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28th ANNUAL NHCA HEARING CONSERVATION CONFERENCE
February 20-22, 2003
Westin Park Central Hotel
Dallas, Texas
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Spectrum is published quarterly in January, April, July, and October. This supplement is published yearly in January. Spectrum is a publication of the National Hearing Conservation Association, 9101 E. Kenyon Ave., Denver, CO 80237. The information contained herein is designed to promote action and discussion among members. The information has been obtained from sources believed reliable, and the editor has exercised reasonable care to assure its accuracy. However, the NHCA does not guarantee that the contents of this publication are correct, and statements published do not necessarily reflect the opinions or official position of the NHCA, its officers or members.

Spectrum is available without charge to NHCA members in all categories. Anyone interested in publishing in Spectrum should contact Karen Wojdyla at the national office or Renu Glaser, Editor.

Because of our concern for the environment, we use recycled paper and soy-based inks for Spectrum.
WELCOME TO DALLAS

We realize what a premium there is on your time these days and are pleased that you have chosen to take some of your valuable time to join us to participate in and celebrate NHCA's 28th Annual Conference.

Laurie Wells, your Vice President and Program Chair, and the NHCA Program Committee have assembled an outstanding collection of workshops, lectures and posters featuring new research in our fields, as well as practical tools and ideas, exhibits and more! The conference truly offers something for everyone working in the field of hearing loss prevention.

We are looking forward to a great conference and another great time in Dallas. Again, welcome to the 28th Annual NHCA Conference. Thank you for coming!

Sincerely,
James E. Lankford, President

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Theresa Schulz and Roy Jackson
Established in 1990, this award is given to a person whose work is exemplary in our field. It is a pleasure to announce this year's recipient, Dr. Mead C. Killion. We honor him for his pioneering development of high-fidelity hearing protection, for his pedagogy concerning the importance of sound quality in both attenuation and amplification, and for his invaluable contributions to hearing research and development.

Mead's love of sound and music began early. He was a precocious youth who recalls singing on the church steps for pennies at the age of two, and also accompanying his preacher-parents during services in the sanctuary. Next came crystal radios at age 8, which proved a pathway to radio and TV repair and installation of hi-fi systems to pay for college. Upon graduation from Wabash College in 1961 with an A.B. degree in mathematics, he took a job with Knowles Electronics. There, he had the good fortune to work under the tutelage of Elmer Carlson, a consummate engineer who taught Mead much of what he was to learn about electroacoustics and engineering. From Elmer, Mead also developed the ability to restate a problem in terms so simple that the solution would become obvious, and he learned something more, to which we will return in a moment.

Mead initially planned to stay at Knowles for only a few years. However, it wasn't until some 21 years later that he departed, subsequent to completion of an M.S. in mathematics and a Ph.D. in audiology from Northwestern University in 1979. His dissertation was on high-fidelity hearing aids. By then he was smitten with a bug to work independently, and thus founded Etymotic Research, Inc. (pronounced eh-im-OH-tik). The name, derived from ancient Greek, means "true to the ear," and well describes the line of products that have been launched from his small company in the ensuing 20 years. In keeping with the name, the company's mission is to develop products for the ear, but of equal importance is one of Mead's guiding principles, which is "making things better for people instead of just making money."

Naturally, Etymotic's first product was a high-fidelity hearing-aid circuit. By high fidelity, Mead meant a hearing aid fine enough that it would be transparent to someone with normal hearing. This was in contrast to most of the aids at that time that substantially degraded a normal listener's hearing ability, and consequently provided inadequate assistance for those with actual impairments.

Etymotic's ear-related products have not solely been limited to hearing assistive products, but have also addressed prevention of hearing losses as well. Here serendipity has played a role. When the sound level committee of the Chicago Symphony Orchestra became concerned about possible hearing loss being experienced by its members, they requested Mead's assistance. At the time, the only feasible options to deal with overexposure were sound barriers or conventional hearing protectors that would block too much sound and seriously distort sound quality; neither was desirable. Recalling an existing but fad from a high-fidelity hearing protector developed by his mentor Elmer Carlson, Mead obtained the rights to refine and develop it since Knowles had no interest.

Thus, in 1983 the ER-15 Musician's Earplugs were introduced, the first hearing protectors that provided a truly flat frequency response combined with a mild 15 decibels of average protection. They were ideal for many music exposures as well as other noises that required only modest attenuation. The ER-15 was the first earplug that delivered what many in the hearing conservation community were starting to express a need for, namely, a plug that avoided overprotection, while simultaneously providing balanced noise reduction over the important audio range.

From the initial offering in a custom-molded version, Mead developed other products with slightly more and slightly less attenuation. He also collaborated on a single-sized slightly less-sophisticated premolded design at one-tenth the cost, that was built into an existing and already popular earplug. These products appeared contemporaneously with the growing perception in the hearing conservation community that maximum protection was not always the ideal solution.

Of course, just introducing a new product, especially one that is unexpected and more expensive, does not assure one of immediate success. Mead observed that many buyers of hearing protectors avoided low-attenuation products because they operated on the more-is-better model. Following the dictum that any self-respecting fallacy should be voiced in Latin, he coined the phrase Parsum bonum, plus melius, meaning "a little is good, more is better," and has proceeded to argue strenuously against that notion, both in word ("If two aspirin are good for your headache, should you take the entire bottle?"), and in deed (by surveying the Etymotic line of flat- and moderate-attenuation earplugs). As a result, other manufacturers and additional hearing conservationists have come to realize the importance of providing such types of de-
serves, and many more noise-exposed people at work and play now benefit from his efforts.

Mead has even proposed an Audibility Reduction Rating (ARR) as an adjuncor to the Noise Reduction Rating (NRR). It is computed by adding, instead of subtracting, a suitable safety factor. Thus a typical high-attenuation product that might sport an NRR of 29 dB, would also be labeled with an ARR of 51 dB to indicate how it would degrade communications in certain applications. As Mead is fond of saying, “Who wants earplugs that won’t let you hear?” And beyond the ARR, Mead has been one of the leaders in developing new, quick, and accurate means of characterizing listeners’ ability to hear in noise, with and without a hearing loss, and with and without protection. These tests, labeled with the catchy moniker, SIN tests (meaning Speech In Noise), have provided a new tool for readily evaluating hearing abilities, hearing aids, and the effects of hearing protectors.

Mead’s contributions have also come in the form of numerous publications (in excess of 60 papers, 15 textbook chapters, and a number of audio demonstration CDs), 40 patents with six pending, and invited presentations and workshops in 19 countries. NHCA members can attest to the quality of his lectures; in 1990 he shared the first of the NHCA’s Outstanding Lecture Awards. Mead received an honorary doctor of science (Sc.D.) from Wabash in 1998 and is on the adjunct faculty at three universities.

Mead’s work is all about hearing. Whether he is making products to preserve, measure, or restore hearing ability, creating delightful sounds as a pianist, violinist, vocalist, and choir director, or teaching students and interacting with peers, Mead’s integrity and passion have enriched the lives of those he has touched. His energy, enthusiasm, and brilliant and peripatetic intellect have galvanized developments that have substantially assisted the hearing-conservation and rehabilitation communities. In fact, today, over two million hearing-aid wearers worldwide benefit from his inventions. And I, for one, am grateful for his contributions to hearing conservation every time my hearing is protected in a way that allows me to hear more comfortably and clearly by a pair of the earplugs that bear his company’s name.

By Elliott Berger

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**LIVE AND SILENT AUCTION**

Participate in NHCA’s Live and Silent Auctions and bid on items to help support our organization! If you are interested in donating an item for one of the auctions, please bring that item(s), or a certificate, to the conference registration desk. The live auction will be held on Thursday evening during the reception. The Silent Auction will run through Saturday morning.
Michael Beall Threadgill Award

"Initially designated the Outstanding Leadership and Service to NHCA Award, it was renamed in 1990 in memory of Michael B. Threadgill. This award is conferred annually if a suitable candidate is recommended by the Nominations Committee and approved by the Executive Council" (NHCA Policy Manual)...to formally honor individuals whose outstanding commitment of time and effort has significantly contributed to the leadership and continuing excellence of the National Hearing Conservation Association.

Mary M. McDaniels (trademark “m3”)—your professional peers are pleased to present the prestigious 2003 Michael Beall Threadgill Award to you in recognition of your distinguished leadership of and service to the National Hearing Conservation Association (NHCA).

Members and friends of NHCA, if you have ever remotely participated in an area of responsibility in our association within the past 15 years, you automatically have name recognition when you use “m3” on the signature line of a written communication. While this trademark may not be directly linked to “Sesame Street”—you have to admit—Mary brings special significance to words that begin with the letter “M.”

Academic Mission—Masters degree in Audiology—first job, second job—Bingo!!!

Mary became a Member of NHCA in 1986. Her "Make a difference" Mindset explains the initial force that motivated her to pull a chair up to the table at the Ad Hoc Committee on Baseline Revision, the Ad Hoc Committee for the formulation and publication of Mobile Hearing Test Guidelines, and what became an unprecedented 12 years on the Conference Program Committee.

