Hot Topics in Noise

Bennett M. Brooks, PE

Brooks Acoustics Corporation
Vernon, CT
www.brooks-acoustics.com

Paper 3pID2 -- 6 June 2001

Hot Topics in Noise -- ASA June 2001

Increased public concern about

NOISE

In response, the noise technical community has developed:

- **New methods for assessment**
- **New means for control**

Hot Topics in Noise -- ASA June 2001

OUTDOORS

- **Soundscapes**
- **Natural quiet**
- **Theme parks & amphitheaters**
- **International environmental noise policy**
- **Extreme Hearing Protection (mil aircraft)**

INDOORS

- **Room noise descriptors**
- **Classroom acoustics**
- **Product sound quality**

SOUNDSCAPES

- **Brigitte Schulte-Fortkamp**
  Carl von Ossietzky University
  Oldenburg, Germany

Interaction of people and sound

The way people consciously perceive their environment.

Hot Topics in Noise -- ASA June 2001

- **Berglund (2001) - characterize residential soundscapes in three dimensions: "adverse", "reposing" and "affective"**
- **Ipsen (2001) soundscape components: the context, the focus of attention, and personal knowledge/experience.**
- **Schulte-Fortkamp (2000) - interaction of living space and noise sources moderating effects for noise annoyance**
- **Hohmann (2000) - surroundscapes which demonstrate harmonic / disharmonic effects of an urban environment**
- **Genuit (2000) - aurally-related psychoacoustic analyses objective description of subjectively perceived sound**
- **Chtouris (2001) - sound interpreted in urban environments characterized by high density of activity**
- **Giuliani (2001) - relationship of visual and acoustical space Soundscape analysis - improved quality environments**

The moderator soundscape

- **A positive evaluation of the landscape reduces annoyance of the soundscape whereas a negative evaluation of the landscape increases annoyance (Maffiolo)**
- **A subjective soundscape - dependent on which parts people relate to & how they relate**

  Example: the Sunday walker will clearly have a different experience of a street than a Monday morning late-for-work bus chaser.
  (Fyhri & Klaboe)

Natural Quiet

- **Aircraft overflights & snowmobiles in national parks**
- **Arctic National Wildlife Refuge**
  - **"Loud Turbines" (Washington Post)**

Theme Parks & Amphitheaters

Bill Cavanaugh (Cavanaugh-Tocci)

- **Sound intrusion on communities**
- **Signal to Noise (S/N)**

Hot Topics in Noise -- ASA June 2001

- **Limit L1 minus L90**

L1 – L90	
< 5 dB	rarely audible minimal complaints
5 to 15 dB	sometimes audible significant complaints
> 15 dB	generally audible widespread complaints

International Environmental Noise Policy

Larry Finegold – (Finegold & So)

Current Status of Noise Policies in the U.S. and Europe - Implications for International Consensus

- **Adverse effects of noise on people are the major purpose for noise research and policy-making activities (i.e., "protection of the public health")**
- **International economic competition** (Product Sales) **is becoming more important each year**
- **Noise exposure is still increasing around the world – problem is worst in large cities, especially transportation noise**
- **No international research agenda or coordinated funding**
- **No international coordination on noise management policies**
- New European noise policy initiatives will impact all countries that export manufactured products to Europe

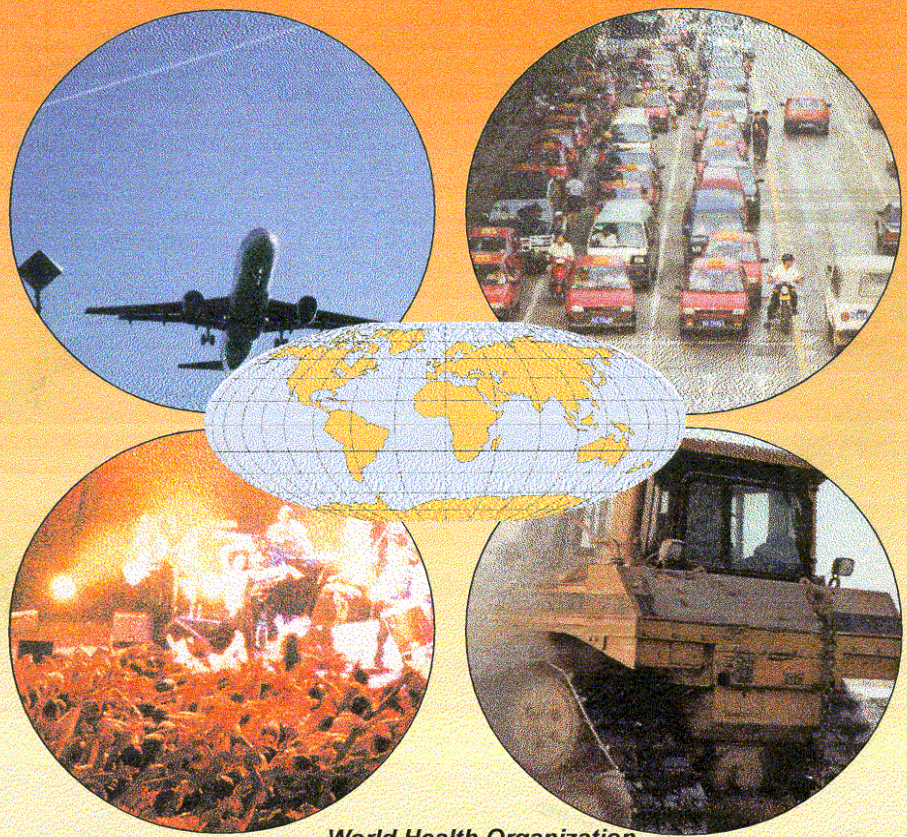
How does the US compare with the rest of the world?

