Special Leo Beranek Memorial Session

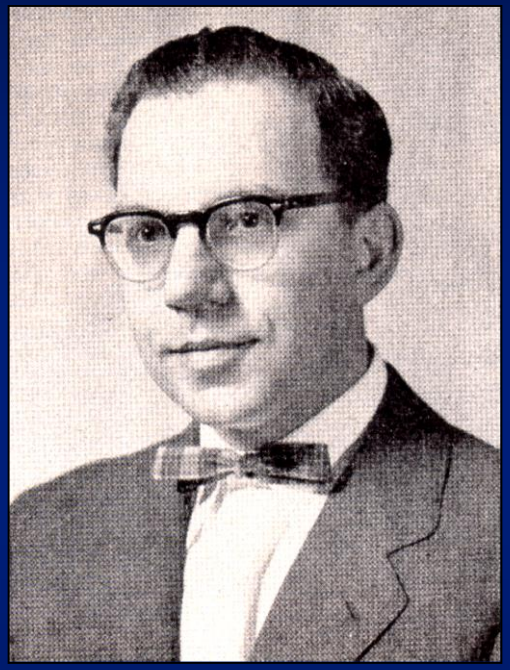
Monday 12 June 2017

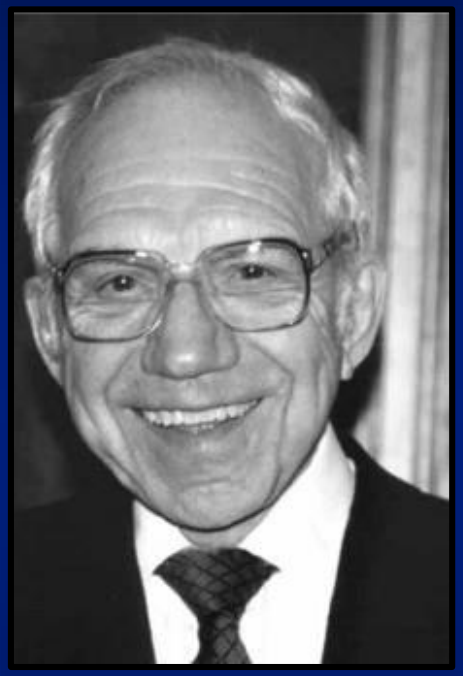
Chaired by: George Maling and Eric Wood

Presentations by:

Joe Cuschieri: Fellow, Lockheed Martin; Executive Director and Past President INCE-USA
Patricia Davies: Professor, Purdue University; Director, Ray W. Herrick Labs; and Past President INCE-USA
Paul Donavan: Senior Scientist, Illingworth & Rodkin, Inc, and Past President INCE-USA
Bob Hellweg: Hellweg Acoustics and Past President INCE-USA
George Maling: Managing Director, Emeritus and Past President INCE-USA
Joachim Scheuren: Müller-BBM GmbH and Past President I-INCE
Eric Wood: Principal, Acentech and Past President INCE-USA

Leo L. Beranek





gentleman and global pillar of our profession

George C. Maling, Jr. and Eric W. Wood

Slide with Embedded Voice Recording by George Maling Followed by His Text

George Maling shares thoughts about Leo Beranek's contributions to noise and vibration control

click to open audio file

Maling Paper NC17

Good afternoon ladies and gentlemen. This is George Maling speaking on the occasion of the NOISE-CON 17 session honoring Leo Beranek.

I'm very pleased to be able to supply this recording. Unfortunately I could not be here in person because I had some medical issues last month and have been advised that I should not do any traveling. Thanks to Eric Wood for putting together this session; I am pleased to participate.

I first met Leo in the summer of 1951. I had transferred to MIT from Bowdoin College to study electrical engineering and needed to take the first EE course which was called 6.01. In that summer the professor teaching that course happened to be none other than Leo Beranek. Normally the course would have been taught by Ernst Guilleman, a man who was very well known in those days for his work on network theory but Leo got the assignment to teach the course that summer. We learned about network theory together and I think that it greatly influenced both the students and Leo because, as I'll show in a few minutes, he used a lot of that material—converted to acoustical nomenclature—to include in his 1953 course on acoustics (6.35). The next year, 1954, he published his book, *Acoustics*.

When he was at Harvard and long before I met him, Leo had made contributions to noise control. He needed acoustical materials for use in airplanes, and worked with acoustical manufacturers to produce acoustical materials that were very light in weight and had a large surface area. The fiber diameters were smaller than had previously been produced.

Leo also had a student named Sleeper. A government program required a reflection-free room for testing high intensity noise sources. Sleeper tested a very large number of fiberglass wedges having different dimensions for what became to be known as an anechoic chamber. The final design became a model for future anechoic rooms; these rooms are commonly used for determination of the noise emissions of sources, and are in use all over the world. That work is clearly a legacy of Leo's and a major contribution to noise control.

In 1953, I took Leo's course 6.35 on acoustics. Leo would bring in reams of notes written and mimeographed with the purple ink of the day. The class went through the notes in detail; we learned a lot and made some corrections to the notes. Leo then further revised those notes, and they became the heart of his 1954 book, *Acoustics*. There was some noise control material in the back of the book and that was really the beginning of his publications on noise control.

There was another interesting series of events at that time and that was MIT summer courses on noise control intended for persons in industry. Leo founded the series; for the first one, almost all of the speakers were from Bolt Beranek and Newman (BBN). Subsequent courses involved speakers from several institutions. His book, *Noise Reduction*, came out of that series. Later, *Noise and Vibration Control* was published, and was followed by *Noise and Vibration Control Engineering*. The entire series was a major contribution to noise control.

By 1955, Leo was deeply involved with the Acoustical Society of America and he managed to convince the executive council of the society to begin a new magazine which was called NOISE CONTROL. Leo did the first issue. Then Lewis Goodfriend became the editor and edited the following issues up until the early nineteen sixties. He did a wonderful job. That was a seminal publication on noise because I believe that it was the first one in the United States which was devoted entirely to noise control. Then the executive council of the Acoustical Society had a change of heart and decided that there should not be a publication that was devoted solely to one aspect of

acoustics. So they essentially killed noise control magazine and launched a new magazine which was called *Sound, It's Uses and Control*. That publication lasted for a couple of years and then was dropped by the Acoustical Society. The founders of INCE-USA were aware of this history, and *Noise Control Engineering Journal* was a direct descendant of NOISE CONTROL.

I won't say much about Leo's years at BBN because I was not directly involved. But there are two items that he has mentioned. One was some work on the quieting of airplanes which he did with a young colleague by the name of Ed Kerwin. Ed was a fraternity brother of mine and a very smart guy who made many contributions over the years to the development of materials for vibration damping.

Next, let's talk about the founding of INCE-USA. The idea for the founding of the organization began, I believe, in Bill Lang's head. He made a trip to Winchester, Massachusetts, where Leo lived, to discuss the situation with Leo. It turned out that Leo was thinking along the same lines and they had a very good discussion about the founding of a new organization which would be able to run conferences, have a professional publication, and would be able to set requirements for membership. Later, they made a list of all persons they knew who were working in noise control, and invited them to a workshop to be held at Arden House in Harriman, New York. About 85 persons attended the workshop in January, 1971. The participants listened to the case for a new organization and, at the end of the meeting, voted to proceed with the formation of the Institute of Noise Control Engineering. Articles of incorporation were completed and INCE-USA was incorporated in the summer of 1971. The first board meeting was held in October of 1971 in Denver, Colorado and the board elected Leo as the first president. One of the major activities discussed was the holding of an international conference on noise control. (Earlier, Bill Lang had walked into my office at IBM and said "INTER-NOISE." What's that?" I said. Bill explained that he had been reading some IEEE information which mentioned an international conference on magnetics which they called INTER-MAG. So, he said, "why not have an INTER-NOISE?" That's where the name came from).

The conference to be held in October of 1972 was indeed named INTER-NOISE, and the board voted to go ahead. In retrospect, it was a rather amazing decision to make. We had less than a thousand dollars in assets—contributed by the newly elected directors of the organization. We had no conference secretariat, no general chair, no plans for producing a proceedings, no hotel arrangements, and no exhibition manager. But we went ahead anyway. Dan Flynn from the National Bureau of Standards (now NIST) volunteered to run the secretariat, Malcolm Crocker volunteered to be the general chair and conference proceedings editor, Lew Goodfriend had a friend at the Shoreham Hotel who arranged for accommodations and meeting rooms, and Jack Mowry volunteered to run the equipment exposition.

In today's world, no hotel would take on an organization like ours with very little in the way of finances and no track record, but the Shoreham Hotel did. The meeting turned out to be a success. Although there were fewer than 100 papers presented at the meeting about twelve hundred people showed up and the organization got off to a good start especially in terms of finances.

One of the highlights of the meeting took place at a luncheon for all attendees. Our speaker was William Magruder who was our White House liaison with regard to work being done on noise control regulation in the Congress. Before lunch he met with Leo, Bill Lang and Ken Eldred. They had a discussion about the noise bills before the Congress. Magruder made a phone call to the White House and learned that if any bill were to be passed by the House and Senate and presented to President Richard Nixon, he would sign it.

That created quite a flurry of activity in the weeks between INTER-NOISE and the end of October.

A bill was passed by both houses of Congress on the last day of the 92nd Congress and that became the Noise Control Act of 1972. Another highlight of INTER-NOISE was the holding of a panel session on what constitutes a national noise program. Leo invited the speakers and chaired the session.

The publication of a new magazine was very high on our agenda. Leo visited and worked with several different government agencies to put together a funding package for the new publication. INCE-USA hired an editor and editorial assistant. Together they worked with Leo and others to produce the first issue. Well, the first issue was published and was not exactly what the INCE-USA board of directors had envisioned for a technical magazine. Funding problems arose, and as a result we could no longer afford the editor and his assistant. Malcolm Crocker kindly stood up and volunteered to be the editor of the magazine, which at that time was called *Noise Control Engineering*. The Board decided to use some of the surplus from INTER-NOISE 72 to get started with Malcolm and that worked out very well. Malcolm later changed the name of the publication to *Noise Control Engineering Journal* (NCEJ) and did an excellent job of editing the publication for more than 20 years.

I will mention one more item and that is more recent work on noise policy. Again, Leo and Bill Lang got together a small group which was named the Peabody Group—only because the first meeting was held in Peabody, Massachusetts. A special issue of NCEJ on noise policy came out of that group, as did a recommendation that the National Academy of Engineering (NAE) get involved in noise policy. That led to the publication of the *Technology for a Quieter America* report and several follow on workshops and reports.

So I think that all of us should be very grateful for the contributions of Leo—for the founding of our organization and for all of the things that he did for noise control engineering. The other speakers in this session will document Leo's other activities during his illustrious career.

# # #

Slides Presented by Joachim Scheuren

NoiseCon 2017

Special Leo Beranek Memorial Session

Leo Beranek and his inspiring contributions to Acoustical Engineering at Müller-BBM in Germany

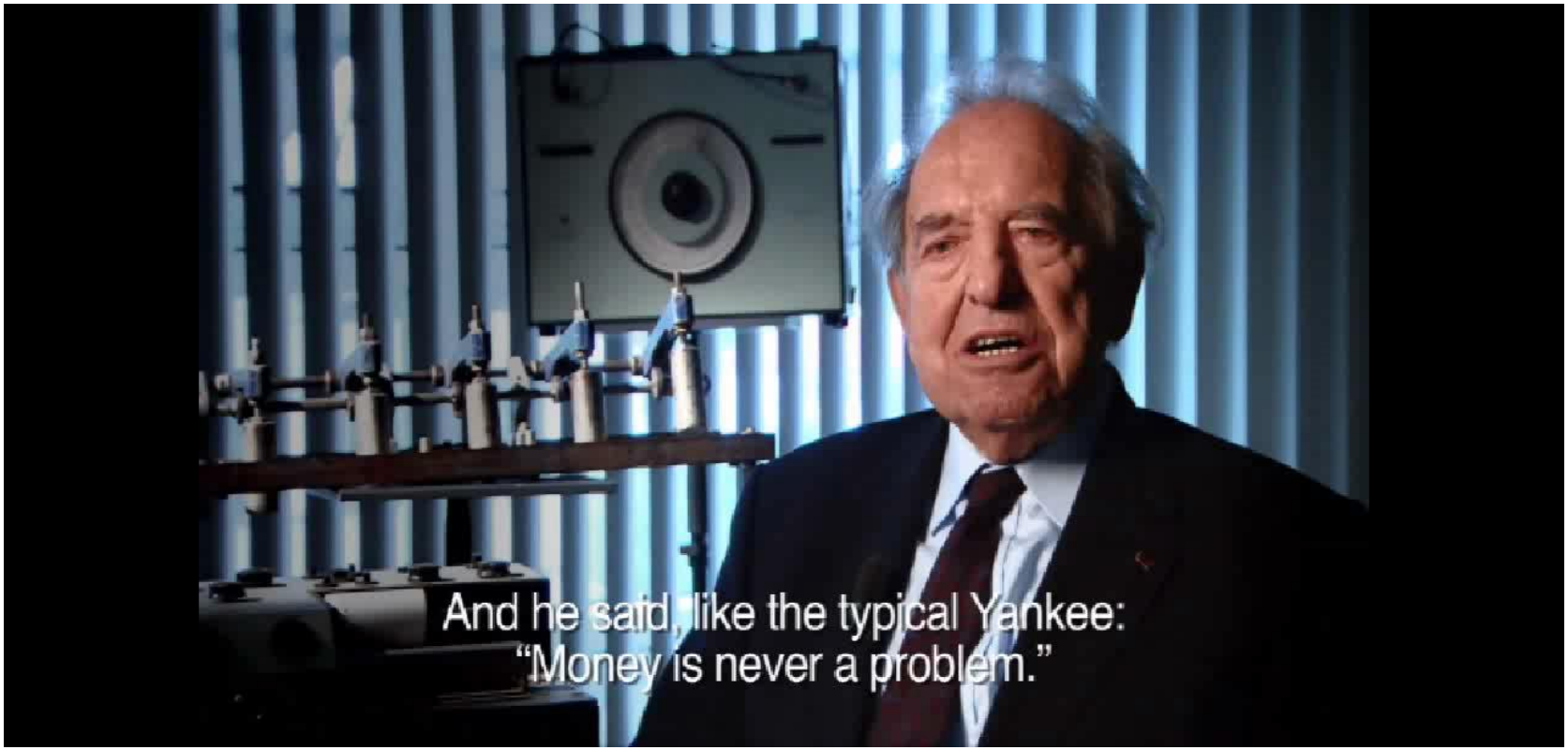
Joachim Scheuren

Müller-BBM

I-INCE

Money is never a problem

Click to see video



Foundation of Müller-BBM in 1962

Early Shareholder Meeting in the 60s

Early Shareholder Meeting in the 60s

Director Leo Beranek

Director Leo Beranek

Renaming Müller-BBN

- after repurchase of BBN's shares in the seventies

Bolt	**B**eratungs-	Consulting
Beranek	**B**üro	Office
Newman	**M**ünchen	Munich

Müller-BBM today

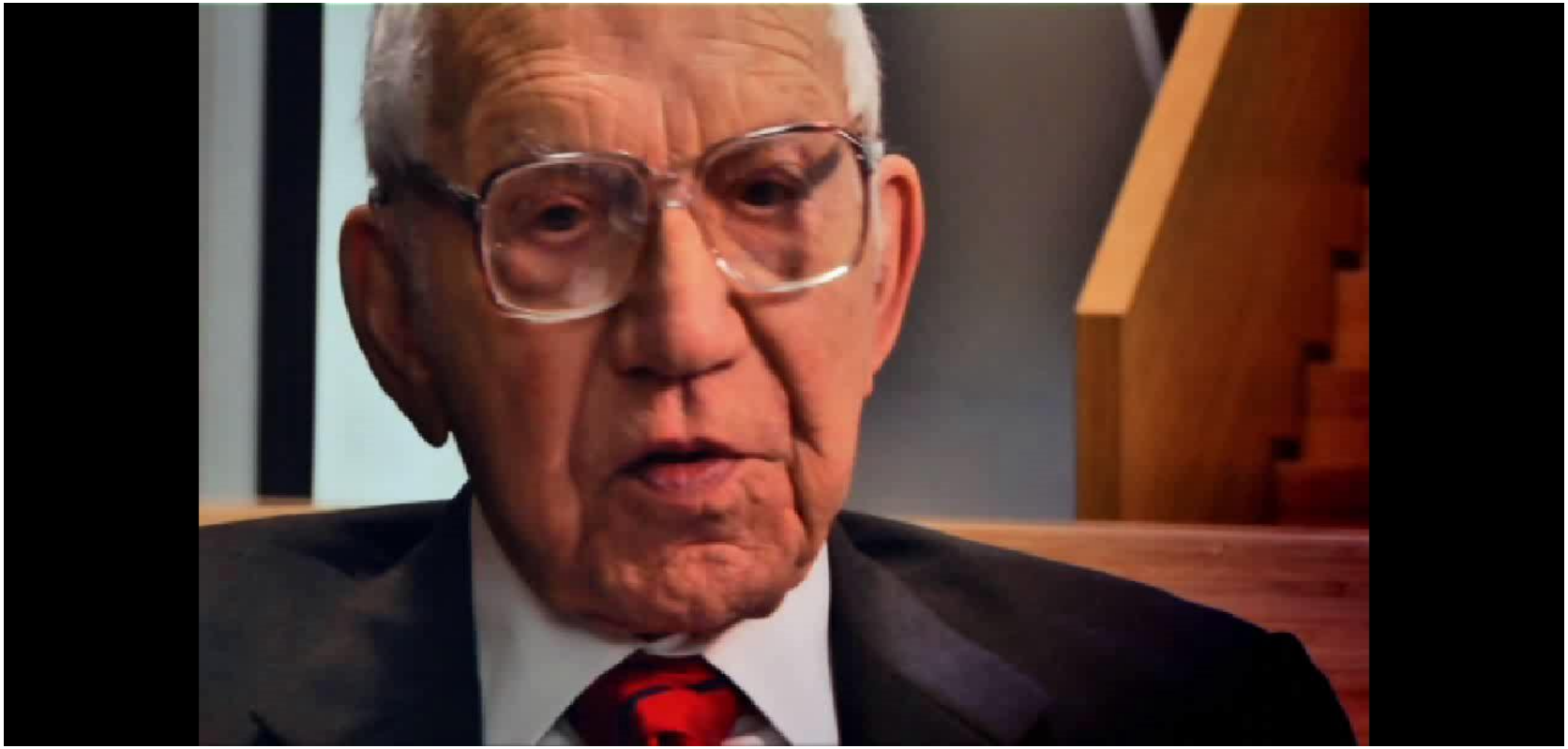
- worldwide group of acoustical engineering companies
- more than 1500 employees
- broad spectrum of consulting services in all domains of acoustics and vibrations
- developing, producing and marketing advanced software and technology for particular applications like
  - data acquisition and evaluation
  - active sound design or
  - industrial sound silencers

Leo at Müller-BBM's 50th Anniversary

Leo at Müller-BBM‘s 50th Anniversary

The only argument

Click to see video



We all are aware of Leo Beranek‘s spirit in Engineering Acoustics

And ..

I am sure we will preserve and keep it alive!

Slides Presented by Bob Hellweg

Leo Beranek:
Contributions in Room Acoustics and Acoustic Standards

Robert D. Hellweg, Jr.

Hellweg Acoustics.
Wellesley, Massachusetts

Leo Beranek: Contributions in Room Acoustics and Acoustic Standards

Outline:

- Room Acoustics –
  * Absorption
  * Criteria for Evaluating Room Noise
- Acoustic Standards
  * Leadership in Acoustic Standards
  * ANSI/ASA S12.2 Criteria for Evaluating Room Noise
- Discussion

Not included: Concert Hall Acoustics

Leo Beranek: Contributions in Room Acoustics and Acoustic Standards

Order of presentation:

* Room Acoustics – Absorption

* Acoustic Standards - Leadership in Acoustic Standards

* Room Acoustics – Criteria for Evaluating Room Noise

* Acoustic Standards - ANSI/ASA S12.2 Criteria for Evaluating Room Noise

Leo Beranek: Contributions in Room Acoustics – Absorption Materials

- Beranek involved in research in very thin fibers in the 1940s
- Absorbers were heavy and flammable
- Owens-Corning fiberglass – thick and heavy
- Leo described ideal absorber – very fine fibers packed into small volume
- Owens-Corning made sample
- lightweight acoustical absorbers
- Still used today in aircraft

Beranek, L.L., et.al., (1944) “Principles of Sound control in Airplanes” (National Defense Research Committee, Office of Scientific Research and Development, Washington, DC.), Report OSRD No. 1543.

(Maling, *Acoustics Today*, Fall, 2014, p21 – 22, Hanson, *Acoustics Today*, Fall 2014 p 30-31)

Leo Beranek: Contributions in Room Acoustics

Absorption: Anechoic Rooms

- Developed anechoic rooms in response to government need
- Problems:
  * Sound Absorptive properties
  * Shape of material => wedges
- Work still relevant in the design of acoustic wedges for anechoic chambers

Beranek, L.L. and Sleeper, H.J. (1945) “The design and construction of anechoic sound chambers,” *JASA* 18, pp140-150
(Maling, *Acoustics Today*, Fall, 2014, p22)

Leo Beranek: Leadership in Acoustic Standards

* Chair of American Standards Committee Z24 (1950-1953) (administered by ASA)
  - Acoustic Terminology
  - Acoustic Instruments

* Why did Beranek chair Z24?