Early on, those in the leadership of NHCA recognized the Multi-talents of this rising star and her willingness to serve. The evolution of Mary's appointments to the Steering Committee, Scholarship Committee and Editorial Committee became increasingly visible to the Membership who responded by repeatedly voting her a seat on the NHCA Executive Council where she served the association as Secretary, Vice President, and the natural progression from President-Elect to the office of President (1997-98) followed by Chairperson of the Steering Committee.

Throughout these various tenures it is words like Meticulous concern for details, Methodical sense of order, and an almost Magical ability to solicit and attain "yes, I will be happy to do that" that describe Mary's Masterful style of team Management.

Having already served full terms of office including President, it was Mary who stepped forward at a critical Moment in the life of NHCA and agreed to dispel the Myth that the responsibilities for Conference Program Chair had become an unreasonably big task. Suffice it to say, Conference 2001 and Conference 2002 are both acclaimed as Memorable examples of what it means to orchestrate an enjoyable and educational Masterpiece... administratively capped by Monetary benefits extraordinarie (for the association!)

Yes, Mary does have a professional life beyond NHCA in the Management of Pacific Hearing Conservation headquartered in Seattle. Her Menu of services includes notoriety for being in the “Top 25 CAOHC Course Directors” year after year after year.

And yes, Mary has a professional reputation recognized by affiliate audiences that have drawn her into committee service with ASHA, representative responsibilities with state regulatory agencies, and her recent approval by the CAOHC Council to a term as ASHA’s appointed representative on CAOHC’s distinguished Board of Directors.

Mary’s internal compass does not waiver from true north. Maneuver, Manipulate, or Mediocre have never been used to describe her decisions or explain her actions. In word and deed Mary’s commitment to the Mission of preventing noise-induced hearing loss in all sectors of society is clear, consistent and will not, under any circumstances, be compromised.

Therefore, if a Model is an example to be imitated or compared, it is easy to understand why the Members of NHCA, in Memory of Michael Beall Threadgill, take pride in formally acknowledging that “m3” symbolizes its standard for leadership and service.

Mary, please accept our sincere gratitude as we rally to extol, “Congratulations, M-A-R-Y!”

By Merlyn Lubiens
COMMITTEE & ALLIED MEETINGS

WEDNESDAY, FEBRUARY 19

Time:  
9:00 A.M. – 12:00 NOON
1:00 P.M. – 6:00 P.M.
6:00 P.M. – 7:00 P.M.

Group:  
Steering Committee
Executive Council
Program Committee

Room:  
Tenison A
Tenison A
Degolyer

THURSDAY, FEBRUARY 20

4:00 P.M. – 5:00 P.M.
4:00 P.M. – 5:00 P.M.

Group:  
Publications Committee
HCE for Children and Adolescents

Room:  
Marsalis
Rosemont

FRIDAY, FEBRUARY 21

7:30 A.M. – 8:15 A.M.

Group:  
Legislation Committee

Room:  
Rosemont

SUNDAY, FEBRUARY 23

8:30 A.M. – 12:00 NOON

Group:  
ANSI S12/WG11 Hearing Protector Attenuation and Performance

Room:  
Alexander

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- Support for multiple companies
- Separate tracking for left and right ear baselines
- Automatic baseline revision (NHCA Criteria)
- Support for new OSHA recordable regulation (29 CFR 1904.10 - 2002)
- Medical history questionnaire (10 medical referral questions, 20 user-defined)
- Medical referral reporting (AAO-HNS - 1996)
- Comprehensive reports
- Customizable notification letters in 12 languages
- Extensive demographic and audiogram user-defined data fields
- Fully configurable import and export routines

Best of all, Solo™ is affordable, easy to use, and available now for clinic and mobile use.

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Solo™ Occupational DBMS

Attend our complimentary Product Seminar Thursday, February 20th 2-4 pm
Westin Park Central Hotel, Dallas, TX. Contact us for further information.

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EXHIBIT SCHEDULE — GRAND BALLROOM SALON E

THURSDAY, FEBRUARY 20
Exhibit Set-up and Registration
11:00 A.M. – 4:00 P.M.
Exhibits Open
Opening Reception in Exhibit Hall
5:00 P.M. – 9:00 P.M.

FRIDAY, FEBRUARY 21
Continental Breakfast/
Exhibits Open
7:30 A.M. – 8:30 A.M.
Break/Exhibits Open
10:00 A.M. – 10:45 A.M.
Luncheon with
Exhibitor Introductions
12:00 NOON – 1:40 P.M.
Break/Exhibits Open
3:15 P.M. – 3:45 P.M.

SATURDAY, FEBRUARY 22
Exhibits Open
7:30 A.M. – 8:00 A.M.
Break/Exhibits Open
10:00 A.M. – 11:10 A.M.
Exhibit Dismantling
12:00 NOON – 4:00 P.M.

HOTEL MAP

Second Floor

NHCA Spectrum, Volume 20, Supplement 1, 2003
SPONSORS, AFFILIATES & EXHIBITORS

3M Occupational Health and Environmental Safety Division

The remarkable comfort of 3M™ Hearing Protectors helps increase wear time in order to reduce exposure to hazardous noise and loud sounds. Stop by the 3M exhibit to see new Soft Foam Ear Plugs 1120 and Corded Soft Foam Ear Plugs 1130 featuring a patented 3M design. This unique, “articulated” design helps the ear plug better conform to the shape of the ear canal. The soft, low-pressure foam results in greater comfort for a wider range of ear sizes. 3M Reusable Ear Plugs have also been enhanced for greater comfort. These pre-molded ear plugs now feature a softer elastic material for longer wear time and a unique finger-grip stem for easy insertion. Check out our full line of ear muffs and banded hearing protectors as well. You’ll see why 3M Occupational Health and Environmental Safety Division is the global leader in personal protective equipment.

American Academy of Audiology

The American Academy of Audiology, the world’s largest professional organization of audiologists, is dedicated to providing quality hearing care services through professional development, education, research and increased public awareness of hearing disorders. To learn more about the audiology profession and how audiologists are helping the 28 million Americans who suffer from hearing loss, please visit The Academy’s web site at www.audiology.org.

American Industrial Hygiene Association

The American Industrial Hygiene Association (AIHA), founded in 1939, is the world’s largest association of occupational and environmental health professionals, and its members play an important role on the frontline of worker health and safety. The 12,500 members come from government, labor, industry, academia, and private business. AIHA is the most diverse professional association dedicated to the improvement of the health and well-being of workers, the community, and the environment.

American Speech-Language-Hearing Association

ASHA is the professional, scientific, and credentialing organization representing over 107,000 audiologists, speech-language pathologists, and hearing and speech scientists who provide hearing conservation, diagnostic, rehabilitative, and consultative services and conduct research for children and adults who are at risk for or have hearing, balance, speech, language, and/or swallowing disor-
ders. Approximately 45 percent of ASHA’s audiologists provide hearing conservation services for industry. For more than a decade, ASHA coordinated the efforts of the Coalition to Protect Workers’ Hearing, which addresses federal regulatory initiatives from OSHA, NIOSH, MSHA, and agency reform efforts by Congress. ASHA has a Special Interest Division on Hearing Conservation.

Benson Medical Instruments Co.

Benson Medical Instruments manufactures a full-line of industrial audiometers, hearing conservation software and accessories with advantages in testing speed, quality, ease of use, and data handling. We offer solutions for a single clinic and for multi-station mobile testing.

Bilsom®

Bilsom® hearing protection, a global leader in passive and active hearing protection for over 35 years, is a leader in noise attenuation with breakthroughs in electronic earmuffs and patented Natural Sound Technology®. An ISO 9001-certified manufacturer based in Sweden, Bilsom® has set a strong commitment to providing first-class comfort in noise attenuation, paired with advanced design and technology.

Centers for Disease Control and Prevention; National Institute for Occupational Safety and Health

The National Institute for Occupational Safety and Health (NIOSH) is the federal agency responsible for conducting research, disseminating information, and making recommendations regarding prevention of work-related disease injury. NIOSH is part of the Centers for Disease Control and Prevention (CDC) and also investigates potentially hazardous working conditions when requested by employers or employees. Headquartered in Washington, D.C., NIOSH has offices in Atlanta, Georgia, and research divisions in Cincinnati, Ohio; Morgantown, West Virginia; Bruceton, Pennsylvania; and Spokane, Washington.

Council for Accreditation in Occupational Hearing Conservation (CAOHC)

CAOHC is dedicated to the establishment and maintenance of training standards for those who safeguard hearing in the workplace. CAOHC has been a leader in providing standards for occupational hearing conservation programs since its inception in 1973. CAOHC certification offers the certified occupational
hearing conservationist (COHC) credibility and serves as verification that the conservationist has been trained to the highest standards. CAOHC certification is recommended by the Occupational Safety and Health Administration (OSHA) and is mandatory for the Mine Safety & Health Administration (MSHA). In 2003 the 4th Edition Hearing Conservation Manual, by Alice Suter, Ph.D., was introduced. All hearing conservation team members will find this manual vital in the front-line defense against hearing loss in workers. More information available about CAOHC on the worldwide web at: www.caohan.org.

