HETA 99–0047–2746
Edgcomb Metals
Cincinnati, Ohio

Joshua M. Harney, MS
Randy L. Tubbs, Ph. D.

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Joshua M. Harney, MS and Randy L. Tubbs, Ph.D. of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Jee-Yeon Jeong, MS, PE. Desktop publishing was performed by Ellen Blythe. Review and preparation for printing was performed by Penny Arthur.

Copies of this report have been sent to employee and management representatives at Edgcomb Metals and the Occupational Safety and Health Administration (OSHA) Regional Office. This report is not copyrighted and may be freely reproduced. Single copies of this report will be available for a period of three years from the date of this report. To expedite your request, include a self-addressed mailing label along with your written request to:

NIOSH Publications Office
4676 Columbia Parkway
Cincinnati, Ohio 45226
800–356–4674

After this time, copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161. Information regarding the NTIS stock number may be obtained from the NIOSH Publications Office at the Cincinnati address.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Health Hazard Evaluation Report 99–0047–2746
Edgcomb Metals
Cincinnati, Ohio
July 1999

Joshua M. Harney, MS
Randy L. Tubbs, Ph. D.

SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from an employer representative of Edgcomb Metals in Cincinnati, Ohio. The request listed noise exposure and confined spaces as issues of concern. Because of consolidation of facilities, a substantial portion of the workforce had been hired just in the last year, and new machinery had been added to the facility since the last noise monitoring had been done.

Time-weighted average (TWA) noise exposures during two days of personal noise monitoring showed that exposures were not above the Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL). They were, however, over 85 on the A-weighted decibel [dB(A)] scale when calculated using the NIOSH recommended 3 dB exchange rate. Most workers had at least mild hearing loss (hearing threshold level [HTL] of 25 dB sound pressure level [SPL] or more at tested frequencies), as determined from review of the company's audiometric test records. Of the seven first-shift production building workers that we performed noise dosimetry on, who have worked in this same location for over twenty years, five of them had at least moderate hearing loss (HTL at or above 40 dB SPL at tested frequencies). Due to the observed negative health effects already present at Edgcomb, implementing an effective, ongoing hearing conservation program is indicated. One key component of this program is the proper use of hearing protection.

While it is Edgcomb's policy that their employees not enter permit-required confined spaces, the confined space training program should include emergency response procedures, such as whom to contact if someone were to fall into one of the pits. Training should emphasize that only the emergency responders should enter a permit-required confined space during a rescue. All pits and stairwells into which one may fall should be rail guarded.

Personal noise dosimetry results indicate that exposures do not exceed the OSHA Permissible Exposure Limit. The high incidence of hearing loss in the workforce, however, indicates that a hearing conservation program is needed. Managing noise exposures based on the NIOSH Recommended Exposure Limit is recommended. Several recommendations for engineering controls and a hearing conservation program are included on pages 18–20 of this report. The written confined space training program should address Edgcomb employees' role in emergency response given that only the local emergency medical service is authorized to enter this company's permit-required confined space. All pits and stairwells into which one may fall should be rail guarded.

Keywords: SIC 5051, (metals service centers & offices), noise, confined space, steel, slitting, hearing conservation program, hearing protection devices, HCP, HPD

National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluation at Edgcomb Metals

This HHE was requested by Edgcomb Metals management primarily to address noise issues arising from the recent addition of new process equipment and the hiring of new production workers. Personal noise dosimetry, written program reviews, and audiometric testing records reviews were conducted on February 16-17, 1999. Recommendations are provided for improved hearing conservation efforts and for several safety issues.

What NIOSH Did

- Measured noise levels near the slitters and the Rowe lines.
- Measured workers' noise exposures on first shift for two days
- Reviewed Edgcomb's program for hearing conservation.
- Reviewed latest hearing test results of Edgcomb employees.

What NIOSH Found

- Many Edgcomb workers have some mild hearing loss already.
- Noise exposures did not exceed the OSHA regulation.
- Noise exposures did exceed the NIOSH recommended limit.
- Average noise exposures were above 85 dB[A]. These exposures may still cause some hearing loss in the long run unless workers are protected.
- Current hearing protection devices used may cut out too much sound most of the time, making verbal communication difficult.
- Safety concerns like empty first aid kits, confined space entry program, and unguarded floor openings need to be addressed.

What Edgcomb Metals Managers Can Do

- Fix the squeaking and metal slapping noises from the Rowe 2 machine.
- If the Rowe 2 line cannot be fixed, construct a noise barrier between the operator station and the line.
- Continue worker training and education efforts about hearing conservation both on and off the job.
- Continue annual hearing tests for all employees.
- Offer several kinds of easy-to-use hearing protection devices.
- Keep first aid kits in the warehouse full at all times.
- Finish the confined space entry program that deals with emergency response procedures.
- Rail-guard all pits and stairwells that people can fall into.

What the Edgcomb Metals Employees Can Do

- Participate in all parts of the hearing conservation program.
- Properly wear hearing protection.

