

HETA 93-700-2335
JULY 1993
SILVER MOUNTAIN ENTERPRISES
MONTROSE, COLORADO

NIOSH INVESTIGATOR:
Charles McCammon, Ph.D., CIH

I. SUMMARY

On February 12, 1993, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Safety Coordinator of the Silver Mountain Enterprises (SME) for a health hazard evaluation (HHE) at their manufacturing facility in Montrose, Colorado. The Safety Coordinator with SME was concerned with wood dust and noise exposures in their woodshop. SME operates a program for handicapped individuals working in the woodshop. The current product from the woodshop was surveyor's stakes.

On March 12, 1993, an environmental evaluation of the SME woodshop was conducted. The survey consisted of an inspection of the various work areas, interviews with employer representatives and employees, and personal breathing-zone and area environmental air monitoring for total dust and personal dosimetry for noise exposure.

Short-term wood dust exposures ranged from 0.2 to 4.1 mg/M³. There were two very high results, both over 15 mg/M³, but both of these samples were considered not to be valid samples due to the presence of very large dust particles within the samples. All valid samples were below the OSHA and ACGIH time-weighted averages (TWAs) of 5 mg/M³ and the ceiling values of 10 mg/M³. The calculated TWA exposures ranged from 0.12 to 0.93 mg/M³, all well below the OSHA and ACGIH levels of 5 mg/M³. In general, the highest exposures from normal operations were seen from workers on the two table saws (short-term exposures of 1.5 and 1.9 mg/M³ and TWAs of 0.8 and 0.93 mg/M³). The highest consistent task samples (1.4 and 4.1 mg/M³) were found during clean-up operations. Workers used brooms to dry sweep the floors and brush off machine surfaces.

Personal noise dosimetry exposures were measured over discrete 1-1.5 hour time periods (between breaks) and then 8-hour TWAs were calculated. The average exposures over several time periods ranged from 79.8 to 93 decibels (A-weighted scale) [dB(A)]. The table saw operators (feeders) had the highest general exposures, with equivalent exposures in the 85 to 93 dB(A) range. The peak exposures on the pointer machines were quite high but for very short durations. All 8-hour TWA exposures were below the OSHA 90 dB(A) exposure criteria: two were above the 85 dB(A) 8-hr TWA recommended by NIOSH and ACGIH (both were workers on table saw #2).

Based on the environmental monitoring results, the NIOSH investigator concluded that a potential health hazard existed from overexposure to noise. However, a partial hearing conservation program was already in effect and most all employees were wearing appropriate hearing protection devices. Recommendations are made in Section VIII to help establish a complete hearing conservation program and to correct other identified problems.

KEYWORDS: SIC 2499 (Wood Products, Not Elsewhere Classified), wood dust, noise.

II. INTRODUCTION

On February 12, 1993, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Safety Coordinator of the Silver Mountain Enterprises (SME) for a health hazard evaluation (HHE) at their manufacturing facility in Montrose, Colorado. The Safety Coordinator with SME was concerned with wood dust and noise exposures in their woodshop. SME operates a program for handicapped individuals working in the woodshop. The current product from the woodshop was surveyor's stakes.

On March 12, 1993, an environmental evaluation of the SME woodshop was conducted. The survey consisted of an inspection of the various work areas, interviews with employer representatives and employees, and personal breathing-zone and area environmental air monitoring for total dust and personal dosimetry for noise exposure.

III. BACKGROUND

The Silver Mountain Enterprises is a government sponsored organization which provides a variety of programs for handicapped individuals. As a part of the program, SME runs a woodshop to provide employment for some of the people in the program. Those individuals who can qualify for the employment, work about 6 hours per day in the woodshop and are compensated according to their productivity. The woodshop had recently bid on and received a contract to provide a large number of wood surveyor stakes on a weekly basis. Since the level of effort to meet the output required longer work times in the woodshop, the company was concerned about the potential increase in exposures to noise and wood dust. The company has had several safety and health assessments from different organizations over the past few years.