> “It was becoming obvious that ASA had to get involved in writing standards.”*
>
> “This turned out to be a very interesting job because we produced a number of early standards.”*

(* Beranek quotations from Schmitt, *Acoustics Today*, Fall, 2014, p15)

Leo Beranek: Leadership in Acoustic Standards

ASA Standards Advisors or Directors*:

Laurence Batchelder
Leo Beranek
Kenneth M. Eldred
Tony Embleton
William J. Galloway
Daniel Johnson
Vern Knudsen
William Melnick,
Paul Schomer
Chris Struck
Henning von Gierke.

* Partial list

American Standards Committee on Acoustics Z24

American Standards Committee Z24 =>

ASC S1 (Acoustics)

+

S2 (Mechanical Vibration and Shock)

+

S3 (Bioacoustics)

S12 (Noise) formed later from activities of S1 and S3.

All administered by ASA

Room Acoustics –Criteria for Evaluating Room Noise

- **NC Curves and criteria**
- **NCB curves and criteria**

Criteria for Evaluating Room Noise – NC curves

Beranek developed noise criteria (NC) curves for evaluating room noise.

- Shape of curve approximated equal loudness curves
- Based on measurements in many rooms

Beranek, L.L., “Criteria for office quieting based on questionnaire rating studies.” *JASA*. 28, 833-852 (1956).
Beranek, L.L., “Revised criteria for noise in buildings.” *Noise Control* 3, 19-27 (1957).

Criteria for Evaluating Room Noise – NCB curves

Beranek modified the NC curves

- Balance noise criteria (NCB) curves
- Extended NC curves to lower frequencies
- Rating number related to speech interference level

Beranek, L.L., "Balanced noise criterion (NCB) curves." *JASA*. 86(2), 650-664 (1989).

Criteria for Evaluating Room Noise – RC curves

- Developed by Warren Blazier
- Based on study of 68 installations with HVAC noise with no complaints
- Noise Spectrum described as
  - * Neutral
  - * Rumble
  - * Hiss
- RC curves different from NC and NCB curves
- In ASHRAE standards

Beranek too a break in acoustics

- Left BBN
- Led a group that fought for a TV license in Boston
- Was President of Channel 5 in Boston

- Decided to resume acoustic activities
- Studied journals for ~2 years at MIT library to understand developments.
- Resumed acoustics with full vigor!

Acoustic Standards -
ANSI/ASA S12.2 Criteria for Evaluating Room Noise

S12.2 1980s
- NC

S12.2 1995
- NCB
- RC

S12.2 2008 – A-weighted
- NC (modified)
- RNC

ANSI S12.2 Criteria for Evaluating Room Noise - 1995

S12 WG18: **Beranek, Blazier**, Campanella, Cohen, Guernsey, Herbert, Pei, Peppin (Chair), Winzer

- Both NCB and RC curves
- Issues:
  - Which to use?
  - Which is better

Recommended NCB and RC specifications for various occupied activity areas

NOISE-CON 96 Special Session on Evaluating Room Noise

* Papers by Leo Beranek and Warren Blazier in a special session organized by Jason Pei

Beranek: “Applications of NCB and RC Noise Criterion Curves to Specification and Evaluation of Noise in Buildings”

Blazier: “Room Noise Criteria: The Importance of Temporal Variations in Low-Frequency Sounds from HVAC Systems”

(I played a small role in this session)

NCEJ papers on evaluating room noise

- The NOISE-CON 96 papers were revised and published in *NCEJ*: .

Beranek, L.L., “Applications of NCB and RC noise criterion curves for specification for and evaluation of noise in buildings.” *Noise Control Eng. J*., 45, 209-216 (1997).

Blazier, W.E., "RC Mark II: A refined procedure for rating the noise of heating, ventilating, and air-conditioning (HVAC) systems in buildings." *Noise Control Eng. J*. 45(6), 243-250 (1997).

Schomer, Paul, “Proposed revisions to room noise criteria,” *Noise Control Engineering Journal*, 48(3), 85-96

ANSI S12.2 Criteria for Evaluating Room Noise 2008 version

S12 WG18: **Beranek, Blazier**, Hellweg, Herbert, Peppin (Chair), Schomer, Tocci, Van Houten, Winzer

Three methods for evaluating room noise:

- Survey Grade: A-weighted
- Engineering Grade: NC (extended in low frequency)
- A method for evaluating fluctuating low frequency noise: RNC

Has recommended noise level criteria for various occupied areas

Thoughts on Leo Beranek

Pat Kuhl: “..Leo’s energy, brilliance, and attention to detail…”*

Larry Kirkegaard: “Leo has dedicated himself to defining and refining our understandings of room acoustics.”*

* From Acoustics Today special issue on Leo Beranek, 2014

Leo's 100th Birthday Celebration
Boston Massachusetts

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Thank you, Leo,
for your many contributions
in room acoustics and acoustic standards
for the benefit of all.

Slides Presented by Paul Donavan

Special Leo Beranek Honoring Session

Leo Beranek and Speech Communication

Paul R. Donavan

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

Leo's Work – Harvard Cruft Laboratory

Speech Communication Research

- Crew communications in B17s
- Advanced Articulation Index methods
- Developed Speech Interference Level
- Developed kapok ear donut hearing cup

Leo's Work – Harvard Cruft Laboratory

Other research & developments

- Acoustical materials for aircraft
- Standing wave tube for impedance measurement
- First anechoic chamber
- Light weight phono pickup (w/Hunt)
- Compact loudspeaker for headsets
- Invented the question mark?

On-going Applications of Leo's Speech Communication Work

The Design of Speech Communication Systems*

LEO L. BERANEK†, SENIOR MEMBER, I.R.E.

Summary—**A method is presented for calculating the ability of a communication system to transmit speech intelligibly in the presence of noise. The total speech arriving at the ear of a listener is determined by adding the orthotelephonic gain of the system to the speech spectrum which would be produced by a talker at the eardrum of a listener at a distance of 1 meter. The total noise arriving at the ear is determined in terms of its spectrum level from measurements of the noise pickup of the microphone and the acoustic attenuation of the earphone cushions. The area lying between the spectrum level of the peaks of the speech and the spectrum level of the total noise arriving at the eardrum when plotted on a distorted frequency scale determines a quantity called articulation index which can be correlated with articulation scores. Methods for determining the maximum gain permissible in the system are discussed. The validity of the method is established by comparison of calculated with carefully measured articulation scores.**

I. Introduction

VOICE COMMUNICATION using microphones, earphones, or telephone receivers has risen to a new level of importance as modern transport has

Through the pioneering efforts of the Bell Telephone Laboratories, considerable data had been accumulated by 1941 on what constitutes an effective communication system for the transmission of speech over telephone circuits. Their data apply primarily to the design of systems for operation at low signal levels in reasonably quiet surroundings with the talker speaking in a normal tone of voice. Their findings were succinctly summarized by Fletcher[1] when he wrote in 1942 that "substantially complete fidelity for the transmission of speech is obtained by a system having a frequency range from 100 to 7000 cycles per second and a volume range of 40 decibels." This statement, although conclusive, gives the design engineer no guidance on how far it is safe to depart from these specifications.

More recently French and Steinberg have presented a method for calculating the performance of voice communication systems in environs in which the ambient

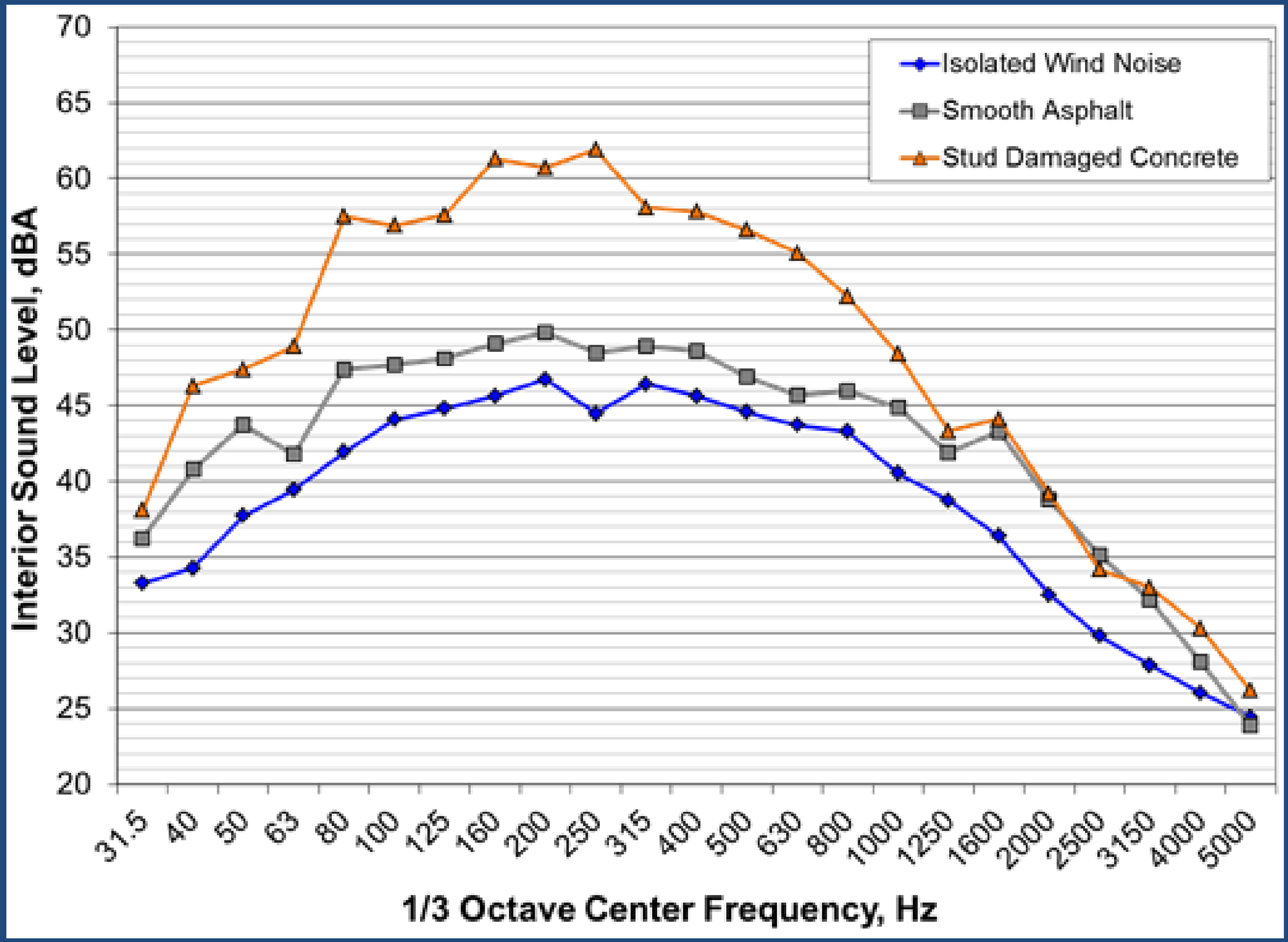
On-going Applications of Leo's Speech Communication Work

- Interior motor vehicle communication in the presence of road noise
- Medical equipment patience/operator communication
- Other personal notes

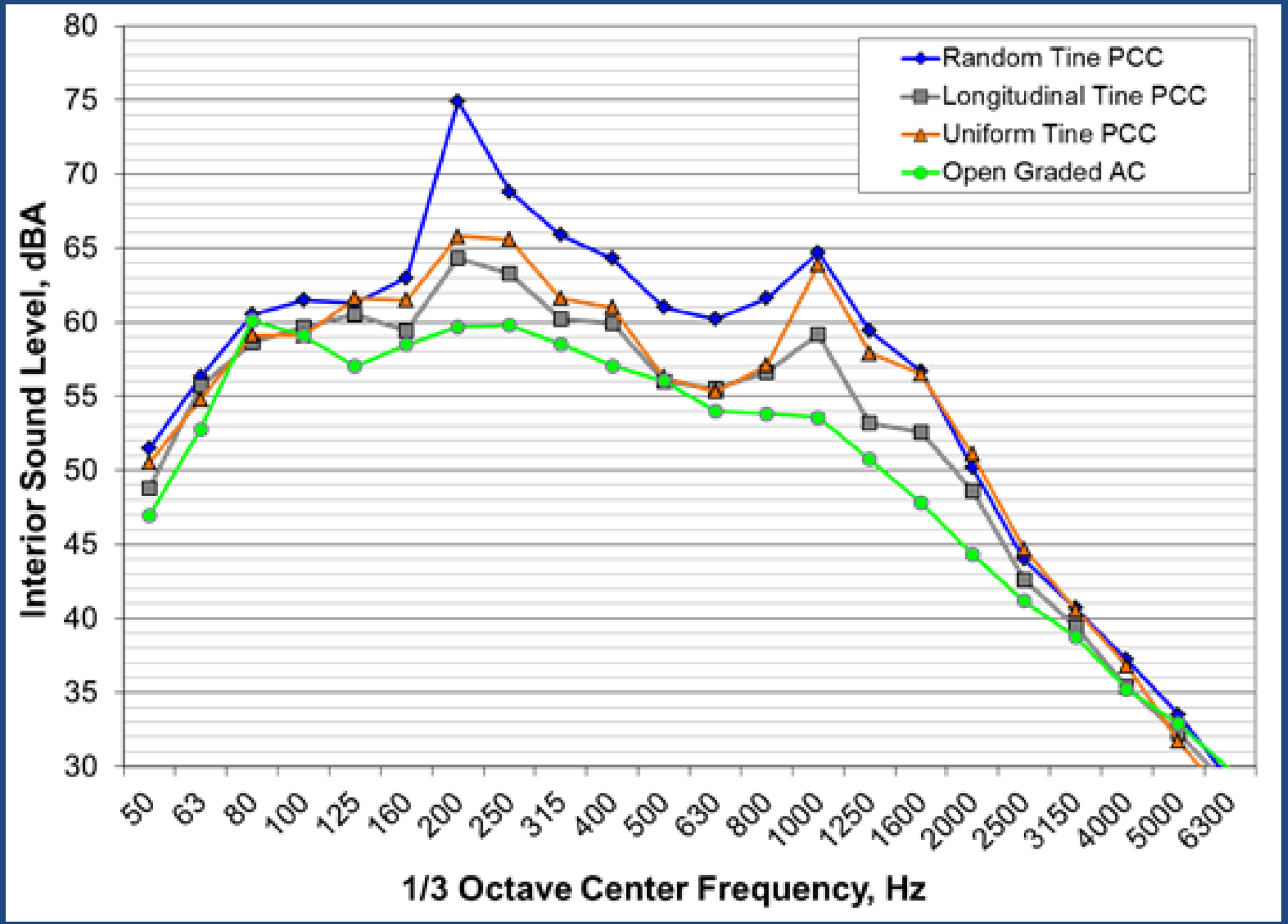
Speech Communications in Motor Vehicles

Influence of Pavement

Interior Noise at 50 mph



Arizona Highway Pavements

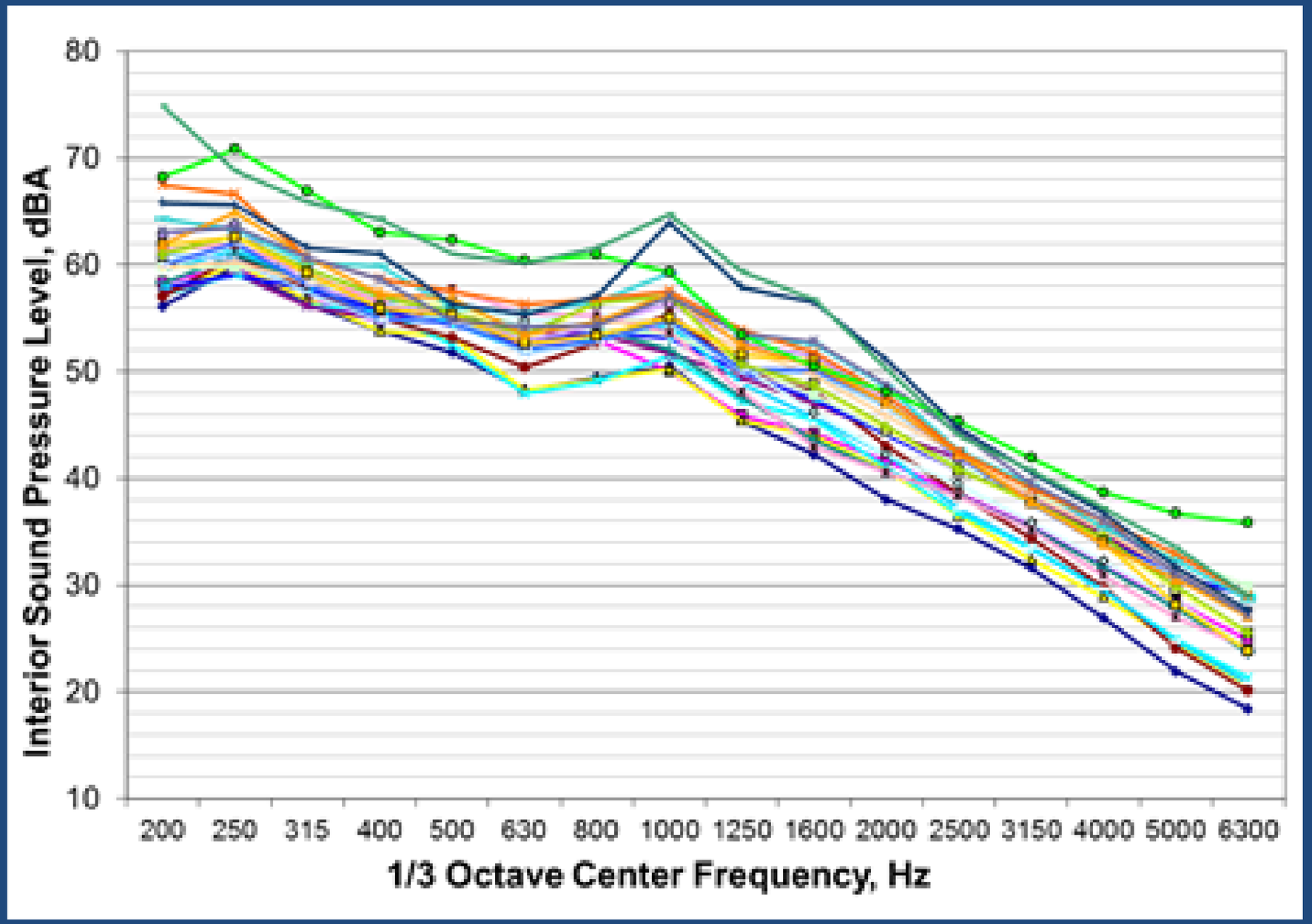


Caltrans Quieter Pavement Research
Noise Measurements

- Interior noise
  - Subaru Legacy Outback test vehicle
  - Right rear passenger seat head position
- Multiple pavement types
- Single tire design
- On-board sound intensity (OBSI) – corresponding conditions

Goodyear Aquatred 3
Test Tire

Interior Noise Data Base



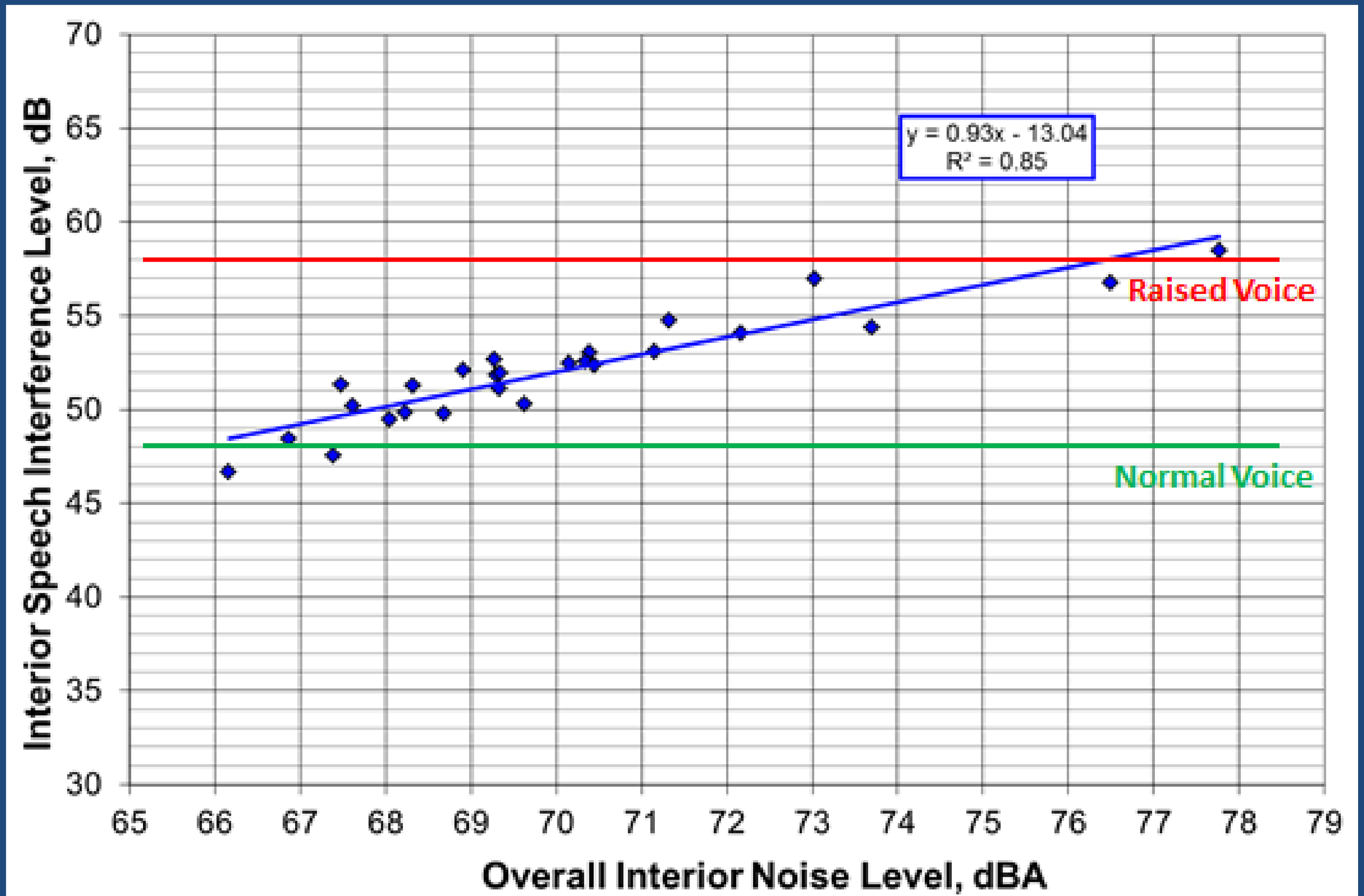
- 26 Pavements
- All at test speed of 60 mph
- 5 second averaging time
- Asphalt & concrete pavements

