Occupational Risk Assessment for Aircrew in Fixed-Wing Transport Aircrafts

Zilberberg M, Karasik D, Zinger E, Erlich-Shoahm Y, Gordon B.

Presenting Author: Yael Frenkel Nir, MD, MHA

Aeromedical Center
Israeli Air Force and the Medical Corps
Israeli Defense Forces

Unclassified
Introduction

• Long-term exposure to high levels of Noise and to Volatile Organic Compound (VOC) present potential health risks

• Most researches for occupational risks assessment to aircrew were conducted in airliners and focused on cabin personnel exposure

• We examined exposure to noise and VOC in military fixed wing transport platforms in the Israeli Air Force
Fixed Wing Transport Aircrafts

Light Transport

- Beech A36 Bonanza
  - Instruction of Flight Cadets and Intelligence Missions

- Beech Super King Air 200 (Kukia)
  - Intelligence Missions

- Beech Super King Air 200 (Tzufit)
  - Light Transport and Intelligence Missions

Unclassified
Fixed Wing Transport Aircrafts

Heavy Transport

C-130 Hercules
Transport of People and Heavy Equipment

Boeing 707
In-flight Refueling

Unclassified
Fixed Wing Transport Aircrafts

Heavy Transport

C-130J Super Hercules
Transport of People and Heavy Equipment

Gulfstream V
Observation, Reconnaissance and Intelligence mission

Unclassified
Noise Measurements

- We used validated and calibrated equipment.
- We performed the measurements according to Israel’s protocol for noise measurement.
- We measured the noise levels in the cockpit and in the cabin (where they are separated).
- The threshold for harmful noise, set by ACGIH, is 85 dB[A].
VOC Measurements

• Light transport
  • Usage of 100-130 Octane fuel
  • Sampling of Benzene, Toluene, Xylene

• Heavy transport
  • Usage of Jet fuel
  • Sampling of Benzene, Toluene, Xylene, n-Hexane and Kerosene

• Sampling points:
  • Light transport – Triplicates (due to inseparability of the cockpit and the cabin)
  • Heavy transport – Cockpit + 3 points in cabin

• Sampling methods:
  • Validated methods defined by NIOSH
  • Threshold values defined by ACGIH
Noise levels in the cockpit

- Super King Air 200 (Kukia): 87.4
- Super King Air 200 (Tzufit): 81.7
- Beech A36 Bonanza: 94.0
- Boeing 707: 79.8
- C-130 Hercules: 88.6
- Gulfstream V: 81.4
- C-130J Super Hercules: 83.8

Unclassified
## Noise Levels in the Cabin Heavy Transport

<table>
<thead>
<tr>
<th>Plane</th>
<th>Takeoff</th>
<th>In-Flight</th>
<th>Landing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cabin Front</td>
<td>Cabin Back</td>
<td>Cabin Center</td>
</tr>
<tr>
<td>Boeing 707</td>
<td>-</td>
<td>85.1</td>
<td>88.5</td>
</tr>
<tr>
<td>C-130 Hercules</td>
<td>92.8</td>
<td>94.8</td>
<td>90.2</td>
</tr>
<tr>
<td>Gulfstream V</td>
<td>82.3</td>
<td>84.7</td>
<td>94.5</td>
</tr>
<tr>
<td>C-130J Super Hercules</td>
<td>84.3</td>
<td>94.4</td>
<td>90.6</td>
</tr>
</tbody>
</table>

Unclassified
## VOC Concentration

### Light Transport

<table>
<thead>
<tr>
<th>Plane</th>
<th>Xylene</th>
<th>Toluene</th>
<th>Benzene</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Super King Air 200 (Kukia)</strong></td>
<td></td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td><strong>Super King Air 200 (Tzufit)</strong></td>
<td>&lt;0.06</td>
<td>&lt;0.07</td>
<td>&lt;0.04</td>
</tr>
<tr>
<td><strong>Beech A36 Bonanza</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Threshold Level</strong></td>
<td>100</td>
<td>50</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Threshold Level**

*Unclassified*
# VOC Concentration

## Heavy Transport

<table>
<thead>
<tr>
<th>Plane</th>
<th>Measurement Point</th>
<th>Kerosene (mg/m³)</th>
<th>Hexane</th>
<th>Xylene</th>
<th>Toluene</th>
<th>Benzene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boeing 707</td>
<td>Cockpit</td>
<td>&lt;0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cabin Front</td>
<td>2.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cabin Center</td>
<td>&lt;0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cabin Back</td>
<td>3.41</td>
<td>&lt;0.004</td>
<td>&lt;0.06</td>
<td>&lt;0.07</td>
<td>&lt;0.04</td>
</tr>
<tr>
<td>C-130 Hercules</td>
<td>All Points</td>
<td>&lt;0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gulfstream V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-130J Super Hercules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Threshold Level | 200 Unclassified | 50 | 100 | 50 | 0.5 |

**Unclassified**
Conclusions

• Harmful noise levels in three airplane cockpits and in the cabin of all planes with a separation

• No harmful levels of VOC were found

• The measurements were conducted in one airplane of every platform, limiting the results power

• Harmful noise levels require attention, especially for pregnant aircrew concerning the fetus

• As a result of our research, aircraft cabin crew in the Israeli transport wing are defined as workers in harmful noise
Thank You