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for HETA Report # 99-0047-2746

NIOSH National Institute for Occupational Safety and Health

TABLE OF CONTENTS

INTRODUCTION

On November 27, 1998, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from an employer representative of Edgcomb Metals, Cincinnati, Ohio. The request listed noise exposure and confined spaces as issues of concern for the production workers. Both the Occupational Health Nurse and the Operations Manager indicated that some workers had been diagnosed with at least moderate hearing loss, that a substantial portion of the workforce had been hired just in the last year, and that new machinery had been added to the facility since the last noise monitoring had been done. The HHE request was submitted by Edgcomb management because of their concern for noise exposure and a wish to have safety concerns evaluated. A walk through inspection of the production building was conducted by NIOSH investigators on January 26, 1999, followed by area noise monitoring and personal noise dosimetry on February 16 and 17, 1999.

BACKGROUND

The Edgcomb Metals steel processing facility in Cincinnati, Ohio is comprised of management and sales offices, and a 213,000 square foot (ft^2) production building. The main business is bringing in large master coils of sheet steel (weighing up to 40,000 pounds [lbs]) and cutting them to size for special orders made by clients. This involves either cutting the metal into smaller sheets or slitting them into different width coils and re-spooling them. During the time of the NIOSH noise evaluation, different thicknesses of steel were used ranging from 7 gauge to 16 gauge. Normal production rates are on the order of 300 tons of finished product per day. Typical operations involve two shifts per day, with slitting and cutting line employees (operators, operator assistants, assistants-takeoff) working ten hours per day while support personnel (maintenance, saw operators, warehouse staff) work eight hour shifts.

Roughly half of the 40 employees who work in the production building have done so for over 20 years. The other half were hired after mid-1997, many as part of a consolidation effort due to the restructuring of another Ohio Edgcomb facility. All newly hired employees are given an audiometry exam as part of their pre-employment physical. Originally, the Cincinnati plant housed one slitter machine (60" slitter) and one cutting line (Rowe 1). In early 1998, an additional slitter (72") and Rowe line (#2) were added, thus increasing the level of workplace noise. Between this time and the time of the NIOSH HHE no noise monitoring was done. Hearing protection devices (HPDs) are not mandatory in the production building, though workers may wear them voluntarily.

METHODS

During the initial walk-through inspection, a Quest model 2400 (Quest Technologies, Oconomowoc, Wisconsin) sound level meter set for A-scale, slow response, was used to identify areas of the production building where personal noise dosimetry would be conducted. During the noise survey of February 16 and 17, the Quest sound level meter was again used to gather area sound level measurements around the four production building machines: Rowe 1 line, Rowe 2 line, 60" slitter, and 72" slitter. On February 16 and 17, personal noise logging dosimeters (Quest M–27), calibrated at 110 decibels (dB) at 1000 Hertz (Hz), were worn for a minimum of nine hours by first shift personnel working at all four machines. The dosimeter microphones were placed on either the right or left shoulder of each worker, midway between the ear and end of the shoulder. The data collected were analyzed using Questsuite 3.74 software. Those monitored included operators and operator assistants, and those working on the banding line, including the banding line assistant who frequently drove a fork truck. In addition, dosimetry was conducted each day on one individual working in the metal saw area. The wood saw/pallet area worker was monitored on the second day of the survey. During the evaluation, audiometry test results and the corporate hearing conservation program were also reviewed.

EVALUATION CRITERIA

General

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[3] NIOSH encourages employers to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria. As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, or a pre-existing medical condition. In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medication or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the limit set by the criteria. These combined effects are often not considered in the evaluation criteria. The OSHA PELs reflect the feasibility of controlling exposures in various industries, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard.

Noise

Noise-induced loss of hearing is an irreversible, sensorineural condition that progresses with exposure. Although hearing ability declines with age (presbycusis) in all populations, exposure to noise produces hearing loss greater than that resulting from the natural aging process. This noise-induced loss is caused by damage to nerve cells of the inner ear (cochlea) and, unlike some conductive hearing disorders, cannot be treated medically.[4] While loss of hearing may result from a single exposure to a very brief impulse of noise or an explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hz (the hearing range is 20 Hz to 20000 Hz) and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recognized. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Although the primary frequencies of human speech range from 200 Hz to 2000 Hz, research has shown that the consonant sounds, which enable people to distinguish words such as "fish" from "fist," have still higher frequency components.[5]

The A-weighted decibel [dB(A)] is the preferred unit for measuring sound levels to assess worker noise exposures. The dB(A) scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dB(A) scale is logarithmic, increases of 3 dB(A), 10 dB(A), and 20 dB(A) represent a doubling, tenfold increase, and 100-fold increase of sound energy, respectively. It should be noted that noise exposures expressed in decibels cannot be averaged by taking the simple arithmetic mean.