Range: 66.2 dBA to 77.8 dBA (OGAC to Random Transverse Tine PCC)

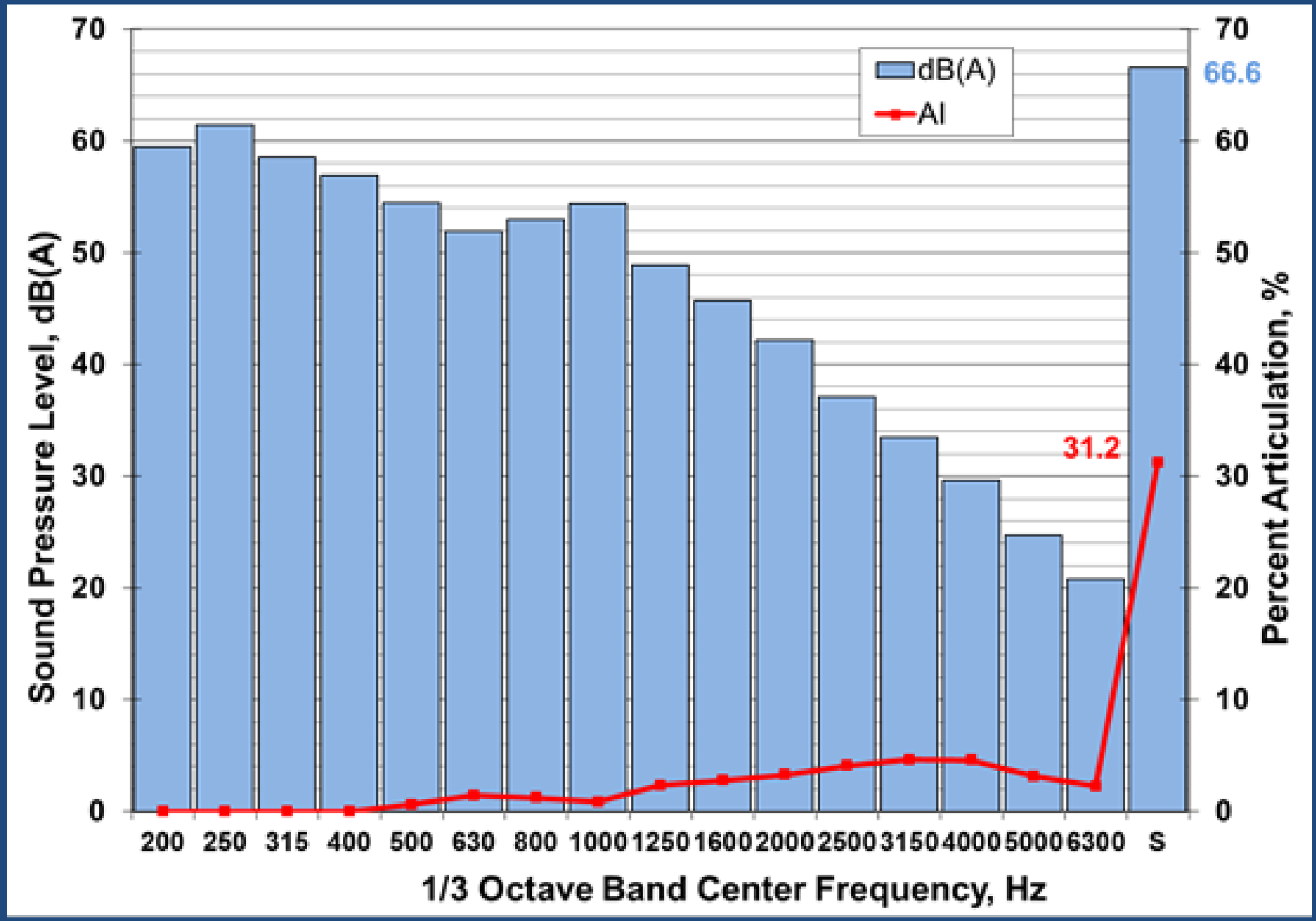
Speech Communication Descriptors

- Speech Interference Level
  - Used to judge speech communication
  - Average of octave bands from 500 to 4,000 Hz
  - 48 dB → normal voice, 55 dB → raised voice for "just reliable" communication
- Articulation Index (AI)
  - Depends on interfering noise, distance, & voice effort
  - Higher is better: AI 0.3 is "unsatisfactory", AI 0.6 is "satisfactory", AI 0.75 is "good"

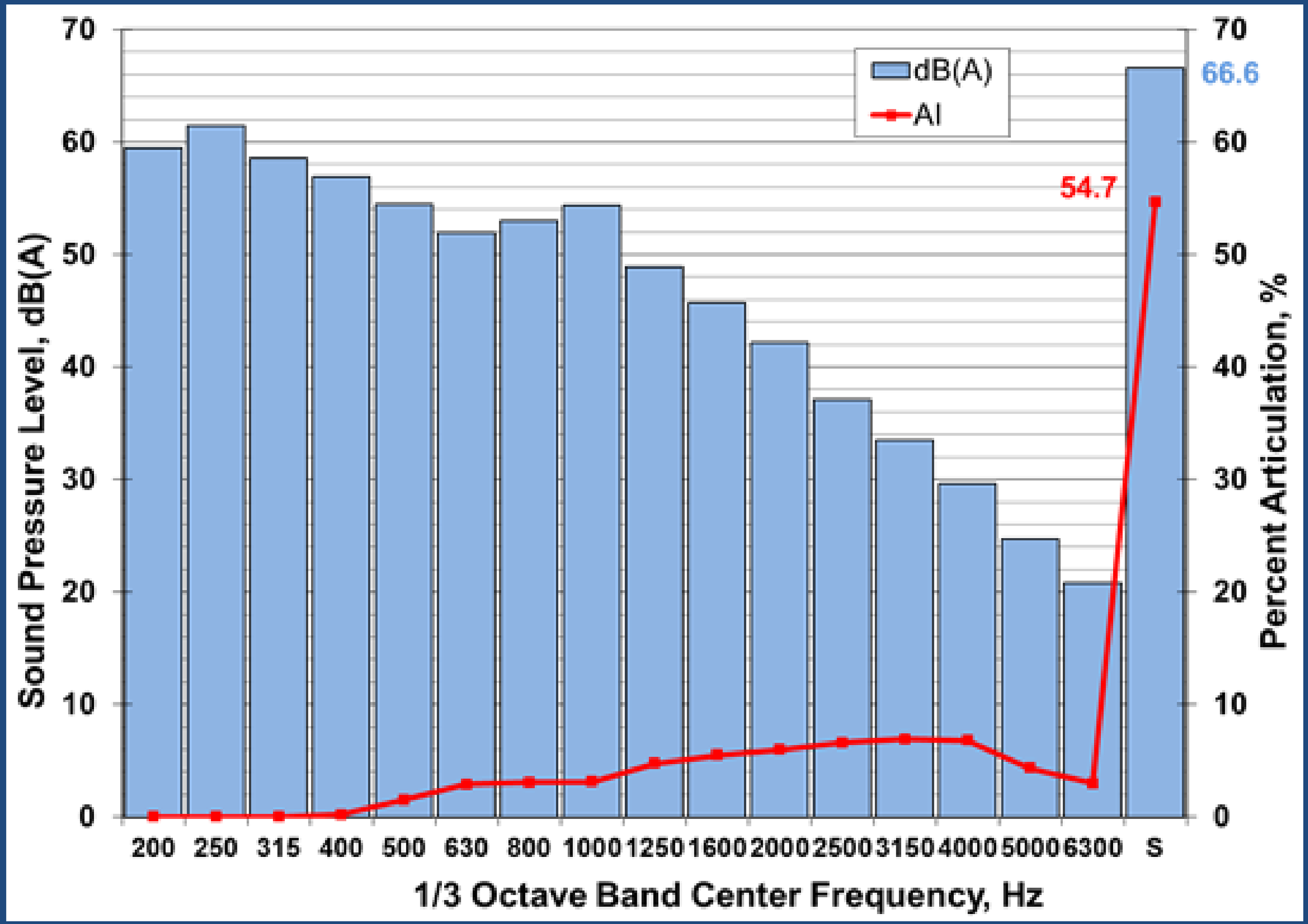
Speech Interference Level



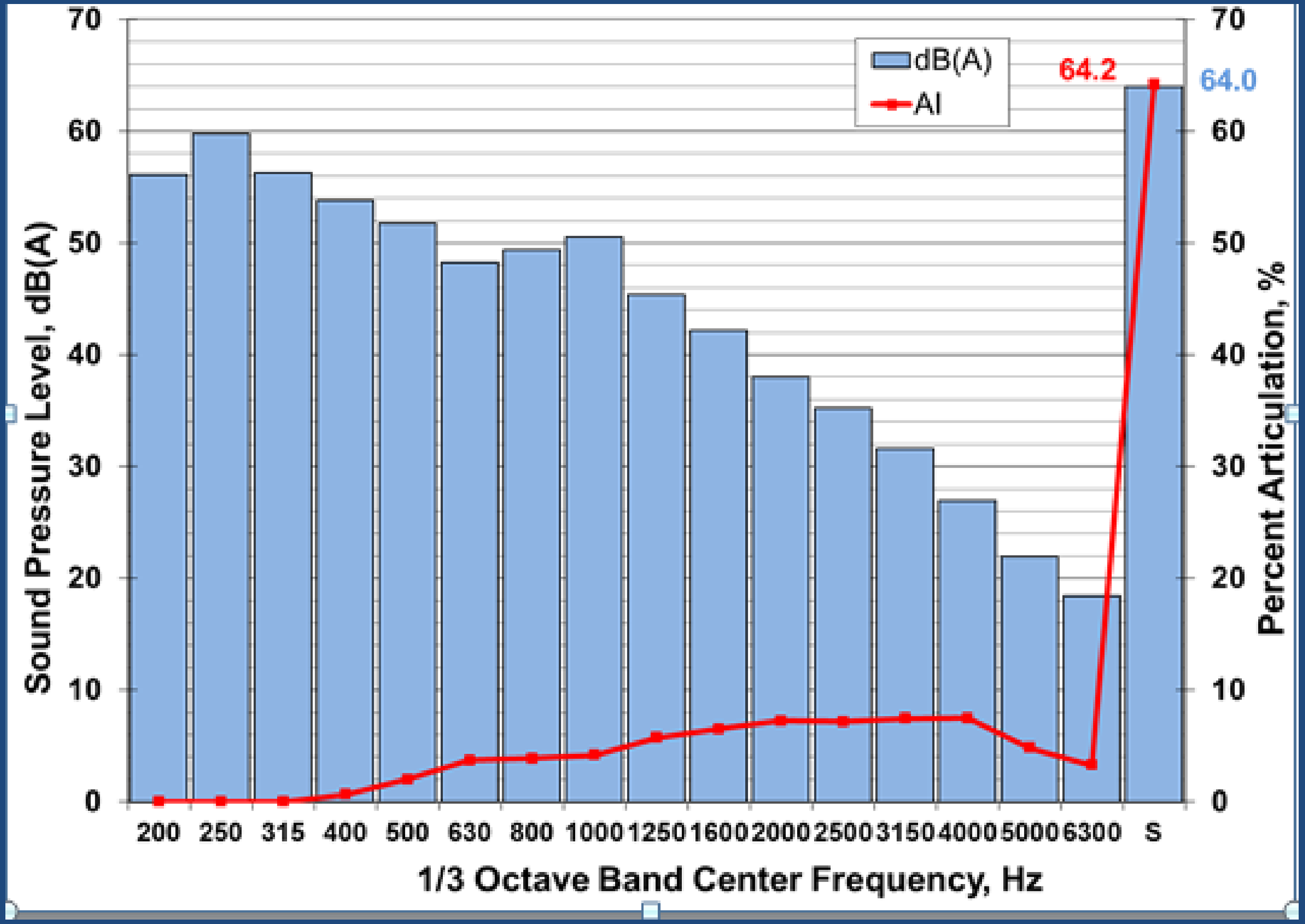
AI for Moderate Asphalt Pavement & Raised Voice



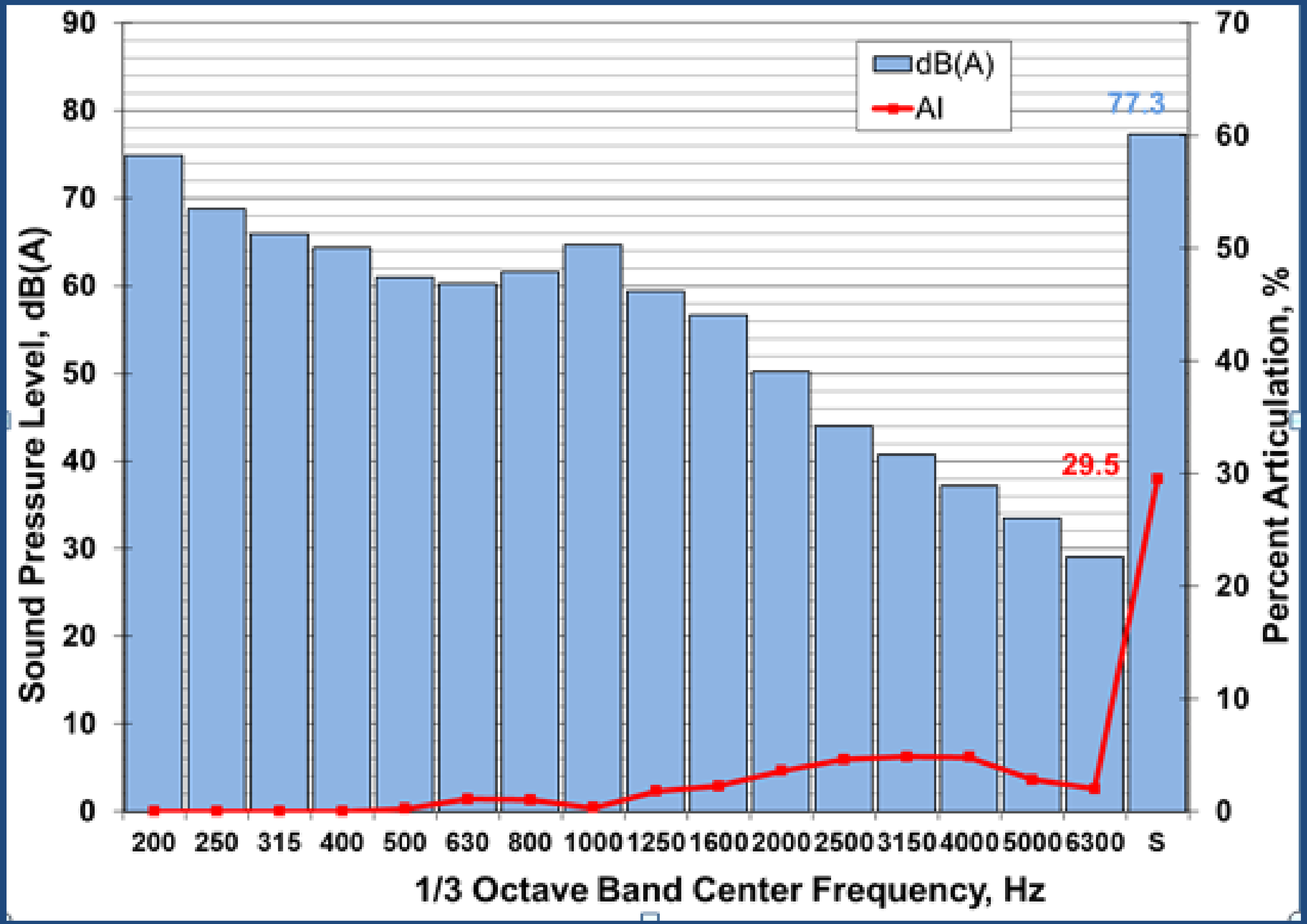
AI for Moderate Asphalt Pavement & Loud Voice



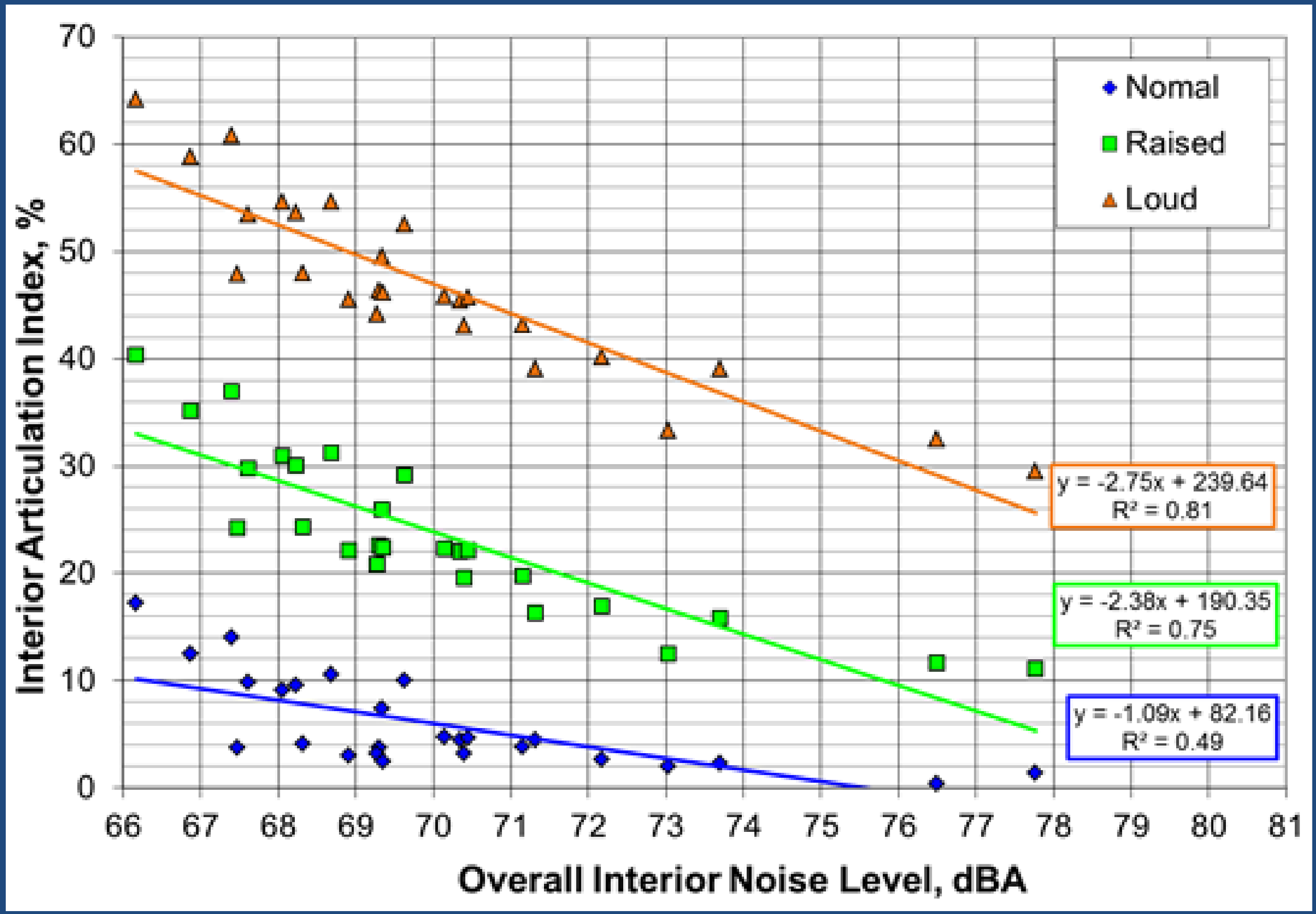
AI for Quieter OGAC Asphalt & Loud Voice



