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NIOSH INVESTIGATOR:
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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH contacted by an employee at the Collins Road Station of the U.S. Service (USPS) in Lansing, Michigan on November 14, 1991. The employee, a letter carrier for the USPS, was concerned about the at his work station from an automated Small Parcel and Bundle So (SPABS) that had been located adjacent to the letter carriers' s cages approximately two years ago. The employees in the sorting view the additional noise from the SPABS as a source of mental s The USPS purchased a 30-foot x 8-foot canvas curtain in February and hung it near the ceiling between the sorting area and the SP an attempt to control the noise.

An investigator from NIOSH conducted noise surveys at the Collin location on December 17-18, 1991, and January 21, 1992, to docum noise exposures experienced by employees in the letter sorting a SPABS areas. Personal noise dosimetry was conducted on letter c in the sorting area and on postal clerks and mail handlers servi the SPABS. Additionally, octave-band analyses were carried out these areas with an integrating, precision sound level meter.

The employee noise exposures were found to range between 70 and 80 decibels on an A-weighting scale [dB(A)], values which are be exposure levels associated with hearing loss. The pattern seen employees' noise exposures was variable throughout the work day. area octave band measurements revealed that a warning signal on SPABS emitted noise levels up to 103 dB(A), a value 30-40 dB(A) than the ambient noise levels measured in the area while the SPA operating.

Although no noise levels were measured that exceed current evaluation criteria for noise exposure and occupational heari loss, the letter carriers do perceive that the noise emitted the SPABS is stressful and interferes with their work. The noise from the automated sorting machine measured by the NIOS investigator is clearly audible above the ambient noise in th letter sorting area, with the stop/start warning device being much louder than background noises. The type of noise emitte by the warning device, measured in the evaluation, meets several researchers' definition of noise as an occupational stressor because of its unpredictability and lack of controllability. Therefore, recommendations are made to redu the noise in the SPABS and letter sorting areas. However, there are no current evaluation criteria to cite specific noi levels that must be reached in order to eliminate the non-auditory effects of the noise exposure.

KEYWORDS: SIC 4311 (United States Postal Service), noise, autom sorting machines, letter carriers.

II. INTRODUCTION

On November 14, 1991, employee representatives from the U.S. Pos Service (USPS) in Lansing, Michigan, requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a H Hazard Evaluation (HHE) at the Collins Road facility of the USPS Employees were concerned about the noise from an automated Small and Bundle Sorter (SPABS) that had been installed approximately years ago in a location adjacent to the sorting cages used by le carriers to sort the mail for their daily route. The employees that they were concerned about the mental stress created by the additional noise from the SPABS and how it might affect their he after years of exposure to the noise. An evaluation of a canvas curtain which was installed as a noise control was also requeste the employees.

A noise survey was conducted by a NIOSH investigator on December 1991, to document employees' noise exposures in the area of the cages and the SPABS. However, because the large volume of First mail for the holiday period reduced the volume of bulk mail (2nd 3rd Class mail) at the facility, the SPABS operated for only a p of the work shift on the day of the noise survey. It was decide a return visit was necessary during January when the volume of m sorted by the SPABS would be more representative of typical cond A second survey was conducted on January 21, 1992, a day when th was operational for the entire time that the letter carriers wer their sorting cages. An interim letter reporting the results of first noise survey was sent to union and management representati January 14, 1992.

III. BACKGROUND

The Collins Road location of the USPS is a general mail facility sorts and delivers mail to Lansing, Michigan residents and sorts for smaller post offices in the Lansing area. A new SPABS machi located in the facility adjacent to the area where letter carrie the mail for their daily routes. The carriers reported that the immediately noticed discomfort in their working environment from additional noise produced by the SPABS. The letter carriers con were brought to the attention of USPS management through the uni grievance mechanism. The union was told that the noise levels f SPABS did not exceed the Department of Labor's Occupational Safe Health Administration (OSHA) noise regulation and therefore ther no reasonable grounds to determine that a hazard existed in the Continued concern by the letter carriers resulted in a 30-foot x canvas curtain being purchased in February 1990. The curtain, w was bought without specifying any noise attenuation properties, hung between the carrier sorting cages and the SPABS. The locat where it was hung allowed for openings above and below the curta as not to hamper air flow or circulation in the area. In June 1 letter carriers were told that management would furnish ear plug carriers who still had problems from the noise emitted by the SP

