

# SCHOMER AND ASSOCIATES, INC.

Consultants in Acoustics and Noise Control

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## **PAUL D. SCHOMER** **Acoustical Engineer**

BS, Electrical Engineering, University of Illinois, 1965.  
MS, Electrical Engineering-Acoustics, University of California, 1966.  
Ph.D., Electrical Engineering-Acoustics, University of Illinois, 1971.

### **EXPERIENCE**

Dr. Schomer has extensive experience, publications, and patents in the areas of environmental noise and its assessment, human and community response to noise, instrumentation and methodology for the measurement and monitoring of noise, sound propagation, and acoustical measurements of building parameters. He is a consultant to industry and government and a research leader in acoustics. His recognition by his peers as an international leader in the area of environmental noise is demonstrated by his chapters in reference books, his more than 45 refereed publications, his leadership in Standards organizations and professional societies, and his awards and honors. Dr. Schomer is also standards Director for the Acoustical Society of America.

As an international leader in the area of environmental noise, Dr. Schomer is chairperson of the United States delegation to International Organization for Standardization (ISO) Acoustics and Noise committees, past chairperson of the American National Standards Institute (ANSI) Committee dealing with noise, chairperson of the ISO working groups which deal with environmental noise and with impulsive noise measurement, chairperson of the ANSI/ASA working group which deals with environmental noise, and he is the United States representative to the International Organization for Standardization in the areas of aircraft noise and impulsive sources. He is the Standards Director for the Acoustical Society of America, a past member of the Society of Automotive Engineers Aircraft Noise Committee, a principle contributor to current efforts in the area of standardizing airport noise monitoring, and former Executive Director, past vice-president for membership, and twice a past member of the board of the Institute of Noise Control Engineering. He is also a past adjunct Professor of Electrical and Computer Engineering (Acoustics) and member of the graduate faculty of the University of Illinois

Dr. Schomer has 44 years of experience dealing with noise measurement and the effects of noise on people and communities. This experience includes airport, aircraft, helicopter, construction and traffic noise, general industrial and urban noise, wind turbine noise, blast and mining noise, small arms gunfire noise. The citation for his selection as a Fellow of the Acoustical Society of America references his studies on community response to noise, and most of his work with the National Academy of Science has been concerned with noise assessment.

**MEMBER FIRM, NATIONAL COUNCIL OF ACOUSTICAL CONSULTANTS**

**MEMBERSHIPS AND AWARDS**

Fellow - Acoustical Society of America.

Member, Board Certified, Institute of Noise Control Engineering

Selected as Corps of Engineers Engineer of the Year and One of the Top 10 Federal Engineers of the Year (1990)—National Society of Professional Engineers

Several times a member of the board and/or officer; Institute of Noise Control Engineering.

Former Executive Director, Institute of Noise Control Engineering of the USA, Inc.

Standards Director, Acoustical Society of America

Chairman, Acoustical Society of America Committee on Standards

Head of U.S. Delegation, International Organization for Standardization, Technical Committee 43 (acoustics) and Subcommittee 1 (noise).

Convener (chairman), International Organization for Standardization, Working Group 45 dealing with environmental noise assessment.

Chairman, S.A.E. Construction Site Sound Level Subcommittee, S.A.E. ConAg Committee.

Past Member, S.A.E. Aircraft Noise Committee and the noise monitoring subcommittee.

Reviewer for *Applied Mechanics Review*, *Journal of the Acoustical Society of America*, and *Noise Control Engineering Journal*.

Fellowship, University of Illinois (1968-1971).

Registered Professional Engineer (DC).

Member, Institute of Noise Control Engineering, Acoustical Society of America, Institute of Electrical and Electronic Engineers, German Acoustical Society (DEGA), European Acoustical Association

### BOOKS

**Handbook of Acoustical Measurements and Noise Control, Chapter 50. Community Noise Measurements**, 2nd edition, John Wiley and Sons, Inc., New York, 1991.