AI for Noisy Random Transverse PCC Tine & Loud

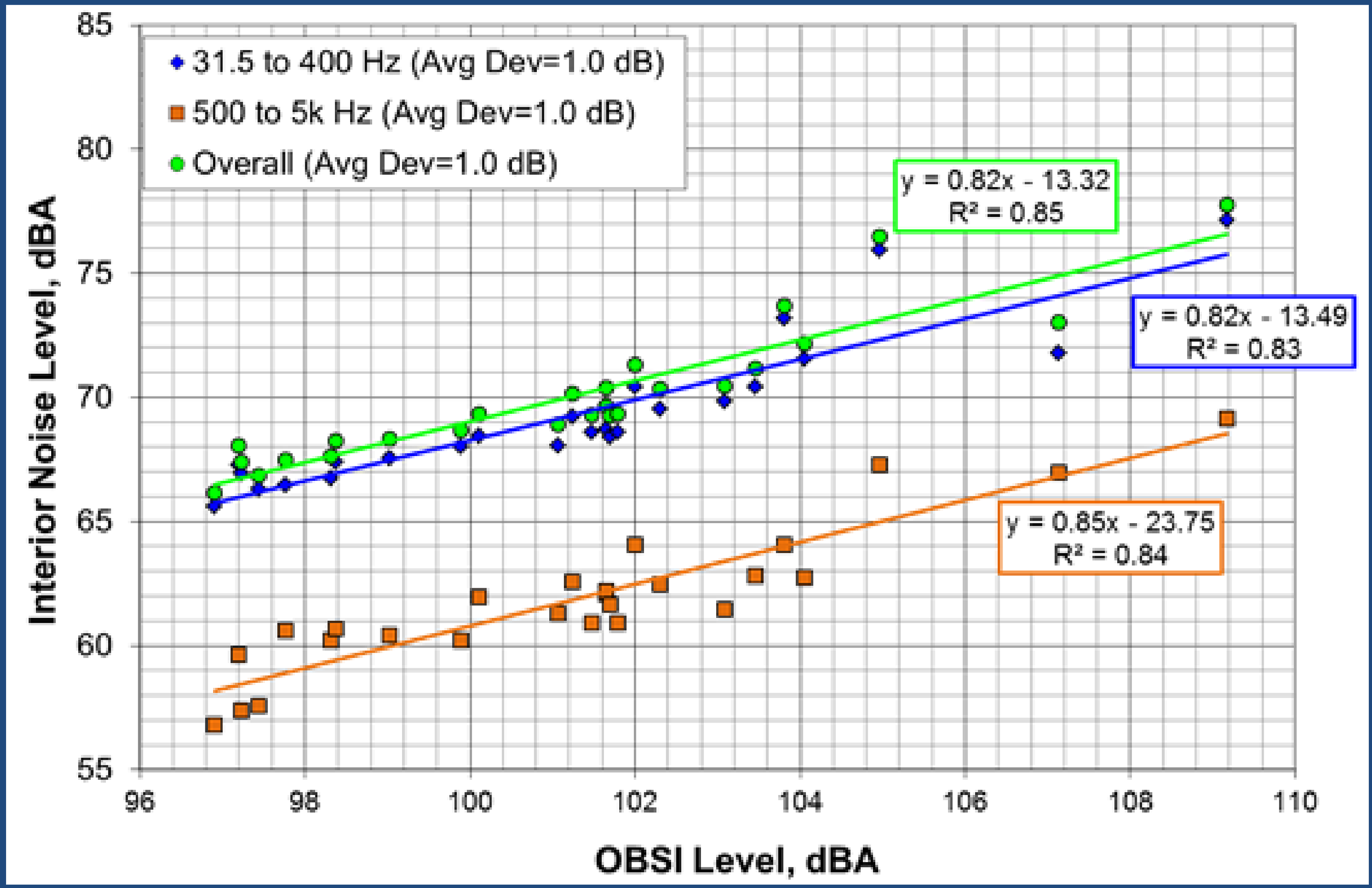


AI Index vs. Interior Noise Level

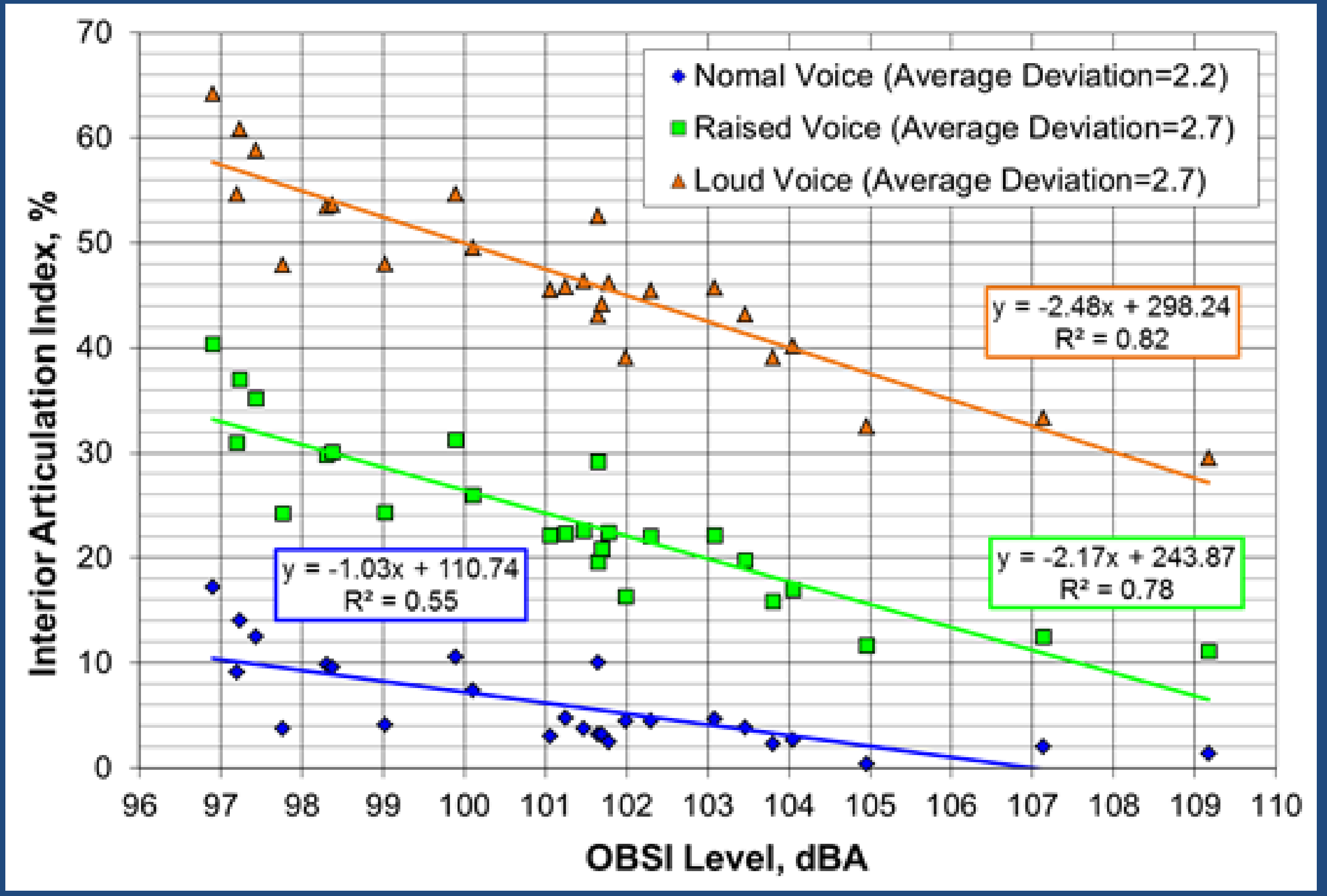


On-Board Sound Intensity Measure of Exterior Tire/Pavement Noise

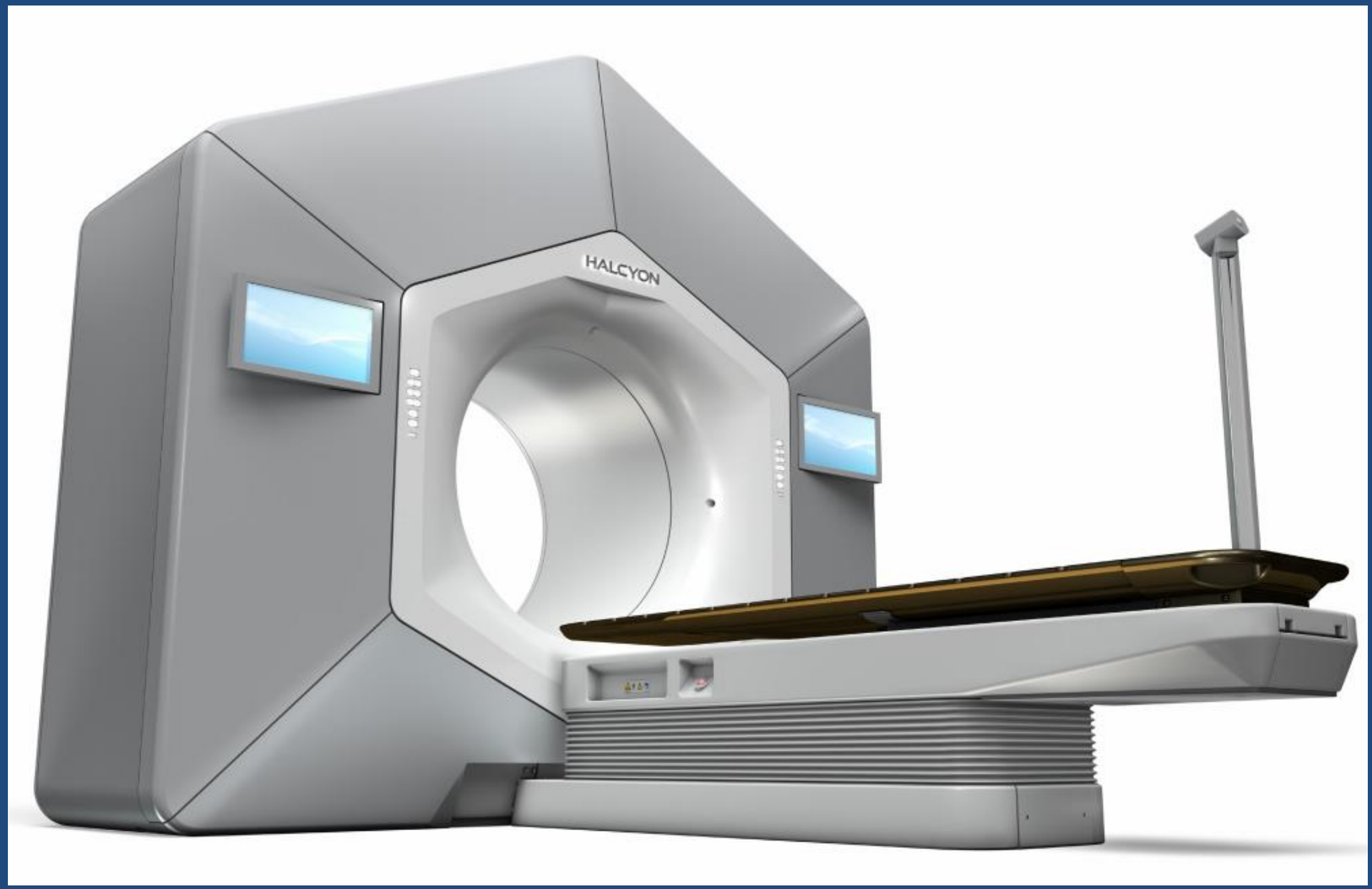
Overall & Band-Passed Interior Noise vs. OBSI



Interior Percent Articulation vs. OBSI

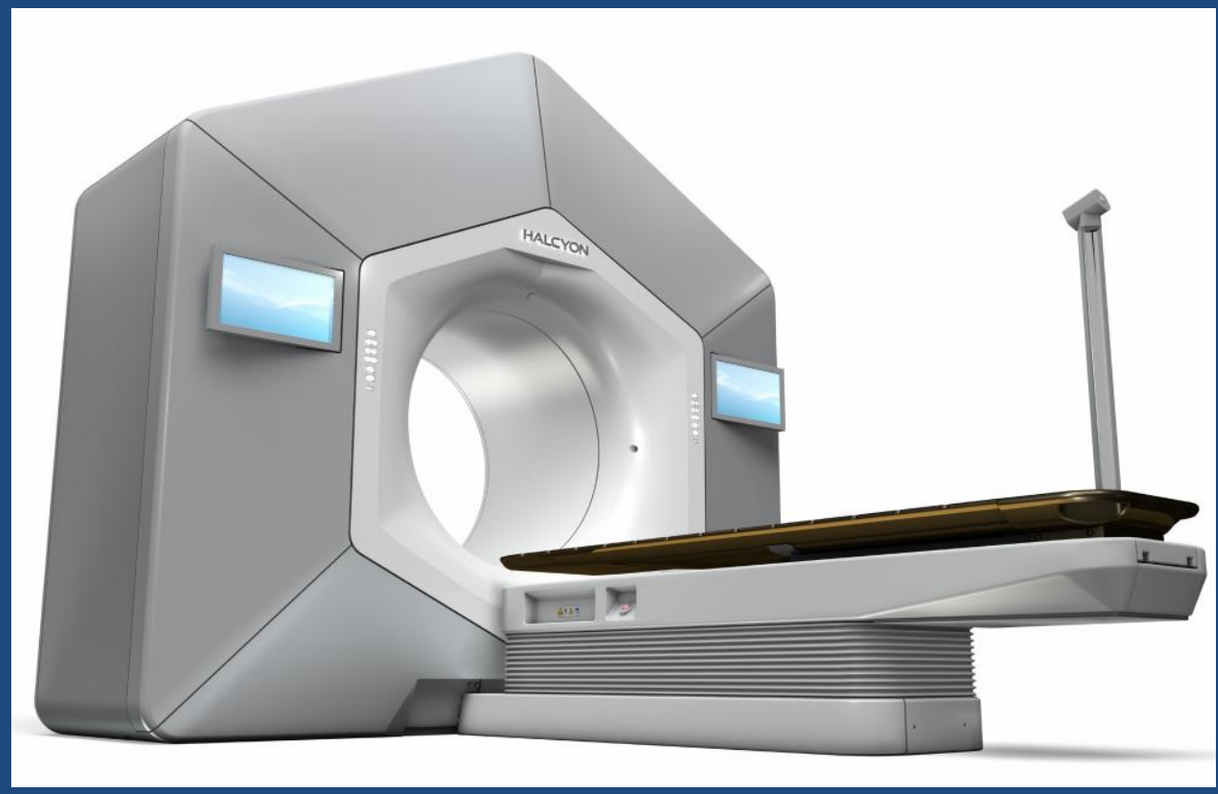


Speech Communications for Radiotherapy Machines



Communication Issues

- Beam off
  - Operator to patient face-to-face
  - 2m separation
  - Normal voice
- Beam on
  - Operator in control room
  - Microphone & speaker on machine for patient
  - Patient to microphone & speaker – 2m separation
  - Raised voice

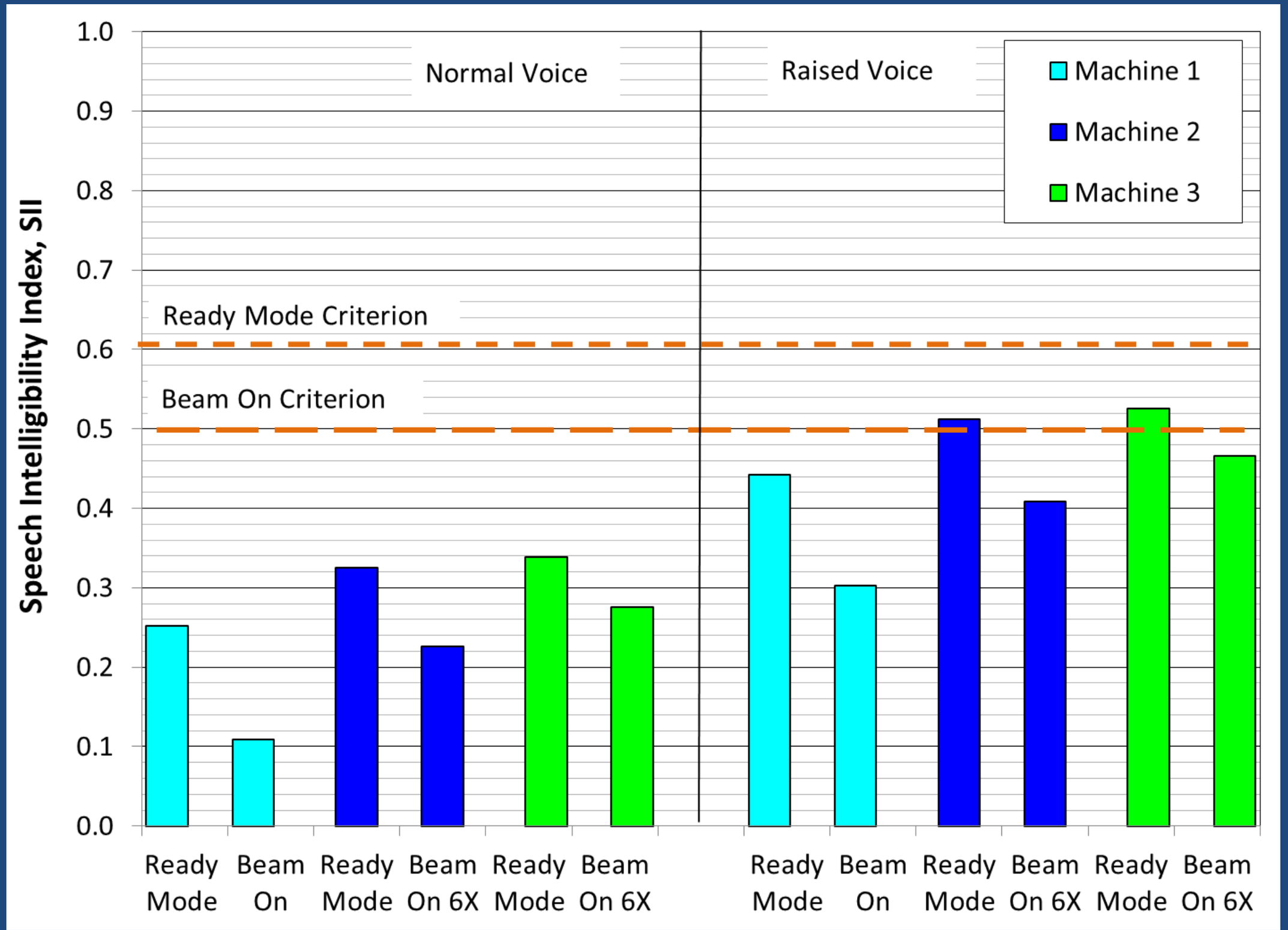


Communication Criteria

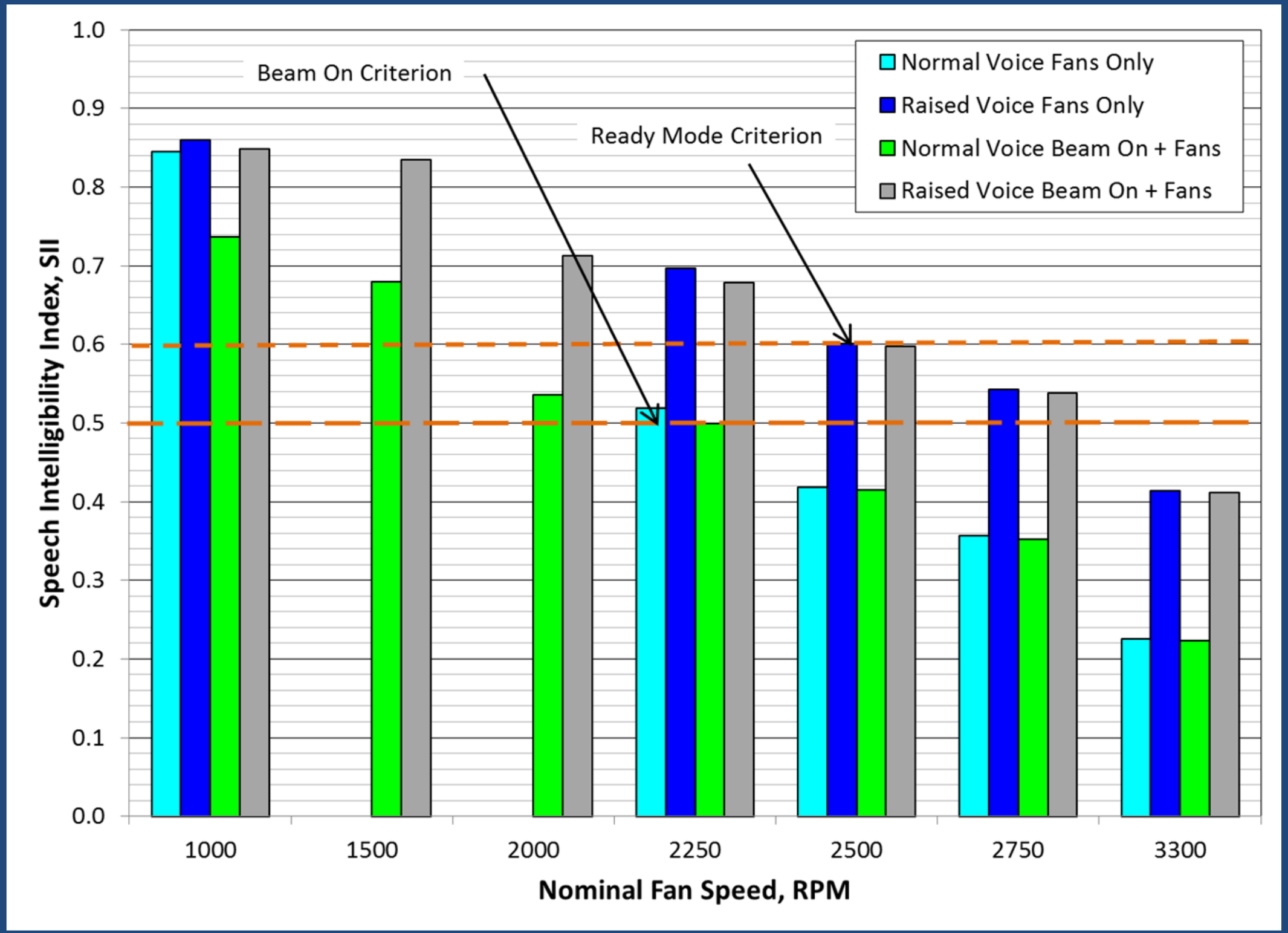
- Beam off
  - Overall – 55 dBA used for screening
  - SII – 0.6 (normal voice)
  - “very easy” to “easy” to hear[1]
- Beam on
  - Overall – 58 dBA used for screening
  - SII – 0.5 (raised voice)
  - “just reliable” to hear[1]

[1] -Ryherd, E. E., Moeller, M., and Hsu, T., “Speech Intelligibility in Hospitals”, J. Acoust. Soc. Am. 134 (1), July 2013, pp. 586-595.

