NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2003-0273; 2003-0280; 2003-0287-2974
Kaiser-Permanente
Santa Teresa, Redwood City, and
Santa Clara, California

June 2005

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation 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 employers 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 Randy L. Tubbs of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS) and Chucri A. Kardous of the Engineering and Physical Hazards Branch, Division of Applied Research and Technology (DART). Laboratory support was provided by Pamela Graydon of the Hearing Loss Prevention Team, DART. Desktop publishing was performed by Shawna Watts. Editorial assistance was provided by Ellen Galloway.

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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 a Telephone Dictation System (C-Phone) used by Medical Transcriptionists for Excessive Noise Exposures Through Their Headsets

The local union representing medical transcriptionists at Kaiser-Permanente Hospitals' Health Information Management (HIM) department submitted a health hazard evaluation request because of concerns about excessive noise exposures. The noise levels delivered through headsets transcriptionists wear while recording medical records onto computer files were evaluated through a site visit to the facilities and an extensive laboratory study.

What NIOSH Did

- We measured the background noise in the offices where the transcriptionists work.
- We interviewed employees about the amount of time they have been transcriptionists and what they felt about the C-phone dictation system. We also asked if they had any symptoms they felt were the result of their work conditions.
- We tested a C-phone dictation system in the NIOSH laboratory to determine the noise levels delivered through the headsets.

What NIOSH Found

- Noise levels can be excessive when the volume control on the C-phone is left in the maximum position.
- The C-phone limits the noise levels to 110 dB SPL at the workers' ears.
- Of the interviewed transcriptionists, 62% had problems with the C-phone (for example, voice prompts too loud, varying noise levels, little control over volume levels), and 28% of them reported symptoms they felt were related to their work.

What Kaiser Permanente Managers Can Do

- Work with the manufacturer of the C-phone to further reduce the noise levels and improve the clarity of the dictation.
- Train physicians about effective ways to improve the quality of the dictated records.
- Offer yearly hearing tests to the medical transcriptionists.

What Kaiser Permanente Employees Can Do

- Do not set the volume control above the middle point on the C-phone whenever possible.
- Continue to participate in the headset committee and voice your concerns to the HIM department managers.

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 #2003-0273; 2003-0280; 2003-0287-2974

Health Hazard Evaluation Report 2003-0273; 2003-0280; 2003-0287-2974
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SUMMARY

In May and June 2003, the National Institute for Occupational Safety and Health (NIOSH) received three separate requests from the Service Employees International Union (SEIU) Local 250 officials to conduct health hazard evaluations in the Health Information Management (HIM) offices of Kaiser Permanente hospitals in the South Bay region of California. The requests involved medical transcriptionists who use a telephone dictation system to transcribe medical records dictated by hospital physicians. The transcriptionists were concerned about excessive noise from the telephone headset. Before NIOSH received the union's request, a California Occupational Safety and Health Administration (Cal-OSHA) industrial hygienist began an investigation at Kaiser Permanente in April 2003. Shortly thereafter, Cal-OSHA contacted the Federal OSHA Salt Lake Technical Center about a procedure for measuring headset noise they had published in the OSHA Technical Manual. Cal-OSHA also contacted NIOSH to discuss the technical difficulties associated with the investigation. These discussions eventually led to the request from the union on behalf of the employees.

During the week of January 27, 2004, NIOSH and OSHA investigators visited the Kaiser Permanente hospitals and measured the noise levels through the transcriptionists' headsets with an acoustic mannequin and the ambient noise levels in their offices. Employees in each of the three HIM departments were interviewed by a NIOSH investigator to document their concerns about the dictation system and any symptoms they felt were the result of their work. In the fall of 2004, a telephone dictation system similar to the ones used at Kaiser Permanente was evaluated in the NIOSH Acoustics Laboratory in Cincinnati, Ohio, using actual medical dictations. These dictations were chosen by the transcriptionists as problematic. The noise levels and quality of the recordings were evaluated at three volume settings to determine the risk for excess noise exposure and the clarity of the dictations.

The NIOSH investigators determined that a potential for excessive noise exposure exists with the dictation equipment used by the medical transcriptionists at Kaiser Permanente. Excessive noise is delivered through the headsets when the manual volume control on the telephone dictation system is left in the maximum position. If the volume control is placed in the middle position or lower, the noise exposures through the headsets are at a safe level for an 8-hour work shift. Recommendations are offered to the employees and management at Kaiser Permanente to maintain the noise levels from the headsets at a safe level and to improve the clarity of medical dictations.

Keywords: NAICS Code 622110 (General medical and surgical hospitals), medical transcriptionists, medical records, dictation, hearing loss, noise, telephone headsets, room noise, hearing conservation program

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INTRODUCTION

In May and June 2003, the National Institute for Occupational Safety and Health (NIOSH) received requests from the Service Employees International Union (SEIU) Local 250 to conduct health hazard evaluations (HHEs) at three Kaiser Permanente hospitals in the South Bay region of California. The request involved the medical transcriptionists at hospitals in Santa Teresa, Santa Clara, and Redwood City. The employees at these three locations had concerns about the dictation telephones, referred to as C-phones, they used to transcribe medical records dictated by physicians, and the amount of noise generated through the system's headsets. Before NIOSH received the union's request, a California Occupational Safety and Health Administration (Cal-OSHA) industrial hygienist began an investigation at Kaiser Permanente in April 2003. Shortly thereafter, Cal-OSHA contacted the Federal OSHA Salt Lake Technical Center about a procedure for measuring headset noise they had published in the OSHA Technical Manual. Cal-OSHA also contacted NIOSH to discuss the technical difficulties associated with the investigation. These discussions eventually led to the request from the union on behalf of the employees.

On January 26, 2004, a meeting was held in Santa Teresa, California, with representatives from the three Kaiser Permanente hospitals, SEIU Local 250, Cal-OSHA, the Federal Occupational Safety and Health Administration (OSHA) Salt Lake Technical Center, and NIOSH to discuss the workers' concerns and the steps the hospital had taken to reduce loud noise transmission through the headsets. These representatives also discussed the protocol the OSHA and NIOSH investigators planned to use to document noise levels employees received during the work day with the transcription system and the room conditions where the transcriptionists worked.

On January 27-28, 2004, NIOSH and OSHA investigators measured noise levels directly from a dictation telephone system through the headsets, measured area sound levels of the office space where employees worked, and interviewed employees about their likes and dislikes about the system in the Santa Teresa location. On January 29, 2004, the NIOSH and OSHA investigators made the same measurements and interviewed transcriptionists at the Santa Clara location. On January 30, 2004, the NIOSH investigator traveled to the Redwood City facility to interview the transcriptionists and measure the room noise where they worked. In April 2004, NIOSH purchased the same dictation telephone system with three headsets from the same manufacturer as those used by Kaiser Permanente to conduct further testing in the NIOSH Cincinnati Acoustics Laboratory. Arrangements were made with the medical transcription department to have actual physician dictations from all three locations available beginning in September 2004, to play through the NIOSH transcription system for detailed analyses of these signals.