- **New World Health Organization "Guidelines for Community Noise"**
  - http:// www.who.int/peh/
- **European Commission Initiatives – new Noise Directives (Outdoor Equipment, Environmental Noise, etc.**
  - http://www.europa.eu.int/comm/environment/noise/
  - http://www.europa.eu.int/comm/environment/docum/00468_en.htm
  - http://www.europa.eu.int/eur-lex/en/
- **Real progress being made in individual countries in Europe, Asia, etc. – Japan is the leader in Asia**

Guidelines for Community Noise

edited by

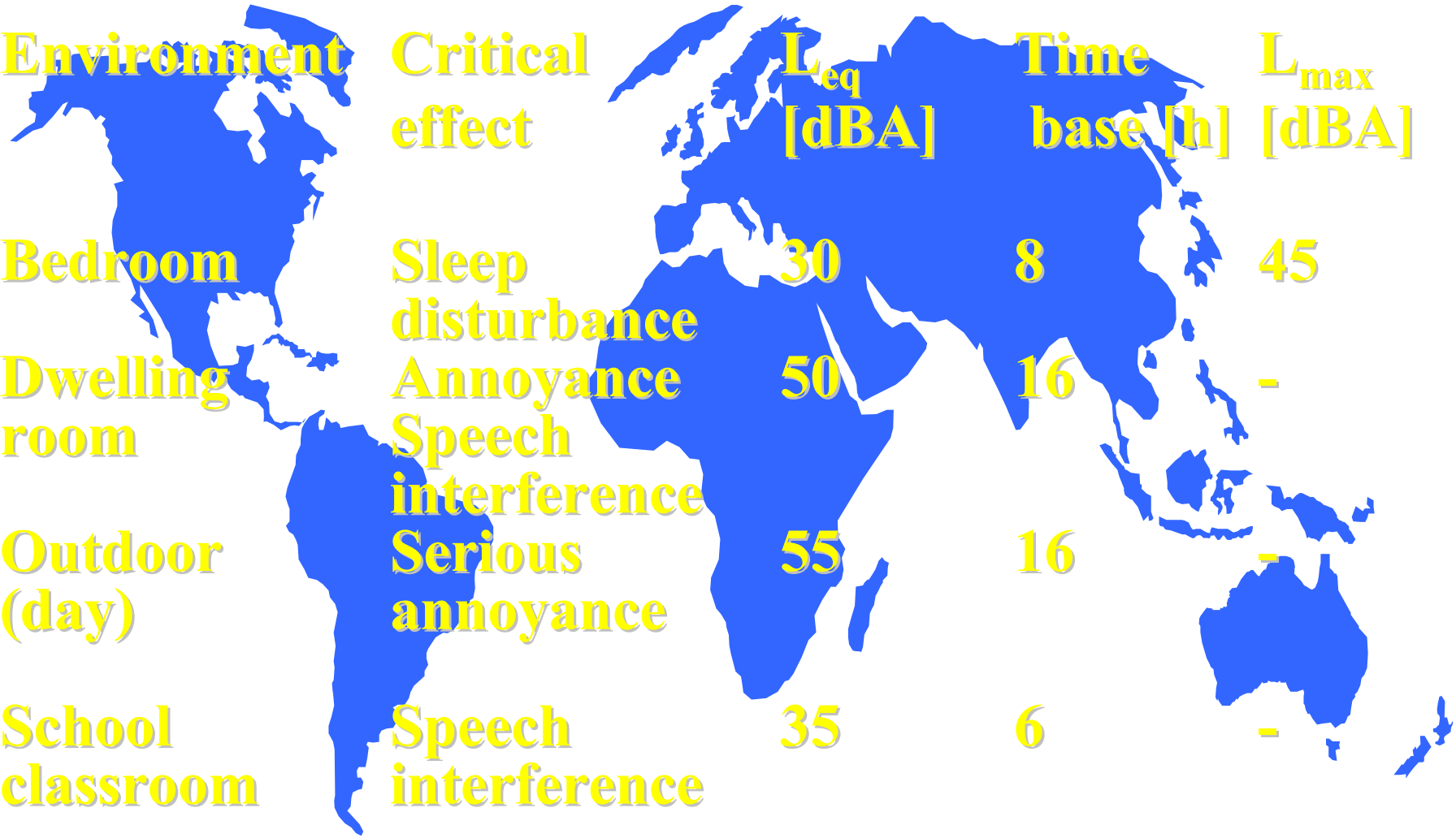
Brigitta Berglund
Thomas Lindvall
Dietrich Schwela
Kee-Tai Goh



World Health Organization
Sustainable Development and Healthy Environments
Protection of Human Environment
Occupational and Environmental Health