**Reference Data for Radio Engineers, Chapter 40. Electroacoustics**, 7th edition, ITT Press, a subsidiary of MacMillan, Inc., Indianapolis, 1985.

**Reference Data for Radio Engineers, Chapter 40. Electroacoustics**, 8th edition, Sams Publishing, Prentice-Hall Computer Publishing, Indianapolis, 1993.

### MAJOR JOURNAL PUBLICATIONS

"A first-principles model for estimating the prevalence of annoyance with aircraft noise exposure," *Journal of the Acoustical Society of America*, **130**(2), 791-806, August 2011.

"A re-analysis of Day-Night Sound Level (DNL) as a function of population density in the United States," *Noise Control Engineering Journal*, **59**(3), 1xx-1xx, (May/June 2011).

"Limitations of current dosage-response relationships for predicting the prevalence of annoyance due to transportation noise," INTERNOISE 2011, Osaka Japan, 4-7 September 2011.

"Wind-induced pseudo-noise and leaf-rustle noise," *Noise Control Engineering Journal*, **58**(2), 121-131, (March/April 2010).

"Explanation of and conclusions drawn from American National Standard Methods for estimation of awakenings associated with outdoor noise events heard in homes," INTERNOISE 2010, paper 1126, Lisbon Portugal, 13-16 June 2010.

"Proposed Ai-Weighting; a weighting to remove insect noise from A-weighted field measurements." INTERNOISE 2010, paper 594, Lisbon Portugal, 13-16 June 2010.

"On Efforts to Standardize a Graphical Description of the Soundscape Concept," INTERNOISE 2010, paper 593, Lisbon Portugal, 13-16 June 2010.

"Wind-induced pseudo-noise and leaf-rattle noise," INTERNOISE 2009, Paper IN09\_584, Ottawa, Canada, 23-26 August 2009.

"The difference between Day-Night Average Sound Level and the European Union Day-Evening-Night Average Sound Level for a typical sample of 100 housing sites," INTERNOISE 2009, Paper IN09\_583, Ottawa, Canada, 23-26 August 2009.

"Visitor perception of park soundscapes: A research plan," *Noise/News International*, **17**(2), 51-56, (June 2009).

"Uncertainties in measuring aircraft noise and predicting community response to it," *Noise Control Engineering Journal*, **55**(1), 82-88, (January/February 2007).

“When there are audible rattle sounds, annoyance may depend only on the worst case— independent of number of events,” INTERNOISE 2006, Paper N190, Honolulu, HA, USA, 3-6 December 2006.

“A-weighting sometimes works for assessing environmental noise—sort of; it should be retired,” INTERNOISE 2006, Paper N202, Honolulu, HA, USA, 3-6 December 2006.

“A statistical description of sound propagation: A comparison of elevated and near-ground sources,” *Noise Control Engineering Journal*, **54**(3), 25-36, (May-Jun 2006).

“Biases introduced by the fitting of functions to attitudinal survey data,” NOISE-CON 2005, *Institute of Noise Control Engineering*, Minneapolis, MN, USA, 17-19 October 2005.

“Criteria for assessment of noise annoyance,” *Noise Control Engineering Journal*, **53**(4), 132-144, (July/August 2005).

“Overview of the theoretical development and experimental validation of blast sound absorbers,” *Noise Control Engineering Journal*, **53**(3), 70-80, (May/June 2005).

“Basic results from full-scale tests at Ft. Drum,” *Noise Control Engineering Journal*, **53**(3), 94-109, (May/June 2005).

“Some Important Factors in Community Response to Sonic Booms,” NOISECON 2004, *Institute of Noise Control Engineering*, Baltimore, MD, USA, 12-14 July 2004.

“The importance of proper integration of and emphasis on the low-frequency sound energies for environmental noise assessment,” *Noise Control Engineering Journal*, **52**(1), 26-39, (January/February 2004).

