe their face without checking the cabin altitude, and several hypoxic incidents have resulted. Outright violations (flying with the mask off intentionally—"We don't need no stinking oxygen") were the root cause of aircrew hypoxia in three recent incidents.

What's Being Done

The following actions are being taken to reduce hypoxia incidents:

• Maintenance solutions focus on reducing occurrences as a result of material or systems problems. AFB 500 addressed system-leak problems by ordering one-time inspections and adding leak-check requirement to 84-day special inspections. PMA-265 procured leak-test adapter kits to accomplish the inspections. Pilot-services-panel "B-nut" torque was established (incorporated in IETM May 2004 release). Excessive hose bending/kinking was addressed by IRAC 22/23. Cabin-pressure-warning system (CPWS) was developed and is planned for incorporation in Lot 29 aircraft and retrofit in Lot 21-28.

• Hypoxia training provides more realistic training and includes mask-on hypoxia scenarios. The new reduced-oxygen-breathing device (ROBD) lets you experience hypoxia while performing flight duties in a simulator. Actual aircraft EPs can be performed in the simulator, and feedback is provided to the aviators on their performance.

• OBOGS-system problems are being corrected. OBOGS contamination problems have been identified, and plans are ongoing to educate aircrew on these regimes and the associated risks.

• Oxygen-paradox training has been added to physiology training. Ensuring aircrew understand this phenomena more completely is critical in managing hypoxia incidents. In several cases, aircrew reported feeling worse and

A Few Numbers

The Naval Safety Center tracks hypoxic-event rates the same way we track flight-mishap rates: number of events per 100,000 flight hours. But, because hypoxia is a self-reported event, the numbers are only an estimate. Hypoxia-event rates, however, are a good indicator of the problem. Since hypoxia events are rare, we can get a good overview of the problem by using a rate ratio (RR). This ratio indicates how rates compare over time, and spikes may draw attention to a particular hypoxic issue.

The hypoxia-event rate for all TacAir is 0.23 per 100,000 flight hours (compare to a Class A flight-mishap rate of about 2.0). The Hornet hypoxia-event rate is 0.55, which is approximately 2.3 times the overall TacAir hypoxia-event rate.

A comparison of all TacAir aircraft, using LOX versus OBOGS, shows the hypoxic-event rate for OBOGS aircraft is 4.3 times the all-LOX rate.

Looking at these rates for the Hornet in Class-A flight mishaps (with hypoxia as the primary causal factor) from 1980 to 2000, the rate was 0.03, while the rate from 2001-2004 was 0.29. This puts the RR at 9.7—a huge difference.

These data indicate some important new hypoxia issues have surfaced in the last few years, and they increasingly are being identified as causal factors in mishaps.

wanting to remove their mask because they weren't convinced the oxygen was helping. These effects also were reported in ROBD trials, where 21 of 30 aircrew stated they wanted to remove their mask. The ROBD allows aircrew to experience oxygen paradox and "tough it out" through the effect.

How To Reduce Your Risk

The following actions are recommended to reduce the risk of hypoxia:

• Know the oxygen system in your jet, whether OBOGS or LOX. Several incidents were caused by aircrew's lack of system knowledge. Oxygen Systems Team "road shows" are available to fleet squadrons. Many aircrew and maintainers are surprised with what they didn't know. These presentations may be scheduled through the NavAir Oxygen Systems Team (Bill Struble, POC, info below). Better knowledge equals less risk.

• Request training from your aeromedical-safety officer (AMSO) or flight surgeon. Annual training at the squadron is an effective tool to keep current on hypoxia issues. The ROBD is an important part of this training.

• Don't set yourself up to get hypoxic or to be more susceptible to oxygen paradox—wear your mask. While there are good reasons to remove your mask momentarily, leaving it off is a flagrant violation of NATOPS. If you get hypoxic, execute your EPs and land. Do not continue your mission, despite feeling better.

With closer scrutiny of a few previously unidentified risks and more realistic hypoxia training, the number of incidents will decrease. In the meantime, use the resources available to you to reduce your risk: Get training, and stay fit, well-nourished, and well-hydrated. If you need any help or guidance, call us.

Lt Ostrander is an aeromedical analyst at the Naval Safety Center.

Hypoxia/Oxygen Systems/Aeromedical POCs:

• Naval Safety Center:(757) 444-3520 (DSN 564), extensions below:
Cdr. Kevin Brooks, flight surgeon, ext. 7268
Lt. Greg Ostrander, aeromedical analyst, ext. 7229
AMEC Ed Cintron, aviation life-support analyst, ext. 7269

• NavAir Oxygen Systems Team:
Mr. Bill Struble, team leader, (301) 342-9237