HETA 2000-0232-2814
Whitepath Fab Tech
Ellijay, Georgia

Lisa J. Delaney, M.S.

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 (OSHA) 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 Lisa J. Delaney, M.S. of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Max Kiefer, C.I.H. and Joshua Harney, M.S. of the HETAB. Analytical support was provided by Michelle Paradise and David M. Rogers of Data Chem Laboratories. Desktop publishing was performed by Nichole Herbert. Review and preparation for printing were performed by Penny Arthur.

Copies of this report have been sent to employee and management representatives at Whitepath Fab Tech and the 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.

Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Hazards at Whitepath Fab Tech

NIOSH conducted a health hazard evaluation at Whitepath Fab Tech in Ellijay, Georgia to evaluate the air quality and noise exposures in the Old Boardtown and the New Assembly Facilities.

What NIOSH Did

We took air samples for lead and tin at the lead soldering stations.

We took wipe samples for lead to see if it was accidentally carried to other work areas.

We measured the noise levels at the terminators and the damper assembly line.

What NIOSH Found

Lead and tin levels were very low at the soldering stations.

Very low surface levels of lead were found in a non-lead work area and the lunch table.

Noise levels were low in the Old Boardtown Facility.

Noise levels approached the OSHA Action Level of 85 d(B)A in the damper line assembly.

What Whitepath Fab Tech Managers Can Do

Conduct more noise monitoring in the damper assembly line.

Replace lead solder with a non-lead solder if possible.

Inspect and maintain the ventilation system and the electrostatic precipitator to assure proper operation.

Re-evaluate work hazards as the business expands and work tasks change.

Establish a health and safety committee.

What Whitepath Fab Tech Employees Can Do

Wash hands and face carefully before smoking or eating if you have been soldering.

Continue to eat and drink only in the break room away from the soldering stations.

Use flux and solder only inside the ventilation hood.

Participate in the health and safety committee to address potential hazards in the workplace.

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 # 2000-0232-2814

NIOSH National Institute for Occupational Safety and Health

Health Hazard Evaluation Report 2000-0232-2814

Whitepath Fab Tech
Ellijay, Georgia
November 2000

Lisa J. Delaney, M.S.

SUMMARY

On April 5, 2000, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request to investigate potential hazards at the Whitepath Fab Tech Old Boardtown and New Assembly facilities in Ellijay, Georgia. Health concerns identified in the request included stagnated pneumatic air, dust, ergonomic issues, and oil spills. NIOSH investigators conducted an initial walk-through on May 17, 2000, and identified noise, lead, and tin as potential hazards. Sampling for these potential hazards was done on August 3, 2000.

All of the personal breathing zone (PBZ) and general area (GA) samples collected for lead and tin were well below the relevant evaluation criteria for occupational exposures. Lead wipe sample results suggest that lead from the soldering area is contaminating other non-lead areas of the facility. Only one noise exposure approached the Occupational Safety and Health Administration (OSHA) action level (AL) while two noise exposures were above the NIOSH recommended exposure limit (REL).

The industrial hygiene sampling data indicate that employees were not overexposed to lead or tin at the Whitepath Fab Tech soldering stations. Noise exposures for one employee approached the OSHA AL. Recommendations for continued monitoring are given in the recommendations section of this report.

Keywords: 3679 (Electronic Components, Not Elsewhere Classified), Wire harness, lead, tin, solder pot, noise

TABLE OF CONTENTS

INTRODUCTION

On April 5, 2000, the National Institute for Occupational Safety and Health (NIOSH) received a confidential request for a health hazard evaluation (HHE) at Whitepath Fab Tech, to evaluate potential hazards in the workplace. During an initial walk-through on May 17, 2000, NIOSH investigators identified noise, lead, and tin as potential hazards in the workplace. Sampling was conducted at the Old Boardtown and New Assembly facilities on August 3, 2000.