A report of the work conducted by the OSHA Salt Lake Technical Center was issued to all parties in March 2004. Cal-OSHA issued Information Memoranda to Kaiser Permanente Santa Teresa and Santa Clara on March 5, 2004. These documents are included in this report as Appendix A and B.

BACKGROUND

Kaiser Permanente employs 270 medical transcriptionists in Northern California, which includes the facilities at Santa Teresa, Santa Clara, and Redwood City. Approximately 30 people are employed at these three locations. The transcriptionists work in an open-office setting, with a computer workstation and the C-phone at their desk. At Santa Teresa and Redwood City, the Health Information Management (HIM) departments are in their own rooms. At Santa Clara, the transcriptionists share office space with other departments (Figures 1-3).

Transcriptionists listen to the medical record through their headsets and type the record into a computer. The transcriptionist continually reverses and forwards the dictation record to

insure that the correct information is being transcribed into the patient's record. In May 2002, a new dictation/transcription system was purchased from the Dictaphone Corporation for use in the HIM departments at the Santa Teresa, Santa Clara, and Redwood City facilities. Shortly after the system's full implementation, transcriptionists reported that fluctuations in the sound intensity of the dictation records occurred without any apparent reason. They reported that the voice level of a physician dictating a medical record would suddenly drop in intensity, which required the transcriptionist to move the volume bar to a higher output to understand what was being said. After a short period of time, the volume would suddenly increase without warning, delivering a very loud sound level through the headset. They also reported that the recorded voice prompts at the beginning and end of the report were at a high intensity level on which the volume bar had no effect. The system additionally played high pitched, beeping sounds that were triggered whenever the foot pedal was pressed or when the keypad of the C-phone was used. The transcriptionists reported that the headsets did nothing to block environmental noises in their workspace, including people talking in the HIM department and in adjacent offices; music played by fellow employees; and heating, ventilating, and air conditioning (HVAC) air noise from the supply vents. After the C-phone had been in place for several months, some transcriptionists complained of tinnitus and subsequently had audiometric testing performed. Four employees were reported to have some degree of hearing loss, ranging from mild to a 40% loss.

In November 2003, the office of EH&S at Kaiser Permanente administered a survey questionnaire to employees at the Medical Centers in northern California where the Dictaphone Corp. equipment was used, which included the HIM departments at Santa Teresa, Santa Clara, and Redwood City. A total of 21 surveys were returned by the employees at these three locations. All but one of the respondents used the C-phone dictation/transcription system. Sixteen of the transcriptionists reported problems with the C-phone, with loudness and volume fluctuations as the most common complaints. Kaiser Permanente attempted to alter the C-phone by retroactively installing electronic resistors in the system to reduce the volume of the signals, but employees reported that this met with limited success.

METHODS

Field Survey

Area noise analysis

The spectral area noise measurements were made with a Larson-Davis Laboratory Model 2800 Real-Time Analyzer and a Larson-Davis Laboratory Model 2559 ½" random incidence response microphone. The analyzer allows for the analysis of noise into its spectral components in a real-time mode. The ½"-diameter microphone has a frequency response range (± 2 decibels [dB]) from 4 Hertz (Hz) to 21 kilohertz (kHz) that allows for the analysis of sounds in the region of concern. One-third octave bands consisting of center frequencies from 25 Hz to 20 kHz were integrated for 30 seconds and stored in the analyzer for later analysis. The analyzer also calculates the overall A-weighted value (dBA) and the overall unweighted value as a sound pressure level (dB SPL).

The sound levels in the room where the transcriptionists worked were captured at each workstation in the three hospital locations, regardless of whether the workstation was occupied at the time of the survey. The analyzer was located near the position where the employee would be seated and the microphone placed where the transcriptionist's ears would be located.

Employee interviews

All transcriptionists at work on the days of the survey along with the HIM department managers were interviewed in private by the NIOSH investigator. Each employee was asked about the number of years worked in medical transcription at Kaiser Permanente and in the

profession. They were also queried about their opinions on the C-phone system currently in use; the physical characteristics of their work space, e.g., temperature, background noise, office ergonomics; whether they had been given a hearing test through work and any changes in their hearing ability; and any other concerns or complaints about health and safety issues at their workplace.

Laboratory Analysis

The assessment consisted of (1) evaluating noise exposures from transcribed recordings identified to be problematic by Kaiser Permanente employees, (2) evaluating the quality and performance of the Dictaphone C-Phone system, and (3) evaluating the three headsets commonly used by Kaiser Permanente transcriptionists.

Equipment description

NIOSH purchased a Dictaphone C-phone and associated equipment and accessories for testing at the Cincinnati NIOSH Acoustics Laboratory. NIOSH was provided access to three sets of dictation recordings identified by employees as problematic from the Santa Clara, Santa Teresa, and Redwood City HIM departments (a total of 20 dictations). Recordings were handled as confidential medical information while in NIOSH possession. The recordings were temporarily downloaded and stored onto a TASCAM DA-P1 digital audio tape (DAT) recorder sampling at 48,000 samples per second (48 kHz). A test signal, the phone line dial-tone, the dictation message header, and the noise emitted by activation of the foot-pedal were also recorded. The recordings were played back into the Knowles Electronic Mannequin for Acoustic Research (KEMAR) with standard adult-size artificial external ears and half-inch Bruel&Kjaer (B&K) microphones Type 4165. The microphones were powered by a B&K 2807 power supply and the outputs analyzed with a Stanford Research Systems Model SR785 signal analyzer. KEMAR's microphones were calibrated using B&K 4230 acoustic calibrator that produces a 94 dB SPL tone at 1000 Hz. The calibration tone was used to evaluate and compare the various sound levels of the recordings. The recordings were transferred to a personal computer for later analysis using an Audiophile M-Audio sound card and GoldWave v5.08 audio editor. The test setup is shown in Figures 4 and 5.

Measurement and analysis

The recordings were analyzed using the NIOSH noise measurement software (NNMS) that measured average and peak levels of each recording as well as analyzing the frequency spectrum and octave and one-third octave band spectra. In addition to evaluating the quality and sound levels produced by the recordings, the overall performance of the three headsets used with the C-phone, namely, the Deluxe headset, the Light headset, and the Sound Band headset were also tested using the sound source feature on the SR785 signal analyzer to produce a swept sine signal from 100 Hz to 20 KHz with increasing levels of outputs from 10 millivolt (mV) to 5 volt (V).