The USPS Regional Safety Engineer was brought into the Lansing f in November 1991, to make noise measurements in the area. He fo that the area noise levels around the SPABS ranged from 82 to 89 decibels on the A-weighting scale [dB(A)]. Noise levels near th carrier sorting cages ranged from 70 to 71 dB(A). During the no survey, the stop/start alarms were identified as a potential pro Six inches of cellular foam packing material was placed over the speakers of the alarm to reduce the amount of noise emitted by t alarms. Area measurements made with the foam in place were foun from 75-77 dB(A), a reduction of 5 to 12 decibels. The Lansing Specialist was directed to locate foam with the proper acoustica attenuation characteristics and place it on all four sides of ea the three alarms on the SPABS. The acoustical foam control meas however, was left in place for only a short time period before i removed by management. The alarm boxes were uncovered during bo the NIOSH noise surveys.

IV. METHODS AND EQUIPMENT

The noise dosimeters used in the survey were Metrosonics Model d Metrologgers. The Metrologger is a small noise level recording which is worn on the waist of the employee, with a 1/4 inch micr attached to the worker's shirt collar, or the shoulder area if t shirt has no collar. This dosimeter is designed to measure nois dB[A] levels four times per second. The noise measurements are integrated according to the Occupational Safety and Health Administration (OSHA) noise regulation (see Evaluation Criteria of this report) for an entire minute and stored separately in th Metrologger for later analysis and final storage. Each dosimete successfully calibrated according to the manufacturer's instruct before being placed on the worker. After the recording period w completed, the dosimeter was removed from the worker and placed standby mode of operation. The data was later transferred to a Metrosonics Model dt-390 Metroreader/Data Collector following th noise sampling. Prior to turning off the dosimeter, it was agai calibrated to assure that the device had not changed during the sampling period. The dosimeter information was finally transfer a personal computer with supporting Metrosonics Metrosoft comput software for permanent data storage and later analysis.

Area noise samples were made with a Larson-Davis Laboratories Mo 800B Precision Integrating Sound Level Meter. Octave band measu at consecutive center frequencies of 31.5 Hertz (Hz) to 16 kiloh (kHz) along with A-weighted and C-weighted scales were made at s locations around the SPABS and the letter carriers' sorting cage measurements were made with the sound level meter integrating th energy over a 1-minute period with a 3 dB exchange rate. Values reported as 1-minute equivalent levels (L_{eq}) at each measurement or scale.

V. EVALUATION CRITERIA

Occupational deafness was first documented among metalworkers in sixteenth century.[1] Since then, it has been shown that workers h experienced excessive hearing loss in many occupations associate noise. Noise-induced loss of hearing is an irreversible, sensor condition that progresses with exposure. Although hearing abili declines with age (presbycusis) in all populations, exposure to produces hearing loss greater than that resulting from the natur aging process. This noise-induced loss is caused by damage to n cells of the inner ear (cochlea) and, unlike some conductive hea disorders, cannot be treated medically.[2]

While loss of hearing may result from a single exposure to a ver impulse noise or explosion, such traumatic losses are rare. In cases, noise-induced hearing loss is insidious. Typically, it b to develop at 4000 or 6000 Hz (the hearing range is 20 Hz to 200 and spreads to lower and higher frequencies. Often, material impairment has occurred before the condition is clearly recogniz 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 ra from 200 Hz to 2000 Hz, research has shown that the consonant so which enable people to distinguish words such as "fish" from "fi have still higher frequency components.[3]

The existing OSHA standard for occupational exposure to noise (2 1910.95)[4] specifies a maximum permissible exposure level (PEL) of dB(A)-slow response for a duration of 8 hours per day. The regu in calculating the PEL, uses a 5 dB time/intensity trading relationship. This means that in order for a person to be expos noise levels of 95 dB(A), the amount of time allowed at this exp level must be cut in half in order to be within OSHA's PEL. Conversely, a person exposed to 85 dB(A) is allowed twice as muc at this level (16 hours) and is within his daily PEL. Both NIOS its Criteria for a Recommended Standard,[5] and the American Confer of Governmental Industrial Hygienists (ACGIH), in their Threshol Values (TLVs),[6] propose an exposure limit of 85 dB(A) for 8 hours less than the OSHA standard. Both of these latter two criteria use a 5 dB time/intensity trading relationship in calculating ex limits.