‖‖ E-A-R®


Eckel Industries of Canada Limited

Eckel Industries is a manufacturer of noise control products and services, including audiometric booths, rooms and suites and an infant acoustic isopleth for hearing screening testing and clinical evaluation; architectural noise control panels for control of room acoustics; machinery and other types of industrial enclosures; ancillary testing facilities for noise research.

Hearing Coach

‖‖ Howard Leight

Howard Leight Industries is a leading manufacturer of hearing protection devices, including disposable and reusable earplugs, banded hearing protectors and earmuffs. An ISO 9001 certified company, Howard Leight has been driving worldwide development and innovation in hearing protection for over 25 years. Its world-class audiology department maintains the highest industry standards in the design and evaluation of hearing protection devices.

Larson Davis

Larson Davis is a leading supplier of Noise and Vibration measurement instrumentation since 1981. Products include Audiometric Calibration systems, Personal Noise Dosimeters, Type 1 Sound Level meters, Octave Band, and Real-time analyzers, and a Hand-arm / Whole Body Vibration monitor for evaluating human exposures to ISO 2631 and 5349.

Maico Diagnostics

A leading U.S. manufacturer of Audiometers has been chosen by major corporations and the U.S. Department of Defense to carry them into the future. If you need a new Audiometer, Maico has the products to meet your needs. In addition, Maico, in connection with the House Ear Institute, will show the HINT! (Hearing in Noise Test) that measures speech intelligibility under conditions that allow assessment of the subject's use of both ears together to hear in quiet and in noise. Stop by our booth for a free demonstration.

Moldex-Metric, Inc.

Moldex manufactures and markets respirators and hearing protectors for the safety and personal protection of workers in industry and healthcare. Moldex strives to design and engineer products that provide comfort and style for wearers and cost savings for employers. This focus on respirators and hearing protectors has made Moldex a recognized leader, with over fifty patents for innovative and unique products.

Occupational Marketing, Inc.

Best known for its spirometry software and continuing education courses, OMI has always been considered a leader in the field of occupational health. Keeping the needs of a program administrator in mind, OMI has created one of the most comprehensive audiometric software packages available today. Let us show you.

‖‖ Peltor®

Peltor, preferred by professionals everywhere, has long been considered the leader in protective communication headsets and earmuff hearing protectors. All Peltor products are designed to provide the optimum attenuation, maximum comfort, and the most sophisticated technology available. Innovative designs include the dual-shell H10 Extreme Performance earmuff, the High Performance Series® of clear cup earmuff for easily monitored dual protection, and the Tactical® 7S electronic “listening” earmuff. The PowerCom™ two-way UHF radio headset has a transmission range of up to 2 miles. The newest communication device is the Hearplug® featuring communications abilities through popular E-A-R® style hearing protectors. Visit our Web Site at: www.peltor.com.

‖‖ Quest Technologies, Inc.

Quest Technologies, Inc., is one of the most widely recognized and respected worldwide manufacturers for both the Quest and Metronics brands of occupational hygiene, safety and environmental instruments, and audiometric calibration systems for measurements and analysis. Included are basic and logging versions of sound level meters, octave band analyzers, hand-arm, whole-body and machine vibration monitors, noise dosimeters, audiometric

Continued on page 12
calibration systems, gas detectors, heat stress monitors, and indoor air quality monitors. Quest Technologies maintains a Registered Quality Management System to ISO 9001:2000 Standards and A2LA Accredited Calibration Laboratory to ISO 17025. The Quest brand is dedicated to offering a “Systems Solution” via our QuestSuite Professional software, whereas the Metrosonics brand is committed to providing “Guaranteed Simple Solutions at an Affordable Price” with uncompromising quality. Our products are available through our worldwide distribution network or direct orders via our U.S. GSA contract. Quest is proud to be a member of NHCA, AIHA, ASA, NATA, NSC and VPPPA.

ResultGroup, Inc., The Internet Occupational Hearing Test Analysis Company

This online program is accessible from any computer with Internet connection. No additional software required, program updates automatically via Internet service N/C, customized to meet client’s needs. Excellent tech. support, for overview visit: www.resultgroup.com or call ResultGroup, Inc. 865-680-6331, email: info@resultgroup.com.

++ Sonomax

Sonomax is dedicated to lowering the incidence of noise-induced hearing loss (NIHL) by developing and marketing leading-edge hearing protection products, and by working to raise public awareness of the unacceptable costs of NIHL. The Sonomax Solution™ is a hearing protection system for industry that combines uniquely designed earpieces, optimized proprietary hardware and an easily navigable Windows®-based support application. Sono-Pass™ software, which drives the fitting process, confirms the acoustic seal, calibrates the level of sound attenuation achieved and records the results. In combination, Sono-Pass™’s hardware and software provides for a simple, on-the-spot procedure, allowing a technician to deliver hearing protection that is custom fitted to the wearer, and function tested for reliability. In addition, the application provides employers the unique ability to quantify and track hearing protection performance and produce thorough reports on collected data that can support an effective and comprehensive hearing conservation program.

Tasco Corporation

Tasco Corporation, leading the industry as the premier manufacturer of circumaural, semiaural, disposable and reusable hearing protection for twenty-seven years. All of our products are proudly made in their entirety in the USA and tested at a NVLAP facility. Government and other independent testing has proven the Tasco Products’ high performance and repeatability of NRRs. You can trust Tasco for all of your Hearing, Face and Head protection needs.

Tremetrics Occupational Health Group

Tremetrics Occupational Health Group provides a complete line of microprocessor/digital audiometers, space-saving mobile testing systems, hearing test booths and comprehensive hearing/health data management software. The NEW Tremetrics HT Wizard®/Easy Touch audiometer provides truly new and innovative features never before offered in a stand-alone screening audiometer. Turn to Tremetrics for total, one source hearing testing solutions consisting of audiometers, booths, software, world-wide service and calibration.

Westone Labs
# PROGRAM

## Thursday, February 20

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m. - 5:30 p.m.</td>
<td>Registration and Information Desk Open</td>
<td>Salon Foyer</td>
</tr>
<tr>
<td>7:30 a.m. - 8:30 a.m.</td>
<td>Continental Breakfast</td>
<td>Salon Foyer</td>
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<tr>
<td>8:30 a.m. - 11:30 a.m.</td>
<td>Concurrent Morning Workshops:</td>
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<tr>
<td></td>
<td>1. Hearing Conservation Training &amp; Outreach Showcase Expo</td>
<td>Salon A</td>
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<td></td>
<td>Richard W. Danielson, Ph.D., CCC-A, Baylor College of Medicine, Houston, TX</td>
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<td>Beth A. Cooper, PE, INCA Board Certified, NASA John H. Glenn Research Center at Lewis Field, Cleveland, OH</td>
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<tr>
<td></td>
<td>2. Chemical Exposure and NIHL</td>
<td>Salon B</td>
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<td></td>
<td>Donald Henderson, Ph.D., Center for Hearing and Deafness, Buffalo, NY</td>
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<td>Thaie Morata, Ph.D., NIOSH, Cincinnati, OH</td>
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<td>Peter M. Rabinowitz, M.D., M.P.H., Yale University School of Medicine, New Haven, CT</td>
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<td>3. Family Business Partners</td>
<td>Salon C</td>
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<td></td>
<td>Melinda Witt, KGA Group, Dallas, TX</td>
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<td>4. Human Factors Principles in Auditory Warning Signal Design</td>
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<td>John Casali, Ph.D., Virginia Tech, Blacksburg, VA</td>
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<tr>
<td>8:30 a.m. - 4:00 p.m.</td>
<td>All Day Seminar – “Hearing Loss Prevention: The Basics”</td>
<td>Marsalis</td>
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<td></td>
<td>Dennis Driscoll, PE, MS, Associates in Acoustics, Inc., Evergreen, CO</td>
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<td>Elliott H. Berger, MS, INCE Board Certified, E-A-R, Indianapolis, IN</td>
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<td>Lt. Col. Theresa Schulz, USAF, San Antonio, TX</td>
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<td>Maj. Tressie Waldo, USAF, Wright-Patterson, Huber Heights, OH</td>
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<tr>
<td>9:45 a.m. - 10:15 a.m.</td>
<td>Workshop &amp; Seminar Break with Refreshments</td>
<td>Salon Foyer</td>
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<tr>
<td>11:30 a.m. - 1:00 p.m.</td>
<td>Lunch (on your own)</td>
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<td>1:00 p.m. - 4:00 p.m.</td>
<td>Concurrent Afternoon Workshops: Repeat of Morning Workshops</td>
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<tr>
<td>2:15 p.m. - 2:45 p.m.</td>
<td>Workshop &amp; Seminar Break with Refreshments</td>
<td>Salon Foyer</td>
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<td>4:00 p.m. - 5:00 p.m.</td>
<td>Free Networking Time</td>
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<tr>
<td>5:00 p.m. - 9:00 p.m.</td>
<td>Opening Reception in the Exhibit Hall</td>
<td>Salon E</td>
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★★★★ **LIVE AUCTION★★★★