The woodshop consisted of a large warehouse with areas for bulk wood storage, the various wood working machines, and storage of stacked pallets with the final product. Two doors connected the shop area with a lunch room, a kitchen, and offices. The woodshop was run by 4 staff personnel. There may be 10 to 20 workers at any given time in the woodshop. The shop received scrap 1x4", 1x6", and 2x4" pine or fir lumber which was first cut to the proper lengths on a top cut saw. The lumber was then cut to the proper width, 1x2" or 2x2" on the two table saws. The 2x2" stakes were then sharpened on a pointer machine and stacked on pallets while the 1x2" stakes were pointed on a band saw and stacked on pallets. Each machine was operated by at least two workers, except the pointer and band saws which were operated by a single worker. Additional workers helped with loading and unloading, stacking and clean-up. The top cut saw and two table saws had an operator (or feeder) who fed the lumber into the machine and a receiver (or helper) who took the cut lumber and stacked it on a cart. Most workers wore hearing protection and eye protection, and most wore single band paper dust masks.

IV. MATERIALS AND METHODS

The NIOSH evaluation consisted of interviews with representatives from management and employees, and an environmental survey. Personal

breathing-zone total dust samples (for wood dust) were collected on mixed cellulose ester membrane filters at a flow rate of 2-4 liters per minute (Lpm) using Gilian Model HFS 513S personal sampling pumps. The filters were analyzed gravimetrically according to NIOSH method 0500.¹

Personal dosimetry noise levels were measured with DuPont Model MK-3 dosimeters. The dosimeters were set on the A-scale, slow response using the Occupational Safety and Health Administration (OSHA) criteria of 90 decibels (dB[A]) for an 8-hour time-weighted average (TWA) and a threshold limit of 80 dB(A).

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for 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 if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a preexisting 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 evaluation 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, such contact may increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of air contamination criteria generally consulted include: (1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), (2) the American Conference of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values (TLVs),² and (3) the U.S. Department of Labor (OSHA) federal occupational health standards, permissible exposure limits (PEL).³ These sources provide environmental limits based on airborne concentrations of substances to which workers may be occupationally exposed in the workplace environment for 8 to 10 hours per day, 40 hours per week for a working lifetime without adverse health effects.

The industrial criteria for the substances evaluated in this survey are presented below. 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 short-term exposure limits (STELs) or ceiling values which are

intended to supplement the TWA where there are recognized toxic effects from high, short-term exposures. A discussion of the substances evaluated in this survey is presented below.

A. Wood Dust

Some woods, both domestic and exotic, are known to cause contact dermatitis. Respiratory diseases associated with wood dust include hypersensitivity, asthma, acute airway obstruction, and allergic disorders of the upper respiratory tract.⁴ An increased incidence of adenocarcinoma of the nasal cavity and ethmoid sinus has been demonstrated in woodworkers in the furniture industry of England, Belgium, France, and Denmark. The most frequent complaints of workers exposed to wood dust include dryness in nose, eye irritation, nasal obstruction, prolonged colds, and frequent headaches.⁴ The current OSHA PEL is 5 milligrams per cubic meter of air (mg/M^3) measured as total wood dust for all types of woods, except for Western Red Cedar which has a PEL of $2.5 \text{ mg}/\text{M}^3$. OSHA also has a STEL of $10 \text{ mg}/\text{M}^3$ over 15-minutes. The ACGIH has a TLV of $1 \text{ mg}/\text{M}^3$ for total hard wood dusts and $5 \text{ mg}/\text{M}^3$ for total soft wood dust. ACGIH further recommends a STEL for soft woods of $10 \text{ mg}/\text{M}^3$ as total dust. NIOSH recommends an 8-hr TWA of $1 \text{ mg}/\text{M}^3$ for all types of wood.

B. Noise

Exposure to high levels of noise may cause temporary or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 dB(A) causes hearing loss in a portion of the exposed population.

The OSHA standard for noise specifies a PEL of 90 dB(A)-slow response for a duration of 8 hours per day. The regulation, in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be exposed to noise levels of 95 dB(A), the amount of time allowed at this exposure level must be cut in half to be within the PEL. Conversely, a person exposed to 85 dB(A) is allowed twice as much time at this level (16 hours) to remain within his daily PEL.⁶ Both NIOSH and ACGIH recommend an exposure limit of 85 dB(A) for 8 hours, 5 dB less than the OSHA standard. Both these latter two criteria also use a 5 dB time/intensity trading relationship in calculating exposure limits.