Ministry of the Environment
Institute of Environmental Epidemiology

Community Noise: Guideline values I



Environment	Critical effect	L_{eq} [dBA]	Time base [h]	L_{max} [dBA]
Bedroom	Sleep disturbance	30	8	45
Dwelling room	Annoyance Speech interference	50	16	-
Outdoor (day)	Serious annoyance	55	16	-
School classroom	Speech interference	35	6	-
School courtyard	Serious Annoyance	55	play-time	-

European Commission Noise Directives

Directive on Environmental Noise

- **The Environment Directorate-General has published a 26 page booklet "The Noise Policy of the European Union Year 2 (1999 - 2000)" -- explains the current scope of the proposed Directive.**
- **On 26 July 2000 the Commission adopted a draft proposal for a Directive on Environmental noise (COM(2000)468).**
- **Two readings in the European Parliament and the Council will probably lead to further changes.**

- - - - - - - - - - - - - - -

European Commission Noise Directives

Directive on Noise from Equipment Used Outdoors

The administrative and legal position is given in Directive 2000/14/EC.

An ad hoc Working Group, number 7, shepherds the new Directive and helps on the old directives that are to be repealed as the new one has come into force.

Example European Commission Noise Directives

Environment Directorate-General

- **Construction Plant Equipment - 79/113/ EEC**
- **Type Approval for Construction Plant and Equipment - 84/532/EEC**
- **Compressors - 84/533/EEC**
- **Tower Cranes - 84/534/EEC**
- **Welding Generators - 84/535/EEC**
- **Power Generators - 84/536/EEC**
- **Concrete Breakers - 84/537/EEC**
- **Lawnmowers - 84/538/EEC**
- **Hydraulic Excavators - 86/662/EEC**
- **Household Appliances - 86/594/EEC**

Example European Commission Noise Directives

Other Directorate-Generals

- **Motor Vehicles - 70/157/EEC**
- **Motor Cycles - 97/24/EC**
- **Subsonic Aircraft - 80/51/EEC**
- **Subsonic Jet Aeroplanes - 89/629/EEC**
- **Limitation of the Operations of Aeroplanes - 92/14/EEC**

Expected New Directives:

- **Tyre/Road Noise**
- **Noise from recreational crafts**

Summary – US Noise Policy-Making Efforts

- **Noise must be considered as a significant environmental "Public Health" problem - Most of the world's developed countries accept this and are making good progress on managing noise exposure**
- **The U.S. was once the world's leader in addressing environmental/community/transportation noise, but this momentum has been lost**
- **Federal agencies and professional organizations need to make a renewed commitment to addressing noise management problems in the 21st Century**
  - **Noise effects research, noise control technologies, and noise management policies**

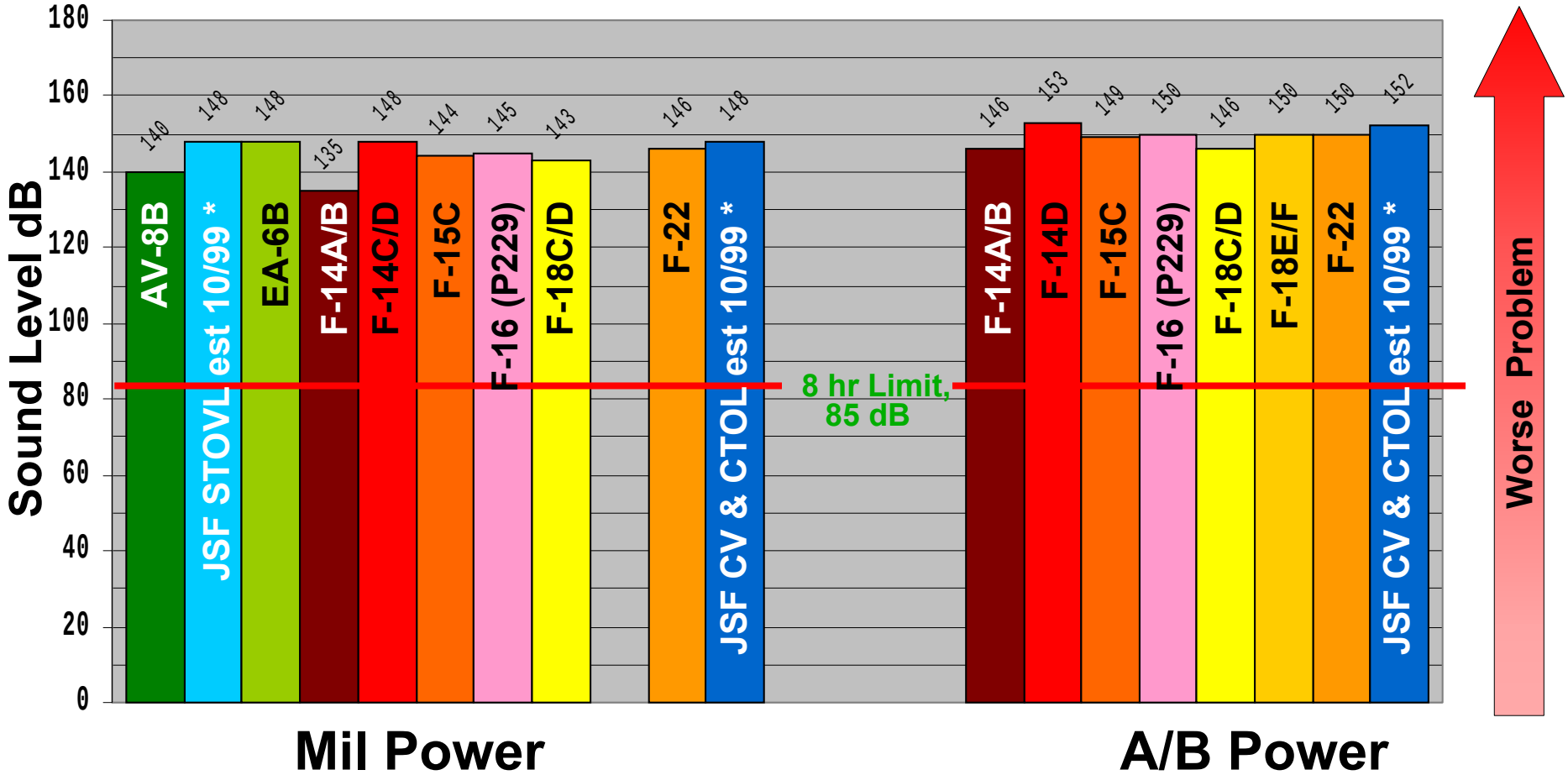
Extreme Hearing Protection (military aircraft)