TABLE 1

Time-Weighted Average (TWA) Noise Limits
as a Function of Exposure Duration

Duration of Exposure (hrs/day)	Sound Level (dB(A)) NIOSH/ACGIH	OSHA
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 has an additional action level (AL) of 85 dB which stipulates that an employer shall administer a continuing, effective hearing conservation program when the TWA value exceed 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) thro (o). The OSHA noise standard also states that when workers are to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to r the workers' exposure levels. Also, a continuing, effective hea conservation program shall be implemented.

There exists a large body of research that has investigated the noise and its effect on peoples' health.[7,8] Two major research a into the non-auditory effects of noise have been on the cardiova system[9] and on the gastrointestinal system.[10] Overall, there are inconsistencies in the results reported on the non-auditory effe from noise. There is no clear dose-response relationship betwee single noise variable (intensity, frequency, duration) and a hea outcome. However, the degree of perceived control over the nois the predictability of its occurrence may be an important factor determining the health effect which results from the exposure.[11] are currently no evaluation criteria available which attempt to noise to a point where the non-auditory effects of the noise exp are eradicated.

VI. RESULTS AND DISCUSSION

A total of 14 noise dosimeter measurements were made on postal employees working in the vicinity of the SPABS during the Decemb January evaluations. All of the TWA noise levels were below the evaluation criteria used in determining the risk of hearing loss occupational noise exposures. The TWA levels ranged from 70 dB(80 dB(A), with a median value of 77 dB(A). The individual noise dosimeter results are given in Tables 2 and 3.

Area noise measurements were made at letter carriers' sorting ca in aisles around the sorting cages in order to determine the lev noise that the carriers work in while the SPABS operates in the background. The octave band results from these measurements are in Figure 1. The **SPABS - at bend** measurements were made in the that separates the end of the SPABS delivery line from the first letter carriers' sorting cages. It also was the location in fro the canvas curtain hung by the Safety and Health Service Departm noise control. **Route 1132 Cage** is in the first row of cages and behind the canvas curtain. An aisle separates row one from row

the letter carriers' sorting cages (**Route 1132 Aisle**). Row two three of the cages are located back-to-back to each other. **Rout Cage** is in the third row of sorting cages. The measurements rev that the sound energy emitted by the SPABS is predominately made lower frequencies with the octave band center frequencies from 3 to 1000 Hz having about equal sound pressure levels with decreas sound pressure levels at the frequencies above 1000 Hz. The ove sound levels measured at the four locations ranged from 78 to 68 decreasing in intensity as one moves farther from the SPABS. Th overall decrease for the noise from the SPABS falls from 77.6 dB the aisle next to the SPABS to 72.5 dB(A) at Route 1132's sortin located in the first row of cages. This drop in sound level is partially the result of the combination of the canvas curtain, t metal walls of the sorting cage, and the increased distance from noise source. It cannot be determined from these data the absol contribution of the canvas curtain in the overall 5 dB reduction

During the evaluation, the NIOSH investigator noticed that the a alarm on the SPABS, which warns employees that the machine is ab start operating, was a major noise source. The alarm is program sound ten separate blasts before the machine starts. These alar blasts were clearly audible throughout the entire postal facilit just the immediate area of the SPABS. The Postal Service had pl packing foam over the speakers of the three alarms on the SPABS order to reduce the noise levels produced by the warning. Howev foam was removed as a possible safety hazard. A **a**-octave band analysis of the ten blasts of the alarm, measured 3 feet from th speaker, revealed that the sound energy was concentrated in 2.5 3.15 kHz bands, with maximum root-mean-squared (rms) intensities 99.8 dB. The overall A-scale value of the alarm noise was 102.6 A 3-inch thick piece of acoustical foam temporarily placed over speaker of the alarm reduced noise levels emitted by the alarm t dB at the peak frequency of 2.5 kHz and to a overall value of 86 dB(A). The sound spectrum of the warning signal was overlaid on spectrum of the SPABS during its operation at two measurement lo (Figures 2 and 3). These figures clearly show that the warning is 30 to 40 dB above the ambient sound produced by the SPAB it is in operation.