The OSHA standard for occupational exposure to noise (29 CFR 1910.95)[6] specifies a maximum PEL of 90 dB(A) for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship, or exchange rate. This means that a person may be exposed to noise levels of 95 dB(A) for no more than 4 hours, to 100 dB(A) for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dB(A) is allowed by this exchange rate. The duration and sound level intensities can be combined in order to calculate a worker's daily noise dose according to the formula:

Dose = 100 X (C1/T1 + C2/T2 + ... + Cn/Tn),

where Cn indicates the total time of exposure at a specific noise level and Tn indicates the reference duration for that level as given in Table G–16a of the OSHA noise regulation. During any 24-hour period, a worker is allowed up to 100% of his daily noise dose. Doses greater than 100% are in excess of the OSHA PEL.

The OSHA regulation has an additional action level (AL) of 85 dB(A); an employer shall administer a continuing, effective hearing conservation program when the time-weighted average (TWA) value exceeds the AL. The program must include monitoring, employee notification, observation, audiometric testing, hearing protectors, training, and record keeping. All of these requirements are included in 29 CFR 1910.95, paragraphs (c) through (o). Finally, the OSHA noise standard states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels.

NIOSH, in its Criteria for a Recommended Standard,[7] and the ACGIH, propose exposure criteria of 85 dB(A) as a TWA for 8 hours, 5 dB less than the OSHA standard. The criteria also use a more conservative 3 dB time/intensity trading relationship in calculating exposure limits. Thus, a worker can be exposed to 85 dB(A) for 8 hours, but to no more than 88 dB(A) for 4 hours or 91 dB(A) for 2 hours.

The OSHA noise standard uses the "standard threshold shift" as a quantitative marker for noise induced hearing loss. A standard threshold shift is defined as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2,000 (2k), 3k, and 4k Hz in either ear.[6] Workers who have had a standard threshold shift must wear hearing protection devices while at work. To provide early identification of workers with increased hearing loss, the NIOSH Criteria for a Recommended Standard for Noise Exposure uses the "significant threshold shift." A significant threshold shift is defined as an increase of 15 dB or more in the hearing threshold level at 500, 1k, 2k, 3k, 4k, and 6k Hz in either ear, as determined by two consecutive tests.[7]

Confined Spaces

Each year hundreds of confined space related accidents occur resulting in a number of injuries and deaths. NIOSH recognizes that the number of reported fatalities and injuries may actually be underestimated due to the current occupational morbidity data collection and summarization methods.[8] ***Criteria for a Recommended Standard for Working in Confined Spaces*** has been published by NIOSH, and additional technical information regarding recommended confined space procedures have been developed by the American National Standards Institute (ANSI), the American Petroleum Institute (API), and others.[8,9,10,11] Furthermore, on January 14, 1993, OSHA promulgated a final rule titled ***"Permit-Required Confined Spaces,"*** [29 CFR 1910.146], which presents the minimum requirements employers must implement to maintain compliance with the General Industry standards enforced by OSHA.[12]

Review of the circumstances contributing to confined space accidents has allowed NIOSH and OSHA to conclude that a hazardous atmosphere is the most frequently cited condition, in regards to the number of confined space incidents, the number of

injured workers, and the number of fatalities.[8,13] OSHA has reported asphyxiation as the number one cause of death in confined spaces (due to oxygen deficient atmospheres, engulfment in materials, or compression of the torso from slipping into narrow openings).[14] Other confined space fatalities noted by OSHA include burned (by fire or explosion), ground by auger, crushed, battered, electrocuted, and blunt trauma from elevated falls.

The Fatal Accidents Circumstances & Epidemiology (FACE) project conducted by NIOSH focused on confined space accidents during the period 1984–1988 and one result of this initiative was the publication of a Hazard Alert titled ***"Request for Assistance in Preventing Occupational Fatalities in Confined Spaces."***[9] These investigations discovered three recurring confined space program inadequacies — lack of recognition of confined space hazards, lack of testing and evaluation of the confined space prior to entry (and continued monitoring during occupancy), as well as unplanned and inappropriate rescue procedures. Addressing each of these deficiencies could contribute to the prevention of confined space fatalities.

The OSHA confined space rule is a versatile "performance oriented" standard that allows some latitude for employers to interpret and apply the confined space program requirements specific to their establishments providing the fundamental precautionary measures are implemented to prevent confined space injuries and deaths. The definition of a confined space determined by OSHA is any space:[12]

♦ that is large enough and is configured to allow an employee to bodily enter and perform work, ***and***

♦ has limited or restricted means of access into and egress from within, ***and***

♦ is not designed for continuous employee occupancy.

OSHA further distinguishes confined spaces based on the potential of the space to pose hazardous exposure conditions and classifies these spaces as non-permit versus permit-required confined spaces. A space is a **permit-required confined space** if it meets the OSHA definition of a confined space as listed above ***and*** it contains or has the potential to produce at least one of the following hazardous conditions:[12]

♦ a hazardous atmosphere, ***or***

♦ a material which could engulf an entrant, ***or***

♦ has an internal configuration such that an entrant could be trapped or asphyxiated, ***or***

♦ any other recognized serious safety or health hazard.