BACKGROUND

Whitepath Fab Tech is a wire harness and heating, ventilation, and air conditioning (HVAC) components assembly shop which consists of two separate facilities. The Old Boardtown Facility, which employs approximately 79 workers over 2 shifts, is an assembly shop for wire harnesses. Employees primarily assemble wire harnesses for HVAC control boxes. The wire is purchased from the manufacturer in barrels containing approximately 20,000 feet of wire. The wire is then fed into a wire cutter and stamped with appropriate identification. Terminals can be added to the wire mechanically or manually. To add terminals mechanically, the wire from the barrel is fed into automated machines that cut and terminate the wire. Employees manually add terminals to the wire using terminators that are controlled by a foot pedal. Terminals may also require soldering. A water soluble flux and lead/tin solder is used at 8 soldering pot locations. Each solder pot has a dedicated wooden exhaust hood which feeds into the main overhead duct. The air is filtered with a pre-filter, charcoal, and an electrostatic precipitator before exhausting back into the workplace. Approximately 70 employees work at the New Assembly Facility, where the majority of employees assemble HVAC system ducts, dampers and humidifiers. Employees also solder terminals to wires and assemble harnesses. A small recirculated air filtration unit is located behind each of the soldering pots.

METHODS

Full-shift personal noise monitoring using Quest Electronics Model Q-300 Noise Logging Dosimeters was conducted for employees working in the noisiest tasks. At the Old Boardtown Facility, employees operating terminators and the automatic wire cutting and terminating machines in the wire shop area were monitored. Employees working in the damper assembly line were monitored at the New Assembly Facility. The dosimeters were attached to the employee's belt and a small remote microphone was fastened to the work uniform (facing forward) at a mid-point between the ear and the outside of the employee's shoulder. The dosimeters were worn for the entire work day, including the employees' breaks and lunch period. At the end of the work shift, the dosimeters were removed and paused to stop data collection. The information was downloaded to a personal computer with Quest Electronics Metrosoft computer software for interpretation. The dosimeters were calibrated before and after the work shift according to the manufacturer's instructions.

Full-shift personal breathing zone (PBZ) air samples were collected to measure airborne lead (PbA) and tin exposures for all employees soldering on the day of the survey. A general area (GA) sample was also collected at the soldering station at the Old Boardtown Facility. Samples were collected using personal air sampling pumps drawing air at a measured sampling rate of 3 liters per minute (Lpm). Pumps were calibrated in the field pre- and post-sampling. Air samples were collected on 37-millimeter (mm) diameter, 0.8 micrometer (um) cellulose ester membrane filters according to NIOSH Method 7300 (inductively coupled plasma spectrometry).[1] For samples where no PbA was initially detected, the samples were subsequently analyzed by a more sensitive method using NIOSH Method 7300 for trace analysis.[1]

To evaluate the potential for dermal exposure and ingestion of lead, surface wipe samples were collected using Wash'n Dri® pre-moistened towelettes according to NIOSH Method 9100.[1] The samples were collected on surfaces of approximately 100 square centimeters (cm^2). Surfaces wiped were the soldering stations after

clean-up, the lunch room break area table top, and a non-lead work area. The towelettes were digested and analyzed for lead by inductively coupled plasma emission spectrometry according to NIOSH Method 7300.[1]

EVALUATION 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, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[2] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[3] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[4] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 95–596, sec. 5.(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

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.[5] While loss of hearing may result from a single exposure to a very brief impulse noise or explosion, such traumatic losses are rare. In most cases, noise-induced hearing loss is insidious. Typically, it begins to develop at 4000 or 6000 Hertz (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.[6]

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. Because the scale is logarithmic, 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)[7] 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 to calculate a worker's daily noise dose according to the formula:

$$\text{Dose} = 100 \times (C1/T1 + C2/T2 + \ldots + Cn/Tn),$$

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 action level (AL) of 85 dB(A); an employer shall administer a continuing, effective hearing conservation program when the 8-hour 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,[8] and the ACGIH,[3] 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.