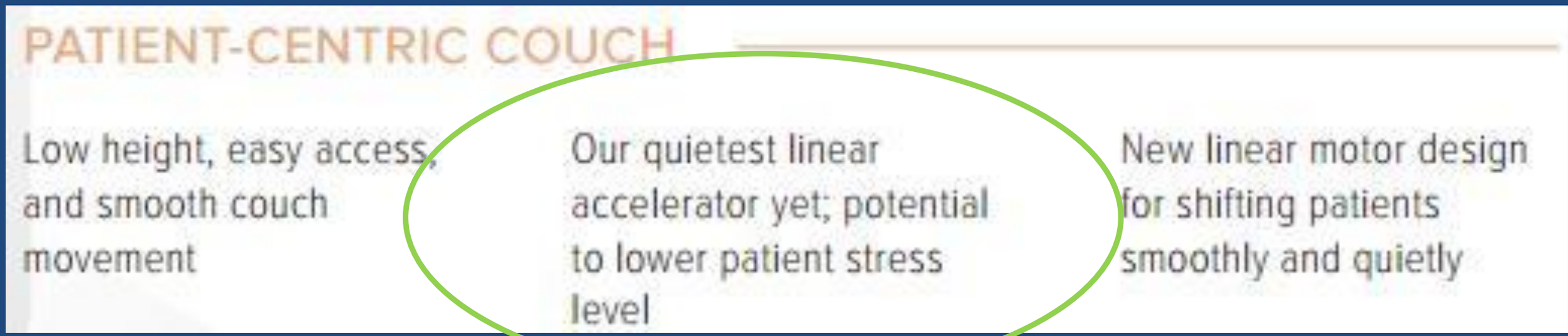
Other Current Radiotherapy Products



Prototype Performance



Marketing Brochure for Final Product



Leo Recollections

- Graduate school days
  - Open house at the Beraneks for MIT A&V Lab Students
  - Winchester Hospital
- Noise-Cons
  - NC 2005 lunch
  - NC 2011 Rose Garden (Bonnie & George)

Thank you, Leo

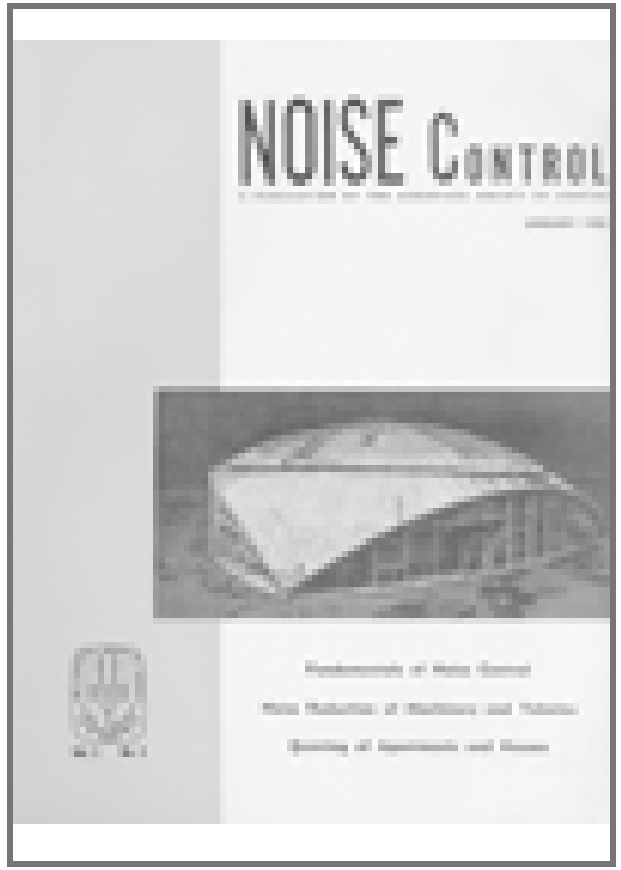
Slides Presented by Joe Cuschieri

Leo Beranek's Influence on INCE-USA And Its Formation

Joe Cuschieri

The Early Events

- In Defining The Role That Leo Beranek Played In Establishing INCE-USA, One Can Start With The Recollection Of Events Related To The NOISE CONTROL Magazine
  - Leo Was President Of ASA From 1954 To 1955 And The Secretary Of ASA At The Time Was Wallace Waterfall
  - Before Leo Assumed The Presidency Of ASA, He Complained To Wallace That Very Few Papers On Noise Were Being Published In JASA
    - The Noise Papers Submitted To The Editorial Staff Were Deemed To Be Too "Practical"
  - Wallace Suggested That Leo Undertakes The Establishment Of A New Magazine To Be Published By ASA Entitled NOISE CONTROL
  - With Lew Goodfriend As The Editor, The First Issue Of The Magazine Appeared In 1955 January.
  - The Magazine Continued Publication Through Leo's Term As ASA President



Financial Support Issues

- Towards The End Of The Decade (1950's), Problems In Support Of The NOISE CONTROL Magazine Began To Develop
- The Executive Council Of ASA Changed And Those Who Supported The NOISE CONTROL Magazine Represented Only A Small Fraction Of The Membership Of The Acoustical Society Of America And The Executive Council
- It Was Perceived By ASA And The Executive Council That Distribution Went To Many Who Were Not Members Of ASA
- The ASA Executive Council, Dominated By Physicists, Psychologists, And Physiologists, Not Professionally Interested In Noise And Its Control, Continually Questioned The Expenditure Of ASA Resources For Only A Small Constituency Of Noise Control Engineers

Editorial Concerns

- Leo And Lew Goodfriend Performed Miracles In Getting The First Issues Of NOISE CONTROL Off The Ground, This Represented An Excellent Start
- After Three Years (1958), Lew Goodfriend Wished To Step Down, He Was Not Easy To Replace And A Succession Of Relatively Short Tenure Editors Took Over Following Lew's Resignation
- At The End Of 1961 The Scope Of The Publication Changed To Broaden The Base Of Interest Within ASA And The Name Of The Magazine Was Changed To SOUND
- Articles Were Solicited And Published In Other Areas Of Acoustics Besides Noise And Its Control
- In 1963 The SOUND Magazine Was Stopped Due to Reduced Interest
- Stopping The Publication Of SOUND Created A Gap That Did Not Get Filled For A Decade

Role Played by ASA

- Leo Beranek Was Not Happy With The Created Gap By The Demise Of The SOUND Magazine and Was Persistent And Determined to Find Ways To Address The Professional Interests Of Engineers Working In Noise Control
- This Gap Was A Key Factor Leading To The Founding Of INCE-USA
- Leo Beranek Recognized That Wallace Waterfall, The ASA President, Was An Influential Figure Within ASA And Wallace's Position Regarding The Development/Creation Of INCE-USA Was Important
- Leo and Others Held A Meeting With Wallace To Explain That The Acoustical Society (ASA) Was Not Able To Fully Serve The Professional Interests Of Engineers Working In Noise Control And That A New Organization Dedicated To Those Interests Was Needed
- As Past President Of The Acoustical Society And As Past Chairman Of Its Technical Committee On Noise, Leo Pledged To Wallace That A Close Relationship Will Be Fostered Between The New Organization And ASA
- The Wheels To The Creation of INCE-USA With Leo's Persistence Were Now In Motion

Formative Years

- In The Early Months Of 1970, The Leaders Of The Emerging Field Of Noise Control Engineering, Including Leo, Considered That The Best Thing To Do Would Be To Organize A Workshop To Meet And Discuss
  - How To Best Serve The Professional Interests Of Engineers Working In Noise Control
  - The Issues Faced In The Forthcoming Environmental Decade By Noise Control Engineers
- In A Telephone Conversation Leo Beranek Had With Bill Lang On 1970 April 22, Leo Agreed To Serve As Chairman Of The Workshop
- The Detailed Program For The "Workshop On Noise Control Engineering," Scheduled For 1971 January 10-12 Was Formulated Early In December, 1970, And Was Mailed To Prospective Participants From All Over The United States.
- Leo Beranek Wrote The Text For The Outline Of The Session Held On 1971 January 12 Entitled: "Professionalism In Noise Control Engineering--future Directions."

Leo Beranek's Session

PROFESSIONALISM IN NOISE CONTROL ENGINEERING—FUTURE DIRECTIONS
L. L. Beranek, discussion leader

A need was discussed for a new professional organization concerned with noise control engineering. Serving as the voice of the profession, this new organization would be expected to speak out on matters of public interest and to take positions on controversial issues. It would publish technical information available to the public. At the end of this workshop, the following course of action will be presented for discussion, modification, and consensus:

a. Immediate establishment of an Institute of Noise Control Engineering (INCE) organized in either New York State or the District of Columbia under Section 501(c)(6) of the U.S. Internal Revenue Code. Nine members would be named to serve on an interim governing board in addition to three interim officers, a President, an Executive Vice President and a Secretary-Treasurer. The interim board members and the organizing officers would be drawn from the workshop committee and would serve until the first annual meeting of the organization.

b. A credentials committee would be named to develop criteria for membership in the Institute. Membership applications would be accepted after the criteria are accepted and agreed upon by the governing board.

c. A publications committee would be named to develop an editorial policy, establish the subscription rate and prepare a budget for the official publication of the Institute. This journal, tentatively named "Noise Control Engineering," would be inaugurated as soon as it is feasible to do so.

Opening of the Workshop

- The opening address by **Leo Beranek** considered "The Noise Control Specialist: His Needs and Responsibilities." In his talk, he stressed the objectives of the workshop and he set the stage for the technical sessions and the discussions of professionalism.
- During **Leo Beranek's** presentation on January 12 at the Workshop, the suggestion was made from the floor that the word "vibration" be included in the title of the new Institute
- There was immediate opposition to this suggestion

Incorporation

- The Articles Of Incorporation Were Signed On 1971 June 4th With Leo Beranek, Bill Lang, And Lew Rivlin As The Incorporators
- INCE Is A U.S. Organization For American Engineers Who Are Concerned With The Control Of Noise In Our Environment
- It Was Recognized That Interest In Noise Is Worldwide And INCE Will Encourage The Formation Of Similar Institutes In Other Countries Which May Lead Eventually To A World Federation Of Institutes Of Noise Control Engineering (I-INCE)
- The First President Of INCE Is Leo L. Beranek, Eminent Noise Control Engineer And Well-known Authority In Engineering Acoustics

Executive Committee

- Leo Beranek Was Obviously Part of The Executive Committee That Also Included Bill Lang, Lew Goodfriend, George Maling, And Ken Oliphant
- The Executive Committee Met In New York On 1971, July 2nd And Again In 1971, October 7th
- The Second Meeting Was To Prepare For The First Regular INCE Board Of Directors Meeting Held Later In October
- At The 1971, October 7th Meeting, A New Set Of Bylaws Incorporating A Preamble Were Developed

First Board of Directors Meeting

- First Meeting Of The Board Of Directors Was Held on 1971, October 22nd With Leo Beranek as President
- This Was An Historic Event And The Atmosphere Was Subdued, But Jubilant
- President Leo Beranek Called The Meeting To Order At 6 P.M. On Friday, 1971, October 22nd
- The Venue Was Denver, Colorado in Conjunction with The Meeting of The Acoustical Society
- Present Were Leo Beranek, President, Bill Lang, Executive Vice President, George Maling, Secretary-treasurer, Lew Rivlin, Counsel
- Also Present Were The Following Directors: Pete Baade, Malcolm Crocker, Ken Eldred, Lew Goodfriend, Warren Kundert, Ken Oliphant, And Glenn Warnaka

Noise Control Engineering

- A Third Workshop Was Preceded By A Second Board Meeting On 1973, January 20th
- President Beranek Announced To The Board That The Funds Required To Start Publication Of The Journal NOISE CONTROL ENGINEERING Had Been Made Available By The National Science Foundation Effective 1973, January 15th
- Leo Beranek As Chairman Of The Editorial Board And Lew Goodfriend As Editor-in-chief Performed A Miracle In Bringing Out The First Issue (Vol. 1, No. 1) Of NOISE CONTROL ENGINEERING In The Face Of Almost Impossible Odds

Birth Of INCE-USA

- There Would Be No History To Write About INCE-USA If It Were Not For People Like Leo Beranek
- Without Leo Beranek The Organization Now Known As INCE-USA Could Not Have Been Founded And Leo Was One Of The Persons Responsible For Getting INCE-USA Off The Ground
- Leo Beranek And Others Worked Intensively In 1970, To Organize The First Arden House Workshop On Noise Control Engineering, Which Led A Few Months Later To The Birth Of INCE-USA
- Leo Was The Charter President Of INCE-USA
  - President 1972 – First President Of INCE-USA
- Leo Was An Incorporator And Founder Of INCE And Has Provided The Backbone That Has Kept INCE A Thriving Organization Since Its Founding
- 1972 – 1974: Board Director
- Leo Was Also Instrumental In The Launching Of NOISE CONTROL ENGINEERING

The Institute of Noise Control Engineering of the United States of America

- The Institute Of Noise Control Engineering Of The United States Of America (INCE-USA) Was Established In 1971 June As A Professional Society Sensitive To The Needs And Responsibilities Of Noise Control Engineers And Dedicated To A Leadership Role In The Application Of Noise Control Technology.
- It Was Predominantly Through The Efforts Of Leo Beranek As Charter President, And Three Other Individuals, Who Under the Leadership Of Leo Were Responsible For Organizing The First Arden House (Harriman, NY) Workshop In 1971 With 150 Invited Participants.
- The First Arden House Workshop Served As The Organizational Meeting That Lead To The Formation Of INCE-USA.
- INCE-USA Was Established To Help American Engineers Respond To The Increasing Demands For Action To Control The Levels Of Environmental Noise.

Inter-Noise 1972

Leo Beranek leads the opening panel discussion, "What constitutes a national noise program," at INTER-NOISE 72. Left to right: Leo Beranek; Thomas Carroll, Assistant Administrator, EPA; F. Karl Willenbrock, Director, Institute of Applied Technology, National Bureau of Standards (now NIST); Grant Walton, Department of Environmental Protection, New Jersey; Peter Metz, Director of Planning, Massachusetts; and H.W. Posten, Commissioner, Environmental Control, Chicago. James Beggs, Under Secretary of Transportation, U.S. Department of Transportation, was a panelist, but was not present when this photo was taken.

Photo by Lou Brott Associates.

Honoring Leo Beranek

- The INCE Board of Directors unanimously passed the following resolution during the annual (111th) INCE-USA Board of Director meeting that was held in Ft. Lauderdale, FL on 2004, January 25th
- The Resolution Read:
  - We congratulate you on the receipt of the National Medal of Science and the accompanying citation for your "leadership, dedication and contributions to the science of acoustics".
  - We are extremely proud of your contributions and we believe that you are the first INCE-USA member to receive this prestigious award, one of the highest honors bestowed on a scientist in the nation.
  - We gratefully recognize your leadership as one of the founding members of INCE-USA and The INCE Foundation, as well as your role in shaping the national policy on noise control engineering

Distinguished Noise Control Engineer Award

- The INCE-USA Board Of Directors Honor Leo Beranek With The Title *Distinguished Noise Control Engineer*
- Leo Is The First Recipient Of This Award That The INCE-USA Board Had Been Working On For Several Years
- The Award Recognizes Individuals Who Have Rendered Conspicuous And Consistently Outstanding Service To The Institute And To The Field Of Noise Control Engineering Over A Sustained Period
- Leo Was In Large Part Responsible For Founding The Field Of Noise Control Engineering
- The *Noise Control Engineering Journal* Would Not Have Been Launched Without Leo's Help In 1973, And In 1993 Played A Major Role In The Restructuring The Publication
- Leo's Distinguished Lecture In 1991 On "50 Years Of Noise Control" At INCE-USA 20th Anniversary Meeting Was The Highlight Of The Meeting.

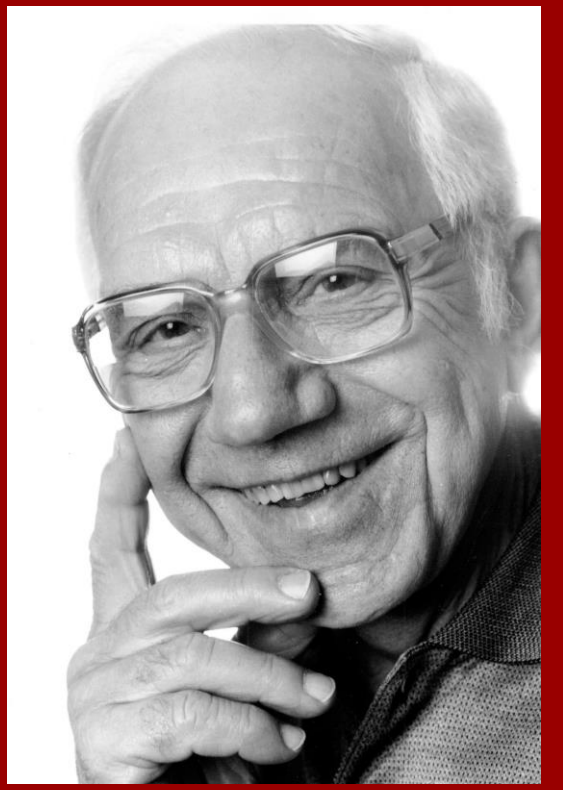
Leo L. Beranek (left) receives the first INCE Distinguished Noise Control Engineer from 1997 INCE President Richard J. Peppin.

Leo Beranek

- INCE-USA Thanks You
  - For Your Vision
  - For Your Persistence
  - For Being A Founder
  - For What You Have Created And For What We Have Today
  - For Providing Evolution And Leadership
  - For Being An Inspiration To Us All

Slides Presented by Patricia Davies

"Beranek" means "lamb"!



Leo Beranek: curious, engaged, focused and practical

Patricia Davies
INCE President 2008-2010
Purdue Faculty Member
Ray W. Herrick Laboratories
School of Mechanical Engineering

Bill Lang's Conversations with Leo Beranek

AIP Oral History Interviews

- ***Financial "Resources"***
  - Radio Repair
  - Band Drummer
- ***High School***
  - Love of Mathematics and Science
  - Love of Making things Work
- ***Cornell College in Iowa in the Depression:***
  - Graduated in 1936, had worked for 1 year at Collins Radio Company to get some money because he wasn't making enough money from Radio Repairs and Band during the depths of the depression.

Bill Lang's Conversations with Leo Beranek

AIP Oral History Interviews

- Iowa → Harvard for Graduate Studies
  - Masters
    interested in recording, worked with Prof. F.B. Hunt on playback devices
  - Ph.D.
    A Different Way of Measuring Acoustic Impedance
    → Precision Measurement of Acoustic Impedance, July 1940.

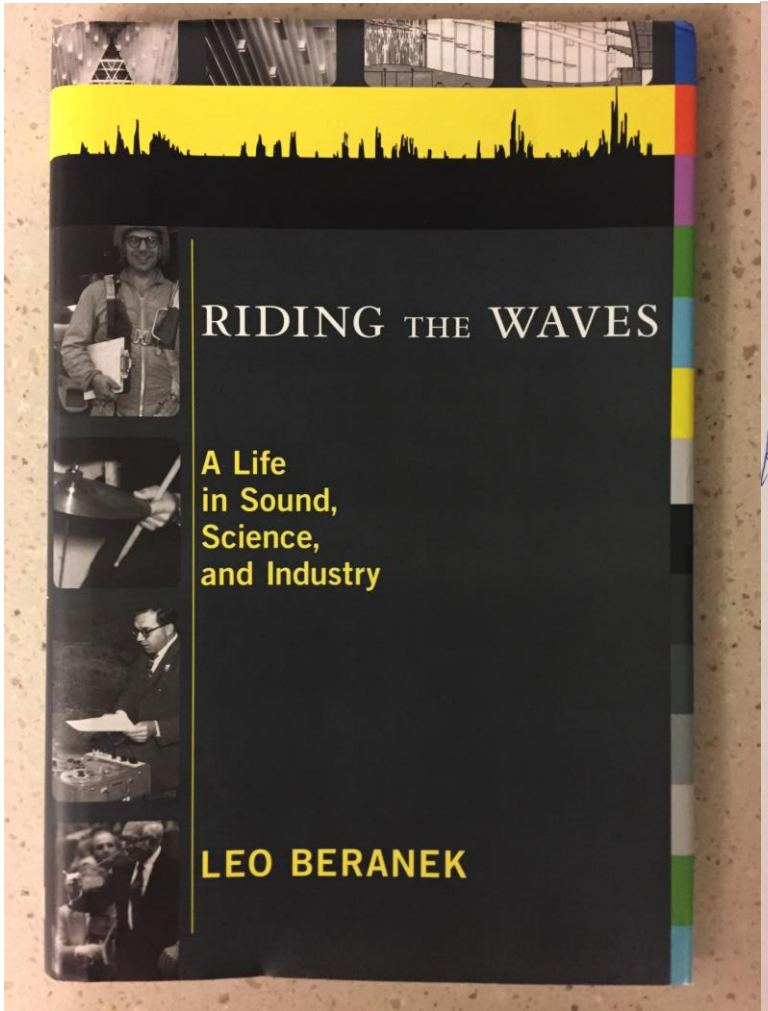
    Basic Data from his studies inspired Prof. P.M. Morse Theory on sound absorption in acoustic materials.