“Noise Assessments: Interaction with the Public—Simplicity and Truth Will Help,” INTERNOISE 2003, Paper N706, pp 1216-1220, Seogwipo, Korea, 25-28 August 2003.

“Does the Soundscape Concept Have Real Utility,” INTERNOISE 2003, Paper N161, pp 2825-2826, Seogwipo, Korea, 25-28 August 2003.

“Noise Assessment Metrics and Criteria in a United States Department of Transportation Multi-Modal Noise Model,” NOISECON 2003, Paper No. 023, *Institute of Noise Control Engineering*, Cleveland, OH, USA, 23-25 June 2003.

“A statistical description of ground-to-ground sound propagation,” *Noise Control Engineering Journal*, **51**(2), 69-80, (March/April 2003).

“On Normalizing DNL to Provide Better Correlation with Response,” *Sound & Vibration*, pp 14-23, December 2002.

“Further Results Using Loudness-Level Weighting to Assess Noise Annoyance,” INTERNOISE 211002, Paper No. N489, *Institute of Noise Control Engineering International*, Dearborn, MI, USA, 19-21 August 2002.

“Alternative Methods to A-Weighting for Environmental Noise Assessment,” NTERNOISE 2002, Paper No. N475, *Institute of Noise Control Engineering International*, Dearborn, MI, USA, 19-21 August 2002.

“Evaluation of loudness-level weightings for assessing the annoyance of environmental noise,” *Journal of the Acoustical Society of America*, **110**(5) Pt. 1, 2390-2397, (November 2001).

“Criteria for the Assessment of Noise Annoyance,” NOISECON 2001, Paper No. NC01\_018, *Institute of Noise Control Engineering USA*, Portland, Maine, 29-31 October 2001.

“Use of the New ISO 226 Equal Loudness Contours as a Filter to Assess Noise Annoyance,” NTERNOISE 2001, Paper No. 197, *Institute of Noise Control Engineering International*, The Hague, Holland, 27-30 August 2001.

“A statistical description of blast sound propagation,” *Noise Control Engineering Journal*, **49**(2), 79-87, (March/April 2001).

“Using fuzzy logic to validate blast noise monitor data,” *Noise Control Engineering Journal*, **48**(6), 193-205, (November/December 2000).

“A comparison between the use of loudness level weighting and loudness measures to assess environmental noise from combined sources,” INTERNOISE 2000, Paper No. 101, *Institute of Noise Control Engineering International*, Nice, France, 27-30 August 2000.

“A test of proposed revisions to room noise criteria curves,” *Noise Control Engineering Journal*, **48**(4), 124-129, (July/August 2000).

“Proposed revisions to room noise criteria,” *Noise Control Engineering Journal*, **48**(3), 85-96, (May/June 2000).

“Loudness-Level Weighting for Environmental Noise Assessment,” *Acustica and Acta Acustica*, **86**(1), 49-61 (January/February 2000).

“Revision to the ISO 1996 series--Description, measurement and assessment of environmental sound,” INTERNOISE 98, Paper No. 190, *Institute of Noise Control Engineering International*, Christchurch, New Zealand, November 1998.

“On spectral weightings to assess human response, indoors, to blast noise and sonic booms,” *Noise Control Engineering Journal*, **46**(2), 57-71, (March/April 1998).

“Evaluation of a re-analysis of the relationship between the results obtained in laboratory and field studies on the annoyance caused by high-energy impulsive sounds,” *Noise Control Engineering Journal*, **45**(6), 251-255 (November/December 1997).

“A comparative study of human response, indoors, to blast noise and sonic booms,” *Noise Control Engineering Journal*, **45**(4), 169-182 (July/August 1997).

“The new ANSI method for assessing combined noise environments; comparison with other methods,” INTERNOISE 97, 1047-1052, *Institute of Noise Control Engineering International*, Budapest, Hungary, August 1997.

“On the contribution of noticeability of environmental sounds to noise annoyance,” *Noise Control Engineering Journal*, **44**(6), 294--305 (November/December 1996).