## Friday, February 21

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<thead>
<tr>
<th>Time</th>
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<tr>
<td>7:30 a.m. - 5:30 p.m.</td>
<td>Registration and Information Desk Open</td>
<td>Salon Foyer</td>
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<tr>
<td>7:30 a.m. - 8:30 a.m.</td>
<td>Continental Breakfast in the Exhibit Hall</td>
<td>Salon E</td>
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<tr>
<td>8:30 a.m. - 8:40 a.m.</td>
<td>Opening Remarks</td>
<td>Salon F</td>
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<td></td>
<td>James Lankford, Ph.D., DeKalb, IL</td>
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<td>NHCA President</td>
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<td>Laurie Wells, MS, FAAAA, Associates in Acoustics, Inc., Loveland, CO</td>
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<td>Program Chair</td>
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<tr>
<td>8:40 a.m. - 9:10 a.m.</td>
<td>Otoprotectants: The Role of Antioxidants</td>
<td>Salon F</td>
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<td>Col. Richard Kopke, U.S. Army, San Diego, CA</td>
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<tr>
<td>9:10 a.m. - 9:30 a.m.</td>
<td>The Role of the Cochlear Efferent System in Humans in Protecting the Ear From Noise Damage</td>
<td>Salon F</td>
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<td>Brenda Lonsbury-Martinson, Ph.D., University of Colorado Health Sciences Center, Denver, CO</td>
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### Friday, February 21

<table>
<thead>
<tr>
<th>Time</th>
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</table>
| 9:30 a.m. - 9:50 a.m. | Genetics of Noise-Induced Hearing Loss Susceptibility  
Sharon Kujawa, Ph.D., Harvard Medical School, Boston, MA | Salon F                         |
| 9:50 a.m. - 10:00 a.m. | Poster Introduction  
Ann Anderson, MS, CCC-A, Mayo Clinic, Rochester, MN | Salon F                         |
|                  | Media Theater Introduction  
Rick Neitzel, MS, IHIT, ASPI, University of Washington, Seattle, WA |                                |
| 10:00 a.m. - 10:45 a.m. | Break – Exhibits, Posters, Media Theater  
Salon E / Degolyer |                                |
| 10:45 a.m. - 11:05 a.m. | Audiology vs OAE in Construction Industry  
Noah Seixas, University of Washington, Seattle, WA | Salon F                         |
| 11:05 a.m. - 11:25 a.m. | Non-Occupational Noise in Construction Workers: Should We Care?  
Rick Neitzel, MS, IHIT, ASPI, University of Washington, Seattle, WA | Salon F                         |
| 11:25 a.m. - 11:55 a.m. | NHCA Business Meeting | Salon F                         |
| 12:00 Noon - 1:40 p.m. | Luncheon – Musical Illusions and Paradoxes  
Diana Deutsch, Ph.D., University of California, La Jolla, CA | Salon D                         |
| **CONCURRENT SESSIONS** | |                                |
| 1:45 p.m. - 3:15 p.m. | Innovations in Providing Hearing Loss Prevention Information  
Bob Randolph, NIOSH-PRL, Pittsburgh, PA | Salon A                         |
| 1:45 p.m. - 3:15 p.m. | Hearing Loss Prevention with Musicians  
Marshall Chasin, Musician’s Clinic of Canada, Toronto, Ontario, Canada | Salon B                         |
| 1:45 p.m. - 3:15 p.m. | Landing on the Roof: Noise Control Efforts on Aircraft Carriers  
Kurt Yankaskas, Special Assistant, System Safety Secretary of the Navy, Washington, DC | Salon C                         |
| 3:15 p.m. - 3:45 p.m. | Break – Exhibits, Posters, Media Theater  
Salon E / Degolyer |                                |
| 3:45 p.m. - 5:00 p.m. | Field Assessment of TTS and Implications for Evaluating and Preventing STS and PTS | Salon F                         |
|                  | Tribute to Dan Johnson  
Mary M. Prince, Ph.D., NIOSH, Cincinnati, OH  
Robert Bertrand, MD, Bertrand-Johnson Acoustics, Inc., Montreal, Quebec, Canada  
George Cook, Jr., CCC-A, Workplace Hearing Inc., Greensboro, NC  
David Lipscomb, Ph.D., Correct Service Inc., Stanwood, WA  
Doug Olbin, Ph.D., USACHPPM, Aberdeen Proving Ground, MD |                                |
<p>| 5:00 p.m. - 6:00 p.m. | Committee Meetings and Free Networking Time |                                |
| 6:00 p.m. - 10:00 p.m. | Special Event: Mad Scientist Reception at the Science Place |                                |</p>
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<td>7:30 a.m. - 8:00 a.m.</td>
<td>Exhibit Hall Open</td>
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<td>7:30 a.m. - 5:30 p.m.</td>
<td>Registration and Information Desk Open</td>
<td>Salon Foyer</td>
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<td>8:00 a.m. - 9:00 a.m.</td>
<td>Round Table Discussions - Breakfast</td>
<td>Salon D</td>
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<td>- Hearing Loss Recordability Issues</td>
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<td>- Baseline Revision</td>
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<td>- Hearing Conservation in Private Practice</td>
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<td>- Building the Construction Regulation</td>
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<td>- Hearing Impaired Employees in the Workplace</td>
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<td>- Risk Management and Worker's Compensation</td>
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<td>- Hearing Protection Old and New</td>
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<td>- Ambient Noise Levels in the Test Environment</td>
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<td>- Certification of OHCs</td>
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<td>- Hearing Conservation Regulations</td>
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<td>- Future Research Ideas</td>
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<td>9:10 a.m. - 9:30 a.m.</td>
<td>Hearing Protection for People with a Typical Hearing Impairment</td>
<td>Salon F</td>
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<td>Per Hiselius, Bilson/Dalloz Safety, Billesholm, Sweden</td>
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<tr>
<td>9:30 a.m. - 9:50 a.m.</td>
<td>When the Sound Gets Thru, What Can You Do? ... the Limits to Attenuation</td>
<td>Salon F</td>
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<td>Elliott Berger, MS, INCE, Board Certified, E-A-R, Indianapolis, IN</td>
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<td>Dan Gauger, Bose Corporation, Framingham, MA</td>
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<td>9:50 a.m. - 10:10 a.m.</td>
<td>Bone Conduction Communication: Applications and Limitations</td>
<td>Salon F</td>
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<td>Tom Letowski, Ph.D., D.Sc., U.S. Army Research Laboratory, Aberdeen</td>
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<td>Proving Ground, MD</td>
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<td>10:00 a.m. - 11:10 a.m.</td>
<td>Break – Exhibits, Posters, Media Theater</td>
<td>Salon E / Degolyer</td>
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<td>11:00 a.m. - 12:25 p.m.</td>
<td>HPD Attenuation Verification: A Viable Option?</td>
<td>Salon F</td>
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<td>Ted Madison, MA, CCC-A, 3M Occupational Health &amp; Environmental Safety Division, St. Paul, MN</td>
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<td>Gail Guðmundsdóttir, GuðHear, Inc., Elk Grove Village, IL</td>
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<td>Professor Dr. B. Vinck, University of Ghent, Belgium</td>
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<td>Jeremie Voix, University of Quebec, Montréal, Quebec, Canada</td>
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<td>Kevin Michael, Ph.D., Michael &amp; Associates, Inc., State College, PA</td>
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### Saturday, February 22