RESULTS

Area noise levels varied widely throughout the survey days depending on which machines were running. Relatively quiet periods of time during set-up when one or more machines are not running are followed by louder times when metal is being slit or cut. For example, we observed slitter cycle times which included 15–20 minutes of relatively quiet (70 dB[A]) set-up time followed by 5–15 minutes of actual slitting time, when levels measured 6 feet (') away from the machinery could reach 90 dB[A]. These time ranges were highly variable depending on how long it took to load a new master coil, change the slitter blades and rubbers, band the slit coils, etc.

The Rowe #2 cutting line appears to be the major contributor of noise in the plant, having three main components to its noise contribution. The first is predominantly high-frequency sounds, produced by the “squeaking” of the master coil tumbler as it unwinds the steel and feeds the cutter. Reportedly, when cutting heavy gauge steel the brakes must be kept partially engaged. The second part comes from the blade cutting the steel. The third part comes from the sheet steel “slapping” the roller bridge after each

cut is made. This slapping occurs because the master coil continues to unroll slightly even when the sheet is held still to allow a clean cut by the blade. This causes tension and bunching on the uncut sheet between the master coil and the blade, resulting in the sheet slapping against the roll table once the tension is released as the blade is raised.

Area Monitoring

During the two days of noise monitoring, the Rowe lines cut a range of metal thicknesses from 16 gauge to 7 gauge. When the Rowe #2 line was running, measurements taken 6' from the line varied from 94 dB(A) at the roll-driver, to 104 dB(A) at the blade, and 84 dB(A) at the sheet take-off area at the end of the line. Measurements on the main operator platform were consistently 96–98 dB(A) when cutting 10 gauge steel. While the Rowe #2 line was running, it was difficult to obtain accurate area sound levels at the Rowe #1 line and the slitters because of the interference caused by the Rowe #2 noise.

Area sound measurements taken 6' from the running Rowe #1 line varied from 85 dB(A) at the coil and coil driver, to 96 dB(A) at the cutting blade, to 83 dB(A) at the take-off area at the end of the line. During this time, 86 dB(A) was measured at the desk at the operator's station. The slitters and Rowe #2 were not running when these measurements were taken.

Because the slitters run at varying speeds even within one short slitting cycle, noise levels fluctuate in the work areas around them. For example, during the slitting of one coil on the 60 inch (") slitter, levels fluctuated from 81–90 dB(A) at the master coil to 83–85 dB(A) at the blades to 77–80 dB(A) at the main operator station (15' away), to 81–90 dB(A) near the collecting coils at the end of the line.

Personal Monitoring

Personal noise dosimetry results are shown in Table 1. One dosimeter failed, on the morning of February 17, on a Rowe #1 assistant operator. For the 29 full shift samples collected over two days, TWA results based on OSHA's criteria recorded one instance over the AL of 85 dB(A). The OSHA criteria use a 90 dB(A) criterion and 5 dB(A) exchange rate for both the PEL and the AL. The difference between the two is the threshold employed, with a 90 dB(A) threshold used for the PEL and an 80 dB(A) threshold for the AL. The threshold level is the lower limit of noise values included in the calculation of the criteria; values less than the threshold are ignored by the dosimeter. The NIOSH criterion differs in that the criterion is 85 dB(A), the threshold is 80 dB[A], and it uses a 3 dB exchange rate. Exposures may be expected to vary slightly from day to day based on production rates, gauge of steel being cut or slit, etc. Eight-hour TWA results based on the more conservative NIOSH criteria (3 dB[A] exchange rate) show that every person monitored but one was exposed above 85 dB(A). All TWAs were between 85–93 dB(A) on February 16, and 84–92 dB(A) on February 17, based on these criteria.

Audiometry

Edgcomb employees most recently had their hearing tested in January 1999. This was done by an outside contractor using a mobile van with audiometric testing equipment. A review of these hearing tests for all Edgcomb employees revealed that of the 18 people who were personally monitored for noise during our survey, four had not yet had their hearing tested. Among those monitored who were hired after October 1997, five of seven had at least mild hearing loss (hearing threshold [HTL] at or above 25 dB sound pressure level [SPL]) at one or more tested frequencies (.5k, 1k, 2k, 3k, 4k, 6k, 8k Hz). Three of these seven newly hired employees had at least moderate (HTL at or above 40 dB SPL) hearing loss, and two have had year-to-year changes in threshold of at least 15 dB SPL at a tested frequency since beginning work at Edgcomb. One of those newly hired reported previously working for another company doing similar work and may have sustained his injury there. Among those monitored who were hired before 1997, all seven had mild hearing loss. Five of seven had at least moderate hearing loss, and

all but one have had year-to-year changes in threshold of at least 15 dB SPL at one or more tested frequency since beginning work at Edgcomb. The decrement is seen most clearly in the 3k, 4k, and 6k Hz range; a range of frequencies that are both sensitive to noise and important to clearly understanding human speech.[5] There were no new standard threshold shifts in the latest year of testing, as defined by the OSHA noise standard.

