RAPID DECOMPRESSION AND HYPOXIA IN AIRCRAFT ACCIDENT AND INCIDENT INVESTIGATION

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

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Presentation

- Epidemiology (RG)
- Characteristics (RG)
- Hazards (RG)
- Analysis and reconstruction (RG)
- Airline perspectives (DP)
- Oxygen / pressurisation equipment (DP)
- Issues (DP and RG)

Epidemiology

- Data limitations
- High profile accidents
- Incidents
- Extreme RDs
- ASRS data (courtesy Mitch Garber, Medical Adviser NTSB)

Recent Incidents of Note

- Local
  - Metroliner
  - Convair
  - Hornet
- Alaska Air
- Payne Stewart

Flight Level (ASRS)

- 40K+ 4%
- 30K+ 69%
- 20K+ 23%
- 10K+ 4%

Maximum Cabin Alt.

- 20K+ 6%
- 14K+ 44%
- 10K+ 42%
- N / S 8%

DECOMPRESSION RATE

- Rapid 30%
- Moderate 30%
- Slow 21%
- Insidious 9%

CAUSE

- Controller 32%
- Structural 21%
- Pressurisation source 29%
- Operator 5%
- N / S 13%

Practical Problems

- Mask / headset donning & retention
- Communications
- Sick / invalid Pax
- Horn and wind noise
- ATC and / or not declaring emergency
- Smoke / heat from Oxygen Candles
- Control of A / C and / or CA
- Emergency procedures

Physical Hazards

- Noise
- Extraction
- Distraction
- Debris
- Cooling & misting

Physiological Hazards

- Hypoxia
- Gas Expansion
- Hypothermia
- Decompression Illness
- Human performance

RD Effects Determined by:

- Vc Cabin Volume
- A Cross sectional area of defect
- P Cabin pressure altitude
- B Flight pressure altitude

Effects

- Vc — Rate
- A — Rate
- P-B — Severity
- P / B — Rate
- B — Physiological effects

Analysis

$$\text{RD Time} = \frac{0.22Vc}{A} \times \text{sq rt}\left(\frac{P-B}{B}\right)$$

OR,

$$\text{RD Time} = tc \times P_1$$

$$\text{Time Constant } tc = V/Ac$$

Pressure factor P_1 = Haber Clamann formula

Pressure Dependent Factor P1

- P / B = 1 $P_1 = 0$
- P / B = 5 $P_1 = 2.9$
- P / B = 10 $P_1 = 4.1$
- P / B = 15 $P_1 = 4.8$
- P / B = 20 $P_1 = 5.3$
- P / B = 25 $P_1 = 5.7$

Any Questions?