Time-weighted average (TWA) noise limits as a function of exposure duration are shown as follows:

Duration of Exposure (hrs/day)	Sound Level (dB(A))	
	NIOSH/ACGIH ^{7,8}	OSHA ⁶
16	80	85
8	85	90
4	90	95
2	95	100
1	100	105
1/2	105	110
1/4	110	115*
1/8	115*	- **

* No exposure to continuous or intermittent noise in excess of 115 dB(A).

** Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

The OSHA regulation, which has an additional action level (AL) of 85 dB(A), stipulates that an employer shall administer a continuing, effective hearing conservation program when the TWA value exceeds the AL. The program must include monitoring, employee notification, observation, an audiometric testing program, hearing protectors, training programs, and recordkeeping requirements. All of these stipulations are included in 29 CFR 1910.95, paragraphs (c) through (o)⁶.

The OSHA noise regulation also 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. Also, a continuing, effective hearing conservation program shall be implemented.

VI. RESULTS AND DISCUSSION

A summary of the personal air sampling results for total wood dust is presented in Table 1. The exposures ranged from 0.2 to 4.1 mg/M³. There were two very high results, samples # 420 and 429, but both of these samples were suspect. After collection, it appeared that large wood particle had been propelled into the cassette when the workers leaned close to the table saw. These samples are not considered valid. All valid samples were below the NIOSH REL of 1 mg/M³ and the OSHA and ACGIH criteria of 5 mg/M³ and the ceiling values of 10 mg/M³. In general, the highest exposures from normal operations were seen from workers on the two table saws. The highest consistent task samples were found during clean-up operations. Workers used brooms to dry sweep the floors and brush off machine surfaces.

Table 2 summarizes the calculated TWA total wood dust exposures by job category. The TWAs ranged from 0.12 to 0.93 mg/M³, all well below the NIOSH

REL of 1 mg/M³ and the OSHA and ACGIH criteria of 5 mg/M³. These values were calculated by taking the 6-hour exposures determinations (Table 1) and factoring in 2 hours of zero exposure. A summary of the personal noise exposures is presented in Table 3. Personal exposures were measured over discrete 1-1.5 hour time periods (between breaks) and then 8-hour TWAs were calculated. The average exposures over several time periods ranged from 79.8 to 93 dB(A). The table saw operators (feeders) had the highest general exposures, with equivalent exposures in the 85 to 93 dB(A) range. The peak exposures on the pointer machines were quite high but for very short durations. The employees worked six hours on the day of the survey which is usually as long as they work in any given day. Factoring in 2 hours of zero exposure helped keep the table saw operators below an 8-hour TWA of 90 dB(A). However, the TWAs were above 85 dB(A) for the two workers on table saw #2.

VII. CONCLUSIONS

Exposures to wood dust for all jobs were below the NIOSH REL of 1 mg/M³ and the OSHA 8-hr PEL of 5 mg/M³ and the 15-minute STEL of 10 mg/M³. The highest task-oriented exposures were during clean-up operations. All 8-hr TWA noise exposures were below the OSHA TWA of 90 dB(A) but two jobs were above 85 dB(A). Most of the jobs had exposures averaging over 85 dB(A) during work on the machines. Not all workers or staff in the machine area were wearing hearing protection or eye protection.