“Penalties for assessing helicopter noise annoyance—There is none?” NOISE-CON 96, 581-584, *Institute of Noise Control Engineering*, Seattle, WA, September 1996.

“A Comparative Study of Human Response to Blast Noise and Sonic Booms,” INTERNOISE 96, *Institute of Noise Control Engineering International*, Liverpool, UK, July 1996.

“Development of a New ANSI Standard for Assessment of Combined Noise Environments,” INTERNOISE 96, 3265-3270, *Institute of Noise Control Engineering International*, Liverpool, UK, July 1996.

“25 Years of progress in noise standardization,” *Noise Control Engineering Journal*, **44**(3), 141-148 (May/June 1996).

“Human and community response to military sounds: Results from field-laboratory tests of small arms, 25 mm cannon, helicopter and blast sounds,” *Noise Control Engineering Journal*, **43**(1), 1-13 (January/February 1995).

“Amendments to ISO Part 2: The Impulse Noise Penalty,” INTERNOISE 95, *Institute of Noise Control Engineering International*, 851-856, Newport Beach, CA, USA, 1995.

“New descriptor for high-energy impulsive sounds,” *Noise Control Engineering Journal*, **42**(5), 179-191 (September/October 1994).

“SoundProp Fast, accurate prediction of sound propagation under varying weather conditions and over hard or soft surfaces,” INTERNOISE 94, 555-558, *Institute of Noise Control Engineering International*, Yokohama Japan, August 1994.

“A revised statistical analysis of blast sound propagation,” *Noise Control Engineering Journal*, **42**(3), 95-100 (May/June 1994).

“Human and community response to military sounds: Results from field-laboratory tests of small arms, tracked vehicles, and blast sounds,” *Noise Control Engineering Journal*, **42**(2), 71-84 (March/April 1994).

“Activity and sleep interference; A new measurement technique,” INTERNOISE 93, *Institute of Noise Control Engineering International*, Leuven, Belgium, July 1993.

“Time-average aircraft noise descriptors; Confusion with no benefit,” INTERNOISE 92, **2**, 987-992, *Institute of Noise Control Engineering International*, Toronto, Canada, July 1992.

“On Using the Generalized Concept of Loudness to Predict Annoyance,” INTERNOISE 91, *Institute of Noise Control Engineering International*, Australia, December 1991.

“Decibel annoyance reduction of low-frequency blast attenuating windows,” *Journal of the Acoustical Society of America*, **89**(4), April 1991.

“Descriptors for Community Noise Assessment; logical Extensions to DNL,” NOISECON 90, *Institute of Noise Control Engineering*, Austin TX, October 15-17 1990.

“Reduction of Wind Noise for Unattended Blast Noise Monitoring,” *Noise Control Engineering Journal*, **34**(2), March/April 1990.

“Indoor human response to blast sounds that generate rattles,” *Journal of the Acoustical Society of America*, **86**(2), August 1989.

“On a theoretical interpretation of the prevalence rate of noise-induced annoyance in residential populations: High-amplitude impulse noise environments,” *Journal of the Acoustical Society of America*, **86**(2), April 1989.

“The role of Helicopter noise-induced vibration and rattle in human response,” *Journal of the Acoustical Society of America*, **81**(4), April 1987.

“High-energy impulsive noise assessment,” *Journal of the Acoustical Society of America*, **79**(1), January 1986.

“Assessment of community response to impulsive noise,” *Journal of the Acoustical Society of America*, **77**(2), February 1985.

“Descriptor for rotary-wing aircraft noise,” American Institute of Aeronautics and Astronautics, October 1984.

“A survey of community attitudes towards noise near a general aviation airport,” *Journal of the Acoustical Society of America*, **74**(6), December 1983.

“Noise monitoring in the vicinity of a general aviation airport,” *Journal of the Acoustical Society of America*, **74**(4), April 1983.

“Sampling strategies for monitoring noise in the vicinity of airports,” *Journal of the Acoustical Society of America*, **73**(6), June 1983.