- ***Richard McKinley (civ AFRL/HECB) (Wright-Patterson AFB)***

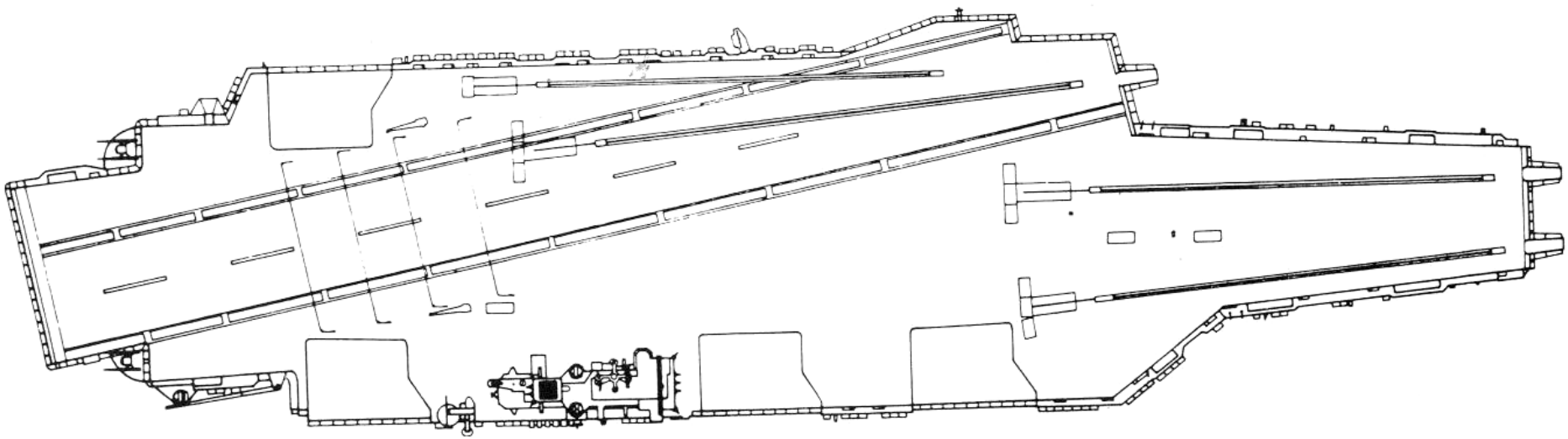
Thanks to: ***US Navy***
US Air Force

Tactical Aircraft Near-Field Noise

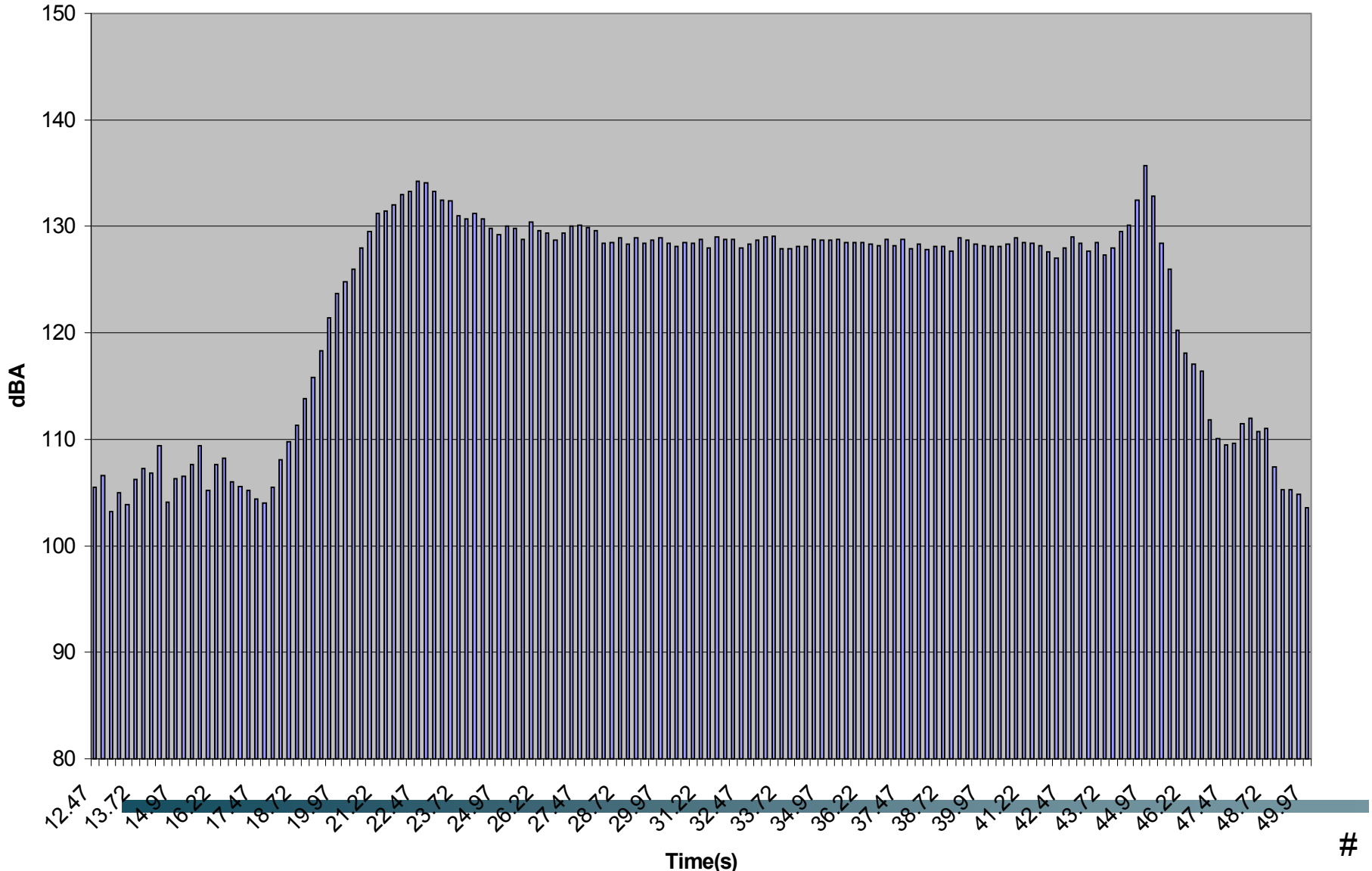
Worst Case Aircraft Noise Levels - @ 50 ft



Aircraft Carrier Flight Deck



Launch Noise Time History
F-18 Mil power Bow Catapult



Carrier Near Field Noise

Crew Positioning Challenges

Carrier Near Field Noise

Crew Positioning Challenges

Carrier Near Field Noise

Crew Positioning Challenges

Carrier Personnel Noise

Crew Positioning Challenges

Directors during STOVL Operations on L-Class Ships

Checkers in front & Behind During Launch

Launch Crew between the Catapults

Hot Topics in Noise -- ASA June 2001

For 85 dBA criterion
(8 hours, 3 dB doubling)