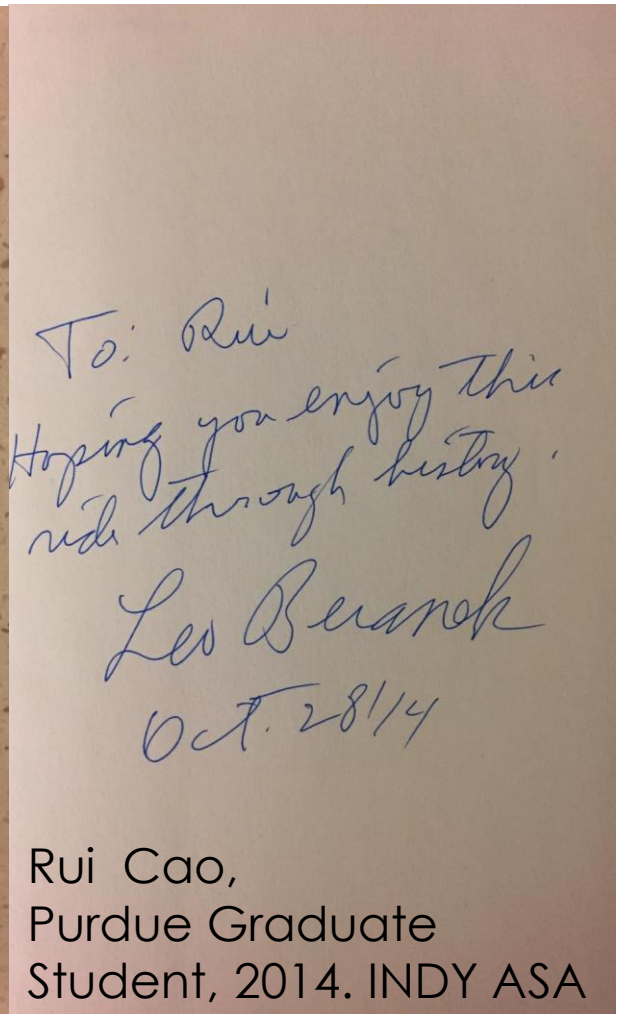
Interview of Leo Beranek by William W. Lang on 1989 September 30,
Niels Bohr Library & Archives, American Institute of Physics,
College Park, MD USA, www.aip.org/history-programs/niels-bohr-library/oral-histories/5190-1

Gracious to students and Committed to Helping

Leo Beranek Student Medal for Excellence in the Study of Noise Control
INCE-USA

Leo and Gabriella Scholarship in Architectural Acoustics and Noise Control
ASA





Rui Cao,
Purdue Graduate Student, 2014. INDY ASA

2014 Fall ASA Meeting at the Indianapolis Marriott

Photograph courtesy of Stuart Bolton

Conference Program, Coffee and IPAD in hand …..

…..So many sessions, so little time.

INCE USA "OLD MEETS NEW"

Steve Sorenson, Stuart Bolton, Patricia Davies

- Student activity at INCE Conferences
  - Students presenting the work in a well-referenced seminal paper related to acoustics and noise control
  - Repeating analysis and expanding on it
  - Showing who has cited the research and do an analysis of the influence of the work

INCE USA "OLD MEETS NEW"

- Sound Perception: Fletcher and Munson, "Loudness, Its Definition, Measurement and Calculation," J. Acoust. Soc. of Am., Vol. 5(2), pp. 81-108, 1933.
- **Aircraft Noise – Noise Criteria: Beranek, L.L., "Airplane Quieting II - Specification of Acceptable Noise Levels," Trans. Am. Soc. Mech. Eng., Vol. 69, pp. 97-100, 1947.**
- **Building Noise: Beranek, Leo L., "Revised Criteria for Noise in Buildings," Noise Control, Vol. 3, pp. 19-27, 1957.**
- Active Noise Control: Olson, H.F. and May, E.G., "Electronic Sound Absorber," J. Acoust. Soc. Am., Vol. 25(6), pp. 1130-1136, 1953.
- **Room Acoustics: Hunt, F.V., Beranek, L.L. and Maa, D.Y., "Analysis of Sound Decay in Rectangular Rooms," J. Acoust. Soc. Am. Vol. 11, pp. 80-94, 1939.**
- Passive Noise Control: Maa, D.Y., "Microperforated-Panel Wideband Absorbers", Noise Control Engineering Journal, Vol. 29(3), pp. 77-84, 1984.
- Modeling Techniques : Lyon, R.H. and Maidanik, G., "Power Flow between Linearly Coupled Oscillators", J. of the Acoust. Soc. of Am., Vol. 34, pp. 623–639, 1962.
- Sound Propagation – Aircraft Noise: Parkin, P.H. and Scholes, W.E., "Horizontal Propagation of Sound from a Jet Engine Close to the Ground at Hatfield," J. Sound and Vib., Vol. 2(4), pp. 353-374, 1965.
- Sound Propagation-Aircraft Noise: Delany, M.E. and Bazley , E.N. "A note on the effect of ground absorption in the measurement of aircraft noise," J. Sound and Vib., Vol 16(3), 315-322, 1971.
- Outdoor Sound Propagation: Embleton, T. F. W. , Piercy,J. E. and Olson N., "Outdoor sound propagation over ground of finite impedance," J. Acoust. Soc. Am. , Vol.59(2), pp. 267-277, 1976.
- Acoustic Materials Modeling: Biot, M.A., "Theory of propagation of elastic waves in a fluid-saturated porous solid 1. Low-frequency range," J. Acoust. Soc. Am. Vol. 28 (2), pp. 168-178, 1956.
- Measurement of Acoustical Properties of Materials: Sabine, P.E., "A Critical Study of the Precision of Measurement of Absorption Coefficients by Reverberation Methods," J. Acoust. Soc. Am. Vol. 3, pp. 139-154, 1931.
- **Sound Transmission: Berank, L.L. and Work, G.A., "Sound Transmission through Multiple Structures Containing Flexible Structures," J. Acoust. Soc. Am. Vol. 21(4), pp. 419-428, 1949.**

A Visit to Purdue Archives

Transactions of the ASME Feb. 1947

Airplane Quieting II—Specification of Acceptable Noise Levels[1]

By L. L. BERANEK,[2] CAMBRIDGE, MASS.

A procedure for determining the effect of aircraft noise on the ability of passengers to converse during flight is presented. Account is taken of the distance apart of the talker and listener, of the voice intensity (i.e., loud talking, shouting, etc.), and of the character of the noise in the cabin. Experimental data are given to confirm the validity of the method. A "speech-interference level" is defined as the arithmetic average of the levels in the three octave bands between 600 and 4800 cycles per sec. Maximum values of speech-interference levels for which satisfactory speech intelligibility is obtained are given.

Introduction

In a companion paper, (1)[3] a review was given of equipment and procedures for measuring sound levels in aircraft. The purpose of the present paper is to interpret the data obtained by the techniques described herein and to present a new procedure for the specification of acceptable sound levels in commercial aircraft.

Several extensive studies have been undertaken to determine the effect of aircraft noise on pilot efficiency and passenger comfort (2, 3). The conclusions, as summarized by Stevens *et al.*, are, "... . airplane noise, apart from the other stresses to which an aviator is subjected, has at worst only a slightly detrimental effect upon functions involving motor co-ordination, reaction time, sensory perceptions, and certain mental functions—even after exposures lasting seven hours." Their data do show, however, that three advantages are to be gained by the use of acoustical treatment, as follows:

1 Greater ease of conversation, both person-to-person and through communication systems.

2 Less subjective annoyance or feeling of fatigue.

3 Considerably less temporary auditory impairment (temporary loss of hearing in the higher frequency ranges and ringing in the ears).

It is beyond the scope of this paper to discuss the latter two points and furthermore, the problem of the effect of vibration on the human is not treated here. The studies of Stevens, *et al.* indicate that if an airplane is sufficiently quiet to permit conversation at reasonable voice levels by persons seated within a few feet of each other, little subjective annoyance or impairment of hearing will result. It seems obvious that the passengers' compartment of an airplane should be designed to be quiet enough to permit conversation between near-by passengers at reasonable voice levels. If that condition is met, it appears from these earlier studies that consideration of fatigue, annoyance, hearing impairment, etc., is obviated.

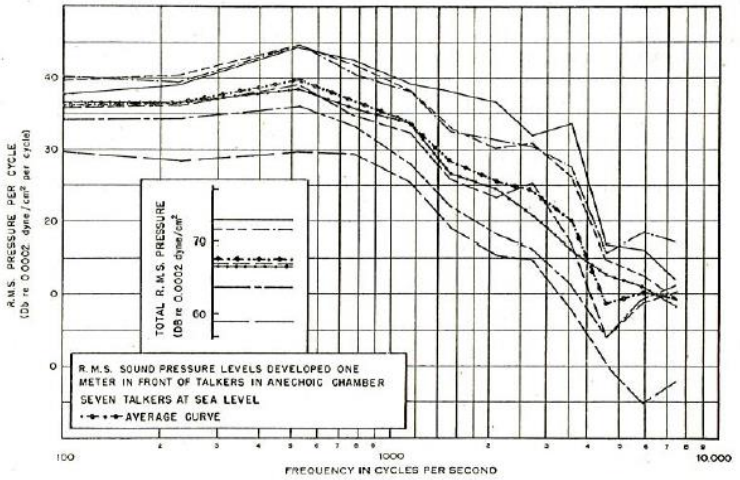


Fig. 1 Spectrum of Speech as Measured on Seven Typical Male Subjects
(Curves are plotted as root-mean-square sound-pressure level in 1-cycle-wide bands, expressed in decibels versus frequency in cycles per second. They are for loud talking, mensured at distance of about 3 ft.)

In the remainder of this paper, a quantitative method for determining necessary sound levels and spectra to permit conversation under the conditions just described is given. The method is the outgrowth of extensive researches of the Bell Telephone Laboratories (4) before World War II and the Electro-Acoustic and Psycho-Acoustic Laboratories of Harvard University during the war (5).

Factors Governing Speech Intelligibility

Speech is a succession of sounds which vary in composition and intensity. The average distribution of energy in speech as a function of frequency for seven male voices was measured in this laboratory (6), and the results are shown in Fig. 1. It is seen

[1] This research, begun under the auspices of the Office of Scientific Research and Development, is continuing under contract with the U. S. Navy, Office of Research and Inventions.

[2] Cruft Laboratory, Harvard University; now at Massachusetts Institute of Technology, Cambridge, Mass.

[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Aviation Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 17–20, 1946, of The American Society of Mechanical Engineers.

Airplane Quieting I—Measurement of Sound Levels in Flight[1]

By L. L. BERANEK[2] and H. WAYNE RUDMOSE[3]

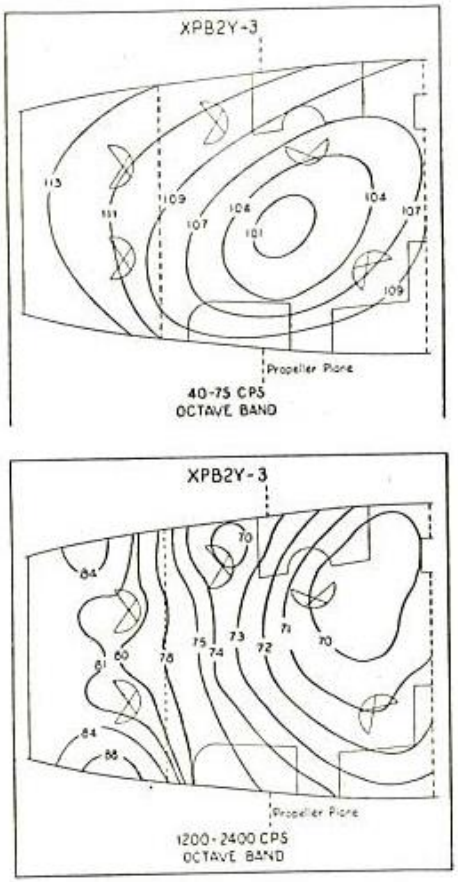


FIG. 10 CONTOURS OF NOISE LEVELS MEASURED IN FLIGHT DECK OF PATROL BOMBER IN FLIGHT
(Note high noise levels near sliding windows on either side of pilots.)

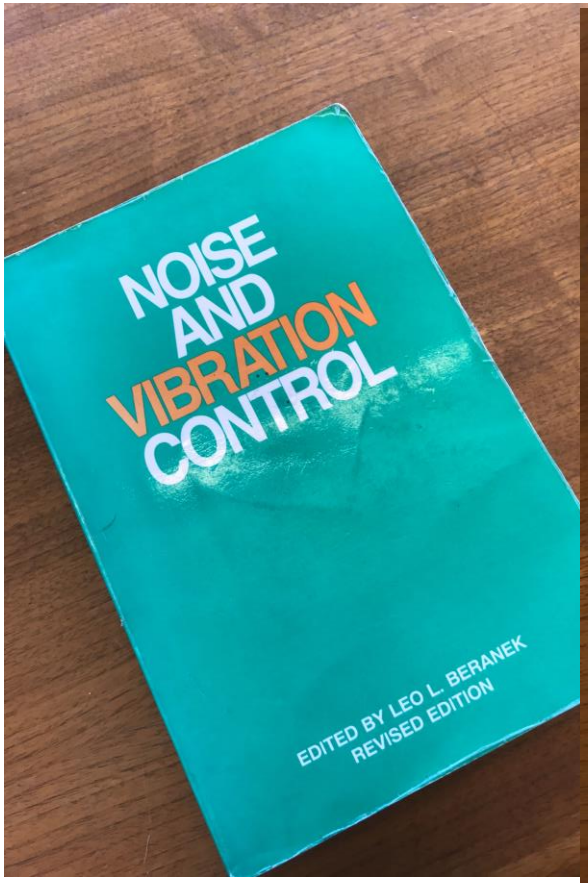
A Visit to Purdue Archives

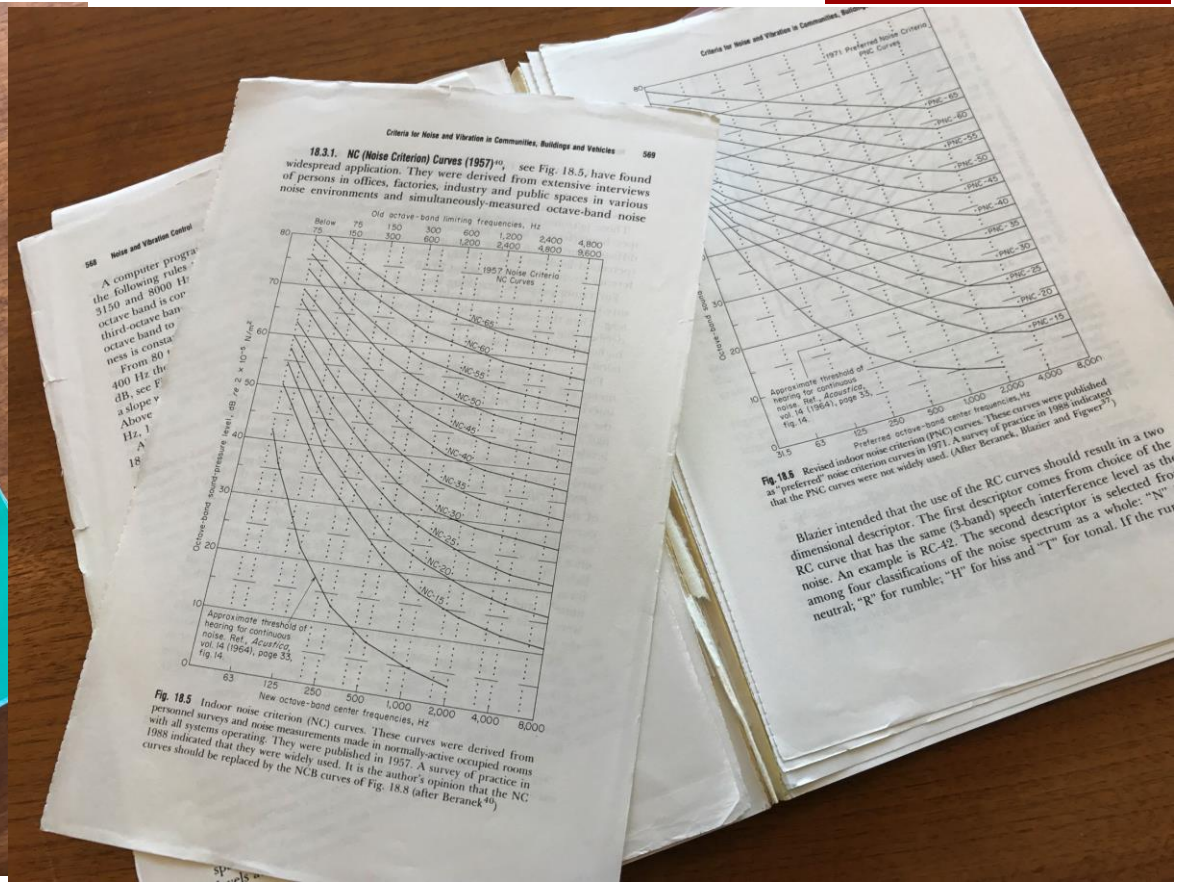
Transactions of the ASME Feb. 1947

Champion for Multi-dimensional Aspects of Acoustics

- Recording & Playback
- Music
- Noise Control
- Noise Criteria, Speech Interference, etc.
- Experiments and Measurements
- Materials
- Aircraft Noise
- Architectural Acoustics
- Physiological and Psychological Acoustics
- Noise Policy
- etc.

Noise and Vibration Control





Curious, Engaged, Focused and Practical

- Imaginative
- Driven
- Charming

- A recipe for a great graduate student
- A recipe for a great life

National Medal of Science Presentation
Thursday, Nov. 6, 2003.
(AP Photo/Gerald Herbert)

Slide with Embedded Voice Recording by George Maling Followed by His 17 Slides

NOISE-CON 2017
Special Leo Beranek Honoring Session

Click for audio file

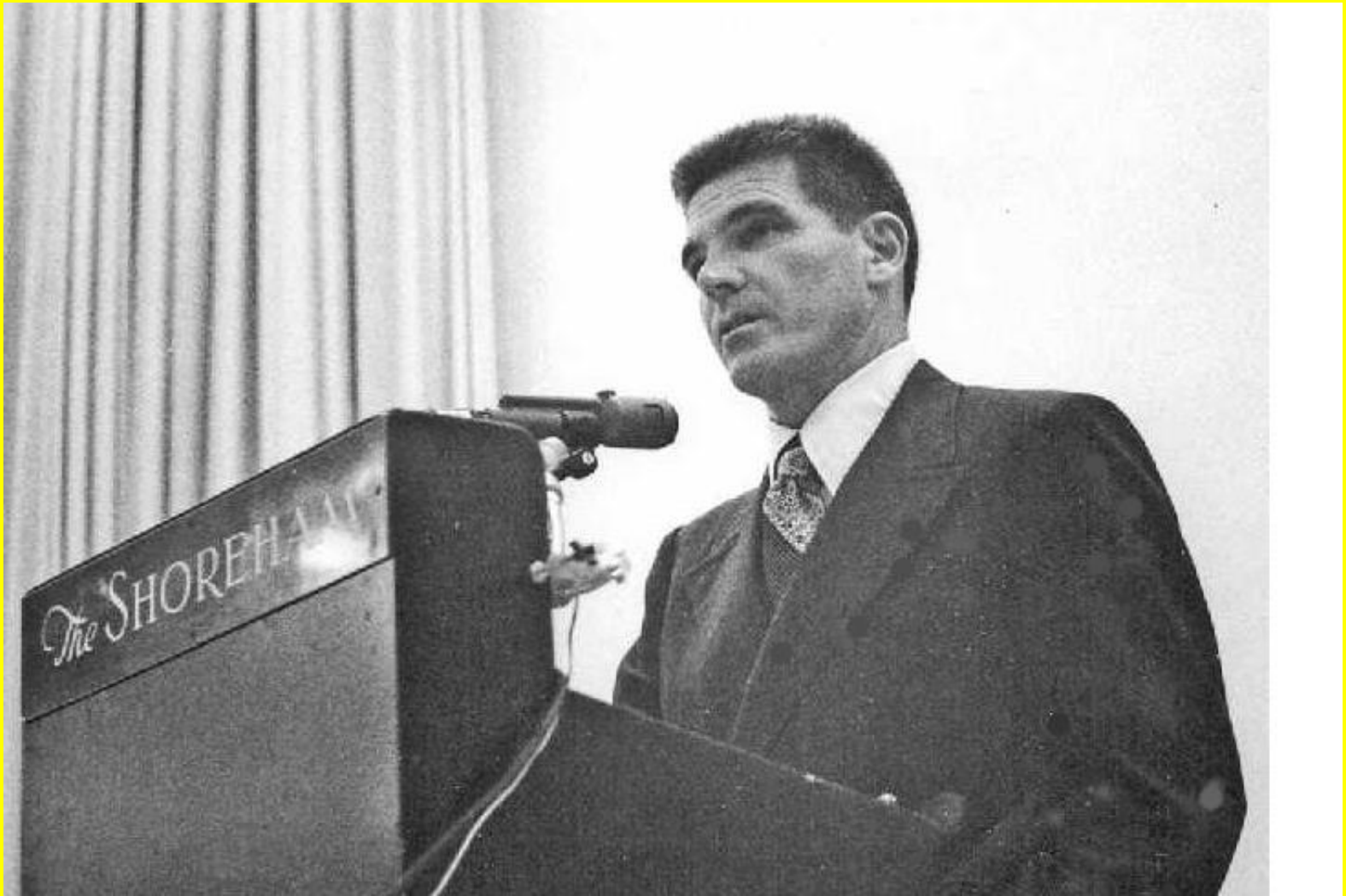
June 12, 2017

Leo in 1955. Editor of NOISE Control magazine

The second Arden House Workshop - 1972

Leo at INTER-NOISE 1972

Bill Magruder at INTER-NOISE 72

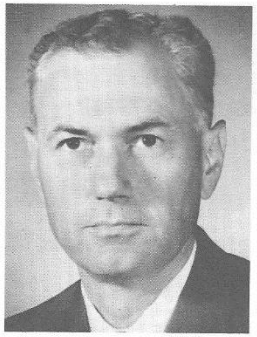


INTER-NOISE 1972 – first morning program

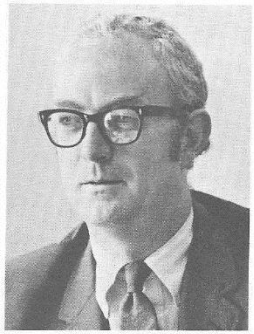
9.00 a.m. WHAT CONSTITUTES A NATIONAL PROGRAM FOR NOISE ABATEMENT?