General Workplace Safety

The 72" slitter pits and Rowe line #2 pit meet the OSHA definition of a confined space because they are large enough for an employee to bodily enter, have limited means of entry and exit, and are not designed for continuous employee occupancy.[12] Edgcomb's policy regarding permit-required confined spaces is to prohibit employees from entering them. The deeper of the slitter pits is prominently marked with the appropriate signs. The local fire department rescue squad is the only emergency response team designated to make an entry into this area, should the need arise.

During this evaluation, one of the Rowe line assistant operators cut his hand and had to be taken to the hospital. Upon inspecting the first aid kits in the warehouse, two were found to be empty (Y29 and X20 beam locations). All first aid kits should contain a complete set of materials at all times or be removed.

In order to cross from one side of the 72" slitter line to other, one can walk down a short stairwell and walkway underneath and up the other side, rather than walking around the entire machine. The edges of the stairwell are flush with the floor and are unguarded. The stairwell is close to one of the slitter control panels, therefore employees will necessarily be near it while performing normal job duties. It is possible for someone to inadvertently step into the stairwell and be injured in the course of normal work activities.

DISCUSSION

Noise Exposure

While the TWA noise exposures were not above the OSHA PEL, they were consistently over the NIOSH REL. A revised risk assessment done by NIOSH investigators on the epidemiology studies used to create the PEL was completed in 1997.[15] It found that there is approximately 25% excess risk of hearing loss even if a workforce is protected to the PEL criteria. Therefore, Edgcomb could protect their employees to the level required by law and still see hearing loss in the workforce.

With the implementation of two changes to the Rowe #2 line, the noise exposure of employees can be reduced. The most favorable option would be to decrease the amount of noise produced by the source, thereby decreasing the need either to reduce the noise by changing its path (eg. enclosure) or to reduce it at the receiver (eg. HPDs). Fixing Rowe #2 operations so that the coil tumbler does not squeak and the sheet metal does not slap the roll table will help decrease exposures. If this can not be done soon, it may be feasible to construct an inexpensive barrier between the Rowe #2 operator station and the line itself. Until it is clear how effective this is, the barrier need not be elaborate or permanent. In fact, simply framing a couple 4' x 8' sheets of plywood with 2" x 4"s and experimenting with different placement locations is acceptable. If after that Edgcomb desires to construct a more substantial barrier, NIOSH can serve as a resource for guidance.

Many of the current design features of Edgcomb machinery already do much to lessen the amount of noise produced by the source. For example, the blades on the Rowe lines are shaped like a flattened, inverted "V"(frontal view) so that the cut is more of a shear than it is a blunt chop, as would be the case with a straight-edged blade. Small coils are gently loaded onto the banding line conveyor by means of a mechanical lift table. The Rowe lines also use a mechanical sheet-drop to stack the sheet metal rather

than letting it fall and clatter directly from the conveyer to the stack.

While the noise dosimetry results did not show OSHA-defined overexposure, it may be wise to implement a hearing conservation program (HCP) because the NIOSH REL was exceeded. The prevalence of hearing loss within the workforce is further evidence of the need for a HCP. Incorporating the principles and practices detailed in the three documents we delivered as guides (*Criteria for a Recommended Standard: Occupational Noise Exposure, Revised Criteria 1998* NIOSH Publication 98–126, *A Practical Guide to Hearing Conservation Programs in the Workplace* NIOSH Publication 90–120, and *Preventing Occupational Hearing Loss – A Practical Guide* NIOSH Publication 96–110) can help employees protect their hearing and provide the structure for an effective HCP. The following details the basic elements of a HCP, but should not be relied on as a substitute for the information supplied by the above documents:

- Initial and annual audits of procedures
- Assessment of noise exposures
- Engineering and administrative control of noise exposures
- Audiometric evaluation and monitoring of workers' hearing
- Use of hearing protectors for exposures equal to or greater than 85 dB(A), regardless of exposure duration
- Education and motivation of workers
- Record keeping
- Program evaluation for effectiveness

Hearing Protection Device Issues

Currently, Edgcomb does not require that its production building employees wear hearing protection devices. Several workers were observed voluntarily wearing either ear muffs, canal caps, or flanged plugs. These types of HPDs may over-attenuate the noise in their work environment, possibly making verbal communication difficult. Their noise reduction rating (NRR) commonly falls in the 20–30 dB range, which may be too effective given the noise environment at Edgcomb. HPDs that have less attenuation may be more appropriate, such as the samples we left with the Occupational Health Nurse. These are easy to don and doff, provide linear attenuation across key frequencies, and give overall attenuation closer to 16 dB than to the 20–30 dB provided by those types currently used. As a result of using HPDs such as these, workers may be able to wear them longer and at the same time experience better verbal communication, because of their linear attenuation properties, while still being protected from the noise.