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 increases 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),[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] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

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 91–596, 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.[4] 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 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 is the preferred unit for measuring sound levels to assess worker noise exposures. The dBA 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 dBA scale is logarithmic, increases of 3 dBA, 10 dBA, and 20 dBA represent a doubling, tenfold increase, and hundredfold 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 dBA 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 dBA for no more than 4 hours, to 100 dBA for 2 hours, etc. Conversely, up to 16 hours exposure to 85 dBA is allowed by this exchange rate. NIOSH, in its Criteria for a Recommended Standard,[7] and the ACGIH,[2] propose exposure criteria of 85 dBA 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 dBA for 8 hours, but to no more than 88 dBA for 4 hours or 91 dBA for 2 hours. Twelve-hour exposures have to be 83 dBA or less according to the NIOSH REL.

The occupational noise regulation promulgated by OSHA,[6] as well as the limits published by NIOSH[8] and ACGIH,[2] are designed to prevent hearing losses from exposures to intense noise levels. However, noise of intensities lower than that which may cause a loss of hearing can be disruptive in the workplace. Interference with speech is a possible result of unwanted noise. The noise can interfere with the efficiency and productivity of the staff and can be detrimental to the occupants' comfort, health, and sense of wellbeing. One set of noise criteria for occupied interior spaces, the balanced noise criteria (NCB) curves, has been devised to limit noise to levels where satisfactory speech intelligibility is achieved.[8, 9, 10] The noise criteria were devised through the use of extensive interviews with personnel in offices, factories, and public places along with simultaneously measured octave band sound levels. The interviews consistently showed that people rate noise as troublesome when its speech interference level is high enough to make communications difficult. The recommended space classifications and suggested noise criteria range for steady background noise heard in various indoor occupied activity areas are shown in Table 1.

RESULTS

Field Survey

Area noise analysis

Area noise sampling was conducted in each of the three Kaiser Permanente facilities; twice at the Santa Teresa location to capture room noise on the day and the afternoon work shifts, and during the day shifts at Santa Clara and Redwood City. Spectral noise data were stored at each of the workstations, regardless of whether they were occupied by a transcriptionist. The measurement locations are noted in Figures 1-3. At Santa Teresa, results from the day shift and afternoon shift were generally consistent with each other. The day shift had a median value of 50.7 dBA and 60.5 dB SPL while the afternoon shift had values of 49.6 dBA and 59.6 dB SPL. The overall values for Santa Clara were 48.4 dBA and 63.9 dB SPL, and 44.4 dBA and 55.0 dB SPL at the Redwood City facility. The third-octave band data were combined into octave bands to simplify their analysis and to compare the area room noise values to the NCB criterion.[10] The octave band data for the three locations are shown in Figures 6-8. The NCB-45 curve is representative of the room noise at Santa Teresa and Santa Clara. At Santa Teresa, the highest frequency octave bands slightly exceed the NCB-45 curve, while at Santa Clara, all of the room noise octave bands are less than the curve. At Redwood City, quieter conditions were measured so that the NCB-40 curve better represents the situation with the highest frequency band slightly exceeding the criterion. The room noise conditions at all three locations are characterized as reception or general secretarial areas (Table 1) and are much less than the NCB-60 maximum recommendation if communications must take place.

Employee interviews

A total of 24 employees from the three Kaiser Permanente facilities working on the days of the site visit were interviewed. This total includes the three HIM managers from each of the

facilities. Thirteen of 21 transcriptionists (62%) interviewed reported having some problem with the noise levels emitted by the C-phone. Their concerns centered on the system's tones and beeps and the voice prompts, such as the voiced medical record number and end of record statement. Most felt that the volume control on the C-phone altered the physician's dictation level, but had no effect on the tones and voice prompt signals. Many of the transcriptionists reported that the dictation sound level would drop as a result of a sudden, loud noise, such as a cough by the physician, and stay lowered for many seconds. To compensate for the lowered volume, they would increase the manual volume control. However, the dictation volume would unpredictably return to the previous volume setting exposing them to loud sounds until they could reset the volume control or remove the headsets. Six of the 21 transcriptionists (28%) reported symptoms they attributed to their employment, including hearing loss and tinnitus, along with headaches, stress, and feelings of depression.

Laboratory Analysis

Twenty different medical records from the three Kaiser Permanente locations were recorded and analyzed in the NIOSH laboratory. The average and peak sound levels from each of the recordings, the dial-tones, and the voice test signal are shown in Table 2. The Dictaphone C-phone volume dial was set for minimum, medium, and maximum. The medical records data from the three HIM departments are shown at maximum level to evaluate any possible excessive noise exposures. The unweighted average levels ranged from 65 dB SPL for the test message at the minimum setting to 107 dB SPL for the C-phone's dial tone with the volume control set at maximum.

The NIOSH RELs are highlighted in Table 3 for dial and test signals, as well as recordings from the three facilities. The results are presented as A-weighted values for the C-phone at minimum, medium, and maximum volume settings. The NIOSH REL for occupational noise exposure is 85 dB, A-weighted, for an 8-hour time-weighted average (85 dBA as an 8-hr TWA) using a 3-dB exchange rate with an allowed noise dose of 100% per day.[8] Exposure at or above this level is considered hazardous. The data analysis revealed that all of the tested conditions can be listened to at a safe level over an entire work shift. However, there are conditions with the volume control set at the maximum level where the sound delivered to the employee's ears should be limited to only a portion of the work day because of the high intensity exposure. All three of the HIM department's dictation examples exceeded the NIOSH REL when the volume control was at the maximum setting.

Figure 9 shows average sound levels of the dial-tone, foot-pedal, phone keypad touch-tones, the test message, and an average of the dictation recordings from each HIM department. The sound levels were obtained from the Dictaphone C-phone system with volume level set to medium. Identical distributions of the results were obtained with the C-phone set at minimum and maximum volume settings.

Another test conducted in the NIOSH laboratory was to quantify the output of the Dictaphone headsets that are supplied with the C-phone and used at Kaiser Permanente. The frequency responses of the three headset models tested are shown in Figures 10-12. The y-axis shows the sound level in dB SPL and x-axis shows the frequency in Hz. A swept-sinusoidal signal was applied to each headset at 10 mV, 100 mV, 1 V, and 5 V. The corresponding output response is plotted in each figure. All three headsets exhibit increasing output levels as the voltage of the input signal is increased from 10 mV to 5 V. The Deluxe and Light models show relatively flat responses from 400 Hz to 5 kHz at all input levels. The Sound Band model varies across most of the frequency range. A comparison of the monaural performance of three headsets at 10 mV is illustrated in Figure 13.