“An analysis of community complaints to noise,” *Journal of the Acoustical Society of America*, **73**(4), April 1983.

“Time of day noise adjustments or ‘penalties’,” *Journal of the Acoustical Society of America*, **73**(2), February 1983.

“A model to describe community response to impulse noise,” *Noise Control Engineering Journal*, **18**(1), January/February 1982.

“The growth of community annoyance with loudness and frequency of occurrence of events,” *Noise Control Engineering Journal*, **17**(1), July/August 1981.

“Temporal sampling requirements for estimation of long-term average sound levels in the vicinity of aircraft,” *Journal of the Acoustical Society of America*, **69**(3), March 1981.

“Development of temporal sampling strategies for monitoring noise,” *Journal of the Acoustical Society of America*, **66**(3), September 1979.

“High-amplitude/low-frequency impulse calibration of microphones; a new method,” *Journal of the Acoustical Society of America*, **65**(2), February 1979.

“Growth function for human response to large-amplitude impulse noise,” *Journal of the Acoustical Society of America*, **64**(6), December 1978.

“Human response to house vibrations caused by sonic booms or air blasts,” *Journal of the Acoustical Society of America*, **64**(1), July 1978.

“Statistics of amplitude and spectrum of blasts propagated in the atmosphere,” *Journal of the Acoustical Society of America*, **63**(5), May 1978.

“Evaluation of C-weighted  $L_{dn}$  for assessment of impulse noise,” *Journal of the Acoustical Society of America*, **62**(2), August 1977.

“Correlation techniques applied to acoustical measurements in reverberant rooms,” *Journal of the Acoustical Society of America*, **56**(5), 1974.

“Measurement and characterization of off-road construction vehicle noise,” *Noise Con73*, 247-249, 1974.

### **STATE OF ILLINOIS REPORTS**

**Proposed Revisions to Property-Line-Noise-Source Measurement Procedures**, ENR Report No. REEA91/10, Illinois Department of Energy and Natural Resources, 1991.

**Impulse Noise Study**, ENR Report No. REEA90/16, Illinois Department of Energy and Natural Resources, November 1990.

**A Demonstration of Airport Noise Impact Mitigation**, ENR Report No. 83/25, Illinois Department of Energy and Natural Resources, June 1983.

**The Economic Impact Study of Proposed Airport Noise Regulations, R774 Volume 1: Technical Study of Public Airports in Chicago**, ENR Report No. 81/38, Illinois Department of Energy and Natural Resources, November 1981.

**The Economic Impact Study of Proposed Airport Noise Regulations, R774 Volume 1: Technical Study of Public Airports Outside Chicago**, ENR Report No. 81/02, Illinois Department of Energy and Natural Resources, January 1981.

**Human and Community Response to Impulse Noise: A Literature Review**, IIEQ Report No. 78/07, Illinois Institute for Environmental Quality, March 1978.

**Motorcycle Noise Levels: A Report on Field Tests**, Report of the Illinois Task Force on Noise, June 1975.

**Control of Noise from Motor Vehicles Part III: Technical Study in Support of Proposed Motor Vehicle Noise Regulations**, Report of the Illinois Task Force on Noise, June 1974.

**Sound Transmission Loss Between Spaces Connected by Multiple Paths: A New Measurement Technique**, Ph. D. Thesis, University of Illinois, August 1971.

### PATENTS

Logarithmic Statistical Distribution Analyzer, Patent No. 3995500.

Microphone Droop and Sensitivity Measurement Device, Patent No. 4347410.

### TYPICAL PROJECT EXPERIENCE

#### AIRPORT NOISE ASSESSMENT AND PART 150 STUDIES

Conducting the acoustical analysis and measurements contained within airport Part 150 studies including (1) the generation of present and future, predicted noise contours, (2) the execution of noise monitoring, the comparison of monitoring results with noise contours, and the analysis of monitoring results by aircraft type, operation, and runway, and (3) the development and analysis of noise mitigation strategies.

