

Health Effects of Aviation Noise

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What are “Health Effects”?

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The World Health Organization (WHO) defines health as:

“A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”

A 1992 WHO Task Force identified noise-related health “effects”, including:

- Annoyance
- Cardio-vascular
- Communication
- Hearing loss
- Performance
- Productivity
- Psycho-social
- Sleep
- Social behavior

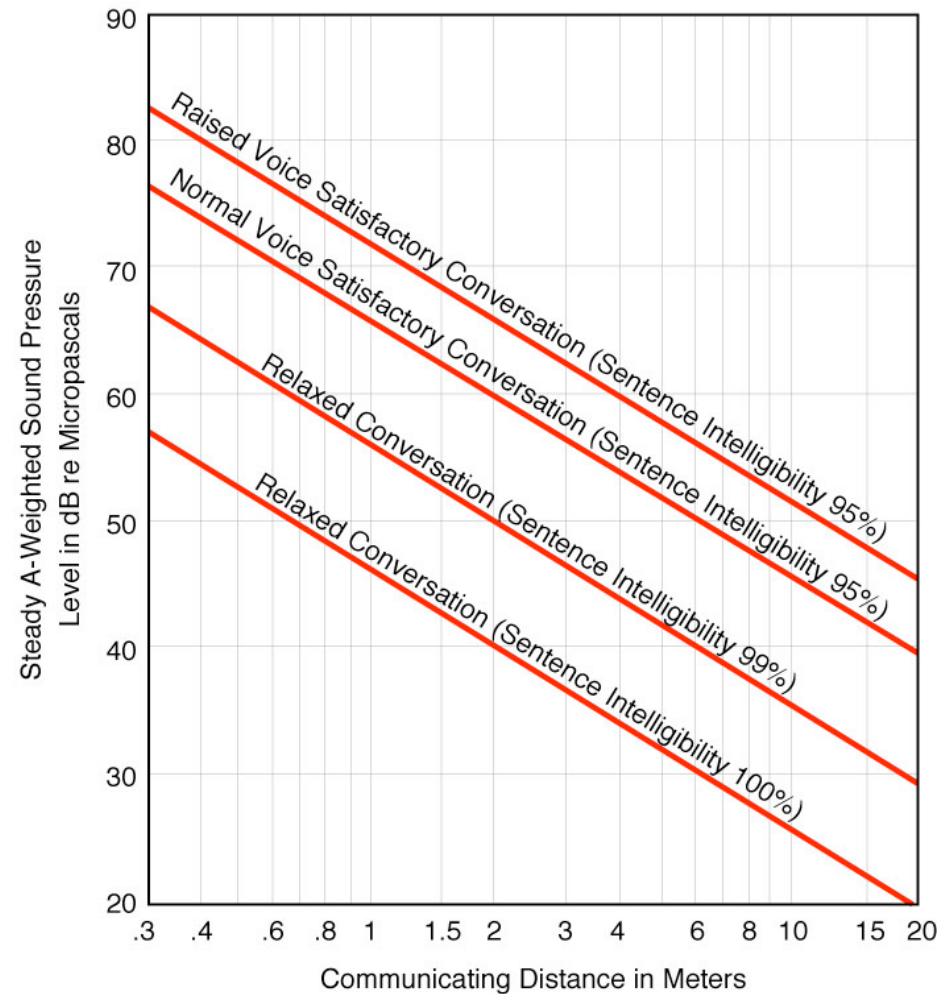
Health Effects of Noise - Topics

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- **Behavioral Effects (Activity Interference)**
 - Speech Interference
 - Sleep Interference
 - Annoyance
 - Children's Learning
- **“Medical” Effects**
 - Hearing Loss (“Auditory”)
 - Physiological (“Non-Auditory”)
- **EPA “Levels Document”**
- **New WHO Guidelines for Community Noise**
- **Land Use Compatibility**
- **Suggested References**