Lead

Occupational exposure to lead occurs primarily via inhalation of lead-containing dust and fume, and ingestion from contact with lead-contaminated surfaces. Symptoms of lead poisoning include weakness, excessive tiredness, irritability, constipation, anorexia, abdominal discomfort (colic), fine tremors, and "wrist drop."[9,10,11] Exposure to lead over time can cause harm gradually, often with no obvious symptoms or clinical effects. Chronic exposure to lead may cause damage to the kidneys, anemia, hypertension, infertility, and reduced sex drive in both sexes, and impotence. Exposure to lead before or during pregnancy can alter fetal development and cause miscarriages. The developing nervous system of the fetus is particularly vulnerable to lead toxicity.[12]

In the OSHA lead standards for general industry and construction the PEL for lead is 50 micrograms per cubic meter ($\mu g/m^3$) (8–hour TWA), which is intended to maintain worker blood lead level (BLLs) below 40 micrograms per deciliter (µg/dL); medical removal is required when an employee's BLL reaches 50 µg/dL.[13,14] NIOSH has concluded that the 1978 NIOSH REL of 100 $\mu g/m^3$ as an 8-hour TWA does not sufficiently protect workers from the adverse affects of exposure to inorganic lead.[15] NIOSH intends to analyze the feasibility of developing an REL that would provide better protection for workers. NIOSH has conducted a literature review of the health effects data on inorganic lead exposure and found evidence that some of the adverse effects on the adult reproductive,

cardiovascular, and hematologic systems, and on the development of children of exposed workers can occur at BLLs as low as 10 µg/dL.[12] At BLLs below 40 µg/dL, many of the health effects would not necessarily be evident by routine physical examinations, but represent early stages in the development of disease. In recognition of this, voluntary standards and public health goals have established lower exposure limits to protect workers and their children. The ACGIH TLV® for lead is 50 µg/m^3 as an 8-hour TWA, with worker BLLs to be controlled to ≤30 µg/dL. A national health goal is to eliminate all occupational exposures which result in BLLs greater than 25 µg/dL.[16]

Lead in Surface Dust

Lead contamination in dust and soil, which is commonly found in the U.S. due to the past use of lead in gasoline and paints, and also industrial emissions, is a risk to children. Lead-contaminated surfaces may be a source of occupational exposure for workers. Lead exposure may occur either by direct hand-to-mouth contact, or indirectly through contamination of hands, cigarettes, cosmetics, or food.

In the workplace, generally there is little or no correlation between surface lead levels and employee exposures. The amount of lead ingested in contaminated work areas depends on the effectiveness of administrative controls, personal hygiene practices, and available facilities for maintaining personal hygiene. There is no federal standard which provides an occupational exposure limit for surface lead contamination. The Department of Housing and Urban Development has established the following dust lead standards for clearance after residential lead-based paint hazard reduction activities in federally owned or assisted housing: floors, 40 micrograms per square foot (µg/ft^2); interior window sills, 250 µg/ft^2, and window troughs, 800 µg/ft^2.[17]

Tin

The health consequences of exposure to tin are acute, as tin is primarily an irritant of the eyes and skin. No systemic effects have been reported from industrial exposures. Inhalation of fumes can also produce headaches, sore throat, and cough. The OSHA PEL and NIOSH REL for inorganic tin compounds are 2 mg/m^3 as an 8-hour TWA.[2,4]