30 dB attenuation reach exposure limit
7 to 30 seconds

Current program achieving improved attenuation 38 – 40 dB

New Room Noise Criteria

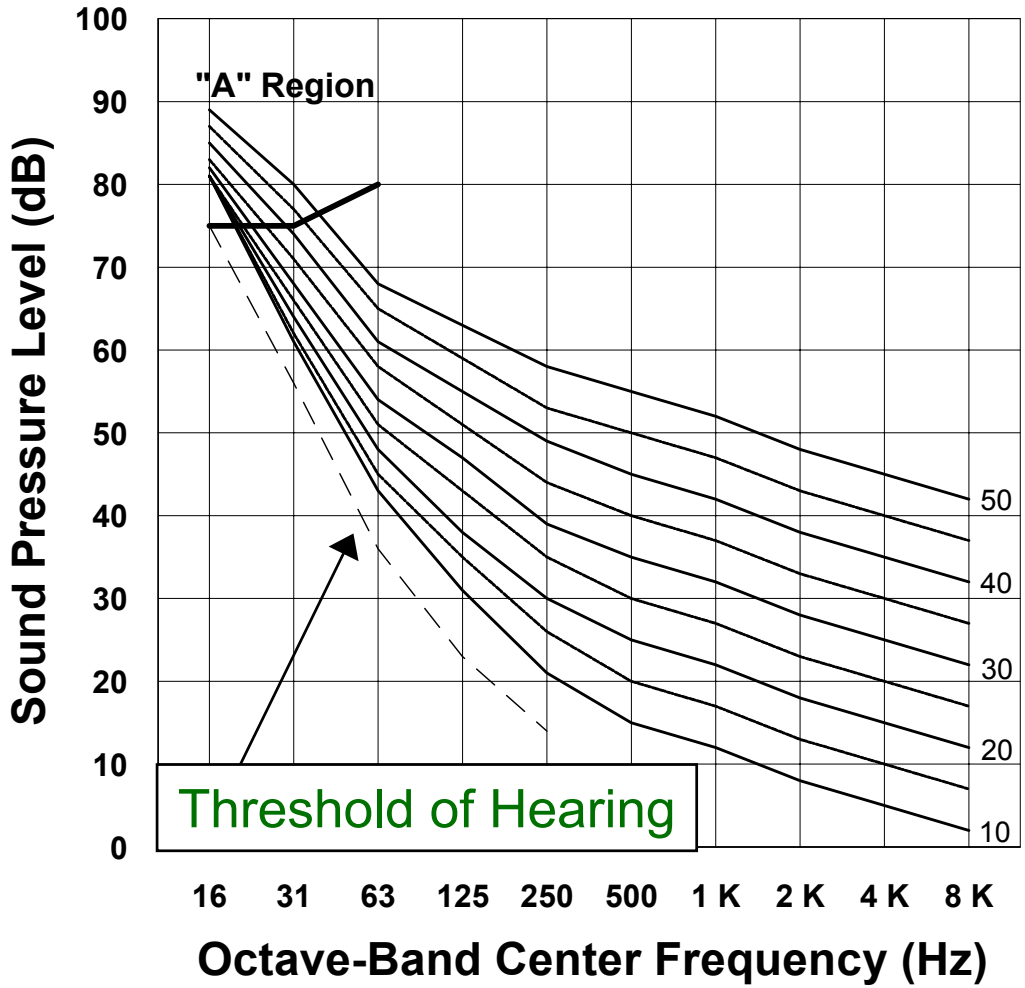
- ***Paul Schomer - CERL***

Room Noise Criteria (RNC)

