

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

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<http://www.ohrca.org/>

- Funded by FAA Office of Aviation Medicine
- Written for health care providers and their “patients”
- Tool to improve health care for airline workers after exposure to bleed air

**EXPOSURE TO AIRCRAFT BLEED AIR
CONTAMINANTS AMONG AIRLINE WORKERS**

A GUIDE FOR HEALTH CARE PROVIDERS

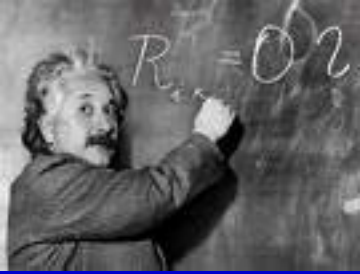
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Take-home points

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

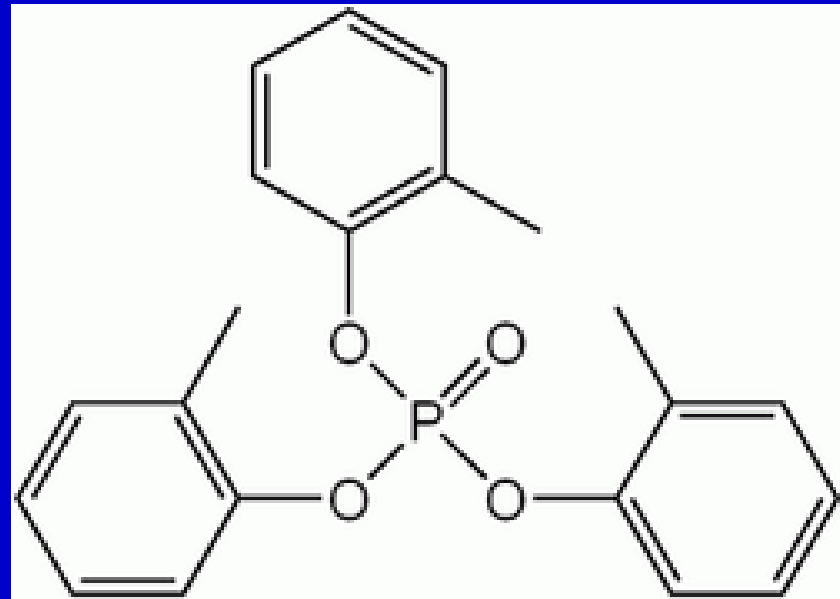
What is bleed air?

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

Type of fault	Example
Mechanical failures	Oil seals leak or fail in APU
Maintenance irregularities	Overfill or spill from oil/hydraulic reservoirs
Faulty designs	Oil seals ineffective during high-temperature engine operations; hydraulic fluid flow through air supply inlet

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/m^3)
- 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

Source	Data	Limitations
Airline	Pilot log book entries, maintenance records	Not covered under OSHA records access
FAA SDR	Service Difficulty Reporting System	Poor compliance
Employee	Material Safety Data Sheets	May be incomplete

What are the health problems from bleed air exposure?