DISCUSSION

The evaluations outlined in this report aimed to identify any potential hearing hazard to Kaiser Permanente transcriptionists generated by the Dictaphone C-phone system and headsets from

actual dictated recordings. The recorded dictations were analyzed for any spurious spikes or unusually high noises using a playback method and a computerized impulsive noise detection software program. Although most of the recordings exhibited inconsistent dictation quality, none seemed to contain noises that might be considered immediately hazardous to hearing.

Three common themes were identified among all the recordings: varying voice fluctuations by the medical dictator, isolated static and phone line noises, and calling from locations with high background noise. Because of the diversity of the medical staff, the many different dialects and accents from male and female medical dictators increased the listening difficulties for the transcriptionists. Several of the dictators spoke rapidly, particularly when dictating routine information, such as vital signs and demographic information. There were also instances where the physician was heard screaming for information ("where are the vital signs") or at others in the room where the dictation was being done ("her arm"). These actions reduced the dictation volume for approximately 15 seconds before it reset to the original level with no warning.

The results show that the highest noise levels were generated by the phone dial-tone, foot-pedal, keypad touch-tones, and the message header played at the beginning and end of each dictation (Figure 9). The dial tones measured as high as 101 dB SPL on mid-volume setting on the C-phone, the foot pedal at 91 dB SPL, and the message headers at 86 dB SPL. The NIOSH analysis also shows that the volume control setting on the C-phone did affect the intensity of the tones, beeps, and voice prompts (Table 3). The recordings from the HIM departments had average levels that ranged from 80-82 dB SPL. Tables 2 and 3 show that hazardous exposure can occur if the volume setting on the C-phone is set to maximum level, especially from the dial and touch tones. The results also show that the NIOSH REL can be reached within approximately 2-3 hours of listening to dictations at maximum levels. It is important to note that the REL will be significantly lower for those dictations when they are combined with the higher noise levels of the dial and touch tones. Conversely, the results also indicate that listening on the low-to-medium volume setting presents no hazard to hearing.

The three headsets supplied with the C-phone were tested for linearity, quality of sound, and frequency response. Figures 10-12 show that all three headsets are capable of producing output levels in excess of 120 dB SPL. However, the maximum level produced by the headsets when connected to the C-phone is 110 dB SPL. This indicates the presence of some type of a noise-limiting circuit in the Dictaphone system. Even with the noise-limiting feature, the maximum output level is at a value potentially harmful to human hearing. It could be lowered to a level that has less potential for damage and still has enough volume to be heard by the transcriptionists in the environments where they work. Figure 13 shows that the Deluxe headset had the best flat response across the most frequencies while the other headsets exhibited significant degradation over their low and high-frequency response curves. These results are also comparable to previous studies that have shown insert-type headsets provide 7-9 dB of increased sound output than regular headsets.[11]

Previous studies on telephone and call center operators found that the risk of hearing damage is minimal.[12,13] In the call center study, the noise exposure of 150 operators from 15 call centers across a wide range of industry sectors were evaluated. The study found that while exposure to high-level noise was possible, the daily personal noise exposure was unlikely to exceed an 85 dBA hazardous exposure limit. In Australia, Patuzzi *et al.* and Milhnich and Doyle are conducting research to investigate other symptoms that allegedly result from exposure to acoustic shock events.[14,15] These symptoms include tinnitus, pain, hypersensitivity to sound, vertigo, numbness/tenderness/soreness around the ear and neck, headache, fatigue, etc. Many of these symptoms were reported by at least one of the transcriptionists at Kaiser Permanente. Their research recognizes that sounds transmitted

through the headsets are generally incapable of damaging the ear directly. The authors believe the trauma is caused by excessive middle ear contractions typically triggered by stress and anxiety. For this reason, these authors believe that control measures targeted at limiting the sound produced by the headsets or modification of the equipment might be misplaced and that stress management strategies might be better suited for such situations.

CONCLUSIONS

A noise exposure assessment was performed on the Dictaphone C-phone system and transcribed recordings provided by Kaiser Permanente to determine the presence of any hearing hazard associated with the use of such equipment. The C-phone had noise-limiting circuitry that lowered any peak sound level above 110 dB SPL. The highest noise levels were produced by dial and keypad tones which averaged 8-20 dB higher in intensity than the medical dictations. The dictations suffered from inconsistent quality and high background noise levels, which were factors of the location from which the doctors called and the type of telephones they used to dictate their messages. Noise exposure to dictations combined with the high-frequency tones played at the maximum volume setting was significantly higher than the 8-hour NIOSH REL of 85 dBA and could lead to noise-induced hearing loss if continued without intervention. When the volume control is set at the mid-position or less, the noise exposures from all of the conditions tested in the laboratory are non-hazardous when compared to the NIOSH REL. The evaluation of the room noise at each of the three facilities indicates that these lower volume playback levels should be audible in the office environment where the transcriptionists work.

RECOMMENDATIONS

The following recommendations are provided to reduce any hazard to hearing that is associated with the use of the Dictaphone equipment and work practices in the HIM departments at Kaiser Permanente. In general, NIOSH recommends that employers and workers implement a variety of control measures to limit worker exposure. The recommendations are based on the examination of the Dictaphone equipment, headsets, and the dictation recordings along with the assessment of the work environments and employee input at the three Kaiser Permanente HIM departments.

1. Most of the headsets are adequate for their intended use. However, the quality and performance of the Deluxe Transcription Headset was vastly superior to the other headsets. Kaiser Permanente managers should consider recommending this headset to its employees.

2. Work with the design engineers at Dictaphone to see if additional limiting circuitry can be included in either the C-phone or headsets to further reduce the maximum output levels from the current value of 110 dB SPL. The clarity of the dictation record must be maintained or improved throughout any changes made to the system.

3. Consider migrating dictation services from the current phone-based system to a computerized, software-assisted system. If the dictations are stored in a WAV format on hard drive servers, they can be downloaded to a transcriptionist workstation for playback. In addition, WAV files can be scanned with software programs prior to listening for any instantaneous spikes or unusual noises and provide warning for problematic dictations. The WAV files can also be normalized to suit the preferred listening level of transcriptionists. A computerized dictation system could rely on visual interactivity features instead of using a foot pedal, thus eliminating one source of noise exposure.

4. The Australian research studies mentioned in the discussion section provide some valuable insight into the discrepancies between the reported problems by transcriptionists and the lack of scientific evidence pointing to widespread hearing damage that would help to support their claims. It is

entirely possible that this might be an issue of workplace stress and anxiety that in turn causes excessive middle ear contractions that lower the threshold for the manifestation of symptoms associated with acoustic shock and trauma. Kaiser Permanente management might want to further study employee stress and anxiety that may be attributable to the work environment.

5. Continue the headset committee at Kaiser Permanente. This committee of transcriptionists and hospital management is a venue where concerns can be brought forward and acted upon in an open forum. Make the minutes of this committee available to all of the employees who work on the dictation and transcription of medical records. Interaction of this committee with the vendor who supplies the dictation equipment used by Kaiser Permanente may yield beneficial changes to the work environment.