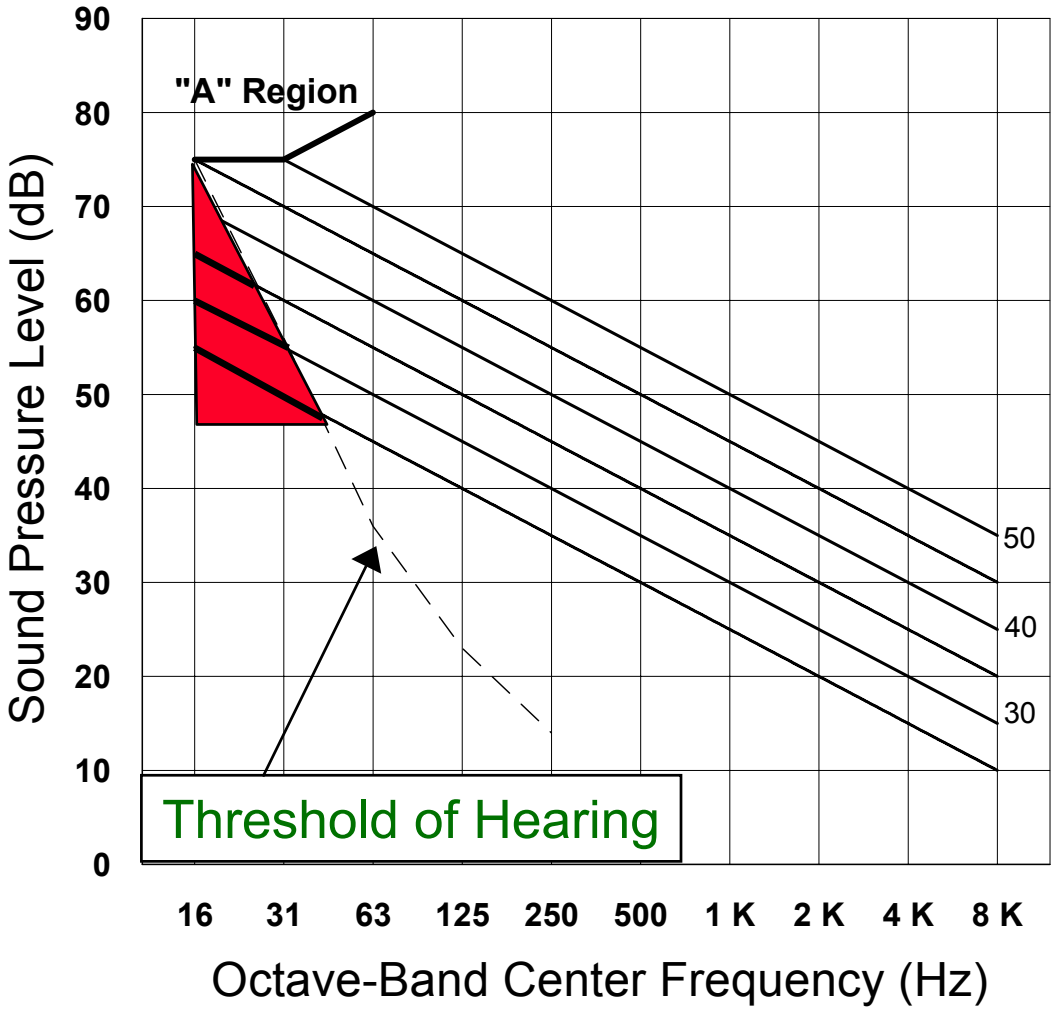
- **Problem--S12.2**
  - **Beranek--NCB**
  - **Blazier--RC**

- **Very different at low frequencies**
  - **Beranek--Well behaved HVAC as in a concert hall**
  - **Blazier--Inexpensive "office" HVAC. May have rumble and surging**