RESULTS AND DISCUSSION

Noise

Full-shift monitoring was conducted on 10 employees, including 8 employees working in the wire shop area (Old Boardtown Facility) and 2 employees working in the damper line (New Assembly Facility). Table 1 shows noise sampling results. When the personal exposure data were compared with the OSHA AL of 85 dB(A) (80-dB threshold, 5 dB exchange), none of the 10 samples exceeded the AL while 2 samples exceeded the NIOSH REL of 85 dB(A) (80-dB threshold, 3 dB exchange). Noise levels measured in the wire shop area ranged from 72.6 to 80.9 dB(A) while the levels measured in the damper line ranged from 76.9 to 84.9 dB(A). One employee's noise exposure (84.9 dB(A)) working in the damper assembly line approached the OSHA AL and exceeded the NIOSH REL. The damper assembly line employees rotate tasks that include operating an air drill and lockformer, and assembling the dampers for approximately 2 hours each. The noise exposure of the other employee sampled in the damper assembly line was much lower at 76.9 dB(A). This employee operated the lockformer all day and did not rotate tasks. Employees with personal noise exposures above the OSHA AL are required to be in an occupational hearing conservation program.

One additional employee's noise exposure of 85.2 dB(A) exceeded the NIOSH REL and one employee's noise exposure of 84.6 approached the NIOSH REL. Both employees operated manual terminator machines and were seated closest to the east wall of the wire shop area facing the automated terminators. The third employee, sampled while operating a terminator, had an exposure of 78.9 dB(A), which was much lower than the other employees. Since all three employees worked consistently throughout the

day, the variation in noise exposures may be due to the difference in noise generated by each machine or the type of terminal added to the wire. The noise variation may also be due to the position of the operator relative to the machine; some operators work closer to the terminators.

Lead and Tin

Six PBZ samples for lead and tin were collected during soldering, including 4 at the Old Boardtown Facility and 2 at the New Assembly Building. Four of the 6 PBZ samples for lead and tin were non-detectable. However, lead was detected at trace levels of 0.28 µg/m^3 at one soldering station at the Old Boardtown Facility and 0.15µg/m^3 at one soldering station at the New Assembly Facility. These trace levels were above the analytical limit of detection (LOD), but below the analytical limit of quantification (LOQ). The LOD for lead was 0.1 µg/sample and the minimum detectable concentration (MDC) was 0.084 µg/m^3. Tin was detected at trace levels of 0.55 µg/m^3 at one soldering station at the Old Boardtown Facility and 0.14 µg/m^3 at one soldering station at the New Assembly Facility. The LOD for tin was 0.5 µg/sample and the MDC was 0.42 µg/m^3. The MDC for lead and tin samples assume an average sample volume of 1192 liters. No lead or tin was detected in the GA sample collected in the soldering area at the Old Boardtown Facility.

Table 3 shows wipe sample results. The highest concentration of lead, 11,146 µg/ft^2, was found at the soldering station not in use the day we sampled. Visible shavings were observed on the surface area sampled which contributed to the high concentration. The high concentration of lead and the presence of shavings suggests that stations may not be adequately cleaned after each work shift. Wipe samples collected at the soldering stations in use during the survey ranged from 2322- 2043 µg/ft^2. Samples were collected at the end of the work shift after employees cleaned the area. Since no occupational exposure limits for surface lead contamination exist, a comparison of results can only be made to residential guidelines. These levels were in excess of what would be allowed to pass a clearance test following a lead abatement project in a residential setting. The concentrations of lead from wipes sampled in non-lead areas were lower and ranged from 11- 223 µg/ft^2. These levels fell within the HUD abatement criteria. However, they do suggest that lead from the soldering area is contaminating other non-lead areas of the facility. Employees occupationally exposed to lead have the potential to carry lead home to family members. Take home lead can be carried into the home on clothing, skin, hair, and in vehicles. High BLLs in resident children, and elevated concentrations of lead in the house dust, have been found in the homes of workers employed in industries associated with high lead exposure.[18]

Work Practices

During the first site visit, wooden local exhaust hoods, which are difficult to clean and are a fire hazard, were used at the soldering stations. A preliminary recommendation was made to change the hoods to a non-combustible, non-porous material. Upon the second site visit, the interior wooden hoods had been lined with sheet metal to address the recommendation. Employees were observed soldering and storing flux outside of the local ventilation hoods. Employees soldering did not wear any personal protective equipment (PPE) including safety glasses, gloves, or respirators. Safety glasses are not required, but are provided to employees. Employees were not wearing PPE at the Old Boardtown facility. Two employees working at the terminator machines wore wrist braces. Some employees working on the Damper Assembly Line wore gloves. Working with the sheet metal poses a cut hazard and employees reported that cuts were common. General housekeeping at both facilities was good.