6. If such materials do not exist already, consider producing a training seminar, or printed materials for doctors advising them on proper dictation protocols. Doctors need to speak clearly and steadily, call from landline phones when possible, and call from quiet environments when feasible.

7. The Cal-OSHA Information Memorandum issued March 5, 2004, noted that a continuing, effective hearing conservation program shall be administered if employee exposure to noise equals or exceeds 85 dBA as an 8-hr TWA (Appendix B). Because the transcriptionists depend a great deal upon their hearing to perform their job, it may be prudent to implement routine audiometric testing of these HIM employees to track their hearing over time even if the noise exposures are not great enough to trigger a hearing conservation program. If the guidelines set by Cal-OSHA for audiometric testing are followed, then management at Kaiser Permanente would have the required audiometric information if the documented noise levels are found to exceed the AL in the future.

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Table 1
Suggested Balanced Noise Criteria Range for Various Occupied Indoor Areas
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

Type of Space and Acoustical Requirements	**NCB Curve**
Concert halls, opera houses, and recital halls	10 – 15
Large auditoriums, large drama theaters, and large churches	Not to exceed 20
Small auditoriums, small theaters, small churches, music rehearsal rooms, large meeting and conference rooms, and executive offices	Not to exceed 30
Bedrooms, hospitals, residences, apartments, hotels	25 – 40
Private or semi-private offices, small conference rooms, classrooms, libraries	30 – 40
Large offices, **reception areas**, retail shops and stores, cafeterias, restaurants	35 – 45
Lobbies, laboratory work spaces, drafting and engineering rooms, **general secretarial areas**	40 – 50
Light maintenance shops, industrial plant control rooms, office and computer equipment rooms, kitchens, and laundries	45 – 55
Shops, garages	50 – 60 *
Work spaces where speech or telephone communication not required	55 – 70

* Levels above NCB-60 are not recommended for any office or communication situation.

Table 2
Unweighted Average and Peak Sound Pressure Levels
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

Event	Avg. Level (Leq in dB)	Peak Level (Lpeak in dB)	Comment
Calibration Tone	94	97	B&K 4230 Calibrator (94 dB@ 1KHz)
Dial Tone @Min.	86	92	Minimum level on C-Phone
Dial Tone @Med.	101	107	Medium level on C-Phone
Dial Tone @Max.	107	110	Maximum level on C-Phone
Test Message @Min.	65	83	Minimum level on C-Phone
Test Message @Med.	80	104	Medium level on C-Phone
Test Message @Max.	93	109	Maximum level on C-Phone
Foot Pedal @Max.	99	110	Foot-pedal at maximum level
Message Header @Max.	99	109	Header at beginning of each message
Touch Tones @Min.	73	87	Minimum level on C-Phone
Touch Tones @Med.	80	101	Medium level on C-Phone
Touch Tones @Max.	102	110	Maximum level on C-Phone
Santa Teresa-726236[1]	95	109	Loud background noise throughout
Santa Teresa-730882	96	110	Loud background noise
Santa Teresa-731514	96	109	Volume surges throughout recording
Santa Teresa-732769	92	109	Soft beginning, changing sound quality
Santa Teresa-734715	94	109	Volume surges and vibration of sound
Santa Teresa-735026	96	110	Volume surges and drops
Santa Teresa-736121	96	110	Drops and then volume surges
Santa Teresa-738814	94	109	Drops in volume
Santa Clara-733548[1]	94	109	Static and high-pitched sounds
Santa Clara-721246	94	110	Yelling into phone
Santa Clara-705580	86	109	Soft dictation with loud noises
Santa Clara-720197	93	109	Keypad loud noise spike
Santa Clara-718385	95	109	Loud volume and coughing
Santa Clara-704773	95	109	Voice raised and throat cleared
Santa Clara-720779	94	109	Soft dictation then loud voice
Redwood City-663204[1]	94	109	Soft speaking voice then loud
Redwood City-663174	91	109	Soft speaking voice then loud
Redwood City-738830	92	109	Soft speaking voice then some noise
Redwood City-732279	94	109	Hit phone button at end of report
Redwood City-730062	94	109	3 dB raise in volume in middle of report

[1] Medical record dictations obtained with C-phone volume set at maximum level. Numbers represent the medical record identification number.

Table 3
A-weighted Noise Exposures and Dose Response
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

Event	NIOSH Recommended Exposure Limits		
	TWA (dBA)	**Recommended exposure duration**	**Dose (%)**
Dial Tone – min	82	16 hours	50
med	97	30 minutes	1600
max	103	7.5 minutes	6300
Touch Tone – min	69	Safe	< 20
med	76	Safe	< 20
max	99	19 minutes	2500
Msg. Header – min	66	Safe	< 20
med	77	Safe	< 20
max	96	37 min 48 sec	1300
Foot Pedal – min	69	Safe	< 20
med	78	Safe	< 20
max	99	19 minutes	< 20
Test signal – min	63	Safe	< 20
med	72	Safe	< 20
max	90	2 hours 31 min	317
Santa Teresa – min	65	Safe	< 20
med	74	Safe	< 20
max	91	2 hours	400
Santa Clara – min	62	Safe	< 20
med	71	Safe	< 20
max	90	2 hours 31 min	317
Redwood City – min	63	Safe	< 20
med	71	Safe	< 20
max	89	3 hours 10 min	250

Figure 1
Floor Plan of HIM Department at Santa Teresa
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

