

The equation, describing oscillations of a spherical bubble in an isotropic, incompressible medium, contains an integral over an elastic energy density function that depends on two invariants of the strain tensor. For moderate bubble oscillations one may use Landau's cubic expansion of energy density, which contains five elastic moduli—shear and bulk moduli corresponding to quadratic terms, and three moduli (*A*, *B*, and *C*) corresponding to cubic terms. With energy density expressed through invariants of

the strain tensor in spherical coordinates, the total elastic energy for an incompressible medium becomes an explicit function of bubble radius and contains only two of the five moduli, the shear modulus and modulus *A*. Compared to the Rayleigh–Plesset equation, the resulting equation has additional terms associated with shear force and elastic nonlinearity. Further modifications of this equation account for weak compressibility, viscosity, surface tension, radiation loss, and elastic shells.

MONDAY AFTERNOON, 28 APRIL 2003

ROOMS 209/210, 1:00 TO 4:35 P.M.

### Session 1pNS

#### Noise, ASA Committee on Standards, Signal Processing in Acoustics and Architectural Acoustics: Dan Johnson Retrospective

Mary M. Prince, Cochair

*National Institute for Occupational Safety and Health, 4676 Columbia Parkway, M.S. R-16, Cincinnati, Ohio 45226*

John P. Seiler, Cochair

*Mine Safety and Health Administration, Cochran Mill Road, Building 038, P.O. Box 1823, Pittsburgh, Pennsylvania 15230*

Chair's Introduction—1:00

#### Invited Papers

1:05

**1pNS1. Dan Johnson—Mr. Standards.** Paul Schomer (Schomer and Assoc., Inc., 2117 Robert Dr., Champaign, IL 61821, schomer@SchomerAndAssociates.com)

Dan Johnson had a long history of involvement in the standards program of ASA. He has chaired and/or participated in many working groups, primarily in the areas of hearing conservation and instrumentation. He was one of a rare set that was an individual expert to all four S-committees, being very familiar with instrument design from his days at Larson-Davis, and being familiar with physiological and psychological effects, noise, and vibratory effects from his work with the Air Force at Wright-Patterson AFB. Dan was the chair of S-12, the vice-chair of ASACOS, and, most recently, the chair of ASACOS and Standards Director. As Standards Director, Dan guided us through many turbulent times including establishment of the Standards Store, the change of the standards manager, the budgetary trials of 2000 and 2001, and the appeal of ANSI S12.60-2002 (Classroom Acoustics) by ARI before Accredited Standards Committee S12. He is very missed.

1:25

**1pNS2. Monitoring audiometry for occupational hearing loss: A case for eliminating 500 Hz.** Mark Stephenson (Natl. Inst. for Occupational Safety and Health, 4676 Columbia Pkwy., Cincinnati, OH 45226)

Audiometric monitoring is an important element in hearing conservation programs. Nearly every existing hearing conservation standard dictate that hearing thresholds should be measured at specific frequencies, and that 500 Hz be among those frequencies tested. Actual and estimated noise-induced permanent threshold shifts were evaluated as a function of exposure duration and exposure level. The results demonstrate 500 Hz to be of little value in assessing noise-induced hearing loss for typical industrial noise exposures of up to 40 years, at least for time-weighted average exposures of up to 100 dB A. Furthermore, few hearing conservation programs currently require audiometric monitoring to be performed in an environment that meets ANSI standards for maximum permissible background noise levels. This is particularly likely to compromise hearing testing at 500 Hz. As a result, this paper argues against the need for testing at 500 Hz, and recommends it be eliminated as a required test frequency in audiometric monitoring for noise-induced occupational hearing loss.

1:45

**1pNS3. Predicting noise-induced hearing loss in human populations. The contribution of the ISO-1999 and ANSI S3.44 standards.** Mary M. Prince (Centers for Disease Control, Natl. Inst. for Occupational Safety and Health, 4676 Columbia Pkwy., R-16, Cincinnati, OH 45226)

This paper reviews the ISO-1999 and ANSI S3.44 standards and the literature related to prediction of noise-induced hearing loss (NIHL) in humans. The dearth of contemporary population-based studies of hearing loss among industrial, low noise-exposed individuals have made the ISO-1999 and ANSI S3.44 standards a key source of comparative data for assessing the risk of NIHL. This paper will highlight how these standards have been used in several published papers to examine the magnitude of NIHL risk, predictions of noise-induced thresholds in hearing conservation data, and to generate hypotheses regarding the biologic plausibility of hearing loss due to chemicals or other ototoxic agents.

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### Session IpNS

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Mary M. Prince, Cochair

*National Institute for Occupational Safety and Health, 4676 Columbia Parkway, M.S. R-16, Cincinnati, Ohio 45226*

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**Prince MM.** [2003]. Predicting noise-induced hearing loss in human populations. The contribution of ISO-1999 and ANSI S3.44. Proceedings of the 145th Meeting: Acoustical Society of America, Nashville, TN, April 28-May 2, 2003. *J. Acoust. Soc. Am.* 113:2194.

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