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>12:30 p.m. - 1:30 p.m.</td>
<td>Awards Luncheon &lt;br&gt;1. Michael Beall Threadgill Award &lt;br&gt;2. Outstanding Hearing Conservationist Award &lt;br&gt;3. 2002 Outstanding Lecture Award &lt;br&gt;4. 2002 Outstanding Poster Award &lt;br&gt;5. 2002 Golden Lobe Awards</td>
</tr>
<tr>
<td>1:40 p.m. - 2:00 p.m.</td>
<td>Gasaway Lecture: NHCA and You: A Penny for Your Thoughts &lt;br&gt;&lt;i&gt;Lt. Col. Theresa Schulz, USAF, San Antonio, TX&lt;/i&gt;</td>
</tr>
<tr>
<td>2:00 p.m. - 2:20 p.m.</td>
<td>HCP Coal Mine or A Model HCP for Coal Miners &lt;br&gt;&lt;i&gt;Tom Frank, Ph.D., Penn State University, University Park, PA&lt;/i&gt;</td>
</tr>
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<td>2:20 p.m. - 2:40 p.m.</td>
<td>Sonification for Audio Displays Based on User Center Design &lt;br&gt;&lt;i&gt;Nancy Vause, US Army Research Lab, Fort Sam Houston, TX&lt;/i&gt;</td>
</tr>
<tr>
<td>2:40 p.m. - 2:50 p.m.</td>
<td>To Scope or Not to Scope: That Is the Question &lt;br&gt;&lt;i&gt;Ross Roeser, Ph.D., CCC-A, UTD/Callier Center, Dallas, TX &lt;br&gt;Lydia Lai, Student, UTD/Callier Center, Dallas, TX&lt;/i&gt;</td>
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<tr>
<td>2:50 p.m. - 3:05 p.m.</td>
<td>Break &lt;br&gt;&lt;i&gt;Salon Foyer&lt;/i&gt;</td>
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<tr>
<td>3:05 p.m. - 4:05 p.m.</td>
<td>OSHA's New Record Keeping Rule: Fence or Hurdle? &lt;br&gt;&lt;i&gt;Lee Hager, Sonomax Great Lakes, Portland, MI &lt;br&gt;Robert Doble, MD, NIDCD, Washington, DC &lt;br&gt;Susan Megerson, MA, CCC-A, University of Kansas, Shawnee Mission, KS&lt;/i&gt;</td>
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<tr>
<td>4:05 p.m. - 4:25 p.m.</td>
<td>Leave for Airport</td>
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<tr>
<td>4:25 p.m. - 4:45 p.m.</td>
<td>Determining Work-Relatedness of NIHL &lt;br&gt;&lt;i&gt;Alan Langman, MD, Puget Sound Hearing and Balance, Seattle, WA&lt;/i&gt;</td>
</tr>
<tr>
<td>4:45 p.m. - 4:50 p.m.</td>
<td>Evaluation of Hearing Conservation Program Effectiveness: Compliance vs Actual Practices &lt;br&gt;&lt;i&gt;Mary M. Prince, Ph.D., NIOSH, Cincinnati, OH&lt;/i&gt;</td>
</tr>
<tr>
<td>4:45 p.m. - 4:50 p.m.</td>
<td>Closing Remarks &lt;br&gt;&lt;i&gt;James Lankford, Ph.D., DeKalb, IL &lt;br&gt;NHCA President&lt;/i&gt;</td>
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</table>
NHCA is pleased to announce the recipients of this year's Annual Conference Award. This award is available to students who are actively pursuing a degree in a discipline related to hearing conservation and who are enrolled at least half-time in an accredited educational institution. Applications were submitted by students from a variety of academic programs across the country and internationally. Recipients receive free conference registration and limited reimbursement for travel expenses. Please welcome these first-time attendees to our conference. Special thanks go to our 2003 sponsors for making this program possible: The American Industrial Hygiene Association, Eckel Industries, James Lankford, and Quest Technologies.

Kimberly Jordan, University of Texas at Dallas  
doctor of audiology (AuD) program

Melissa Norman, University of Alabama at Birmingham  
doctor of public health (DPH) program

Jonathan Thomas, Colorado State University – Fort Collins  
Ph.D. program in industrial hygiene

Elizabeth Thompson, Indiana University – Bloomington  
master's program in audiology

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3M Innovation
CONFERENCE ABSTRACTS

THURSDAY, FEBRUARY 20

WORKSHOP 1

Hearing Conservation Training and Outreach Showcase Expo
Richard W. Danielon, Ph.D., CCC-A, and Beth A. Cooper, PE,
INCE Bd.Cert.

As relentless as NHCA members are in their hearing conservation education efforts, their program success is eternally subject to how well the information is presented and received. This session will offer a comprehensive collection of strategies, teaching materials, and ideas that can increase hearing conservation awareness (e.g., to schools, employees, plant managers, and the public), effectiveness, and compliance. The objective of this workshop will be to offer participants new perspectives on how the media (including printed and electronic forms) can enhance their current training programs, as well as extend efforts into other venues that may be yet untapped. At the end of this fun forum, participants will receive a set of materials that have been contributed by successful hearing conservationists.

WORKSHOP 2

Chemical Exposure and Noise-Induced Hearing Loss
Thais Moneta, Ph.D., Donald Henderson, Ph.D., and Peter M.
Rabinowitz, M.D., M.P.H.

Research over the last decade has indicated that occupational exposure to chemicals, either alone or in combination with noise, can damage hearing. The audiological signs and cochlear pathology associated with chemical exposure are similar, when not identical, to those from noise exposure. This workshop will review the findings from studies on the effects of noise and chemicals on hearing and examine the involvement of reactive oxygen species (ROS) as a common factor in these causes of sensory-neural hearing loss. The second portion of the workshop will present practical steps that workers, employers, and occupational health professionals can take to improve hearing loss prevention. Finally, this workshop will summarize the recommendations of the April 2002 Best Practices Workshop on the Combined Effects of Chemicals and Noise on Hearing and the NIOSH strategy for targeting workers in the workplace.

WORKSHOP 3

Family Business Partners
Melinda Witt, John Chalk, and Jerry McNabb

Family Business Partners is a team of professionals from specific fields of expertise who help design and implement ownership succession and wealth transfer strategies for family-owned businesses. The important part of our work is to assist the family business owner with a plan for succession—getting all the family members together to be sure they are in the communication loop as to what will happen and when. As experienced advisors, we help families achieve the future they envision for themselves and for their businesses. We understand the dynamics of family members working together, and each person in our team has the experience to help you face the unique challenges that you, as a family-owned business, may encounter. Our team consists of representatives from three primary disciplines: Communication Consultant, Tax Advisor and Financial Service Professional.

WORKSHOP 4

Human Factors Principles in Auditory Warning Signal Design
John G. Casali, Ph.D., CPE

Adhering to a human-centered design philosophy, this three-hour workshop will provide practical guidance concerning the selection, design, implementation, and performance of nonverbal auditory alarms and warnings for use in noisy environments. Signal design parameters (frequency spectrum, intensity, temporal patterning, etc.) will be covered in a framework of basic human engineering guidelines, ISO and other standards, and relevant research from the literature. Brief coverage will be given to hearing protector effects, attentional factors, and unconventional auditory warnings, such as auditory icons. Illustrative examples of signal audibility calculations and research on signal detection conducted at Virginia Tech will be presented.

ALL DAY SEMINAR—HEARING LOSS PREVENTION: THE BASICS

Noise Measurement and Control
Dennis Driscoll, PE, M.S.

Noise control is a key component of a comprehensive HCP. The best solution to in-plant noise problems is to implement and maintain an effective noise control program. Successful management of a program requires a basic knowledge of the principles of noise control. In addition, these principles need to be integrated with a clearly defined strategy. This presentation covers the six principles of noise control essential for the analysis and correction of noise problems. New guidelines for program management will also be included. Lastly, this presentation will provide a series of recommendations to assist with the establishment and management of a formal noise control program.

Problem Audiograms—Case Studies
Maj. Trenie L. Waldo

Audiometric monitoring is but one part of a successful hearing conservation or hearing loss prevention program. Annual hearing tests are known to indicate noise-induced hearing loss as well as medical pathologies. Accurate and timely referrals are critical to successful intervention of medical conditions and in hearing loss prevention strategies. Participants will review and discuss a variety of cases. You will be asked to share ideas, plan of action, and patient disposition.
Hearing Protection... You Said What?
Elliott Berger, M.S.

Hearing conservationists can measure, assess, document and counsel, but when it comes to effective intervention, our primary tool is a hearing protector. It is important to gain knowledge of the specifications of hearing protection devices and their use in HCPs. This presentation will focus on how hearing protectors function, how they are tested and rated (with particular reference to the Noise Reduction Rating), the performance gains available from the use of dual hearing protectors, the effects of hearing protectors on speech communication and useful tips on fitting today’s popular products. Emphasis will be placed on new developments such as flat and moderate attenuation hearing protectors and earmuffs with active noise reduction (ANR) circuitry.

Motivation: The Key to Prevention
Lt. Col. Theresa Schults

Education is a required component of a hearing conservation program, but motivation is the key to preventing noise-induced hearing loss. We’ll talk about why this is so and how to motivate people to value their hearing and protect it.

FRIDAY, FEBRUARY 21

Ottoprotectants: The Role of Antioxidants
Richard D. Kopke, M.D.

New understanding of the molecular mechanisms of acoustic injury is leading to exciting strategies to prevent and treat acute noise-induced hearing loss. Acoustic overexposure produces cochlear oxidative toxins known as free radicals. When cochlear antioxidant (AO) defenses become overwhelmed by these toxins, hair cell and neuronal damage ensues. If the damage is extensive enough, hair cells die leading to permanent hearing loss. Mitochondrial injury and depletion of the key inner ear AO, glutathione (GSH), are key events leading to permanent hearing loss. After augmenting the intrinsic cochlear AO defenses with nutritional supplements that protect mitochondria and enhance GSH, a nearly complete prevention of permanent hearing loss from toxic noises is observed. It is also possible to reduce permanent hearing loss using these same compounds if given shortly after acute noise injury. Clinical trials using these compounds are beginning and may prove a significant addition to the hearing conservationist’s armamentarium.

Role of the Cochlear Efferent System in Humans in Protecting the Ear from Noise Damage
Brenda L. Lonsbury-Martin, Ph.D.