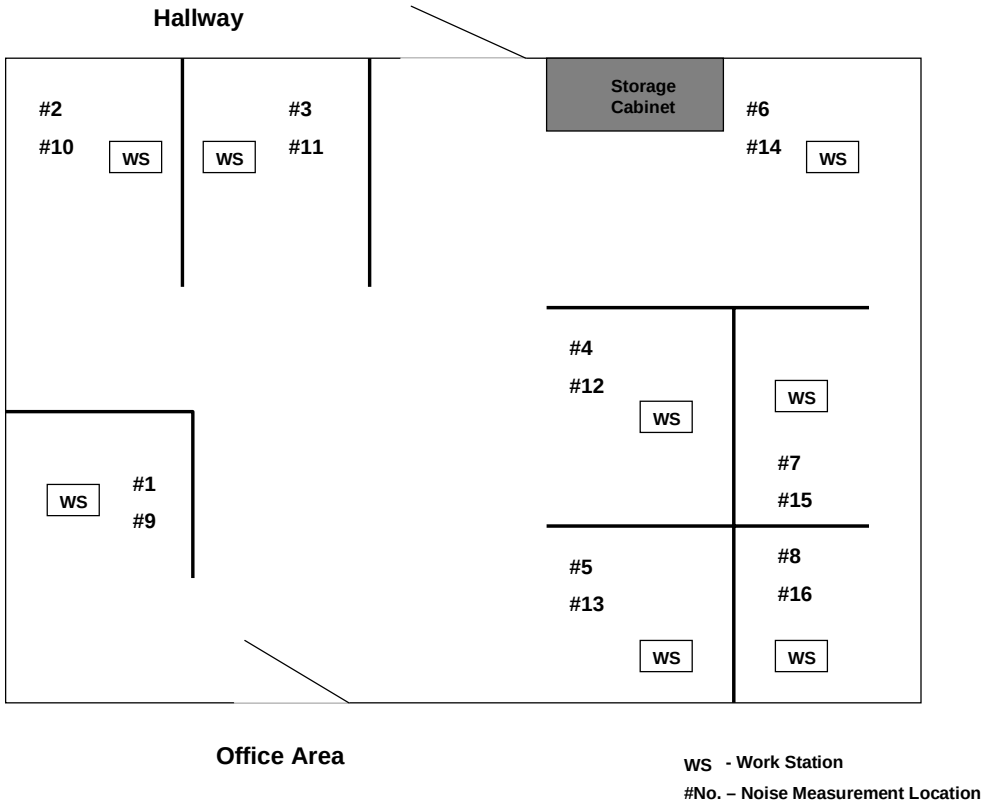


Figure 2
Floor Plan of HIM Department at Santa Clara
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

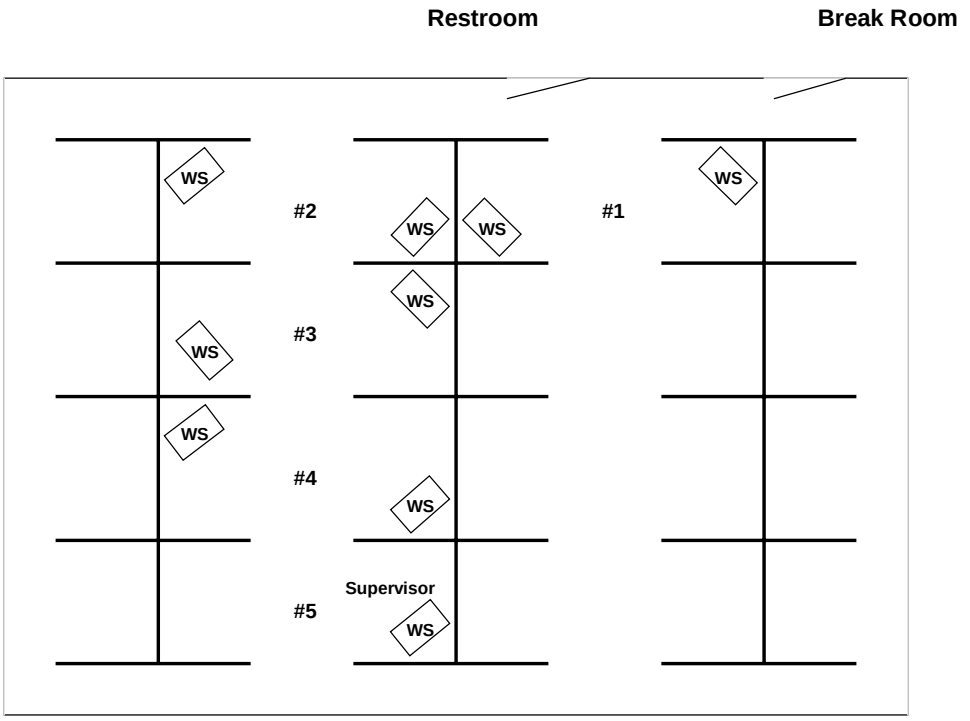


Figure 3
Floor Plan of HIM Department at Redwood City
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

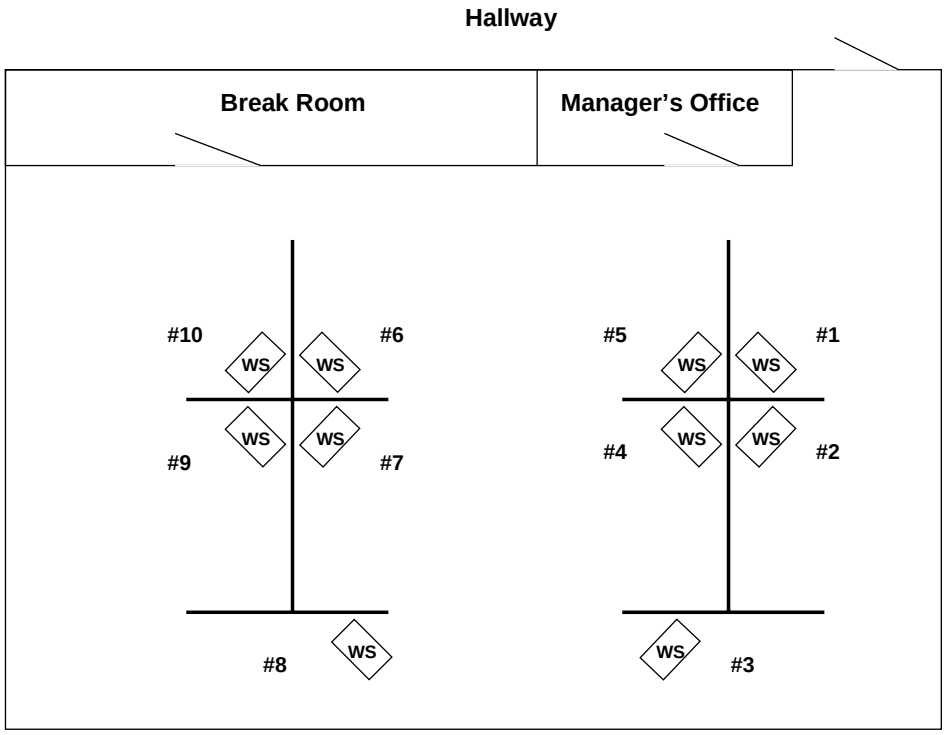


Figure 4
Test Setup of the Dictaphone C-Phone System Using KEMAR
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

Figure 5
The KEMAR Artificial Acoustic Fixture with B&K 4165 Microphones
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