Audiometry Results

All of the employees who have worked in the production building at Edgcomb for longer than the past three years have at least mild hearing loss. Most workers have moderate hearing loss. It cannot be determined whether these cases of hearing loss are due to occupational exposure. Those people demonstrating year-to-year changes in threshold of 15 dB SPL or more at a tested frequency should be retested in order to determine whether the initial test result is valid. If the test showing this change is validated, then this should serve as a warning sign that hearing loss is occurring, even if an OSHA-defined standard threshold shift has not yet occurred.[7] If proper steps are taken in implementing an effective, ongoing hearing conservation program then it is likely that the hearing of the employees can be preserved, especially of those most recently hired who have not yet experienced any hearing loss. The most recent hearing tests done included an evaluation of each worker's threshold at 8k Hz, but this has not been done in the past. In many cases early signs of noise induced hearing loss spread from 4k Hz into higher and lower frequencies, but rarely is 8k Hz affected.[16] Therefore, continued monitoring at 8k Hz may provide useful information about the etiology of hearing loss as it occurs.

General Workplace Safety

Because of their configuration, use, and limited means of entry and egress, several of the pits at Edgcomb meet the OSHA definition of confined spaces (29 CFR 1910.146). But because of their use, most of them would not be classified as 'permit-required' confined spaces. The scrap metal waste pit by the 72" slitter is an example of this. Workers do not normally perform any work in them, and if they must rarely enter them, for example to free a cable as we observed during the survey (note: a second worker did stand nearby to observe his co-worker doing this), their head does not stay below grade. It is highly unlikely for them to contain a hazardous atmosphere, no danger of engulfment or entrapment from converging walls exist, and no other serious safety or health hazards exist in them. However, the largest and deepest pit (under the 72" slitter) is correctly marked as "No entry – Permit-Required Confined Space."

The Edgcomb written confined space program (still being completed at the time of the survey) forbids any Edgcomb employee from entering any permit-required confined space. The removal of any scrap metal from this area, and from the non-permit-required spaces, is accomplished using the overhead crane system. Any authorized entry into the 72" slitter pit will be done by the local fire department, and should only be done after atmosphere testing according to the standard. The OSHA permit-required confined space standard requires that companies that have onsite permit-required confined spaces, but will not allow employees to enter them, comply with paragraphs (c)(1,2,6,8). These paragraphs deal with workplace evaluation for confined spaces, sign posting, and contractor notification. The standard requires that Edgcomb assure that any authorized entry, whether or not it is done by their own employees, is done in accordance with an appropriate written program. *Criteria for a Recommended Standard – Working in Confined Spaces* NIOSH Publication 80–106, given to the plant operations manager, provides additional guidance for Edgcomb as the written confined space program is fully developed.

While the largest pit is rail guarded, the others are not. OSHA standard 29 CFR 1910.23(a) states that every hole into which persons can accidentally walk shall be guarded at least by standard railings with standard toe boards on all exposed sides. Included under this standard would be the short stairwell leading under the 72" slitter, and the Rowe #2 pit.

CONCLUSIONS

Even with the addition of two pieces of machinery, typical noise exposures for slitter and Rowe line workers probably are not in excess of the PEL and frequently will not exceed even the OSHA action level. Yet in the population of workers who have worked there for many years, there is widespread hearing loss. It follows that in order to conserve the hearing of those working in the plant that more health protective evaluation criteria than the PEL, for example the NIOSH REL, should be followed. The most effective way to do this is to implement an effective HCP, beginning with making feasible engineering changes to reduce noise production. Managing noise exposures below the REL in this case need not involve major engineering changes. Edgcomb already has in place machinery that incorporates features that minimize noise production. Making the suggested alterations to the Rowe #2 line should lower exposures. It should be noted that if historic exposures were like the ones measured in this survey, then the current noise exposure management practices cannot necessarily be relied upon to conserve the hearing of those at Edgcomb, whether or not these efforts satisfy the requirements of the OSHA noise standard.

Beyond engineering controls, the success of other components of the HCP will rest in large part on the consistent participation of the workers themselves. Therefore, training and education about the health effects of noise both on and off the job will be essential. The use of the appropriate hearing protection devices will be an important component of the HCP as well, whether the need arises at work or away from work. There are different models of hearing protection devices available that attenuate

sound in a more linear fashion across key frequencies, and have NRRs in the 10–20 dB range. Such devices would be well suited to an environment like Edgcomb where reducing exposures by less than 10 dB is sufficient. These linear earplugs should be easy to don and doff, and allow for verbal communication even when work place noise levels are similar to those measured during this study. The information provided by future audiometric testing will be very important in evaluating the effectiveness of any new HPDs used.

