Aircraft Pressure Checks: Occupational Risk Assessment for Aircrews and Electrical/Environmental Systems Workers

The Hyperbaric Medicine Division has received numerous inquiries recently regarding the occupational health risk associated with ground level maintenance pressure checks conducted with personnel inside the aircraft. These pressure checks constitute an overpressure of approximately 8.6 PSI greater than atmospheric pressure for a period of time (usually short — 5-10 minutes, but with problems can be many minutes up to and including an hour). The personnel who are exposed include aircrew and electrical and environmental systems specialists whose status may be military, civilian or contractor. Aerospace physiologists, flight surgeons, and safety specialists may want to incorporate portions of the following into their briefings.

What are the risks?

With the caveat that this is not an exhaustive response to the question, there are several issues to be addressed. Simply, the greatest threat is associated with flying debris and then pressure changes that affect the ears, sinuses, and lungs in response to catastrophic failure of the fuselage during the overpressure test at ground level. Second, though no predictive algorithm exists for incidence of decompression sickness (DCS), **there is a minor threat associated with DCS for anyone who subsequently flies after one of these pressure checks and then experiences a decompression during a high altitude flight**. To be safe, certain procedures should be followed, and the exposed personnel should meet more restrictive physical standards. The following brief discussion addresses these issues.

The greater risk these personnel are subject to during an aircraft pressure check would occur under mishap conditions such as a sudden, uncontrolled decompression of the fuselage. The major risk would be from flying debris during catastrophic failure of the fuselage. Other less likely risks would be associated with trapped gas barotrauma. An overpressure of about 8.6 PSI is several times the pressure needed to rupture lung tissue and cause potentially fatal arterial gas embolism should a worker be subjected to a ground level rapid decompression (which for this discussion is considered to be a loss of pressure in less than 5 sec) while holding their breath, such as during a sneeze, cough, or yawn. Additionally, workers with sinus congestion, upper respiratory infection, asthma, emphysema, and chronic obstructive pulmonary disease (COPD) may be at somewhat greater risk for barotrauma under these rapid decompression conditions.

Multiple exposures (repetitive pressure checks) in a single day up to 1.6 ATA (14.7 + 8.6 PSI = 23.3/14.7 = 1.58 ATA or 19.3 FSW) would NOT produce any inherent symptoms related to nitrogen loading and bubble formation during pressure reduction characteristic of DCS. The stresses (of pressure changes) may be physically fatiguing, however scuba divers often make several dives per day to greater depths with no adverse effects.

Rate of pressurization and depressurization is another minor issue. It is recommended that while pressurization may be occur as rapidly as comfortable (to 8.6 PSIG), that the decompression to atmospheric pressure should occur no more rapidly than 4 PSI per minute (or about 2 minutes). There is no particular reason for this other than the notion that the more rapid decompressions may be slightly more stressful than slower ones. (The Standard Navy ascent rate is 30 ft per minute on a dive, which predicts depressurization in about 40 seconds—a safe decompression, if desired.)

New, experimental decompression tables (based on a decompression calculator pending official approval) have been used to provide a more scientific approach to using decompression tables and determining safety of operational mission demands for dives, repetitive dives, and flying after diving. The decompression algorithm used in the calculator permits entering safety factors based on truer nitrogen loading and desaturation values. **Accordingly, when applied to pressurization exposure during an aircraft pressure check, one may expect no adverse effects from remaining indefinitely at 19.3 FSW (8.6 PSIG) pressure, followed by an immediate return to the surface.* These tables also predict NO threat of DCS associated with spending up to 17 min performing such a pressure check to 8.6 PSIG and then surfacing and/or flying immediately afterward to a cabin altitude of 8,000 feet.** Additionally, one may expect no adverse effects from spending up to a total of 90 minutes at 19.3 FSW (8.6 PSIG) and then flying PROVIDED cabin altitude remains less than a pressure equivalent of 8,000 feet.****

Physical Standards

Physical standards for personnel undergoing aircraft pressure checks should be addressed. A reasonable expectation is that physical qualifications for these workers would be a mix of the standards for those working in enclosed spaces PLUS the standards for chamber technicians (AFI 48-123 A7.9 — see excerpt below). Although this may be a bit conservative, it is a reasonable starting point. It may also be reasonable to have workers who petition for waiver to the physical standards, claiming prior demonstrated performance, sign a waiver of liability form before being allowed to continue working in the pressurized environment.

It must also be noted that just because an individual meets all the physical criteria, there is no guarantee that in the event of an accidental catastrophic depressurization, they would emerge without injury.

Summary

Aircraft pressure checks are generally safe. Personnel experiencing barotrauma symptoms after a pressure check should seek medical care. Flying shortly after a routine pressure check is very low risk. All personnel who experience an unplanned decompression while flying should be seen promptly by a flight surgeon.

*[Recommendations incorporate a safety enhancement (SE) of 20 compared to standard USN Tables with SE = 0.]
**[Even following the straight US Navy Air Decompression Tables, bottom time at 20 FSW is unlimited, and immediate surfacing is allowed. However, strict adherence to Navy protocols normally preclude flying after diving, and this pressure exposure would be considered diving.]

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AFI 48-123 A7.9 excerpt

A7.9 Hyperbaric Chamber Training or Duty

The medical standards listed in attachment 3 and this section are cause to reject an examinee for initial hyperbaric chamber training duty and for continued duty unless a waiver is granted. Acute medical problems, injuries or their appropriate therapy may be cause for withholding certification for initial training or temporarily restricting from duty until the problem is resolved.

Any disease or condition that causes chronic or recurrent disability, sudden incapacitation or has the potential of being exacerbated by the hyperbaric environment.
History of injury or procedure involving entrance into thoracic, pericardial or abdominal cavities in the previous 6 months, or the cranial cavity at any time.

Ear, Nose Throat:
Any history of inner ear pathology
Any history of inner or middle ear surgery except PE tubes before age 10
Inability to equalize middle ear pressure

Pulmonary:
Abnormal inspiratory or expiratory chest x-ray
Chronic obstructive or restrictive pulmonary disease of any type
History of spontaneous pneumothorax

Neurological:
Unexplained or recurrent syncope
Neurosis, or psychosis
History of claustrophobia

Dental-Class III
Anemia, significant chronic or nonreversible.
Gastrointestinal - tendency to excessive flatulence