VII. CONCLUSIONS

The noise from the SPABS is perceived by the letter carriers as stressor that interferes with their work. The noise levels meas during the carriers' work shift on two separate occasions are, h well below the evaluation criteria used to assess the risk of he loss from occupational noise exposures. The results of the nois survey in the area show that the warning signal from the SPABS i clearly audible in the work area of the carriers. The sounding

alarm is outside of the control of the letter carriers, making i unpredictable and variable in nature.

The variable and unpredictable nature of the loud warning alarm SPABS meets researchers' criteria of a stressor that could lead adverse health effects discussed earlier in the report.[7-11] Becau warning alarm is 30-40 dB above the facility's background sound unpredictable, the initial sounding of the alarm could startle a carrier as he or she sorts their daily mail. Previous research shown that over a wide range of intensities and frequencies, sig need to be only 5-15 dB greater than background noise in order f to be heard.[12] This finding of warning signals that are excessiv loud in the Postal Service has also been documented in another N Health Hazard Evaluation at a different U.S. Post Office facilit

The canvas curtain purchased by the Postal Service is not very efficient in blocking the noise from the SPABS. The procurement process did not take into account any measurement standards or performance data on the sound attenuating characteristics of the curtain. If these characteristics had been investigated, it wou been discovered that the canvas curtain, as installed, would pro little noise protection for the letter carriers. The American S of Testing and Materials (ASTM) is one source of consensus stand that deal with the classification of materials and systems for t acoustical properties.[14] Information of this nature should be investigated prior to installing any noise reduction system.

VIII. RECOMMENDATIONS

The area adjacent to the SPABS is affected by the noise emitted operation of the automated sorter and its warning signals. The reduction control installed by the Postal Service does little to decrease exposures to the variable and unpredictable noise on le carriers in the sorting cage area. Because the employees in thi feel that the noise from the SPABS is stressful and interferes w their work, the following recommendations are offered to the Pos Service to reduce noise exposures to the employees in the SPABS letter sorting area. The recommendations are given in a similar to the methods that are typical used to control noise exposures; (1) reduce the noise at the source, (2) alter the pathway of the or (3) reduce the noise at the receiver (worker).

1. The noise emitted by the three warning signals on the SPABS s be reduced to a level 5-15 dB above the ambient noise of the workplace. This reduction in sound level can be achieved by placing acoustical material over the speakers of the signal b or electronically lowering the signal with a variable resista potentiometer placed in the circuitry of the warning signal.

latter change will act as a volume control for the signal and be changed at a later time if the sound conditions in the bui change as a result of the introduction of new equipment or th relocation of personnel.

2. The warning signal on the SPABS is composed of both an audito alarm and a flashing light on all three alarm locations. The used by the alarm system is enclosed in an amber-colored fixt and is cycled on and off along with the audible alarm during warning period. The NIOSH investigator observed that the vis signal was not very perceptible unless one looked directly lo at the light fixture. Perhaps a blue or red light that is la and has a rotating mirror inside the fixture would be more re perceptible by employees in areas adjacent to the SPABS. Als would be beneficial to change the pattern of the warning syst such that the light would be cycled on for several seconds be the audible signal sounds. The number of blasts from the aud signal could be reduced if the rotating light focused employe attention toward the SPABS machine. This recommendation woul eliminate the unpredictability of the warning signal and redu potential as an occupational stressor.

3. If a barrier is the desired noise control, it should be insta as a rigid structure connected to the floor and reaching to n the ceiling. It should also extend from the outside wall all way to the end of the row of sorting cages. A rigid structur preferred because of its additional sound reduction performan the fact that is will provide a solid barrier in case the pal of mail which were observed stacked along the back side of th of sorting cages would tip and fall into the cages. If a bar is to be built, it would be beneficial to seek the advice of acoustical engineer in the selection of construction material needed to maximize the sound reduction to the letter carriers without interfering with ventilation in the area. It must be that this method of noise reduction will not reduce the noise exposures experienced by the postal clerks and mail handlers operate the SPABS. The reduction of the intensity of the war signals would, however, lower noise exposures for all employe the area.

4. The canvas curtain installed by the Postal Service should be removed. Because the curtain has a low sound transmission lo value, particularly at low frequency sounds, and has been ins as a partial barrier with openings above, below, and to one s the curtain, it provides little protection from the noise emi by the SPABS. It has also become a focal point in the discus of the Postal Service's handling of the noise complaint in th area.