Even though Edgcomb employees will not make planned entries into permit-required confined spaces, the company's confined space training program should have emergency response procedures as a part of training. For example, employees should be made aware that if policy states emergency rescue (if someone were to fall into the 72" slitter pit and be unable to self-rescue) is to be done only by the local fire department, then Edgcomb employees' role in the emergency response is merely to contact the fire department. Unguarded areas near the slitter and Rowe machine into which one may accidentally fall are not compliant with OSHA standard 29 CFR 1910.23, "Guarding floor and wall openings and holes."

RECOMMENDATIONS

♦ Implement an effective, ongoing HCP including continued audiometry, worker education, and providing several types of HPDs, with linear attenuation and a lower NRR rating than those currently used. If HPD use is not required of all workers in the production building, perhaps a regimen can be adopted where slitter, Rowe line, saw area, and banding line workers must don HPDs only when they are near equipment that is running. HPDs are mandatory (to reduce exposures to 85 dB[A] or less) for those production workers who have had an OSHA defined standard threshold shift.[6]

At a minimum, the following topics should be included in the employee training and education portion of the HCP:

- ✓ Requirements and rationale for the occupational noise standard
- ✓ Effects of noise on hearing
- ✓ Company policy for the elimination of noise as a hazard, including noise controls already implemented or planned for the future
- ✓ Hazardous noise sources at the worksite
- ✓ Training in the use of hearing protectors (including supervised, hands-on practice in proper fitting techniques)
- ✓ Audiometry
- ✓ Individual responsibilities for preventing hearing loss

Further specific components of the recommended HCP for Edgcomb include:

- ✓ Include all employees in annual audiometric testing.
- ✓ The site HCP coordinator should attend, at a minimum, to a Council for Accreditation in Occupational Hearing Conservation training course for training in implementing an effective HCP.
- ✓ The HCP coordinator should conduct face-to-face interviews with employees when informing them of their hearing test results.
- ✓ Calculate average hearing loss for employees for the current and previous year(s) as a group (department, job title, etc.) to track group hearing loss from year to year.
- ✓ Continue including 8k Hz as a frequency tested during annual audiometric exams. This will enhance Edgcomb's ability to determine the probable etiology of a hearing loss.[7]
- ✓ Use proposed audiometric database assessments[17,18] as a quality control check on audiometric test results from the hearing test provider. Fully utilizing the audiometric database analysis techniques described in these sources can also help detect weaknesses in an HCP before significant permanent threshold shifts develop in the workforce.

♦ Fix the Rowe #2 line to eliminate or reduce both the squeaking from the coil driver and the slapping on the roll tables. Eliminating the slapping may be done by lowering the roll tables, allowing the steel to stream through the underlying pit.

♦ If the Rowe #2 line cannot be fixed, construct a noise barrier to be placed between it and the operator station.

♦ All pits and stairwells into which people may accidently walk should be guarded by standard rails with toe boards. Removable rails may be appropriate, but the OSHA standard (29CFR1910.123) should be consulted for complete treatment of this issue.

♦ Make sure that all first aid kits placed in the production building contain adequate materials that are readily available at all times according to the OSHA standard 29CFR1910.151, "Medical Services and First Aid."

♦ Even if the Edgcomb confined space program prohibits permit-required confined space entry by Edgcomb employees, a written program should be developed that addresses entry procedures by contractors or fire department personnel. This will necessarily require the involvement of the designated EMS provider especially in the planning stage. Specifically, at least paragraphs (c)(1,2,6,8) of 29CFR1910.146 must be complied with because they deal with companies that prohibit confined space entries by their own employees. Refer to the complete standard to fully address these issues.

REFERENCES

1. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92–100.

2. ACGIH [1999]. 1999 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. Code of Federal Regulations [1999]. 29 CFR 1910.1000. Air contaminants. Washington, DC: Occuaptional Safety and Health Administration. U.S. Department of Labor. U.S. Government Printing Office, Office of the Federal Register.

4. Ward WD [1986]. Anatomy & physiology of the ear: normal and damaged hearing. Chapter 5. In: Berger EH, Ward WD, Morrill JC, Royster LH, eds. Noise & hearing conservation manual. 4th ed. Akron, OH: American Industrial Hygiene Association, pp 177–195.

5. Suter AH [1978]. The ability of mildly hearing–impaired individuals to discriminate speech in noise. Washington, DC: U.S. Environmental Protection Agency, Joint EPA/USAF study, EPA 550/9–78–100, AMRL–TR–78–4.

6. Code of Federal Regulations [1999]. 29 CFR 1910.95. Occupational Noise Exposure. Washington, DC: Occupational Safety and Health Administration. U.S. Department of Labor. U.S. Government Printing Office, Office of the Federal Register.

7. NIOSH [1998]. Criteria for a recommended standard: occupational noise exposure (revised criteria 1998). Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 98–126.

8. NIOSH [1979]. Criteria for a recommended standard: working in confined spaces. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 80–106.

9. NIOSH [1986]. ALERT – Request for assistance in preventing occupational fatalities in confined spaces. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 86-110.

10. ANSI [1989]. American national standard safety requirements for confined spaces. Des Plaines, IL: American Society of Safety Engineers and American National Standards Institute, Inc. ANSI Z 117.1–1989.