#### HELIPORT DESIGN AND ASSESSMENT

Assessment of the heliport noise. Establishing the need for mitigation. Assessing mitigation alternatives.

#### ENTERTAINMENT NOISE

Evaluated measurements for a large, outdoor music venue. Evaluated band and DJ noise from a club as it affected the neighborhood. Suggested mitigation methods. Evaluated measurement and monitoring plans for an outdoor music performance arena.

#### EXPERT WITNESS REGARDING NOISE PREDICTION AND ITS EFFECTS ON PEOPLE EXPERT WITNESS REGARDING NOISE PREDICTION AND ITS EFFECTS ON PEOPLE

*Numerous cases, the following are examples:*

For the defense: Class action suit of homeowners against ARCO Oil.

For the plaintiff: Class action suit of homeowners against Peabody Coal Company.

For both of these, performed analysis of the physical noise and its predicted levels in the community, and assessed the received noise and its effect on individuals and the community.

For the defense/plaintiff: Predicted, measured and analyzed noise from parked outdoor refrigerator trucks in a special situation.

For the plaintiff: Predicted and analyzed the effect of strip-mining explosions on a distant factory structure.

For the plaintiff: Class action and community suits against airport noise including as \$128,000,000 settlement for the city of Minneapolis.

For the community: Class action suits against airport noise.

#### GUN CLUBS/POLICE FIRING RANGES

Performed noise assessment and mitigation at several civilian and police small arms firing ranges including siting, layout, operations, and noise mitigating structures and fixtures.

#### INDUSTRIAL NOISE CONTROL--OUTDOORS

Performed noise assessment and mitigation at a variety of outdoor industrial operations such as an asphalt plant, a kitty-litter plant (similar drum to asphalt plant for drying clay), an ammunition disposal plant (again a heated drum), and grain elevators.

#### MOTOR RACEWAY NOISE

Performed assessment, evaluated existing and planned mitigation and developed alternatives. Evaluated management and operational plans and developed alternative strategies.

#### PARK SOUNDSCAPES

Review and develop research plans for the NPS to develop the basis for National and International Standards for assessing and measuring park soundscapes.

#### PRODUCT DEVELOPMENT

Design, testing and evaluation of outdoor warning sirens.

#### VEHICLE/HIGHWAY NOISE

Assessment of highway noise. Monitoring highway noise. Establishing the need for mitigation. Assessing mitigation alternatives.

#### ILLINOIS NOISE REGULATIONS

Examination of the adequacy of existing noise regulations contained in Subtitle H, 35 Illinois Administrative Code. Analysis of the existing rules and whether they appropriately encompass the various types of discontinuous noise and specifically, impulse noise. Recommendations for changes to sections of the Code dealing with definitions and regulatory levels.

#### REVISIONS TO ILLINOIS PROPERTY-LINE NOISE MEASUREMENT PROCEDURES

Examination of existing measurement procedures as related to American National Standards. Recommendation of measurement procedures for determination of octave-band 1-hour equivalent levels corrected for background ambient. (No American National or International Standards exist for this type of measurement, but these are the type required by the Illinois Pollution Control Board.)

#### HUMAN AND COMMUNITY RESPONSE TO NOISE

Conducting and supervising international research experiments designed to explain, qualify and quantify human and community response to noise of varying character, spectra and temporal patterns. This research concentrates on comparing and contrasting special noises such as small arms, rotary-wing aircraft, or large explosions to more common noise such as road vehicles or artificially generated noise. A key to this work is conducting these experiments in real houses with

real sources of sound.

TEMPORAL SAMPLING STRATEGIES FOR MONITORING AIRPORT NOISE

Analysis of daily monitoring results from many of the nation's airports. Modeling of the results by auto-regressive moving average (ARMA) models, and analysis of the results by "Monte Carlo" methods. Recommendation of airport noise sampling strategies for obtaining the required degrees of precision.