Leo L. Beranek
INCE President

Chairman



Hon. James M. Beggs
Undersecretary of Transportation

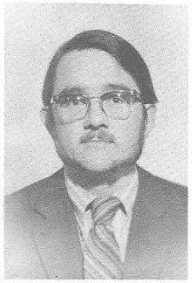


Hon. Thomas E. Carroll
Assistant Administrator,
Environmental Protection Agency

Carl Willenbrock
Director of Applied Technology
National Bureau of Standards

Grant Walton
Department of Environmental Protection
State of New Jersey

Peter Metz
Director of Intercity Transportation Planning
Commonwealth of Massachusetts



H. W. Posten
Commissioner of Environmental Control
City of Chicago

INTER-NOISE 1972 – the actual session

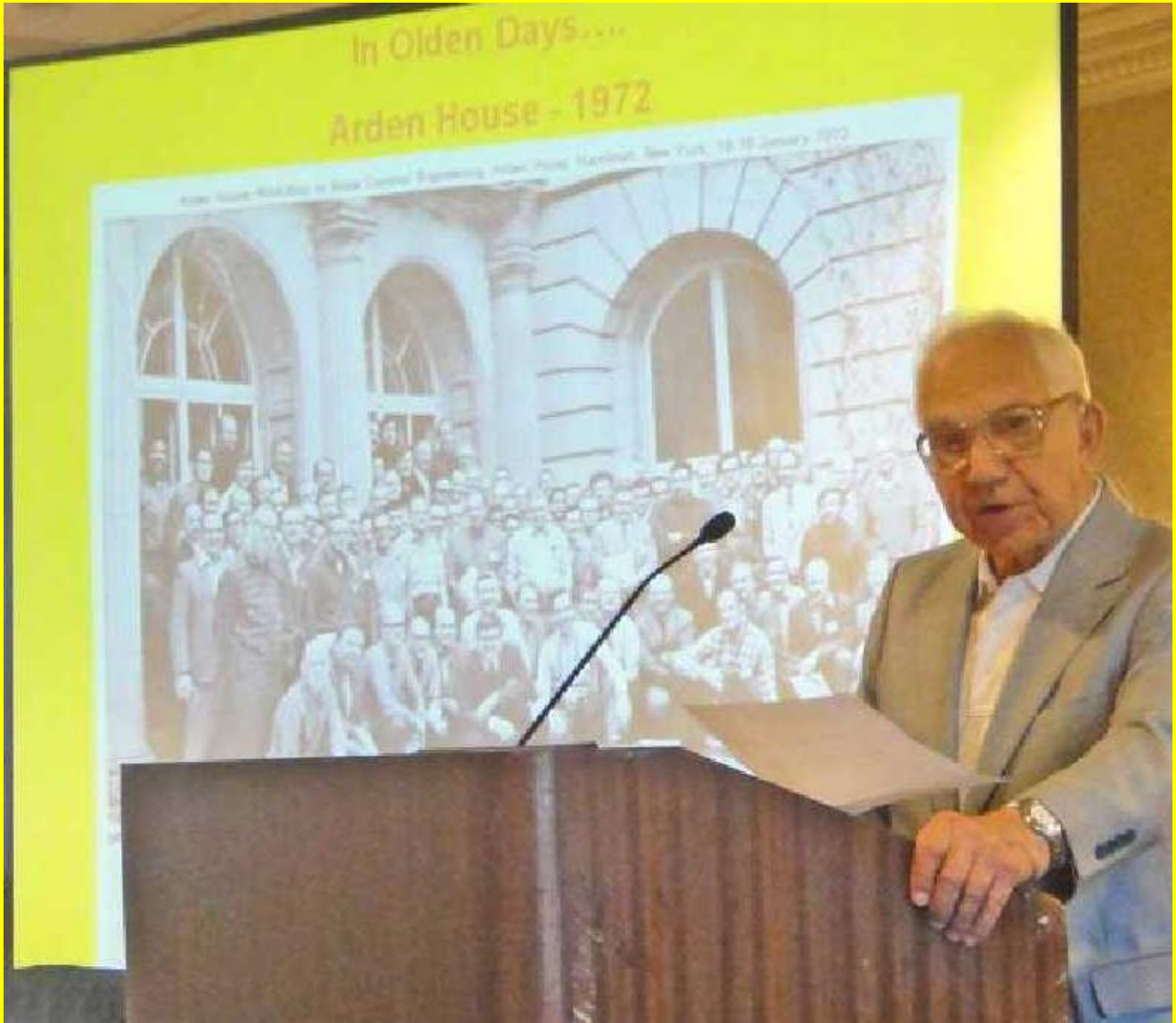
The INTER-NOISE 72 Exhibition

Leo and Bill Lang – 20th anniversary celebration

20th anniversary celebration – Leo and Eileen Embleton

Leo at the 40th anniversary session

Leo at the 40th anniversary session



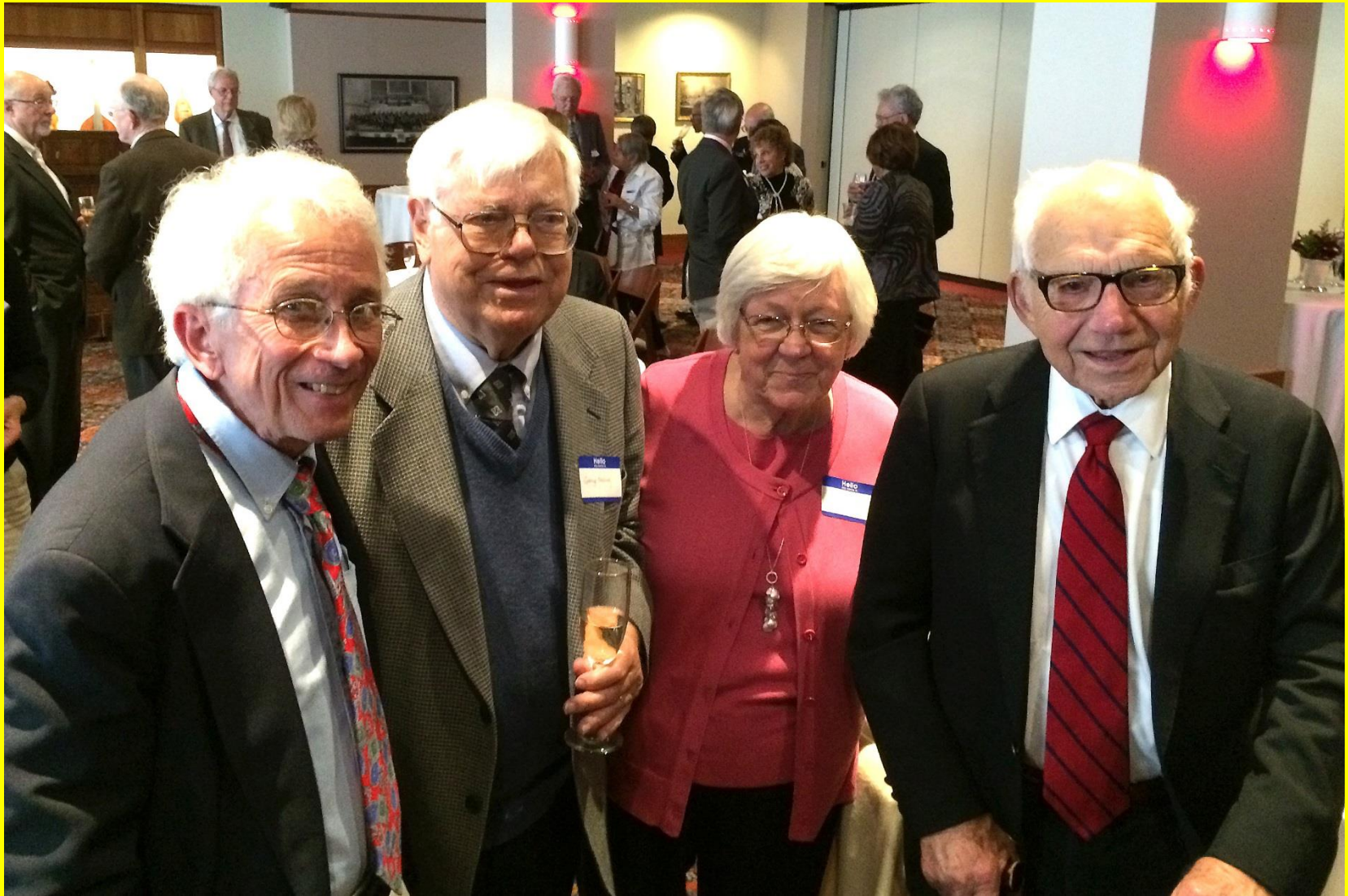
Leo and the ship captain – 40th anniversary

Leo and Bob Lotz- 40th anniversary celebration

The team that worked on the Beranek medal 2011

Leo with George, Ken, and Bill. Ken's 75th birthday

Leo and friends – Leo's 100th birthday

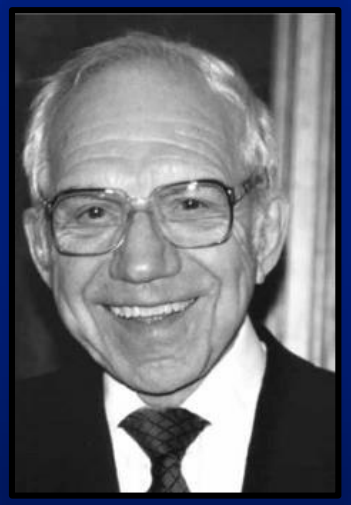


Leo cutting the cake –100th birthday

Slides Presented by Eric Wood

Leo L. Beranek

Evolution of Acoustical Consulting at BBN



gentleman and global pillar of our profession

Eric W. Wood

ACENTECH

October 1948

Dick Bolt

Dick Bolt was invited to provide acoustical consulting services for the United Nations headquarters building to be built in New York City.

Dick said to Leo:
“Too much work to do alone”

Acoustical consulting partnership
Bolt and Beranek formed in November 1948 to undertake the acoustical design aspects of the United Nations Headquarters.

United Nations General Assembly Hall

UN Headquarters Project

Leo, Dick, and Bob worked together on the acoustics of the UN General Assembly hall (the main auditorium), three large conference rooms, one of which is the Security Council room, noise isolation between rooms, and HVAC noise.

Leo's contribution included design of the sound system for the General Assembly Hall.

The “Original Five”

Leo and Dick hired three MIT graduate students

Bob Newman

Sam Labate

Jordan Baruch

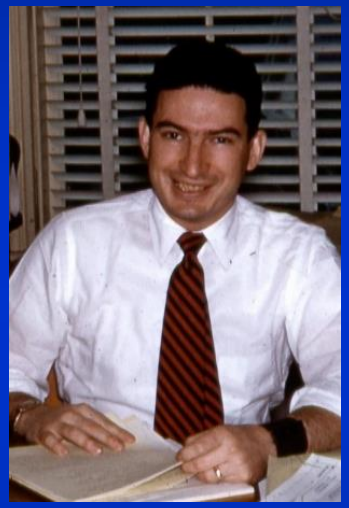
Academic Backgrounds of Original Five

Richard Bolt	Architecture, Physics
Leo Beranek	Electrical Engineering, Physics
Robert Newman	Physics, Architecture
Samuel Labate	Mathematics, Physical Acoustics
Jordan Baruch	Electrical Engineering

BBN East Coast Offices

1948 - Consulting partnership's working offices initially within MIT.

1949 - Moved to a single second floor room at 57 Brattle Street in Harvard Square where Bill Lang and Ira Dyer worked as early employees.



1950 - Expanded into the basement of a six apartment building at 16 Elliot Street, also in Harvard Square. By 1955, they occupied the entire building.

1956 - Expanded into new offices at 50 Moulton Street in Cambridge.

BBN Offices, 16 Eliot Street, Cambridge, MA

Some Early BBN Staff

Jack Purcell
Ed Kerwin
Clay Allen
Laymon Miller
Eric Ungar
Bob Hoover
Karl Pearsons

Bill Cavanaugh
Bill Galloway
Dave Keast
Bill Watters
Ranger Farrell
Parker Hirtle
Russ Johnson

Eric Ungar is one of the few still practicing. How fortunate we are that he is with us at Acentech.

1958 BBN Staff

Clayton Allen
Jay Ball
Jordon Baruch
Leo Beranek
Richard Bolt
Wm. Cavanaugh
Joseph Colaruotolo
Norman Doelling
Ira Dyer
Ranger Farrell
Peter Franken
William Galloway
Creighton Gogos
John Higgins
Parker Hirtle
Robert Hoover
Uno Ingard
Russell Johnson
Royal Jones
George Kamperman
David Keast
Edward Kerwin
David Klepper
Karl Kryter
Samuel Labate
Laymon Miller
Robert Newman
Dennis Noiseux
Anthony Nowlan
Karl Pearsons
William Pickett
Adone Pietrasanta
Jack Purcell
Donald Ross
John Sharp
Kenneth Stevens
Eric Ungar
William Watters
Francis Wiener
Lloyd Williams

They had produced more than 100 bound technical consulting reports by 1958

BBN Annual Principals' Dinner - 1991

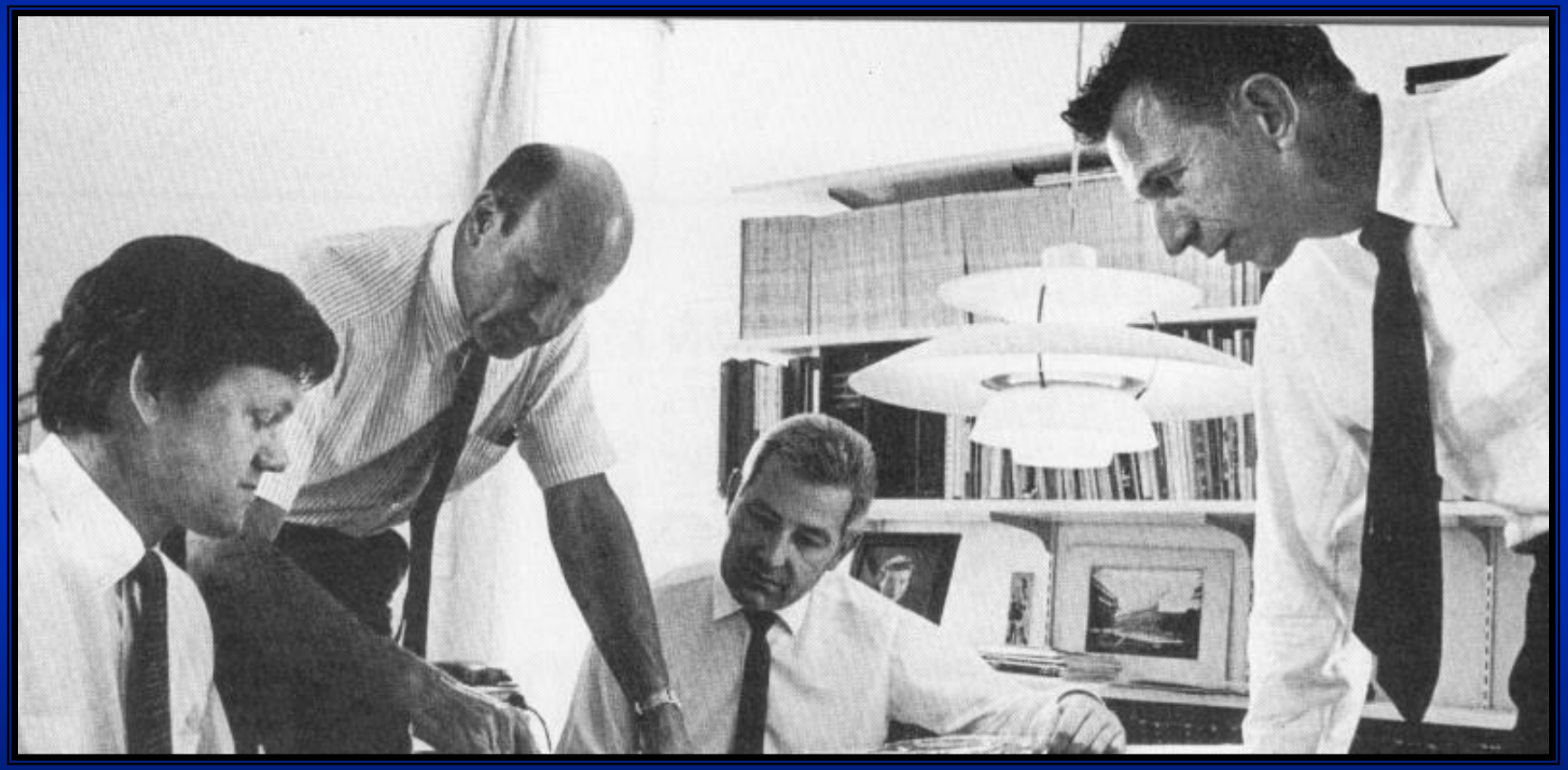
“Cambridge’s Third University”
Senior Staff from many Countries

Staff from overseas brought a highly dedicated work ethic.