11. API [1984]. Guidelines for confined space work in the petroleum industry. First edition. Washington, DC: American Petroleum Institute. API Publication 2217.

12. Code of Federal Regulations [1993]. 29 CFR 1910.146. Permit-required confined spaces. Washington, DC: Occupational Safety and Health Administration. U.S. Department of Labor. U.S. Government Printing Office, Office of the Federal Register.

13. OSHA [1993]. Preamble for permit-required confined spaces for general industry: final rule. (29 CFR 1910.146) Washington, DC: Occupational Safety and Health Administration, U.S. Department of Labor, U.S. Government Printing Office, Federal Register, January 14, 1993. 58 FR 4462–4549.

14. OSHA [1989]. Notice of proposed rulemaking: permit-required confined spaces for general industry. (29 CFR 1910.146) Washington, DC: Occupational Safety and Health Administration, U.S. Department of Labor, U.S. Government Printing Office, Federal Register, June 5, 1989. 54 FR 24080–24110.

15. Prince MM, Stayner LT, Smith RJ, Gilbert SJ [1997]. A re-examination of risk estimates from the NIOSH Occupational Noise and Hearing Survey (ONHS). J Acous Soc Am 101(2):950–963.

16. Benjamin GS, Benjamin BJ [1995]. The Ears. In: Plog BA, Niland J, Quinlan PJ, Fundamentals of Industrial Hygiene. 4th ed. Itasca, IL:National Safety Council, p. 98.

17. Royster JD, Royster LH [1990]. Hearing Conservation Programs – Practical Guidelines for Success. 1st ed. Chelsea, MI: Lewis Publishers, pp 81–85.

18. ANSI [1991]. Draft American national standard: Evaluation of the effectiveness of hearing conservation programs. New York, NY: American National Standards Institute, ANSI S12.13–1991.

Table 1
Personal Noise Dosimetry Data
HETA 99–0047
Edgcomb Metals, Cincinnati, Ohio

Job title	Date	Run time (hr.-min.)	TWA, 5 dB exchange rate (PEL = 90 dB[A])	TWA, 3 dB exchange rate (REL = 85 dB[A])
Rowe 1 operator	2/16/99	9 hr. 28 min.	81.2	88.2
Rowe 1 asst. operator	2/16/99	9 hr. 32 min.	77.1	86.4
Rowe 1 asst. – takeoff	2/16/99	9 hr. 36 min.	74	85.1
Rowe 2 operator	2/16/99	9 hr. 44 min.	86.4	92.2
Rowe 2 asst. operator	2/16/99	8 hr. 38 min.	84	90.3
Rowe 2 asst. – takeoff	2/16/99	8 hr. 31 min.	73.5	86.4
72" slitter operator	2/16/99	9 hr. 46 min.	79.4	87.4
72" slitter asst.	2/16/99	9 hr. 43 min.	82.1	89.8
72" slitter asst.	2/16/99	9 hr. 31 min.	77.5	86.6
60" slitter operator	2/16/99	9 hr. 41min.	73.8	85.7
60" slitter asst.	2/16/99	9 hr. 39 min.	73.2	85.3
60" slitter asst.	2/16/99	9 hr. 37 min.	74.1	85.5
banding operator	2/16/99	9 hr. 22 min.	77.6	87.2
banding line asst.	2/16/99	9 hr. 20 min.	75.8	85.8
metal saw asst	2/16/99	9 hr. 4 min.	75.7	86.7
Rowe 1 operator	2/17/99	9 hr. 37 min.	83.9	89.3
Rowe 1 asst. – takeoff	2/17/99	9 hr. 38 min.	79.5	88
Rowe 1 asst. op.	2/17/99	failed	failed	failed
Rowe 2 operator	2/17/99	9 hr. 39 min.	84.1	89.5
Rowe 2 asst. – takeoff	2/17/99	9 hr. 35 min.	67.3	86.6
Rowe 2 asst. op.	2/17/99	9 hr. 38 min.	83.3	89
72" slitter operator	2/17/99	9 hr. 19 min.	73.2	85.2
72" slitter asst.	2/17/99	9 hr. 36 min.	75.7	86.2
72" slitter asst.	2/17/99	9 hr. 42 min.	75.7	85.9
60" slitter operator	2/17/99	9 hr. 39 min.	79.1	87.5
60" slitter asst.	2/17/99	9 hr. 39 min.	73.1	85.4
banding operator	2/17/99	9 hr. 35 min.	68.8	84.1
banding line asst.	2/17/99	9 hr. 37 min.	76	85.9
metal saw op.	2/17/99	9 hr. 26 min.	83	89.1
wood saw/pallet dept.	2/17/99	7 hr. 11 min.	83.9	91.9

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Web site at:
www.cdc.gov/niosh

National Institute for Occupational Safety and Health
NIOSH

Delivering on the Nation's promise:
! Safety and health at work for all people through research and prevention