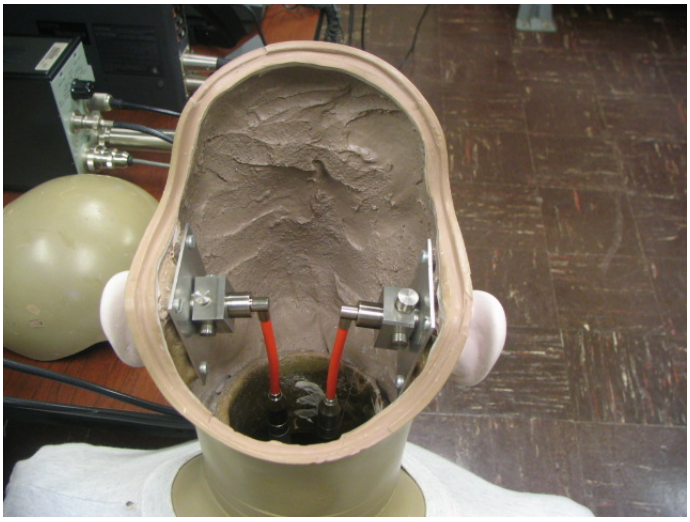


Figure 6
Octave Band Levels and NCB Curve for HIM Department at Santa Teresa
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

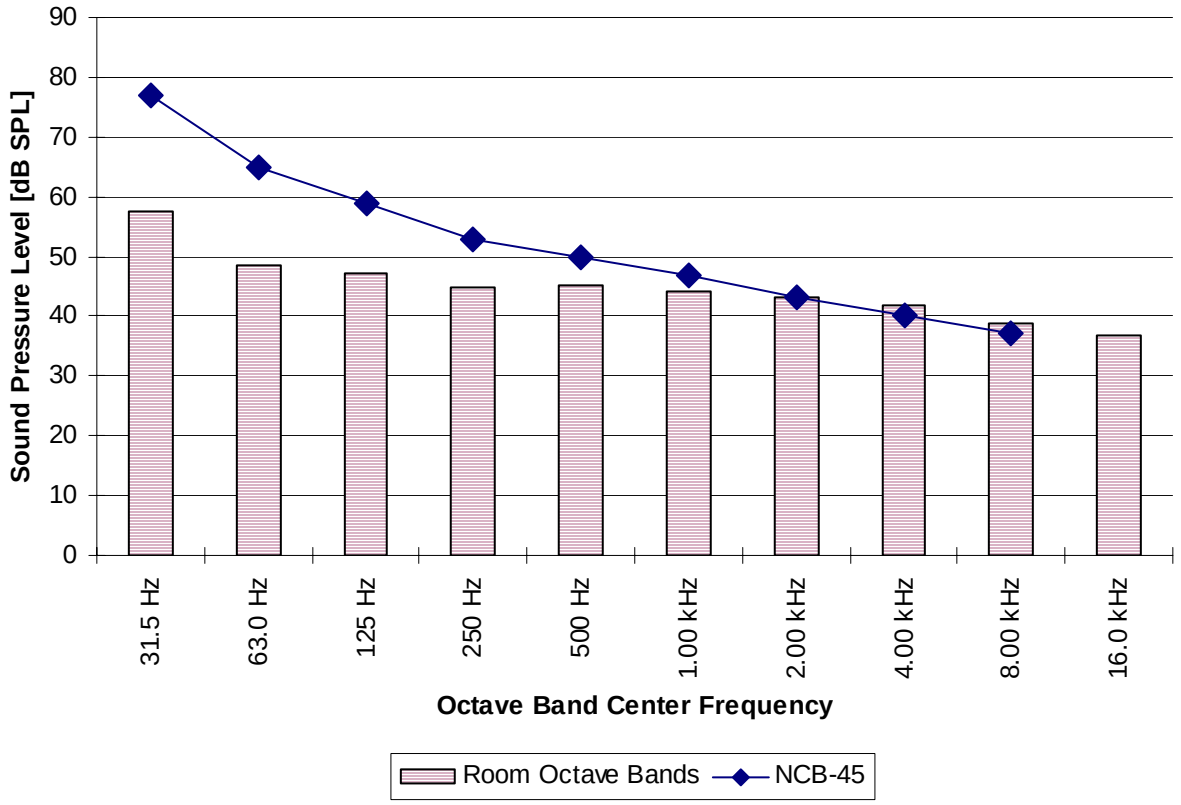


Figure 7
Octave Band Levels and NCB Curve for HIM Department at Santa Clara
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

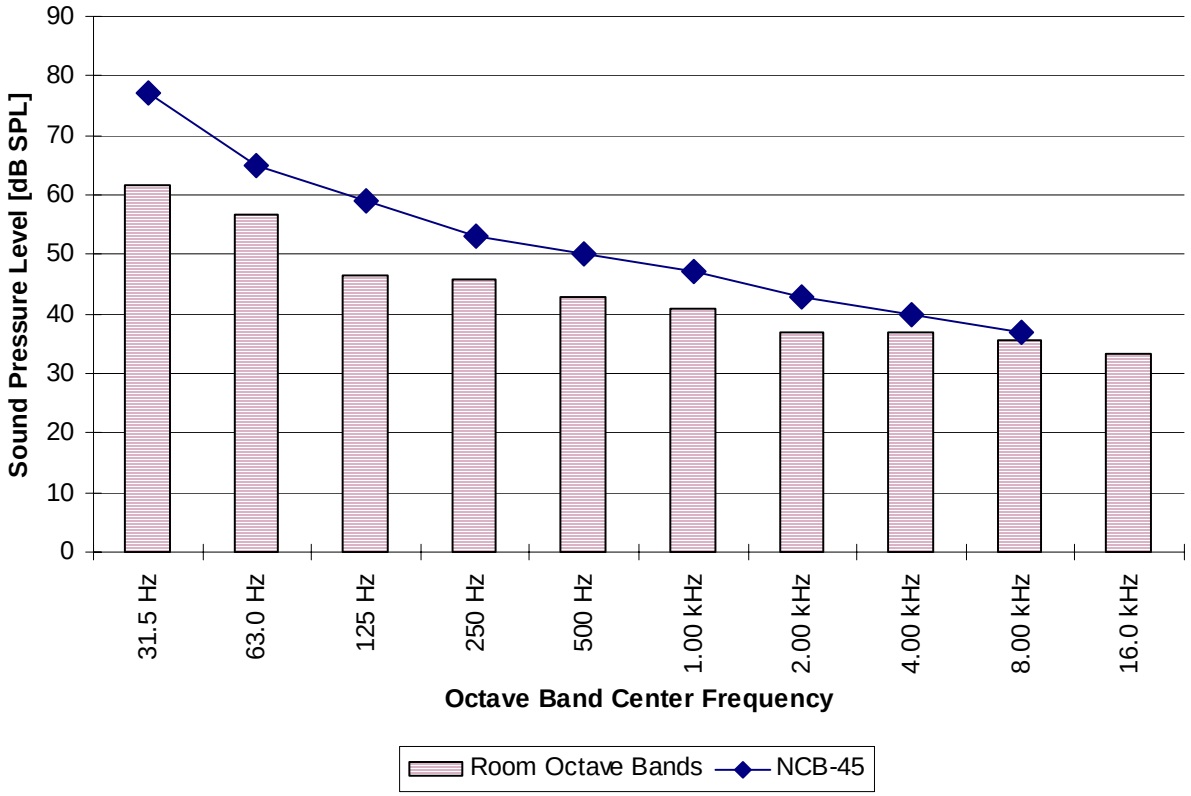


Figure 8
Octave Band Levels and NCB Curve for HIM Department at Redwood City
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