VIII. RECOMMENDATIONS

- 1) The wood dust exposures do not warrant the need for additional engineering controls or respiratory protection. If the company wishes to continue supplying respirators to employees for their added safety and comfort, then a comprehensive respirator program will have to be developed. The existing written respirator program appears acceptable. However, most of the elements that are detailed in the written program are not being followed, e.g., fit testing, worker education, maintenance and cleaning of respirators, and medical assessment of the ability of workers to wear respirators. Bulk respirators were stored in the work area and workers would leave their respirators laying around in the work area during breaks. Included with this report is a copy of a NIOSH document on the requirements of a good respirator program.⁹ This includes fit testing of employees, the use of certified respirators, training for employees on use and maintenance of respirators, medical testing for the ability to wear respirators, and having a written respirator policy. Workers will not be able to wear beards with any respirators.
- 2) Based on noise exposure levels, a comprehensive hearing conservation program is needed. Included is a NIOSH document which should help with the implementation of the program. This document is titled, "A Practical Guide to Effective Hearing Conservation Programs in the Workplace."¹⁰ Elements include annual audiograms for all affected employees, appropriate hearing protection, a written program, etc. This applies to all workers and staff. All visitors who enter the wood shop machine area are required to wear hearing protection. Signs should be posted at the entrances to machine area reminding people that hearing protection is required in this area. Since SME already provides annual audiograms and a

good variety of adequate hearing protection devices, the primary elements for a comprehensive hearing conservation program that are still needed include: worker training, periodic noise surveys, record keeping, and a written program.

- 3) All workers, staff, and visitors should be required to wear eye protection with side shields when in the machine area. Several "observers" were quite near the table saws while they were being operated. Once again, signs should be posted on all doors entering the machine area, reminding everyone that eye protection is required when entering the area.
- 4) All personal protection equipment (respirators, hearing protection, and eye protection) should be kept clean and stored in plastic bags away from the machine area.

IX. REFERENCES

1. NIOSH [1986]. NIOSH Manual of Analytical Methods. 3rd ed. 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. 84-100.
2. ACGIH [1991]. Threshold limit values and biological exposure indices for 1991-1992. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. CFR. Code of Federal regulations. Occupational Safety and Health Administration "General Industry Standards" (29 CFR 1910), Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
4. ACGIH [1986]. Documentation of the Threshold Limit Values and Biological Exposure Indices, Fifth Edition. Cincinnati, Ohio: American Conference of Industrial Hygienists (ACGIH)ACGIH; 1971.
5. 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.
6. CFR. Code of Federal regulations. Occupational Safety and Health Administration "Occupational Noise Exposure" (29 CFR 1910.95), January 1981. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
7. NIOSH [1972]. Criteria for a recommended standard: occupational exposure to noise. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Health Services and Mental Health Administration, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 73-11001.
8. ACGIH [1990]. 1990-1991 threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

9. NIOSH [1987]. Guide to Industrial Respiratory Protection. 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. 87-116, 1987.
10. NIOSH [1990]. A practical guide to effective hearing conservation programs in the workplace. 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. 90-120.

X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By: Charles S. McCammon, Ph.D., CIH
Regional Consultant for
Occupational Health
Denver Regional Office
Denver, Colorado

Originating Office: Hazard Evaluations and
Technical Assistance Branch
Division of Surveillance, Hazard,
Evaluations, and Field Studies
Cincinnati, Ohio

XI. DISTRIBUTION AND AVAILABILITY

Copies of this report may be freely reproduced and are not copyrighted. Single copies of this report will be available for a period of 90 days from the date of this report from the NIOSH Publications Office, 4676 Columbia Parkway, Cincinnati, Ohio 45226. To expedite your request, include a self-addressed mailing label or envelope along with your written request.

Copies of this report have been sent to:

1. Adult Services Director, Silver Mountain Enterprises, Montrose, Colorado.
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH, Region VIII

