



SICK FROM SMOKE/FUMES ONBOARD? WHAT YOU NEED TO KNOW AND WHAT YOUR DOCTOR NEEDS TO KNOW

The outside air that gets supplied to the cabin and flight deck is “bled” off either the aircraft engines or an auxiliary engine called the APU. Because of design and maintenance issues, engine oil/hydraulic fluid from the engines/APU sometimes contaminate the cabin supply air. The oil/fluid gets heated to high temperatures in the engines/APU (250-950°F), and the fumes are delivered (unfiltered) to the cabin/flight deck. You will likely notice an unpleasant odor, sometimes accompanied by visible smoke/fumes. The fumes contain a complex mixture of nasty chemicals, including carbon monoxide (if system temperature > 450°F) and organophosphates. Read the bulletin posted at <http://ashsd.afacwa.org/docs/prevent.pdf> for advice.

You can find the name of the oil or hydraulic fluid that your airline uses and print the Safety Data Sheet(s) (SDS) at this AFA website: <http://ashsd.afacwa.org/practical.htm> **Give the the relevant document to your doctor.** Make sure your doctor understands that the SDS do not explicitly describe health hazards associated with inhaling pyrolyzed (chemically degraded by heat) oil or hydraulic fluid, so the health hazard warnings on the SDS are incomplete. Also, give your doctor a copy of a FAA-funded and doctor-authored Health Care Providers’ Guide (<http://ashsd.afacwa.org/docs/HCPquick.pdf>). **It is preferable to print and carry these documents with you. Alternatively, download them and store them on your phone.**

If you have either suspected or confirmed exposure to engine oil fumes, inform your doctor that aviation engine oils used to service commercial and military aircraft contain 1-10% tricresylphosphates (TCPs), and many contain ≤1% phenyl-1-naphthylamine, per the product safety data sheets. Exposure to TCPs has long been associated with initial symptoms of stomach cramps, muscle weakness, flu-like symptoms, and delayed problems with gait, balance, and tingling/numbness. More recent medical research suggests that even very low levels of organophosphates can cause chronic symptoms of neurotoxicity such as problems with fatigue, memory, concentration, and speech. These symptoms can develop over days or weeks, and there may be a delay between exposure and symptoms. Hydraulic fluids contain tributylphosphates, and various phenyl phosphates, carboxylates, and epoxides, depending on the specific product.

Notify your doctor that you are **unaware of a specific blood test to definitively determine if you have been exposed to oil fumes.** Scientists at the Univ. of Washington and Univ. of Nebraska have, independently, published papers on the preliminary stages of their work to develop blood tests specific to some of the TCP additives in aviation engine oils, but no test is yet finalized. The Univ. of Washington researchers have stored hundreds of archived blood samples, drawn largely from crews shortly after onboard exposure to oil fumes. Once the blood test development is finalized, the researchers will test those samples and communicate the results to each individual. **In the meantime, there are some blood tests that may be helpful:**

- Discuss whether a **carboxyhemoglobin** (CO-Hg) blood test is necessary because you can be exposed to carbon monoxide (CO) during these events because oil and hydraulic fluid in the air supply system get heated to high temperatures (250-950°F). Report to your doctor how long it has been (hours) since you were exposed to fumes and whether or not you have taken oxygen since then because your CO-Hg levels will likely normalize within a few hours after an incident, and even faster if you took oxygen before your blood draw (during/after the flight). The effects of exposure to CO are more intense in-flight than on the ground because you are in a reduced oxygen environment. Even though CO clears from your blood relatively

quickly, it can still cause a variety of short or long-term symptoms such as dizziness, headaches, and fatigue. There is some evidence that CO takes longer to leave your tissues.

- Tell your doctor that **red blood cell cholinesterase (also called "acetyl cholinesterase")** is a poor indicator of TCP exposure. Ask your doctor to **test the level of plasma cholinesterase (PChe; also called "serum cholinesterase" or "butyl cholinesterase")** in your blood. Classically, TCP exposure should cause a depression in PChe level, followed by a "rebound effect" a week or more after the event, although the exact time scale is difficult to predict. Multiple measurements over time and careful interpretation of the test results are necessary. Your doctor also needs to know that there are documented reasons why some people have depressed levels of PChe to begin with, putting them more at risk of toxic effects during an incident. For example, menstruation, pregnancy, and specific medical conditions have been associated with reduced PChe.
- Ask your doctor if it would be suitable to test your **serum C-reactive protein**. This is a blood marker of inflammation; see <http://www.ncbi.nlm.nih.gov/pubmed/17389175> and there is some evidence that exposure to organophosphate chemicals (like the TCP additives in engine oil) can cause levels to increase.
- If you suspect oil fume exposure, ask your doctor if your **urine** can be tested for the presence of TCP metabolites. More than 99% of the TCP isomers in aviation engine oils are mmp, mmm, and mpp. The remaining seven TCP isomers are < 1% of total TCPs in oils.

The following **medical tests may be helpful to show damage or malfunction** to your body that is consistent with exposure to engine oil or hydraulic fluid fumes:

If you have breathing problems, a doctor can examine your respiratory system and perform lung function tests.

If you have memory or concentration problems, a neuropsychologist can have you take specific tests, both to assess and document any problems and to suggest therapy.

If you have tremors or tics, a neurologist can assess and document the problems, probably with some combination of a physical exam and a brain scan. Published articles and crew experience show that PET scan or SPECT scan may be suitable to assess damage caused by exposure to organophosphates. An MRI is not expected to be sensitive enough.

If you suffer from depression or anxiety after an event (whether due to brain damage from the chemicals or simply as a reaction to being ill), a psychiatrist can assess your symptoms and help you to manage them, possibly with some combination of therapy and medication.

In the realm of complementary medicine, some affected crews have reported benefits from oxygen therapy, IR sauna, and nebulized glutathione.

As general advice, **keep a journal** of any symptoms. For any visible symptoms (such as a rash or tremor), take **videos or photographs**. See a doctor as soon as possible to make sure that there is an official record. Keep a copy of all documents and keep a record of every related phone call. **If you have more questions or need documentation to give to your doctor, contact Judith Anderson at AFA's Air Safety, Health, & Security Department at 206-932-6237 or Judith@AFAnet.org.**