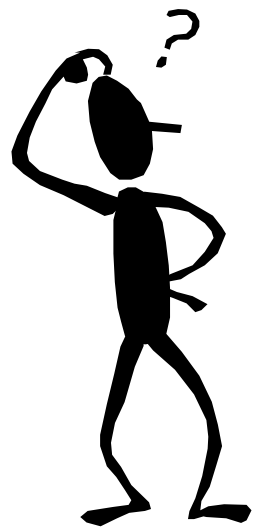
Beranek--NCB Room Noise Criteria Curves



Blazier--RC Room Noise Criteria Curves

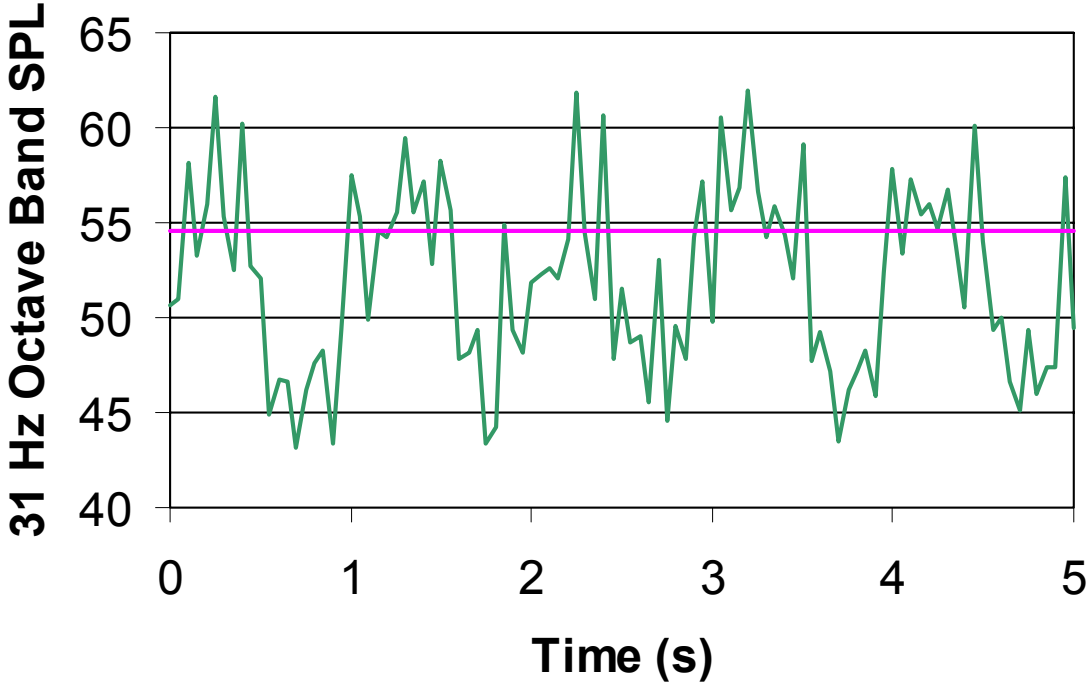


Are Curves Below the Threshold of Hearing at Low Frequencies A Mistake?



Why The Difference Between Beranek and Blazier?

- Beranek--Concert Halls, “well designed” HVAC
- Blazier--Surging, Rumbling HVAC



LEQ = 54.5

Threshold = 55 dB

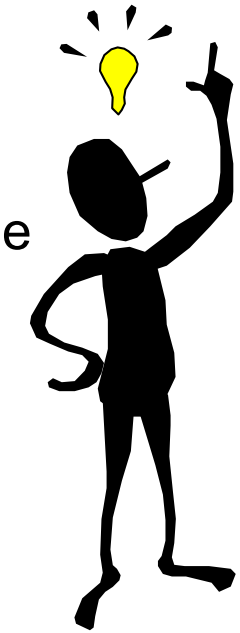
Surging = 10 dB Peak, 1/2 Hz

Sigma = 3.3 dB

Is This Heard? The LEQ is Below the Threshold of Hearing.