CONCLUSIONS

All measured lead and tin air concentrations were well below occupational exposure limits. Wipe samples suggest soldering stations may not be thoroughly cleaned at the end of each shift, therefore some contamination from the lead soldering area to other non-lead work areas may occur. Only one noise exposure in the damper assembly line approached the OSHA AL.

RECOMMENDATIONS

Based on our investigation, the following recommendations are provided. These address several issues that arose during our investigation.

Conduct additional noise exposure monitoring in the damper assembly line. Since one employee's noise exposure approached the OSHA AL, further monitoring is necessary to assess employees' noise exposures and to determine if a Hearing Conservation Program is required.

Encourage employees to practice good hygiene (e.g., thoroughly washing hands and face) before smoking, eating, and leaving work. Employees should also continue to eat their lunch in a lunchroom separate from the solder stations. Drinking and eating at the solder station should not be permitted. Utilizing proper hygiene practices in the workplace will help prevent exposures to lead both at work and home.

Restrict exposures to lead solder to the lowest possible level, with emphasis on eliminating its use by substituting less hazardous products.

Periodically inspect and maintain all components of the ventilation system (e.g. fans, pulleys, belts, motors, dampers, and air filtration devices) to assure proper operation, and document maintenance activities. Establish a preventive maintenance schedule for the electrostatic precipitator according to the manufacturer's instructions.

Instruct employees on proper use of solder ventilation hoods. All soldering and flux storage should be done inside the ventilation hood.

Re-evaluate work hazards as the business expands and work tasks change. According to management, new work will be added at the New Assembly Facility. Management should consider the potential hazards that may arise with the addition of new work tasks.

Establish a health and safety committee comprised of management and hourly employees to address potential hazards in the workplace. Good communication between management and employees is very important. The committee should develop procedures and mechanisms to evaluate safety goals and monitor progress. These goals and objectives should be organized into a written safety program that is endorsed by management and communicated to all employees. Health and safety committee meetings should be held on a regular basis to evaluate progress, assign responsibilities, and identify potential problem areas.

REFERENCES

1. NIOSH [1994]. NIOSH manual of analytical methods, 4th edition. Eller, P and Cassinelli, ME, Eds. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94–113.

2. 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 and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

3. ACGIH [2000]. 2000 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

4. CFR [1997]. 29 CFR 1910.1000. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

5. 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.

6. 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.

7. CFR [1992]. 29 CFR 1910.95. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

8. 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.

9. Hernberg S, et al. [1988]. Lead and its compounds. In: Occupational medicine. 2nd ed. Chicago, IL: Year Book Medical Publishers.

10. Landrigan PJ, et al. [1985]. Body lead burden: summary of epidemiological data on its relation to environmental sources and toxic effects. In: Dietary and environmental lead: human health effects. Amsterdam: Elsevier Science Publishers.

11. Proctor NH, Hughes JP, Fischman ML [1991]. Lead. In: Chemical hazards of the workplace. 3rd ed. Philadelphia, PA: J.B. Lippincott Company, pp 353–357.

12. Sussell A, et al. [1998]. Protecting Workers Exposed to Lead-Based Paint Hazards: A Report to Congress. 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. 98-112. January 1998–revised with minor technical changes.

13. Code of Federal Regulations. OSHA lead standard for general industry. 29 CFR, Part 1910.1025. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

14. Code of Federal Regulations. OSHA construction industry lead standard. 29 CFR, Part 29 CFR 1926.62. Washington, DC. U.S. Government Printing Office, Office of the Federal Register.