5. The issuance of ear plugs to employees bothered by the noise the SPABS is not recommended. Most hearing protection device (HPDs) are designed to reduce the risk of hearing losses from occupational noise, not to reduce annoyance from noise. If H are distributed by the Postal Service, NIOSH recommends that individuals who are given the devices be included in a period audiometric testing program to ensure that the employees are properly protected.[5]

IX. REFERENCES

1. Alberti [1591 (1970)], cited by Bunch, C.C. Traumatic deafn In E.P. Fowler, Jr. (Editor), Medicine of the ear, chapter X Reprinted Translations of the Beltone Institute for Hearing Research, No. 23.

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

3. Ward WD, Fleer RE, Glorig A [1961]. Characteristics of hear loss produced by gunfire and by steady noise. Journal of Au Research, 1:325-356.

4. Code of Federal Regulations [1989]. OSHA occupational noise exposure standard. 29 CFR 1910.95. Washington, DC: U.S. Government Printing Office, Federal Register.

5. NIOSH [1972]. Criteria for a recommended standard: occupat exposure to noise. Cincinnati, OH: U.S. Department of Heal Education, and Welfare, Health Services and Mental Health Administration, National Institute for Occupational Safety a Health, DHEW (NIOSH) Publication No. 73-11001.

6. ACGIH [1991]. Threshold limit values and biological exposur indices for 1991-1992. Cincinnati, OH: American Conference Governmental Industrial Hygienists.

7. NIOSH [1976]. Effects of noise on non-auditory sensory func and performance. Cincinnati, OH: U.S. Department of Health Education, and Welfare, Health Services and Mental Health Administration, National Institute for Occupational Safety a Health, DHEW (NIOSH) Publication No. 76-176.

8. Fay TH, ed. [1991]. Noise and health. New York, NY: The N York Academy of Medicine.

9. Sloan RP [1991]. Cardiovascular effects of noise. In: Fay ed. Noise and health. New York, NY: The New York Academy Medicine.

10. Raymond LW [1991]. Neuroendocrine, immunologic, and gastrointestinal effects of noise. In: Fay TH, ed. Noise health. New York, NY: The New York Academy of Medicine.

11. Cohen S, Evans GW, Stokols D, Krantz DS [1986]. Behavior, h and environmental stress. New York, NY: Plenum.

12. Yost WA, Nielsen DW [1977]. Fundamentals of hearing. An introduction. New York, NY: Holt, Rinehart, and Winston, p

13. NIOSH [1990]. Health hazard evaluation report: U.S. Postal Service, Columbus, OH. Cincinnati, OH: U.S. Department of and Human Services, Public Health Service, Centers for Disea Control, National Institute for Occupational Safety and Heal NIOSH Letter Report No. 90-180.

14. ASTM [1991]. Classification for rating sound insulation. Philadelphia, PA: American Society of Testing and Materials of Standards Volume 04.06, ASTM Standard E413.

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

TABLE 2

Noise Dosimeter Results from December 18, 1991 Survey
U.S. Postal Service
Lansing, Michigan General Mail Facility
HETA 92-056

Measurement Location	Sample Period (hh:mm)	Time-Weighted Average [dB(A)]	Maximum 1-min Average [dB(A)]
Letter Carrier - Route 1132	03:13	77.5	88
Letter Carrier - Route 1155	03:26	77.6	89
Letter Carrier - Route 1108	03:17	71.2	81
Letter Carrier - Route 1143	04:22	79.7	94
Mail Clerk - SPABS	03:57	78.2	93
Mail Handler (Sweeper) - SPABS	03:54	77.6	91

TABLE 3

Noise Dosimeter Results from January 21, 1992 Survey
U.S. Postal Service
Lansing, Michigan General Mail Facility
HETA 92-056

Measurement Location	Sample Period (hh:mm)	Time-Weighted Average [dB(A)]	Maximum 1-min Average [dB(A)]
Letter Carrier - Route 1132	07:46	76.9	94
Letter Carrier - Route 1142	08:00	71.6	89
Letter Carrier - Route 1173	08:00	71.8	83
Letter Carrier - Route 1156	7:45	69.7	83
Letter Carrier - Route 1143	08:00	79.2	93
Postal Clerk - SPABS	06:53	77.1	85
Mail Handler (Loader) - SPABS	6:53	76.9	90
Mail Handler (Sweeper) - SPABS	06:52	76.3	88