The notion that the olivocochlear efferents to the outer hair cells protect the ear from acoustic overstimulation is long-standing. Early research showed that stimulation of this pathway raises acoustic thresholds or decreases physiological activity related to cochlear function. In recent times, otoacoustic emissions have permitted efferent function to be examined in humans. Using distortion product otoacoustic emissions (DPOAEs), time-dependent changes in emission levels in response to long-lasting primary tones have been observed in the ipsilateral test ear. This time-varying activity or fast adaptation is assumed to reflect the effects of the ipsilateral reflex of the medial olivocochlear (MOC) system. Most recently, a number of investigators have derived the strength of the MOC reflex from the magnitude of DPOAE adaptation. The current presentation will describe a DPOAE-based MOC reflex-strength test that can be applied to humans to screen for susceptibility to the adverse effects of noisy environments.

Genetics of Noise-Induced Hearing Loss Susceptibility
Sharon Kujawa, Ph.D.

Estimates suggest that 30 million persons in the United States are exposed to dangerous sound levels each day (NIDCD, 1998). Hearing loss from these exposures, however, is highly variable; some individuals appear to be vulnerable, while others are resistant to noise-induced hearing loss (NIHL). Identifying factors that influence NIHL susceptibility has important implications for basic science, industry, and clinical care.

Although it is possible to study such issues in humans, the task is easier in inbred strains of mice where many individual variables can be specified and where exposures can be precisely controlled and quantified. Such studies have observed relative homogeneity within-strain and significant heterogeneity between-strain in NIHL susceptibility, clearly suggesting genetic contributions to NIHL susceptibility. Given the close correspondence of mouse and human genome, it is likely that such information will aid our understanding of human susceptibility to NIHL. This presentation will summarize current work on genetic underpinnings of NIHL susceptibility and the implications for prevention and treatment of noise-induced cochlear damage.

Audiometry vs. OAEs Among Construction Apprentices
Noah S. Seixas, Ph.D., Sharon Kujawa, Ph.D., Susan Norton, Rick Neisler, Lianne Sheppard, Bryan Goldman and April Ster

Oto-acoustic emissions have been proposed as a sensitive measure of sensory-neural hearing damage, with high potential value in monitoring noise-exposed subjects for early effects. We are conducting a prospective study of noise exposure and hearing damage using standard audiometry (HTLs) and distortion product Oto-Acoustic Emissions (DPOAEs) among apprentices in the construction industry. In this preliminary report, the DPs and HTLs are compared among our cohort at baseline. A total of 843 ears among 436 subjects were successfully tested at baseline and are included in this analysis. Correlation of the HTLs and DPs demonstrate the highest correlations where the frequencies of the two tests are similar, with maxima of 0.6 – 0.7 at about 4 kHz. Modeling of multiple potential risk factors for DPs and HTLs indicated similar patterns of risk for both outcomes, with age, years of construction work and other noisy activities producing the largest effects in both. The results indicate a reasonable correspondence between DPs and HTLs in their response to various exposures. Any advantages in the use of DPs over HTLs will have to await further analysis.

Continued on page 20
Musical Illusions and Paradoxes
Diana Deutsch, Ph.D.

This talk demonstrates and discusses some musical illusions that were discovered by the author—including some new ones. The illusions show that people can differ strikingly in the way they hear very simple musical patterns. These disagreements do not reflect variations in musical ability or training. In the case of some of the illusions, disagreements tend to arise between right-handers and lefthanders, which indicate that they reflect differences in brain organization. In the case of another illusion—the tritone paradox—perception varies with the region in which the listener grew up, and so with the language or dialect to which he or she has been exposed. Recent work indicates that perception of the tritone paradox is strongly influenced by the language or dialect that the listener heard in early childhood. The tritone paradox also relates to the question of absolute pitch, and this is here explored.

Innovations in Providing Hearing Loss Prevention Information
David C. Byrne, M.S., CCC-A, and Robert F. Randolph, M.S.

NIOSH is researching more effective hearing loss prevention strategies that motivate workers to participate extensively in protecting their own hearing. Several experimental informational and training products are being evaluated to determine their impact on actual prevention behaviors. The design of these products is driven by grounded theories of health protective behavior, specifically increasing motivation by addressing the severity and likelihood of hearing loss, and by increasing the worker’s ability to take effective preventive action (wearing hearing protectors properly, maintaining noise controls, etc.). In this presentation, we will demonstrate some of these products, including a simplified earplug donning technique and a computerized simulation of noise-induced hearing loss. The theory-driven aspects of each product will be detailed, and the strategy for evaluating their effects on attitudes, beliefs, intentions, and behaviors will be discussed.

Musicians and the Prevention of Hearing Loss: The A, B, and C’s
Marshall Chain, M.Sc., Reg. CASLPO, Aud (C)

Professional and amateur musicians pose a unique challenge for the hearing health care professional. The musician is similar to an industrial worker in many ways; however, a wholesale adoption of an industrial hearing conservation model is simplistic. Similarities and differences between music and noise, and about musicians and industrial workers will be discussed. An assessment and treatment model is described that takes into account what is known about the hearing mechanism, auditory perception of musicians, the effects of music exposure, and the various spectra to which they are exposed. Case examples (including otoacoustic emission results) will be shared demonstrating how clinical assessment and recommendations can be successfully transferred to musical practice. Recommendations for hearing protection and inexpensive environmental strategies to minimize the effects of music exposure will be discussed which will ensure that musicians will still be able to play and listen effectively while protecting their hearing.
Landing on the Roof: Noise Control Efforts on Aircraft Carriers  
Kurt Yankbas

“Landing on the Roof” is a multi-media presentation which examines high noise levels in military operations and daily living. This exposure is reflected in the growth of VA hearing disability payments to over $326 million annually and the increasing incidence of civilian hearing loss. “Landing on the Roof” demonstrates numerous noise sources in the military and in daily life, their impact and applied solutions. It centers the discussion on shipboard applications and shows cross-service applications. It shows how integrated engineering disciplines used in designing and building our Navy ships can have commercial applications. At the same time, the ships of the U.S. Navy fleet serve as the home to over 107,000 sailors. The features built into these ships determine their mission success, be it at the Point of the Spear or the ever-important supply chain. A big factor in quality of life, Force health prevention and mission success is shipboard noise. This presentation reviews the history of ship silencing, the relation to the growing concern of hearing damage in the U.S. and its applicability to ship design as the Navy considers the re-capitalization of its fleet. The techniques outlined in this presentation have tri-service, commercial and personal application for shipboard noise control and hearing safety.

Assessment of Temporary Threshold Shift and Implications for Evaluating Standard Threshold Shift and Preventing of Permanent Threshold Shift  
Mary M. Prince, Ph.D., Robert Bertrand, M.D., George Cook, CCC-A David Lipscomb, Ph.D., and Doug Othlin, Ph.D.

This forum brings together practitioners and researchers in the area of evaluating temporary threshold shift (TTS) in human populations and implications for introducing corrective measures to prevent permanent hearing loss. The forum will provide a mix of theory and practical experience and explores the underlying mechanisms of noise-induced temporary threshold shift, audiometric manifestations of TTS, and its relationship to predicting noise-induced permanent threshold shift (NIPTS). Specific topics for discussion include: (1) new procedures for measuring TTS in the field; (2) audiometric manifestations of TTS in hearing conservation data; (3) practical experience with different measures of TTS and STS for identifying early hearing damage; and (4) detection of temporary shifts and their impact on intervention strategies for reducing hearing loss. The purpose of this forum is to provide hearing conservation practitioners with information that may be useful in assessing the causes of standard threshold shifts and in motivating employees to wear hearing protection to reduce temporary threshold shifts that could lead to more permanent losses in the future. After the short lectures, the audience will have an opportunity for interactive discussions with the forum speakers.

TTS Acquisition—Theoretical Considerations  
David Lipscomb, Ph.D.

Numerous investigators have quantified the amount and range of threshold shifts as a function of sound level and exposure duration. Some have attempted to use TTS as a predictor of permanent threshold shift (PTS) for both individuals and for groups. The complex physiology attendant to TTS has frustrated attempts to use TTS as a predictor of PTS. However, innovative methods for measuring TTS and statistical approaches to results of such measures still offer a verdant area of consideration. In this presentation, physiological and anatomical changes in the presence of noise and after noise exposure are summarized along with the possible indications of exposure hazard given by TTS. Initial use of TTS has been to motivate workers to participate fully in hearing conservation programs (HCP) by demonstrating for the individual worker that noise exposure does, in fact, create changes in hearing that might later translate to PTS. The transient and seemingly reversible nature of TTS lulls workers into thinking that the change in hearing is neither permanent nor indicative of injury. Given that PTS is generally a slowly developing and insidious condition, the earlier one notes this warning, the more likely PTS can be avoided.

Temporary Threshold Shift: The First Manifestation of Noise Induced Hearing Loss (NIHL)  
Robert A. Bertrand, M.D., F.R.C.S. (c)

Temporary threshold shift (TTS) is the first manifestation of hearing loss related to exposure to noise, whether its cause is occupational or non-occupational in origin.