15. 62 Fed. Reg. 206 [1997]. National Institute for Occupational Safety and Health; occupational exposure to inorganic lead: request for comments and information.

16. DHHS [2000]. Healthy people 2010-conference edition; National health promotion and disease objectives. Washington, DC: U.S. Department of Health and Human Services. Available on the internet at: www.health.gov/healthypeople/Document/default.htm

17. 64 Fed. Reg. 178 [1999]. Department of Housing and Urban Development: requirements for notification, evaluation and reduction of lead-based paint hazards in federally owned residential property and housing receiving federal assistance, September 15, 1999. (To be codified at 24 CFR Part 35, et al.)

18. Grandjean P and Bach E [1986]. Indirect exposures: the significance of bystanders at work and at home. Am Ind Hyg Assoc J 47(12):819-824.

Table 1
Noise Monitoring Results
Whitepath Fab Tech
Ellijay, Georgia
August 3, 2000
HETA 2000-0232-2814

Location	Occupation	Task	OSHA AL [a]	NIOSH REL [b]	Maximum Level [c]
Old Boardtown Facility	Heat Shrinker	Operated manual heat shrink machine	73.2	80.3	110.6
	Terminator	Operated manual terminator machines	72.6	78.9	107.9
	Terminator	Operated manual terminator machines	80.7	84.6	104.8
	Terminator	Operated manual terminator machines	80.9	85.2	112.1
	Wire Cutter	Operated mechanical wire cutter	72.8	79.4	106.6
	Wire Cutter	Operated mechanical wire cutter and stamper	73.1	78.9	106.8
	Wire Cutter	Operated mechanical wire cutter and stamper	75.1	80.1	106.2
515 Building	Damper Line Assembler	Operated lockformer	76.9	82.4	116.6
	Damper Line Assembler	Operated air drill, marked corners, and ran lockformer	84.9	90.2	118.2
Evaluation Criteria			85 dB(A)	85 dB(A)	

a = Data collected with a 85 dB criterion, 80 dB threshold, and 5 dB exchange rate.
b = Data collected with a 85 dB criterion, 80 dB threshold, and 3 dB exchange rate.
c = Maximum slow-response level measured during sampling period.

Table 2
Personal and Area Lead and Tin Concentrations
Whitepath Fab Tech
Ellijay, Georgia
August 3, 2000
HETA 2000-0232-2814

Location	Type of Sample	Sample Duration (minutes)	Lead Concentration ($\mu g/m^3$)*	Tin Concentration ($\mu g/m^3$)
Old Boardtown Facility Soldering Station	Personal	482	ND	ND
	Personal	483	0.28	0.55
	Personal	140**	ND	ND
	Personal	473	ND	0.14
	Area	329	ND	ND
515 Building Soldering Station	Personal	434	ND	ND
	Personal	437	0.15	ND
Evaluation Criteria	OSHA PEL†		50	2000
	NIOSH REL‡		50	2000

* $\mu g/m^3$ = micrograms per cubic meter
** Employee was moved to another non-lead work task
† OSHA Permissible Exposure Limit
‡ NIOSH Recommended Exposure Limit

Table 3
Surface Wipe Lead Concentrations
Whitepath Fab Tech
Ellijay, Georgia
August 3, 2000
HETA 2000-0232-2814

Area	Location Sampled	Lead Concentration ($\mu g/ft^2$)*	Comments
Soldering Area	Solder bench	11,146	Soldering not done at the station on the day of sampling
Soldering Area	Solder bench	2322	Wipe sample collected after daily clean-up
Soldering Area	Solder bench	2043	Wipe sample collected after daily clean-up
Wire Carousel	Assembly table	223	Non-lead work area
Break Room	Lunch table	11	Sample collected after lunch

* $\mu g/ft^2$ = micrograms per square foot

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