Speech Interference

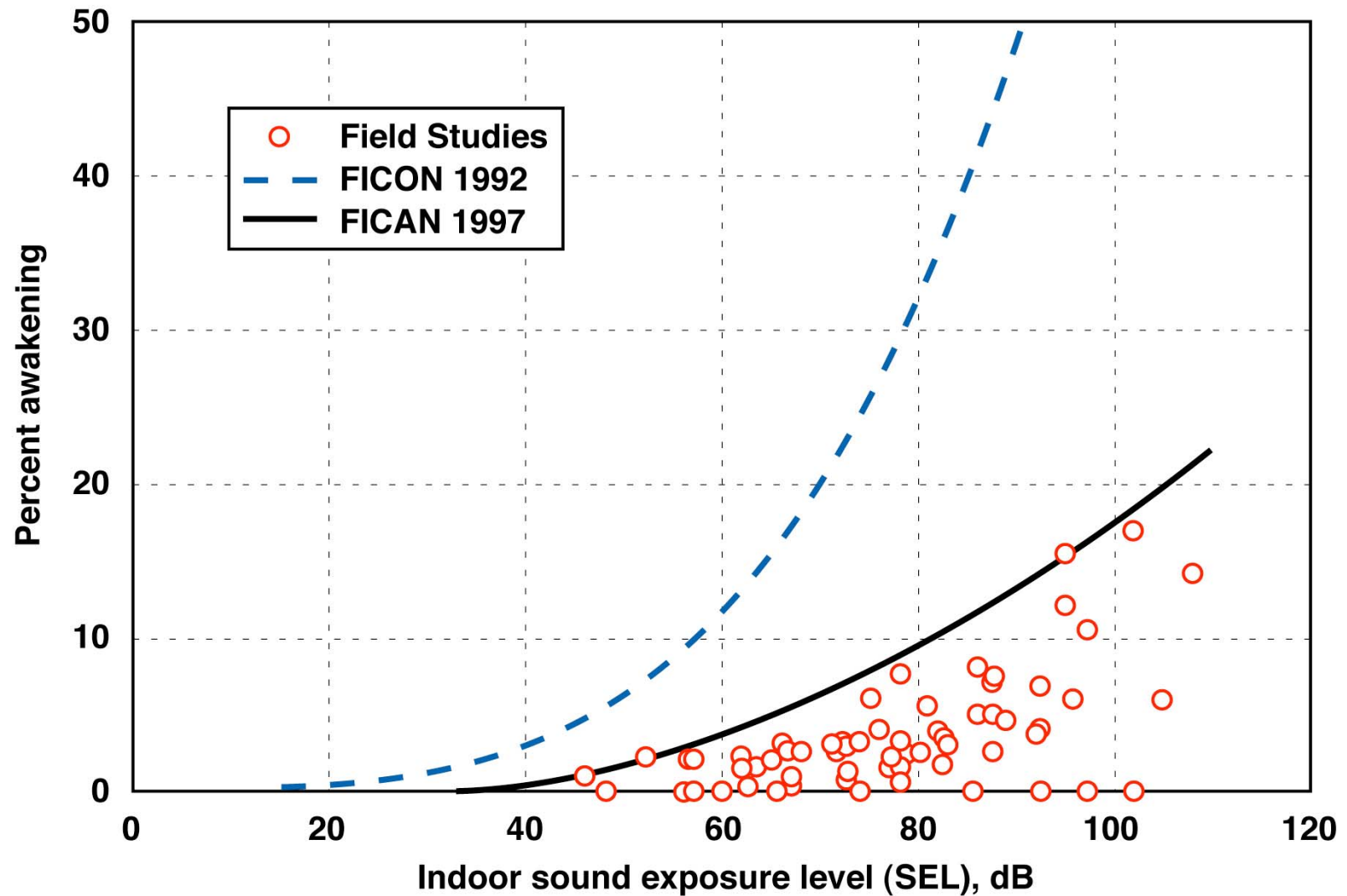
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Source: US EPA, "Information on Levels of Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety", March 1974, Washington, D.C., 1973, p. D-5