It has been demonstrated that in a normal hearing subject, a TTS can be manifested within 2 hours of exposure to noise at the 4 kHz frequency. The degree of the hearing loss and recovery from TTS varies according to the intensity. Considering that a temporary threshold shift (TTS) is the first manifestation of modification of hearing thresholds following exposure to noise, an approach has been developed with the purpose of using the TTS as a first sign of a NIHL to introduce appropriate corrective measures.

This approach is intended to avoid evolution of auditory damage to permanent hearing loss as manifested by either a confirmed STS. The ultimate goal of the proposed procedure is to reduce, and potentially eliminate permanent threshold shifts due to noise exposure of occupational and non-occupational origin.

Practical Considerations in the Prevention of Occupational Hearing Loss  
George R. Cook, Jr., CCC-A

This presentation addresses the challenges in detecting early damage of hearing with changes in regulatory policy. It focuses comparing current best practices based on early detection and intervention of temporary threshold shift using OSHA STS requirements. It discusses how the new changes in STS recordability will impact the practice of hearing conservation. Practical methods to continue the prevention of hearing loss in industry are presented.

Hearing Protection for People with a Typical Hearing Impairment  
Per Hietelius, M.S.

In workplaces where hearing protection is required, a great percentage of the workers will have some kind of hearing impairment. A typical impairment will not only affect the hearing threshold, but also increase the problem of auditory masking. Masked thresholds have been measured on people with some degree of hearing impairment in order to learn more about how the increase of masking affects the ability to perceive speech and warning signals when using hearing protection.

Continued on page 22
When the Sound Gets Thru, What Can You Do?…the Limits to Attenuation
Elliott H. Berger, M.S., and Dan Gauger

With louder and louder weapon systems being developed and military personnel being exposed to steady noise levels approaching and sometimes exceeding 150 dB, a growing interest in greater amounts of hearing protection is evident. When the need for communications is included in the equation, the situation is even more extreme. New initiatives are underway to design improved hearing protection, including active noise reduction (ANR) earplugs and perhaps even cancellation of head-borne vibration. With that in mind it may be useful to explore the limits to attenuation, and whether they can be approached with existing technology. Data on the noise reduction achievable with high-attenuation foam earplugs, as a function of insertion depth, will be reported. Previous studies will be reviewed that provide indications of the bone-conduction (BC) limits to attenuation that, in terms of mean values, range from 40 to 60 dB across the frequencies from 125 Hz to 8 kHz. Additionally, new research on the effects of a flight helmet on the BC limits, as well as the potential attenuation from deeply inserted passive foam earplugs, worn with passive earmuffs, or with active-noise reduction (ANR) earmuffs, will be examined.

Bone Conduction Communication: Applications and Limitations
Tomasz Letowski, Ph.D., D.Sc.

Modern warfare requires the fighting force to be linked together through extensive radiocommunication network connecting “factory to foxhole” and “base to mud.” The network includes individual soldiers wearing communication equipment embedded in the headgear. Earphones or other air transducers occlude the ears of the wearer or otherwise shield them from surrounding acoustic environment. This is not an acceptable solution to field soldiers because it compromises auditory situation awareness that is critical to soldier effectiveness and survivability. An alternative solution is to provide radiocommunication traffic through a full-duplex bone conduction interface. Such interface permits the soldier to listen to and to send out radio messages with ears open and without a boom microphone hanging in front of the mouth. The author discusses the factors affecting bone conduction communication including transducer placement, power requirements, medical considerations, and limiting levels of environmental noise. Specific solutions will be discussed and evaluated.

HPD Attenuation Verification: A Viable Option?

Use of an Inexpensive Seal Meter to Estimate Real-World Attenuation of HPDs.
Gudmundsen, Collee, Killion

Collee (2001) compared probe-tube-based 250-Hz attenuation measurements of filtered earmolds with 250-Hz REAT values obtained at TNO on the same earmolds and subjects. For the probe measurements, the probe tube of a hand-held ER 33 seal meter was sealed into an occluded filter button; for the REAT measurements, a 20-dB filter button was used. The REAT values always equaled or exceeded the seal-meter readings, suggesting that the seal meter might provide valuable on-site estimates of the real-world attenuation of custom earmolds. To see if these results would generalize to other types of earmolds, we made probe-tube attenuation measurements through the center of multiple-flanged and foam earplugs. Measurements were made with the 0.4 mm thick ER-33 probe tube first placed alongside the earmold and then removed. Limited data on seven-frequency REAT measurements performed at EARCAL will be reported.

Jeremie Voix, ing., M.Sc.A.

To address the issues related to the field performance of HPD, a new concept has been developed using a reusable earplug that is custom-fitted by injecting silicon between a hard inner core and a soft expandable envelope. A miniature bore in the hard core is used to determine the sound pressure level difference (noise reduction) across the earplug. The benefits of this measuring capability are the real time monitoring of the acoustic seal during the injection process—until an adequate fit has been reached—and the development of a field method to estimate the noise attenuation obtained by such expandable earplugs as worn in the workplace. This estimation method uses a statistical approach to link subjective attenuations with objective measurements of the noise reduction. The support of Sonomax Hearing Health, Inc., IRSS (Quebec Occupational Health and Safety Research Institute) and NSERC (Natural Sciences and Engineering Research Council of Canada) is gratefully acknowledged.

Kevin Michael, Ph.D.

It is well documented that the field effectiveness of hearing protectors is not represented accurately by laboratory measurements and that the ratings derived from these measurements can be misleading. Verifying effective attenuation on the end-user can document proper HPD selection and provide evidence of sufficient training. These attenuation data may even be useful in compensation hearings. To date, however, the only field monitoring systems used in industry have performed point measurements of protector effectiveness. There are shortcomings to this approach, since potential individual attenuation is not the critical quantity. Instead, protected exposure is the only quantity that is directly related to the potential of noise-induced hearing loss. Point measurements simply fall short because they cannot account for variables that are major factors in exposure determination, such as wearing time and on-the-job quality-of-fit.

Gasaway Lecture: NHCA and You: A Penny for your Thoughts
Lt. Col. Theresa Schulz

The Gasaway lecture honors Don Gasaway and is used as a vehicle to continue the values that Don brought to the National Hearing Conservation and to the hearing loss prevention community. The year’s lecturer is Theresa Y. Schulz. Her focus will be “communication through participation.” The goal of hearing conservation is to preserve the ability to communicate through our precious sense of hearing. We work toward that goal by communicating with each other as members of NHCA. The best way to reach YOUR goals in hearing conservation is through participation in NHCA.
A Model Hearing Conservation Program for Coal Miners
Chris Bise, Ph.D., Tom Frank, Ph.D., and Kevin Michael, Ph.D.

The purpose of this presentation will be to describe a model hearing conservation program for the coal mining industry. The presentation will include a description of traditional and innovative methods and techniques for competency-based initial and annual training, noise measurements, and record keeping software. In addition, we will be presenting some of our findings concerning the effectiveness of our training programs, relations between hearing loss and hearing handicap, the use and attenuation provided by HPDs, and noise exposure levels relative to MSHA job codes. Finally, we will discuss some problems and solutions that we have encountered as we have instituted the model hearing conservation program at cooperating coal mines.

To Scope or Not to Scope: That Is the Question
Ross J. Roeser, Ph.D., CCC-A, and Lydia Lai

Blockage of the ear canal will result in varying degrees of hearing loss, depending on the extent of the occlusion. This presentation will report data on the degree and configuration of hearing loss associated with varying amounts of ear canal blockage. Otoscopy as part of hearing conservation will improve correct identification of permanent hearing loss by identifying ear canal blockage that should be removed prior to baseline and periodic retesting.

OSHA's New Recordkeeping Rule: Fence or Hurdle?
Lee Hager, Robert Dobie, M.D., and Susan Megerson, M.A., CCC-A

The recent revision to 29 CFR 1904.10 clearly dictates for the first time a national strategy to address work-related hearing loss as an occupational illness. What are the implications of the new rule? What are the likely outcomes? How do we as hearing conservation professionals comply? This panel will address various aspects of the new rule and the implications of compliance.

The New Rule: Medical Implications
Robert Dobie, M.D.

OSHA’s new rule will dramatically increase the number of threshold shifts that must be recorded, unless they are determined not to be work-related, thus increasing demand for clinical evaluation of work-relatedness. The key question for employers and their clinical consultants will be “would this worker’s hearing loss have been different if the workplace exposure had not occurred?” The answer will depend mostly on the worker’s noise exposures (occupational, non-occupational, use of hearing protection), complete set of audiograms (especially audiometric shape and change over time), age, and medical history. Consultants will usually have to rely on the file review instead of a face-to-face visit; some will decline to participate. Hearing conservation program managers may now need to maintain three different baselines for each ear of each worker: one for STS, one for recordability, and one for referral.

Determining Work-Relatedness of NIHL
Alan Langman, M.D.