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

TABLE 1
SUMMARY OF PERSONAL AIR SAMPLES FOR TOTAL WOOD DUST
SILVER MOUNTAIN ENTERPRISE
HETA 93-700
MARCH 12, 1993

Sample #	Description	Volume (Liters)	Time (min)	Concentration (mg/M ³)	
428	Pointer operator		150	75	0.87
409	Pointer operator		530	147	0.74
429	Table saw #1 feeder		140	72	24.**
420	Table saw #1 feeder		580	148	17.6**
415	Table saw #1 receiver		92	46	0.5
410	Table saw #1 receiver		210	54	1.9
430	Table saw #2 feeder		140	70	0.8
424	Table saw #2 feeder		100	49	0.7
417	Table saw #2 feeder		500	123	1.5
411	Table saw #2 feeder, clean-up		94	23	4.1
431	Table saw #2 receiver		140	68	0.74
422	Table saw #2 receiver		82	41	0.5
419	Table saw #2 receiver		480	119	0.55
412	Table saw #2 receiver, clean-up		64	16	1.1@
426	Band saw operator		132	66	0.4
423	Band saw operator		100	50	0.2
432	Cut saw operator		130	64	0.5
416	Cut saw operator		520	126	0.5
413	Cut saw operator, clean-up		57	14	1.4
421	Cut saw receiver		90	44	0.22

Evaluation Criteria:

NIOSH, all woods = 1 mg/M³ as an 8-hr Time-weighted Average (TWA) Wood dust, soft
 OSHA = 5 mg/M³ as an 8-hr TWA, 10 mg/M³ ceiling
 ACGIH= 5 mg/M³ as an 8-hr TWA, 10 mg/M³ ceiling

** Large dust particles observed on sample, probably from direct stream of wood particles.
 These samples are highly questionable.

@ Sample fell off, therefore this sample is > or equal to this value.

Note:

mg/M³ = milligrams of wood dust per cubic meter of air sampled

TABLE 2
 TIME-WEIGHTED AVERAGE PERSONAL WOOD DUST EXPOSURES
 SILVER MOUNTAIN ENTERPRISES
 HETA 93-700
 MARCH 12, 1993

Job Title	Hrs Monitored	Hrs Worked (mg/M ³)	8-Hr TWA Conc.	
Pointer operator		3.7	6	0.45
Table saw #1 feeder		3.7	6	**
Table saw #1 receiver		1.7	6	0.93
Table saw #2 feeder		4.4	6	0.80
Table saw #2 receiver		4.1	6	0.36
Band saw operator		1.9	6	0.20
Cut saw operator		3.4	6	0.31
Cut saw helper		0.7	6	0.12

Evaluation Criteria:

NIOSH, all woods = 1 mg/M³ as an 8-hr Time-weighted Average (TWA) Wood dust, soft
 OSHA = 5 mg/M³ as an 8-hr TWA, 10 mg/M³ ceiling
 ACGIH= 5 mg/M³ as an 8-hr TWA, 10 mg/M³ ceiling

** TWA was unable to be calculated due to the lack of valid data.

Notes: 8-hr TWA = average exposure over an 8-hour time period. Workers were exposed 4.5 of the 6 hours they were at work, resulting in 3.5 hours of zero exposure.

TABLE 3
SUMMARY OF PERSONAL NOISE DOSIMETRY LEVELS
SILVER MOUNTAIN ENTERPRISES
HETA 93-700
MARCH 12, 1993

Job Title	Time Monitored(hrs)	Leq (dB)	LmaxdB (dB)	Estimated 8-Hr Dose %	TWA	
Pointer operator		3.6	85-86	110.5	31.4	81.7
Table saw #1, feeder		3.6	85-91	103.5	36.5	82.7
Table saw #1, receiver		3.0	88-89	103.3	43.1	83.9
Table saw #1, stocker		0.9	85	105.8	30.0	81.3
Table saw #2, feeder		4.5	89-93	106.0	59	86.2
Table saw #2, receiver		1.1	92.6	108.8	76	88.2
Cut saw operator		3.5	85-86	111.0	28.7	81.0
Cut saw helper		0.8	79.8	102.0	14.0	76.0
Band saw operator		0.8	81.8	98.3	18.5	77.8

Notes:

Time Monitored = the number of hours actually measured with a dosimeter

Leq = the range of average noise levels measured for different time periods for each job title.

LmaxdB = maximum noise level measured over 1/16 of a second.

Estimated 8-hr Dose = based on exposure for 4.5 hours (with 0 exposure for the remaining 3.5 hrs), the estimated percentage of the OSHA allowable dose. Exposure not measured was assumed to be at highest monitored level.

Estimated 8-hr TWA = based on exposure for 4.5 hrs, 0 exposure for 3.5 hrs, the estimated time-weighted average noise exposure level.