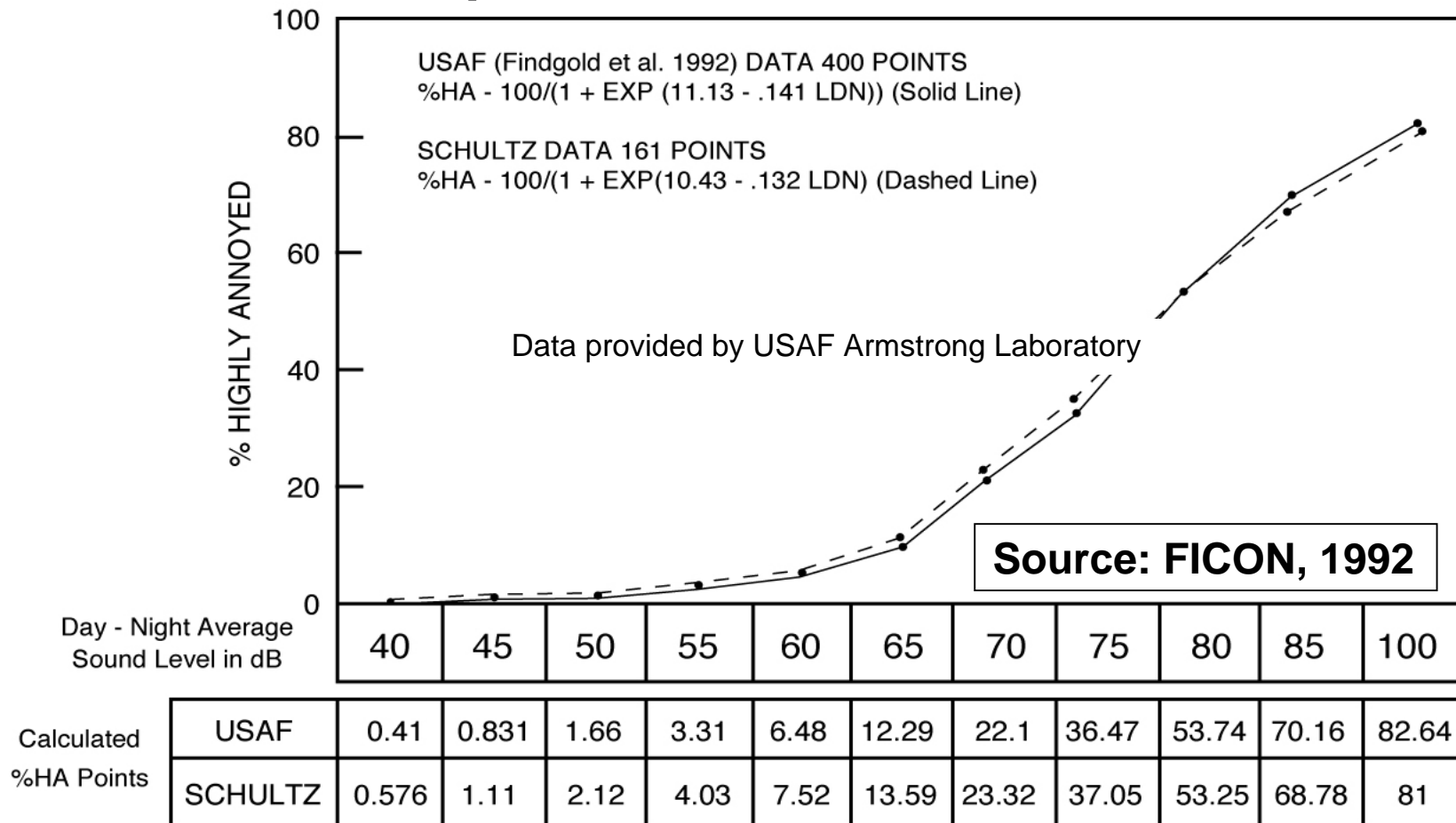
FICON / FICAN Sleep Disturbance Dose-Response Recommendations

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Annoyance

- Schultz developed accepted “dose-response” relationship in 1970s. FICON re-affirmed, 1992



Effects of Aircraft Noise on Children's Learning

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- Reading – Studies suggest effect on test scores
- Motivation – “Learned helplessness”
- Speech – Potential delays in language acquisition
- Memory – Some studies suggest memory deficits



Noise-Induced Hearing Loss

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- **Temporary threshold shift (TTS)**
 - Caused by prolonged high exposure
 - Ear will usually recover overnight
- **Noise-induced permanent threshold shift (NIPTS)**
 - Repeated prolonged exposure can result in permanent damage
- **OSHA standards: 90 dBA for 8 hours**
 - Would require thousands of loud overflights per hour
- *Risk of hearing loss due to community exposure to aircraft noise is very low*

Hearing Loss in Children

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- Centers for Disease Control, National Center for Health Statistics, Third National Health and Nutrition Examination Survey (NHANES), 1988-1994, included questions related to hearing loss
- Prevalence of hearing loss in children as high as 15%,
 - Generally in frequency range of 3- to 6 KHz
 - Generally only one ear
- Potential causes:
 - Personal audio devices
 - Noisy toys
 - Environmental sources



Non-Auditory Health Effects

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- **Non-auditory health effects claims:**
 - Cardio-vascular
 - Hypertension
 - Mental health
- **Claims are difficult to prove or disprove**
- **Noise can contribute to stress-related syndromes; however, annoyance, emotion, or attitude are generally the significant factor, rather than the noise itself.**
- ***In general, it is assumed that protecting against hearing loss, or speech and sleep interference, also protects against non-auditory health risks***

EPA “Levels Document”, March 1974

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- “Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety”
- *Does not consider technical or economic feasibility*