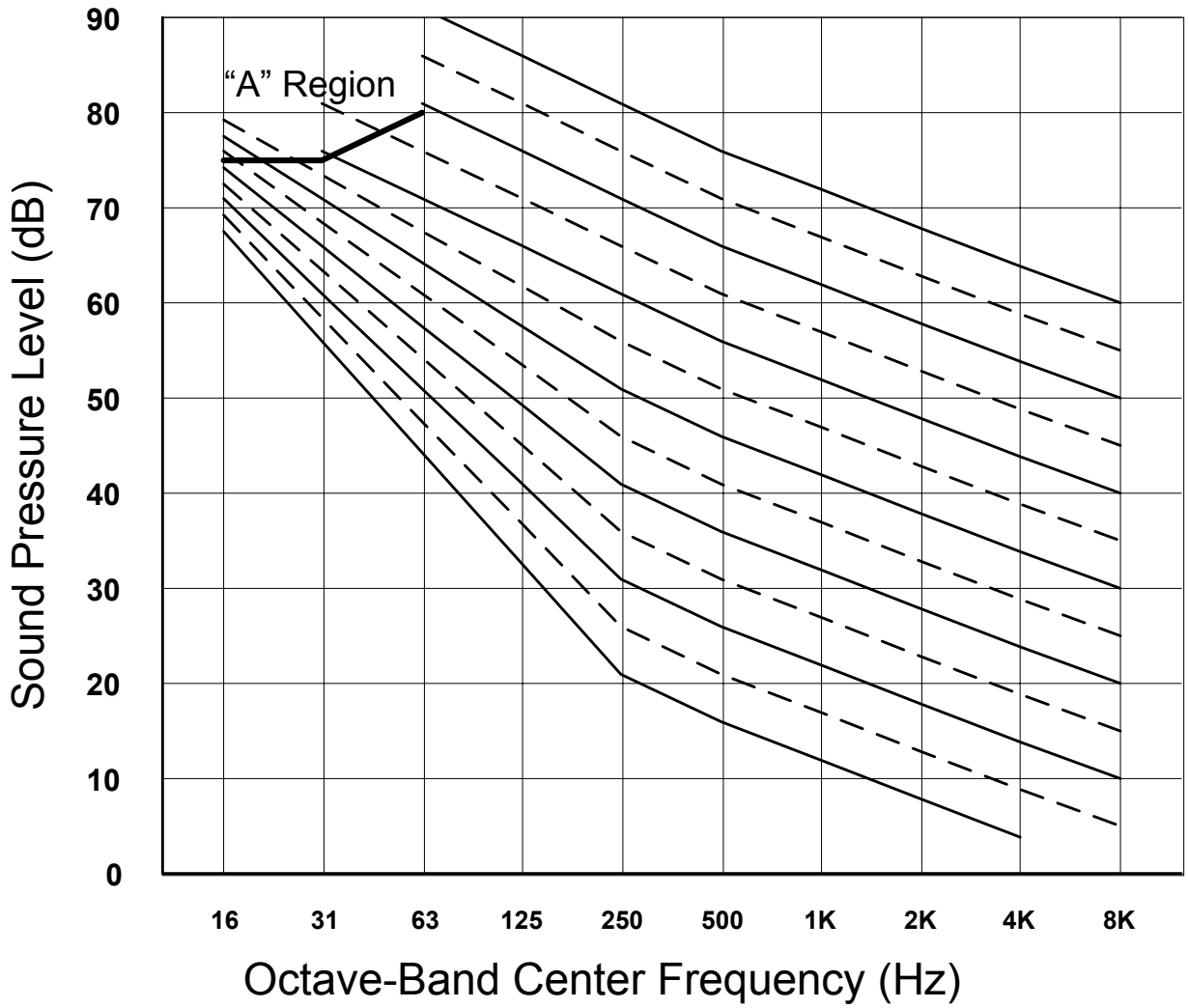
RNC Room Noise Criteria

- Correction to NCB-like curves
  - A function of frequency and AMPLITUDE
  - Detect with fast-time-response to simulate the integration time of human hearing
  - Use 1/3rd octave bands each ~100 ms
  - Maintain log10 arithmetic



- Find the low-frequency correction for 16, 31 and 63 Hz
- Use loudness-level contour arithmetic--the hearing function at 31 Hz--5 dB change in SPL is a 10 phon change.

Proposed New--RNC (Room Noise Criteria) Curves



A Test of New Room Noise Criteria (RNC)

- John Bradley--1994 study
  NRC Canada
- 9 Subjects
- Main Frequency--31 Hz Band
- Modulation Depth--10 dB, 17 dB
- Modulation Frequencies:
  0 (none), 0.25, 0.5, 1, 2, 4 Hz

- Results:
- Difference RNC-Bradley: 1.2 dB
- Standard deviation: 1.1 dB
- Correlation Coefficient 0.92

- THIS SEEMS TO WORK

Classroom Acoustics Standard

- ***David Lubman – Consultant***

Good Classroom Acoustics Is Vital to All Knowledge-based Societies

The ability to hear & be heard is central to all language based learning.

- **Students of all ages need good acoustics. Lifelong learning is paramount in new world economy.**

- **Demanding new standards are being developed for noise and reverberation control in schools.**
  - **Higher standards expected to greatly increase the acoustical content of future school design.**
  - **More acoustically trained architects and mechanical engineers will be needed for the school building boom.**

Inclusive vs. exclusive classroom acoustics

Good classroom acoustics are *inclusive* for:

- **Non-native listeners and talkers.**
- **Students & teachers with hearing or voice impairments.**
- **Young children & inexperienced learners**
- **Fatigued learners**
- **Poorly motivated learners**
- **Elderly**

New Standards for Classroom Acoustics to Benefit All!

- **ANSI S12 standard nearing completion**
  - **Draft 9 approved by S12 in spring.**
  - **Full ANSI approval of draft 10 possible by fall**
  - **Noise levels not to exceed 35 dBA**
  - **Reverberation times under 0.7 sec (small classrooms)**
- **New noise guideline in Alberta, Canada**
  - **Standards & guidelines for school facilities**
- **New HVAC noise guidelines for NYC schools**
- **LA expected to endorse 35 dBA for new schools**

Product Sound Quality

- ***David Bowen – R. H. Lyon Corp***

WE (every acoustician)

Are All Ambassadors

For NOISE