Exposure to aircraft bleed air contaminants
A guide for health care providers

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Tool to improve health care for airline workers after exposure to bleed air

http://www.ohrca.org/
Take-home points

• What is bleed air?
• What are the health problems from exposure?
• What are recommendations for diagnosis and treatment?
### What is bleed air?

Pyrolyzed engine oils and hydraulic fluids that leak into aircraft cabin and flight deck air supply systems.

<table>
<thead>
<tr>
<th>Type of fault</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical failures</td>
<td>Oil seals leak or fail in APU</td>
</tr>
<tr>
<td>Maintenance irregularities</td>
<td>Overfill or spill from oil/hydraulic reservoirs</td>
</tr>
<tr>
<td>Faulty designs</td>
<td>Oil seals ineffective during high-temperature engine operations; hydraulic fluid flow through air supply inlet</td>
</tr>
</tbody>
</table>
Tricresylphosphates (TCPs)

- Added to most synthetic engine oils for anti-wear properties (1 to 5%)
- Three cresyl groups attach to phosphate molecule to form 10 isomers (including one tri-ortho isomer)
- Aviation engine oil is a mixture of isomers
Tricresylphosphates (TCPs)

- 1920’s - Ginger Jake
- organophosphate-induced delayed neuropathy (OPIDN) from inhibition of neuropathic target esterase (NTE)
- damage to long nerves (neuropathy), balance problems (ataxia), paralysis
Bleed Air and TCP Exposure

• Detectable TCP residual on air filters, cabin and flight deck walls; and in airborne samples
• No exposure limits (PELs) except for TOCP (0.1 mg/m³)
• Crewmembers report most bleed air events during taxi/take off or upon descent
• Estimated 2-3 bleed air events/day in U.S.
# Documentation of bleed air exposure

<table>
<thead>
<tr>
<th>Source</th>
<th>Data</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline</td>
<td>Pilot log book entries, maintenance records</td>
<td>Not covered under OSHA records access</td>
</tr>
<tr>
<td>FAA SDR</td>
<td>Service Difficulty Reporting System</td>
<td>Poor compliance</td>
</tr>
<tr>
<td>Employee</td>
<td>Material Safety Data Sheets</td>
<td>May be incomplete</td>
</tr>
</tbody>
</table>
What are the health problems from bleed air exposure?

Acute and/or chronic symptoms

<table>
<thead>
<tr>
<th>Respiratory</th>
<th>Neurological</th>
<th>Systemic</th>
<th>Psychiatric</th>
<th>Dermal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough</td>
<td>Headache</td>
<td>Nausea</td>
<td>Anxiety</td>
<td>Rash</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>Dizziness</td>
<td>Fatigue</td>
<td>Sleep problems</td>
<td></td>
</tr>
<tr>
<td>Chest tightness</td>
<td>Lightheadedness</td>
<td>Muscle weakness</td>
<td>Depression</td>
<td></td>
</tr>
<tr>
<td>Wheezing</td>
<td>Memory</td>
<td>Palpitations</td>
<td>PTSD</td>
<td></td>
</tr>
<tr>
<td>ENT irritation</td>
<td>Concentration</td>
<td>Diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tremor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gait/balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Other exposures: reduced oxygen, ozone, insecticides, deicing fluids, exhaust fumes, disinfectants, deodorizers
Case definition

Documented exposure to bleed air contaminants or history of flying on aircraft known to have increased risk of air supply contamination events and

Initial symptoms within 48 hours of exposure and

Objective documentation of acute or persistent symptoms
Irritant-induced asthma

- Acute, single episode of chemical inhalation
- Asthma symptoms persist for > 3 months

**Diagnosis**
Pulmonary function studies/methacholine challenge

**Treatment**
Remove from exposure
Bronchodilators
Inhaled corticosteroids
Neurotoxic injury

- Cognitive dysfunction
- Headaches
- Movement disorder
- Peripheral neuropathy

**Diagnosis**
- Neuropsychological testing
- Evoked potentials
- Brain MRI
- NCVs/EMGs
- SPECT/PET scans

**Treatment**
- Migraine medications
- Cognitive rehabilitation
Recent cases (9)

- January 16, 2010
- B767 from Charlotte
- “dirty sock” odor on ascent and descent
- Acute symptoms: burning eyes, sore throat, headaches
- Persistent symptoms: headaches, balance problems, problems concentrating, shortness of breath
Future research

• Biological assay for TCPs (Furlong)
• Exposure monitoring (Van Etten)
• Improved engineering systems

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