Effect	Level	Areas
Hearing loss	Leq(24) > 70 dBA	All
<u>Outdoor</u> activity interference and annoyance	Ldn > 55 dBA	Residential, farms, and areas where people spend varying of time and where quiet is basis for use.
	Leq(24) > 55 dBA	Outdoor limited use; e.g., playgrounds
<u>Indoor</u> activity interference and annoyance	Ldn > 45 dBA	Indoor residential
	Leq(24) > 45 dBA	Other indoor

WHO Community Guidelines, April 2001

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- **Developed by WHO “Expert Panel” to represent international scientific opinion**
- **Uses “precautionary principle”:**
 - “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically”.
- **Does not consider non-scientific aspects:**

“Regulatory standards usually include aspects, including technological feasibility, costs of compliance, prevailing exposure levels, and the social, economic, and cultural conditions.”

WHO Recommendations: Residential Environments

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Specific Environment	Critical Health Effect(s)	Guideline Metrics / Values
Outdoor living areas	Serious annoyance, day and evening	Leq (16) 55 dBA
	Moderate annoyance, daytime and evening	Leq (16) 50 dBA
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	Leq (16) 35 dBA
Inside bedrooms	Sleep disturbance, nighttime (indoor level)	Leq (8) 30 dBA; Lmax 45 dBA
Outside bedrooms	Sleep disturbance, window open (outdoor level)	Leq (8) 60 dBA

WHO Recommendations: Noise-Sensitive Environments

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Specific Environment	Critical Health Effect(s)	Guideline Metrics / Values
Classrooms and pre-schools	Speech intelligibility, information extraction, message communication	Leq 35 dBA
Preschool bedrooms	Sleep disturbance	Leq 30 dBA
School playgrounds	Annoyance (external source)	Leq 55 dBA
Hospital ward rooms	Night sleep disturbance	Leq(8) 30 dBA; Lmax 40 dBA
	Day and evening sleep disturbance	Leq(16) 30 dBA
Hospital treatment rooms	Interference with rest and recovery	As low as possible

WHO Recommendations: Other Environments

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Specific Environment	Critical Health Effect(s)	Guideline Metrics / Values
Industrial, commercial shopping, and traffic areas, indoors and outdoors	Hearing impairment	Leq(24) 70 dBA
Ceremonies, festivals, and entertainment events	Hearing impairment (Patrons < 5 times/yr)	Leq(4) 100 dBA; Lmax 110 dBA
Public addresses, indoors and outdoors	Hearing impairment	Leq(1) 85 dBA; Lmax 110
Music and other sound through head/earphones	Hearing impairment (free-field values)	Leq(1) 85 dBA Lmax 110 dBA
Impulse sounds from toys, fireworks, and firearms	Hearing impairment - adults - children	Lmax 140 dBA Lmax 120 dBA
Outdoors in parkland and conservation areas	Disruption of tranquility	Minimize intrusions

Land Use Compatibility

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- DNL is most widely accepted metric, worldwide
- Part 150 provides FAA “*guidelines*”
 - All uses compatible below DNL 65 dB
 - FICON reconfirmed in 1992
 - Local responsibility for determining acceptability
- US Dept. of HUD publishes “*standards*” for federal funding of residential construction
 - Acceptable \leq DNL 65 dB
 - Normally unacceptable DNL 65 to 75 dB (additional sound attenuation required)
 - Unacceptable above DNL 75 dB (case-by-case conditional approval)

Implications of WHO Guidelines

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- **Policy and regulatory aspects need to be separated from scientific guidelines:**

“Regulatory standards usually include aspects other than scientific data, including "technological feasibility, costs of compliance, prevailing exposure levels, and the social, economic, and cultural conditions (Chapter 5).”

Popular References

www.hmmh.com

- US EPA, “Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety”, March 1974 (*“Levels Document”*)
- Harris, *et al.*, “Land Use Compatibility Study: Aircraft Noise and Land Use”, FAA Report EE-84-16, June 1984 (*“reverse engineers” Part 150 guidelines*)
- Newman and Beattie, “Aviation Noise Effects”, FAA Report EE-85-2, March 1985 (*summary of broad range of effects, including extensive references*)
- Federal Interagency Committee on Noise (“FICON”), “Federal Agency Review of Selected Airport Noise Analysis Issues”, August 1992 (*reconfirmed DNL and Schultz curve*)
- Federal Interagency Committee on Aviation Noise (“FICAN”), Effects of Aviation Noise on Awakenings from Sleep, June 1997
- Berglund, *et al.*, “Guidelines for Community Noise”, World Health Organization (“WHO”), Geneva, 1999 (*caution: ignores feasibility*)
- www.fican.org