Argentina
Australia
Austria
Denmark
England
Estonia
Germany
Hungary
India
Israel
Poland
Scotland
Sweden

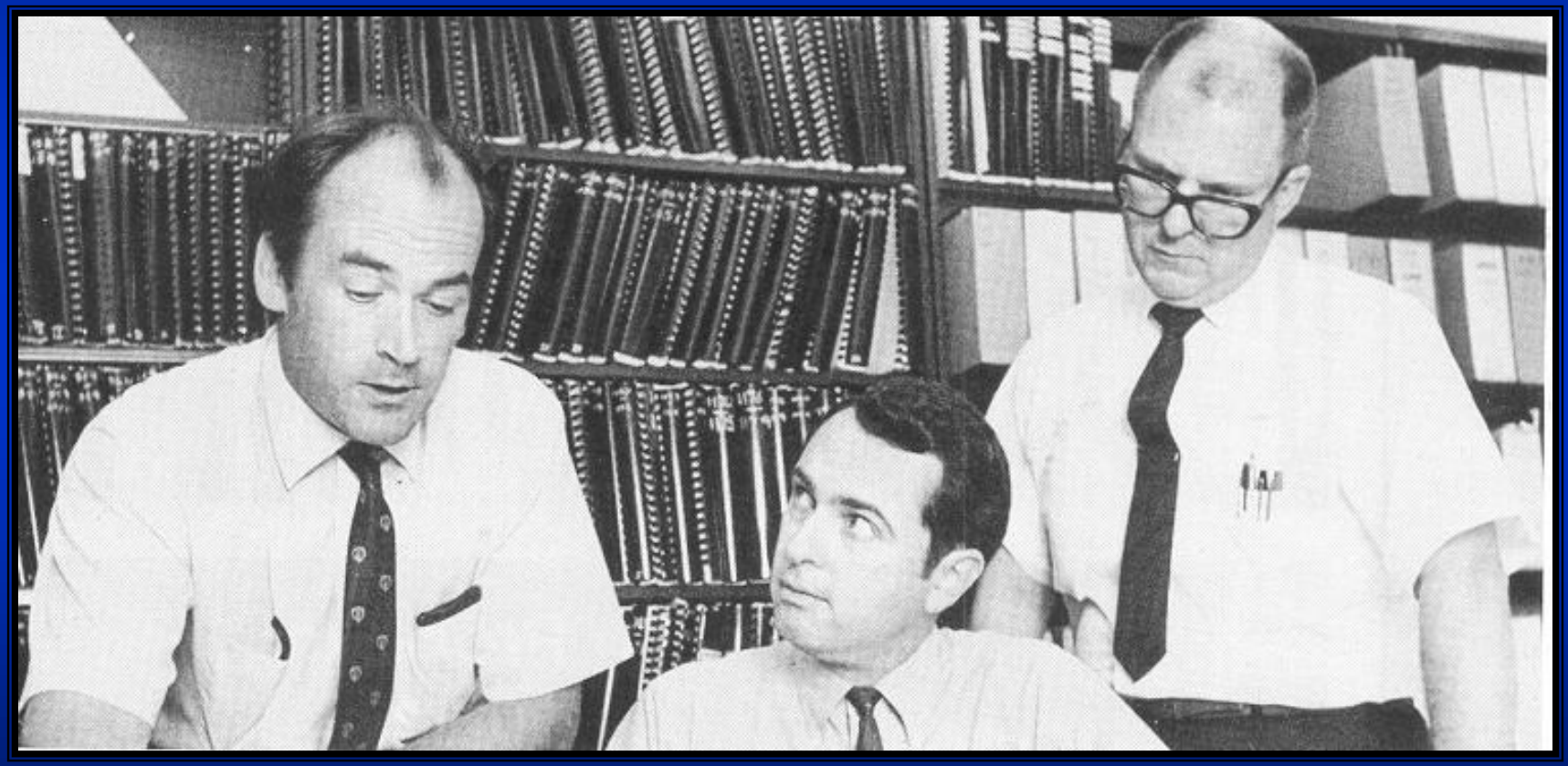
Cambridge 50 Moulton St. Office 1956

Parker Hirtle, Ted Schultz, Jacek Figwer, and Bob Hoover



Los Angeles Office 1956

Colin Gordon, Ron McKay, and Dwight Bishop



1959 Breaking ground for addition to BBN headquarters at 50 Moulton Street, Cambridge

Sam Labate

Bob Newman

Chicago Office 1960

Larry Kirkegaard, George Kamperman, and David Klepper

New York Office 1962

Allan Teplitzki, Tom DeGaetani, Russel Johnson, Andy Harris, and Jim Nuckolls

San Francisco Office 1968

Red Wetherill and Warren Blazer

Houston Office 1975

BBN Houston office opened by Bob Hoover.

Staffed with Tony Thompson, Dave Green, and Jack Randolph.

Now operating as Hoover & Keith Inc, an independent acoustical consulting firm

Architectural Acoustics Services

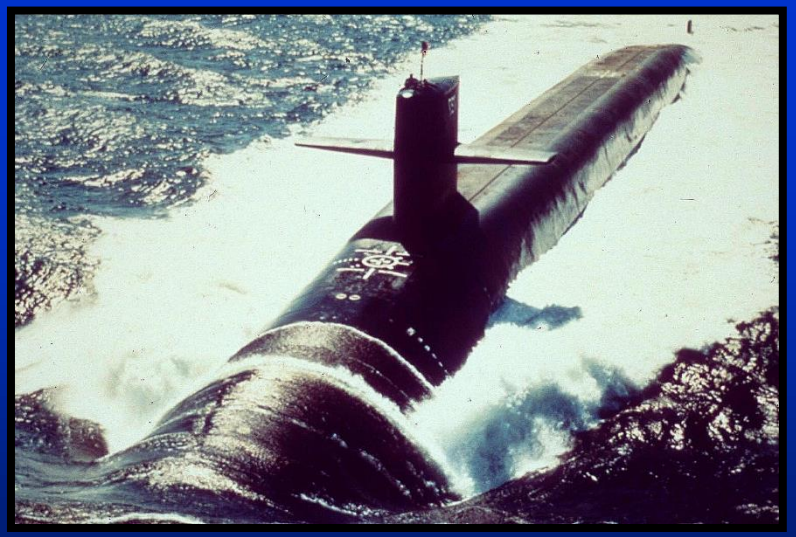
- Residential
- Offices
- Conference rooms
- Worship spaces
- Museums
- Performance spaces
- Mechanical equipment
- Sound masking
- Classrooms
- Laboratories
- Medical facilities
- Libraries
- Sports facilities
- Movie theaters
- Research facilities
- Auditoriums

Engineering Noise and Vibration Services

- Engine test cells
- Wind tunnels
- Airplanes
- Airports
- Highways
- Rail lines
- Energy plants
- Industrial plants
- Noise models
- Trucks
- Handbooks & Courses
- Industrial equipment
- Consumer products
- Mufflers
- Vibration mitigation
- Construction & demolition sites
- Noise regulations
- Litigation support
- Firing ranges
- Building dynamics
- Accident analysis
- Residential evaluations

BBN Physical Sciences Division

Signal processing
Quieting ships
Underwater acoustics
Propulsion systems
Vibration mitigation



Sonar systems
Sound propagation
Torpedoes
Psychoacoustics
Wind tunnels
Structural fatigue
Surveillance & detection
Test facility design
Software development
Tape analysis

Testing Facilities Supporting Client Projects

Anechoic chamber

Dual reverberation chambers

Free-jet quiet wind tunnel

Sonic boom chamber

Water tank

Extensive dry and wet instrumentation

Some Other Ventures Included

New Staff and Additional Services

Program for Advance Study

Air Quality

Asbestos Removal

Economics

Architectural Lighting

Instrument Systems

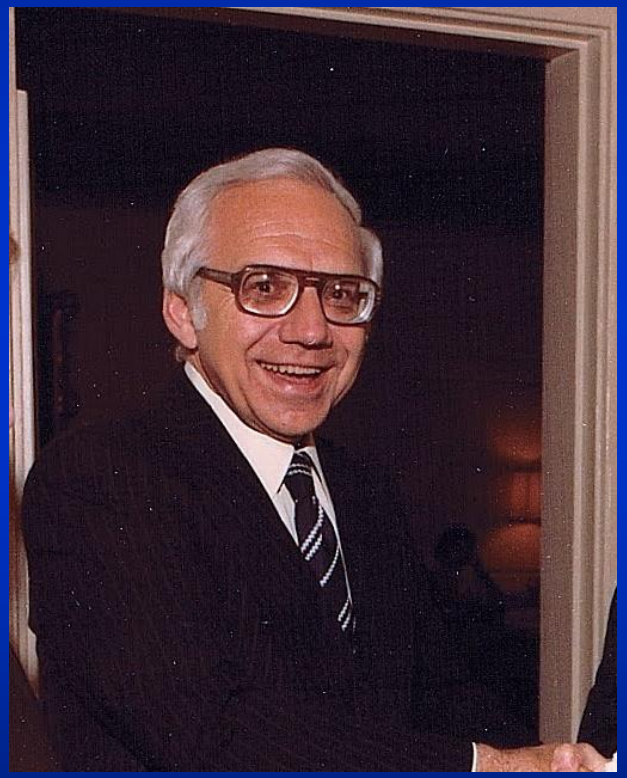
Industrial Hygiene

Sound Masking Systems

Audiovisual and Sound System Design

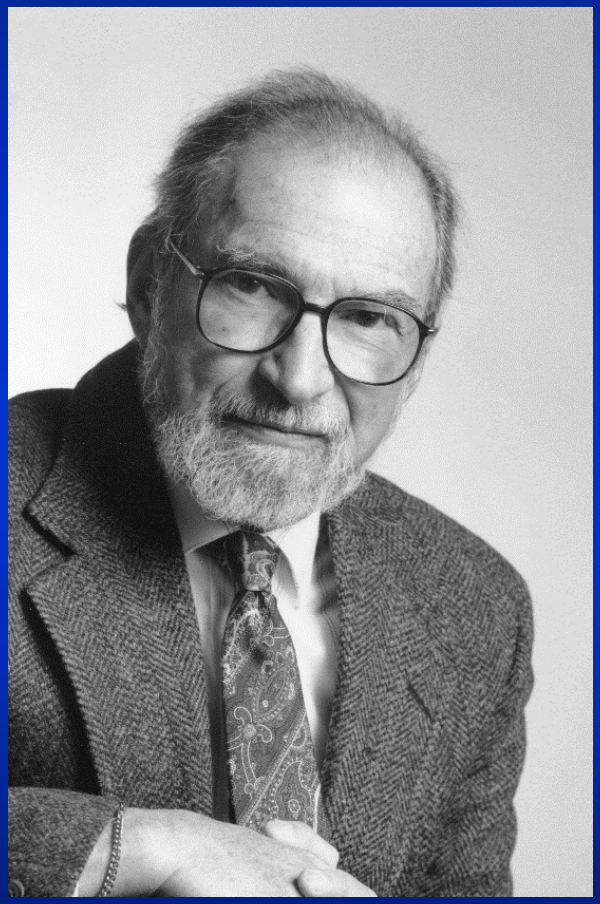
BBN's Culture

Leo Beranek: "Everyone we hired should raise the level of competence of the company – they all had to be brighter than myself."



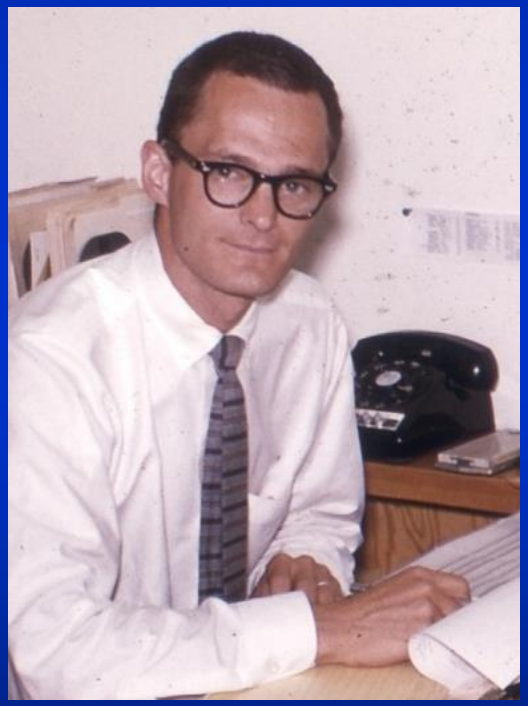
BBN's Culture

Ira Dyer: "We all believed that we could learn whatever we needed to know to solve whatever problems came up."



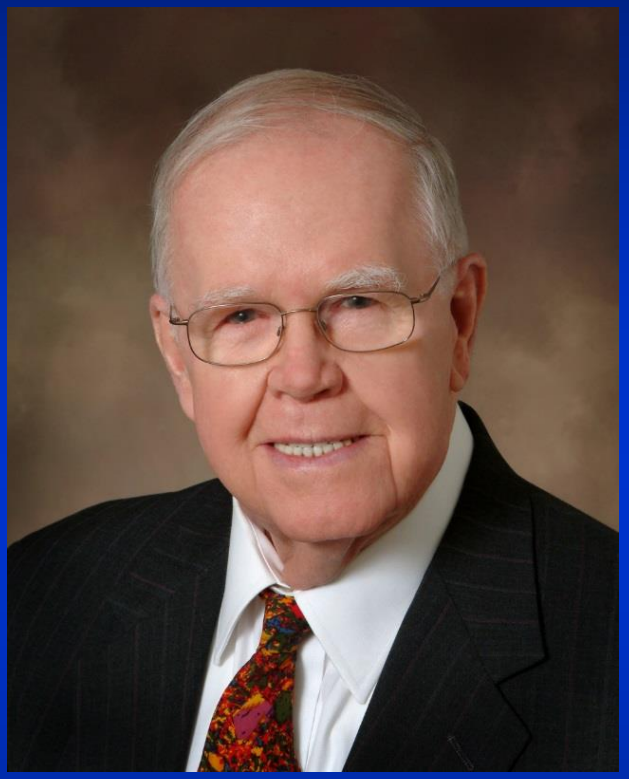
BBN's Culture

David Keast: "Leo would drop into people's offices, show interest in their work, offer suggestions. He was always active professionally - consulting, giving lectures, and publishing articles and books. Leo and Bob Newman's attitudes created BBN's personality."



BBN's Culture

Bill Cavanaugh: "No one asked why we are getting into a problem. We felt we could solve anything. Bob Newman had the ability to make his Architectural Acoustics course at MIT fun for his students. They later would turn to BBN for consulting assistance."

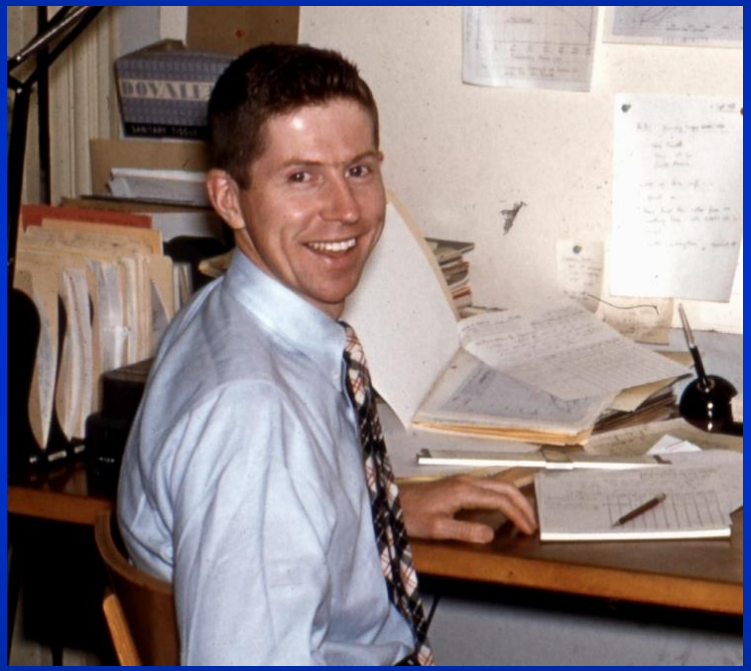


BBN's Culture

Laymon Miller: "People at BBN did not protect their own domains selfishly. All were willing to share their expertise."

BBN's Culture

Edward Kerwin: "The smartest people at BBN were often the most generous, which made it a wonderful place to work. People came in early and stayed late."

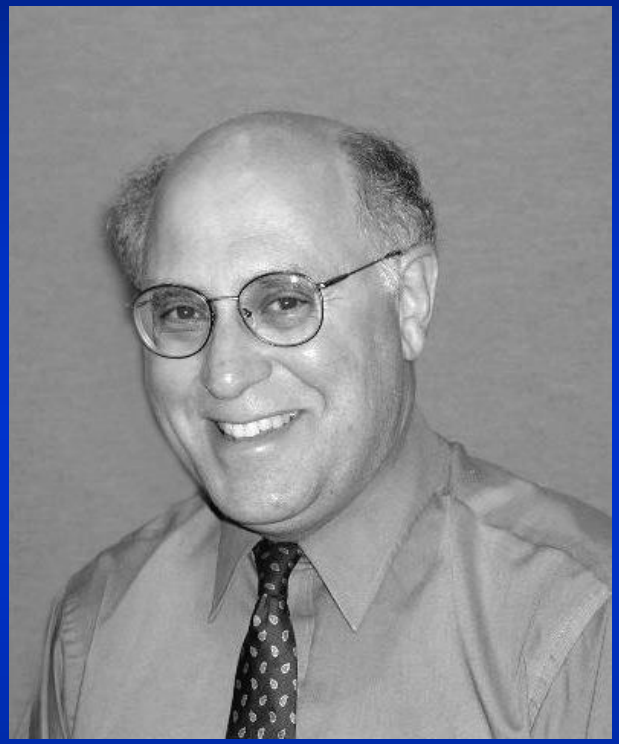


BBN's Culture

James Barnes: "At BBN, there was an informal atmosphere and admiration of eccentric people. One walked around barefoot winter and summer."

BBN's Culture

Carl Rosenberg: "People at BBN were interested in new ideas. Bob Newman's door was always open, and he was always willing to talk to people."



Mueller-BBM, GmbH in Munich, Germany and BBN Formed an Affiliation

Founder's Meeting, Muller-BBM GmbH, February 1962

Partnership formed in October 1948
Incorporated in December 1953
Initial Public Offering in June 1961

Signing IPO Documents
27 June 1961

Eaton, Jordan Baruch, Robert Newman, Bradlee, Leo Beranek, Samuel Labate

Some Honors to BBN Staff

National Medal of Science

2002: Leo Beranek

ASA Gold Medal

1975: Leo Beranek

1979: Richard Bolt

2011: Eric Ungar

OTHERS ???

ASA Silver Medal

1976: Ted Schultz

1994: Ken Eldred

2011: Jim Barger

More Honors to BBN Staff

ASA Wallace Clement Sabine Medal

1961: Leo Beranek

ASA Trent-Crede Medal

1983: Eric Ungar

1996: Preston Smith

ASME Per Bruel Gold Medal

1994: Eric Ungar

INCE Distinguished Noise Control Engineer Award

1997 : Leo Beranek

2004 : Eric Ungar

Some BBN Fellows of ASA

Jim Barger
Erich Bender
Leo Beranek
Dick Bolt
Tony Galaitsis
Bob Newman
Sam Labate
Clay Allen
Warren Blazier
Ken Eldred
Laymon Miller
Dave Keast
Bob Hoover
Eric Ungar
Parker Hirtle
Nate Martin
Jude Nitsche
Rein Pirn
Paul Remington
Carl Rosenberg
Tom Horrall
Eric Wood

Principal Consultants, Scientists, Engineers

Our most outstanding technical staff not wanting management responsibilities were elected as a principal of BBN.

They received prestige and a six-month paid sabbatical every five years to pursue a subject of interest.

Early principals included Laymon Miller, Preston Smith, and Eric Ungar.

Some of Our Department and Division Mangers Over the Years

Erich Bender

Frank Berkman

Bob Bruce

Bill Cavanaugh

Jack Curtis

Ira Dyer

Ken Eldred

Bill Galloway

Frank Jackson

Paul Jensen

Dave Keast

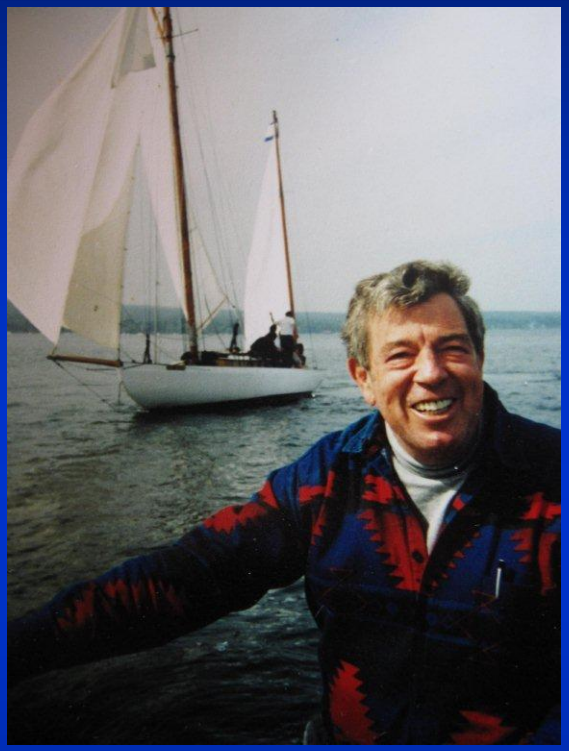
Bob Newman

Carl Rosenberg

Eric Ungar

Group Vice President

Ken Eldred, recruited from Wyle Labs, served as our group vice president and a principal consultant from 1973 to 1982.



BBN CEO

Steve Levy served as BBN CEO from 1976 to 1994 leading many of the developments in the computer and communications

Compensation

To attract and maintain BBN staff:

We were well compensated.

Profit sharing that provided nice year-end bonuses.

Significant company contributions to our retirement plan.

Medical and life insurances.

Paid vacations and holiday time.

Bolt Beranek and Newman

Dick Leo Bob

Now Acentech

Commercial acoustical consulting business purchased from BBN by our senior staff

October 4, 1991

Steve Levy, BBN president, understood and agreed to our proposed purchase with three conditions. It had to be good for the employees. It had to be good for our clients. And we had to pay a reasonable price for the assets.

Sound Ideas: Acoustical Consulting at BBN and Acentech

This 300 page book describes people at BBN practicing acoustical consulting, the firm's culture, clients and projects, professional contributions, spin-off consulting firms and, forty years later, the transition of the acoustical consulting practice to Acentech.

Available from ASA and Acentech

Also Available

100 color photos by Leo of early BBN staff

And the recording of an interview with Leo by Tom Horrall in 2012

The Beginnings of What Evolved to a World-Class Computer and Communications R&D Company

1959 - Purchased DEC PDP-1 s/n 1 from Ken Olsen

1962 – First public demonstration of a time-sharing computer system

1969 - Launching of the ARPANET across the nation, forerunner of the Internet "when it was just a dirt trail"

1971 - Transmission of person-to-person email messaging

Computer Technologies at BBN

Two interesting books:

Where Wizards Stay Up Late

Katie Hafner and Matthew Lyon, 1996

A Culture of Innovation: Insider Accounts of Computing and Life at BBN

Dave Walden and Ray Nickerson, editors, 2011

A Recent View

BBN Technologies was purchased by Raytheon in 2009

Awarded the National Medal of Technology and Innovation in 2013

For sustained innovation through the engineering of first-of-kind practical systems in acoustics, signal processing and information technology.

Continues R&D in acoustics