Noise induced hearing loss (NIHL) cost industry billions of dollars in settlements to workers in the form of monetary compensation and the purchasing and maintenance of hearing aids. Not all NIHL is due to occupational causes. Frequently, it is the responsibility of the health care professional to determine whether the hearing loss is work related or not. Though guidelines exist to make the diagnosis of NIHL, there are few standards that are available to determine the work-relatedness of NIHL. The audiologist or physician must at times use one or a combination of factors to determine if NIHL is occupationally related. These factors include state statutes, worker history, audiometric findings, industry historical data as well as noise survey data. Illustrations of using these factors in determining work-related NIHL will be given.

Evaluation of Hearing Conservation Program Effectiveness: Compliance versus Best Practices
Mary M. Prince, Ph.D.

The National Institute for Occupational Safety and Health (NIOSH) has conducted a study examining factors affecting hearing conservation program (HCP) effectiveness in three manufacturing plants. The study purpose was to develop methods for evaluating hearing conservation programs and to identify predictors of program effectiveness. The presentation will illustrate how focus groups, comprised of line workers and supervisors, were used to clarify and augment information gathered through more traditional program assessments (paper audits, interviews with HCP administrators) at three plants to provide a more enriched picture of hearing conservation practices. Results indicate that exclusive reliance on such practices as policy review, audiometric testing audits, and noise surveillance to evaluate the effectiveness of workplace hearing conservation programs fails to capture the impact of these programs as experienced by workers at the “shop floor” and offers little insight into the reasons and potential remedies for noted deficiencies.

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1. Reconstruction of Employee Noise Exposure History at a Large Automotive Manufacturer
Scott E. Brueck, M.S., CHF;1 Mary Prince, Ph.D.;1 Susan Woskie, Ph.D., CIH2
1 National Institute for Occupational Safety and Health, Cincinnati, OH
2 University of Massachusetts Lowell, Department of Work Environment, Lowell, MA

An ongoing NIOSH study to evaluate hearing loss risk for workers with long-term exposure to high noise levels required reconstruction of employee noise exposure history. The following steps, which were used for the process of noise exposure reconstruction, will be presented:

a) Sound level measurements, documented during plant-wide surveys in 1970-71 and 1985-86 were linked to plant departments based on measurement locations.

b) Based on company documents indicating when plant process or equipment changes occurred, two time periods having different exposure conditions were identified: 1970-84 and 1985-90.

c) Average sound levels for each department were calculated for the two time periods.

d) Work histories for each job code, which included department/job task locations and task times were developed based on employee interviews and current job code information.

e) Using work history information and calculated department sound levels, a time-dependent job exposure matrix was developed for each department/job code combination.

2. Hearing Protector Allowing Improved Acoustic Communication
Joseph G. Deloge, Ph.D., and Patrick M. Zurek, Ph.D.

The aim of this project is to develop an advanced hearing protector that combines maximal attenuation of ambient sounds with signal processing that extracts the most important components of the sound field for controlled presentation to the user. BY processing the signals from a microphone array mounted on the headband of the hearing protector, this device enhances desired signals from a specified “look” direction relative to signals from other directions, allowing face-to-face acoustic communication in many high-noise environments where it would be impossible otherwise. In addition, the signal processing is designed to allow the preservation of sound localization ability. To date, has developed implementations of array-processing algorithms on a portable DSP processor and evaluated their impact on listener’s sound localization and speech reception performance. [Work supported by NIOSH].

3. Inter-laboratory agreement of S3.19-1974 estimates of hearing protector performance
Vern Laran, Ph.D.

Even though ANSI S12.6 superseded ANSI S3.19-1974, EPA regulations (40 CFR, Part 211) incorporate the latter into current-day regulations for testing and labeling hearing protectors. This presentation reports the results of a study that retested existing products and compares the results with manufacturer’s estimates of 1/3 octave band insertion loss and noise reduction ratings. The data support the assertion that inter-laboratory variability is acceptable when the “evaluator fix” procedure of ANSI S3.19 is employed.

4. Reporting 24-h Leq’s arising from the nonoccupational noise-exposed population in the 21st century.
Elizabeth Thompson, B.S., Elliott Berger, M.S., and Nick Hipskind, Ph.D.

It has been suggested that both presbycusis and sociocussis play a role in the phenomenon of hearing loss due to age. Since sociocussis can only be studied by obtaining data on societal noise exposure, there is a continued need to evaluate individuals who are not routinely exposed to occupational noise but instead are exposed to societal and recreational noise on a daily basis. Nineteen subjects, living in Bloomington, IN, were asked to “wear” a dosimeter for seven consecutive 24-hour days. Subjects were also given a standard audiometric assessment to establish pure tone thresholds. Furthermore, individuals were asked to record noise events of interest in a small notebook so that they could be used in analysis. The average 24-hr Leq across all subjects was 76 dBA with a range of 73 to 81 dBA.

5. Hearing Aids + Ear Muffs: Safe & Effective within Limits
Bahette L. Verbsky, Ph.D.

Hearing-impaired workers often suffer from reduced speech intelligibility in everyday conversation relative to their normal-hearing counterparts. Hearing aids are the aural rehabilitation tool of choice for many hearing-impaired people. However, in high noise levels, hearing aids are not worn and earmuffs (or other HPDs) further reduce speech intelligibility by further reducing the audibility of the speech signal beyond that of the hearing loss. A model for the prediction of “safe” amounts of hearing aid gain based on the acoustic environment was developed and tested on an Acoustic Test Fixture (ATF). With hearing aid gain levels set below the maximum acceptable level for the acoustic environment as determined by the model, adult subjects were tested with their own hearing aids worn in combination with each of two passive sets of earmuffs. Speech intelligibility significantly improved over the earmuff only listening condition.

6. Auditory Risk Assessment of Portable Compact Disc Players
Brian J. Fligor, Sc.D., CCC-A

This study investigated the output levels of CD players from five different manufacturers using different headphone styles (e.g., in-ears, supra-aural). Additionally, the output levels were measured in nine new and nine used units from the same manufacturer. Results using white noise and music indicated all systems were capable of causing noise-induced hearing loss, but the hazard varied according to system and style of headphone used. A hazard-risk assessment for each system was generated based on daily-percentage noise-dose.

7. A Wireless and Batteryless Communications Earplug
Thomas von Wiegand, Ph.D.

In order to achieve maximal isolation from environmental sounds it is desirable to simultaneously use earplugs with over-the-ear ANC muffs. A transducer is often incorporated into the earplug to enable the user to receive audio communications while maintain-
ing sound isolation. For both convenience and to minimize sound conduction to the earplug, it is desirable to drive the transducer without a wired connection. It is further desirable for the earplug to be self-powered, simplifying the use of the system and obviating the consumable battery. The self-powered receiver earpiece described here uses optical signal transmission from a signal transmitter in the muff. The optical transmissions are contained within the muff and do not pose a risk of interfering with other systems. Some additional advantages of using optical transmission (over RF or inductive methods) are that an optical receiver can be made immune to interference from external electromagnetic fields, and the circuitry is simple and inexpensive.

8. An Assessment of Noise Frequency Spectra Associated with Selected Construction Tasks

Irby, N., Neitzel, R., Seixas, N., Johnson, P., and M. Yost

The risk of developing noise-induced hearing loss depends not only on intensity of noise exposure, but also on frequency. In this project, digital recording technology was used to capture the continuous noise signal associated with selected construction tasks and tools; the resulting frequency and time domain data were then analyzed. Forty-three recordings were made on twelve common tasks (and associated tools) at several construction sites. All measured tasks had unweighted noise levels exceeding 89 dB, and over half had weighted levels above 85 dBA. Six tasks had the majority of their energy in low frequencies (12.5-400 Hz), five had the majority in mid-range frequencies (500-4000 Hz), and one had equal amounts of energy in the low, mid, and high frequencies. The tasks and tools assessed which represent the greatest risk of hearing damage after prolonged exposure are concrete finishing, surface cleaning, materials processing, hammer and chisel, router, and screwgun.

9. Analysis of Impact/Impulse Noise for Predicting Noise Induced Hearing Loss

Jeffrey S. Vipperman, Mary M. Prince, Ph.D., Angela M. Flamm

Studies indicate that the structural properties and temporal structure of the sound signal are important in determining the extent of hearing hazard. As part of a pilot study to examine hearing conservation program effectiveness, NIOSH collected noise samples of impact noise sources in an automobile stamping plant, focusing on jobs with peak sound levels (Lpk) of greater than 120 dB. Digital tape recordings of sounds were collected using a Type I Precision Sound Level Meter and microphone connected to a DAT tape recorder. Preliminary analysis of wavelet files were conducted to characterize each event using several metrics (e.g., number of impulses/unit time, repetition rate or temporal pattern of impulses, index of peakedness, crest factor, kurtosis, peak time, etc.). The spectrum, duration, and inverse of duration for each waveform were computed and data were evaluated with the Auditory Hazard Assessment Algorithm (AHAAH). Improvements to instrumentation, data quality, repeatability, spatial sampling, and calibration are addressed.

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