Acute and/or chronic symptoms

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

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

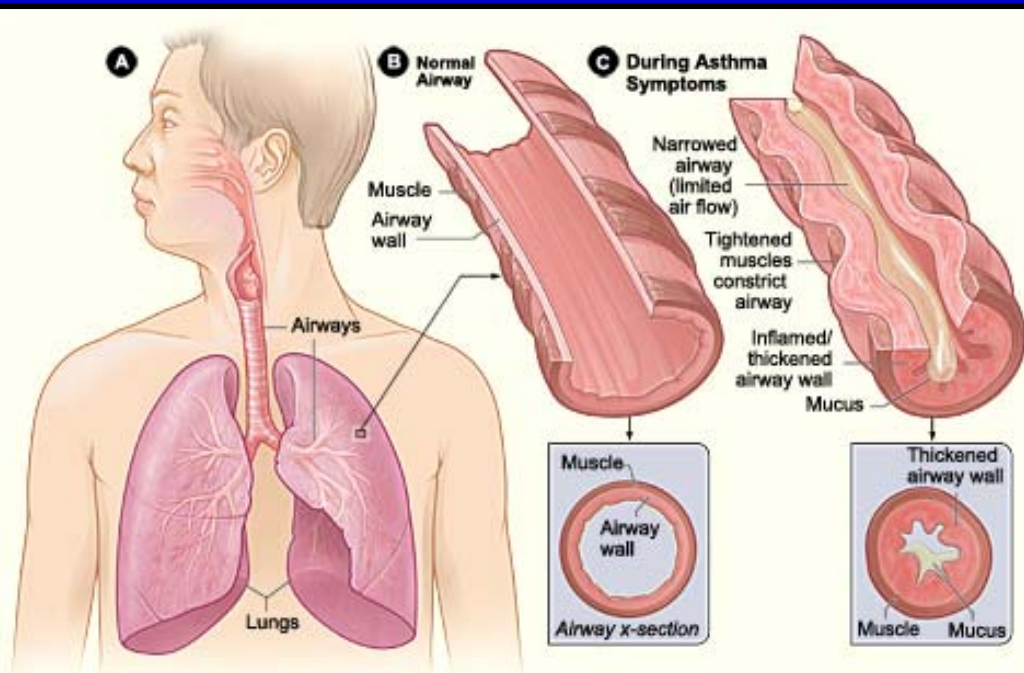
Initial **symptoms** within 48 hours of exposure

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

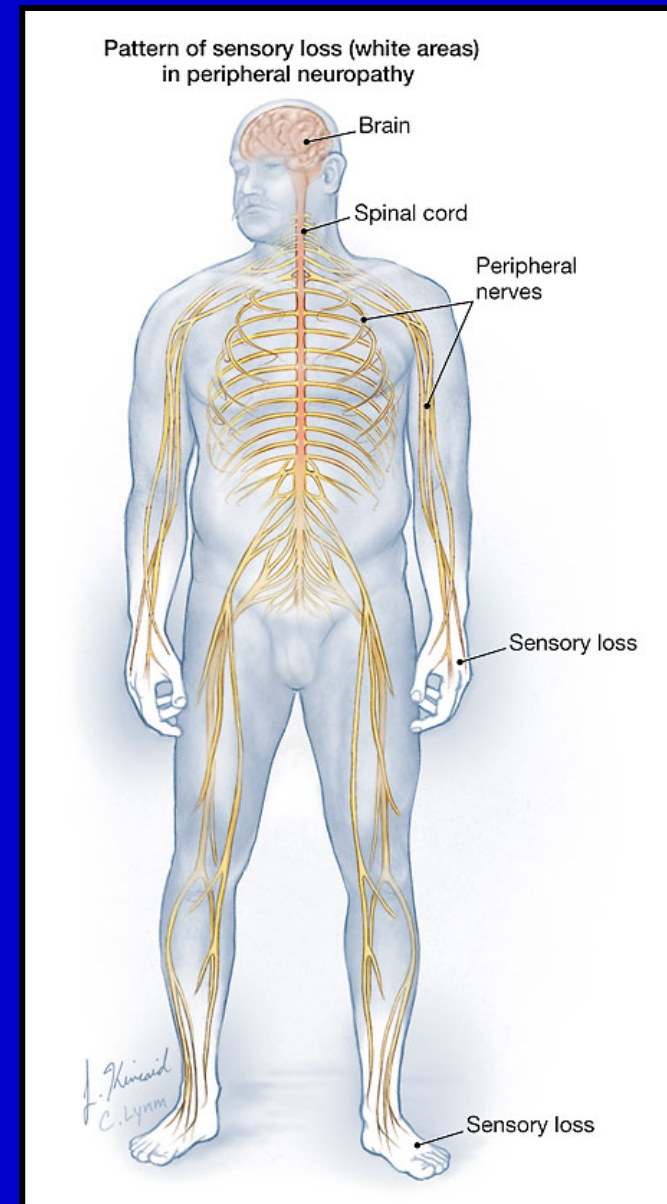
NCVs/EMGs

SPECT/PET scans

Treatment

Migraine medications

Cognitive rehabilitation



What do we need?

- Improving engineering systems (manufacturers)
- Tracking injuries and illnesses: “transparency, accountability” (FAA, employers)
- Confirming exposures in aircraft (Van Etten)
- Developing sensitive measures of exposure (Furlong)
- Promoting standardized treatment (“Dr. Bob”)



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