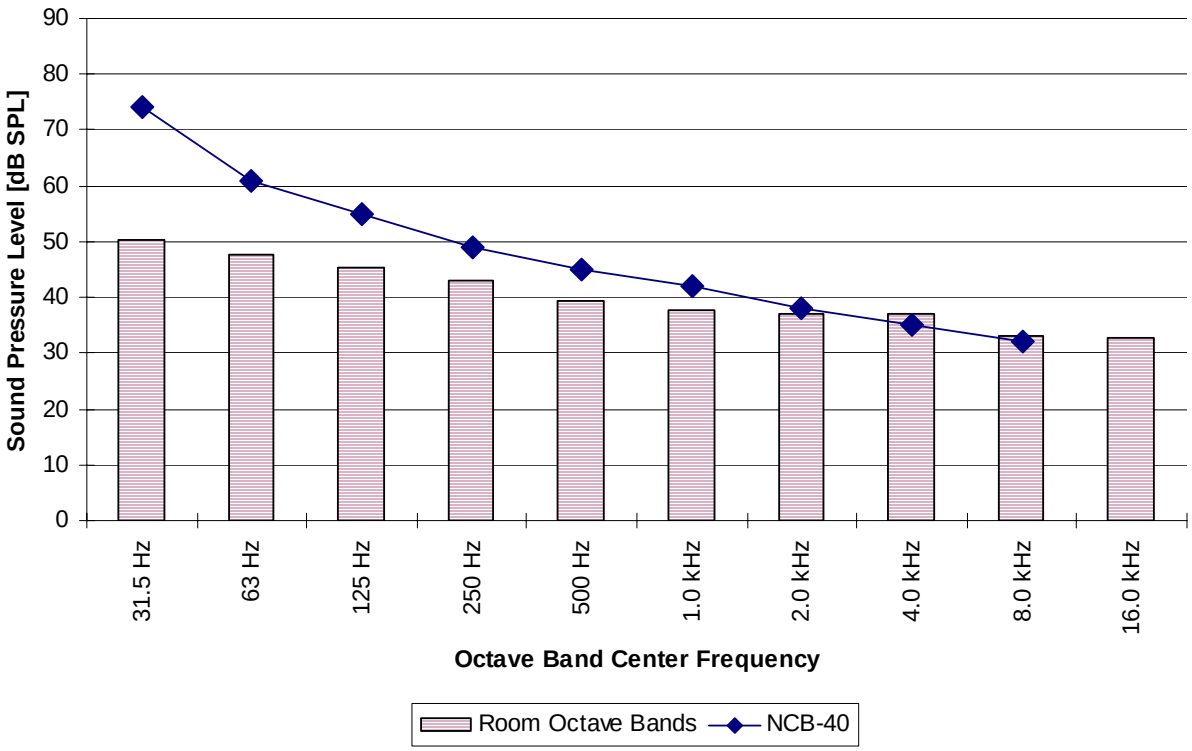


Figure 9
Comparison of Averaged Sound Levels Generated by the C-Phone at Medium Volume Setting
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

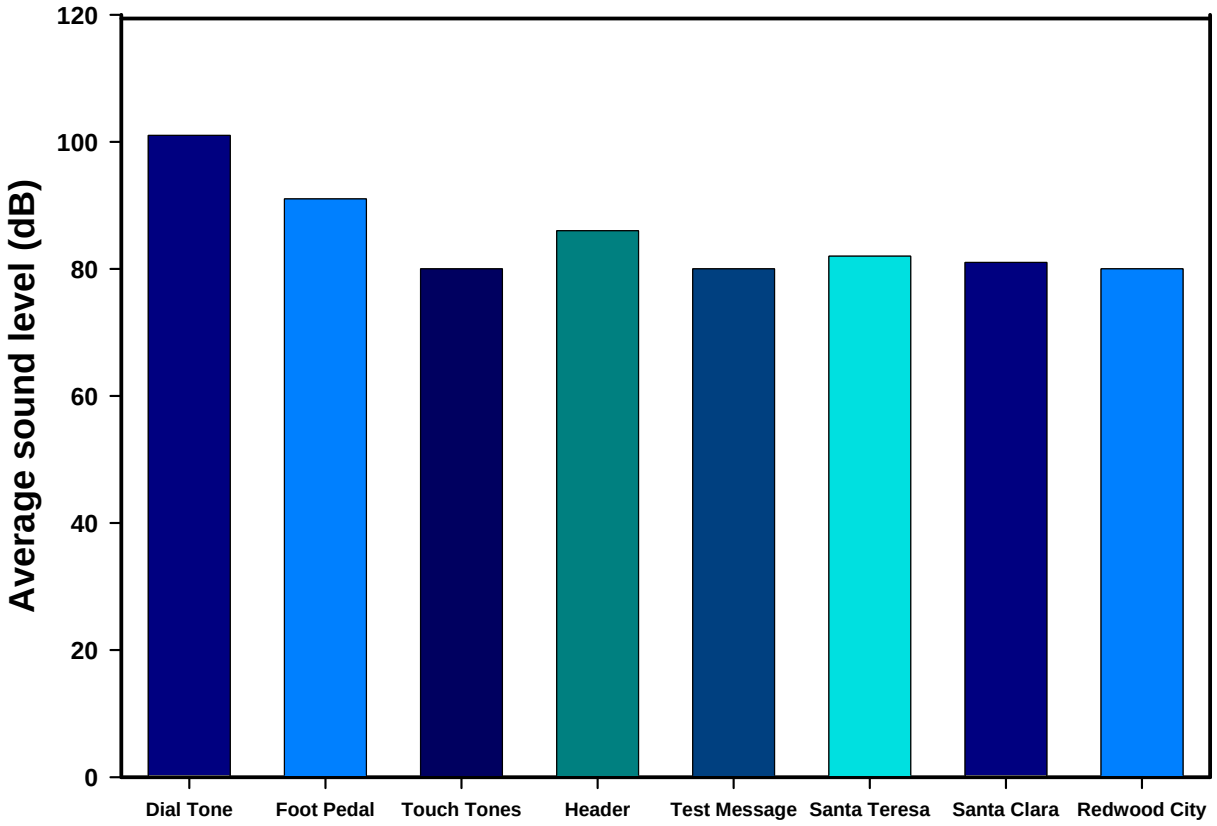


Figure 10
Frequency Response of the Dictaphone Deluxe Headset
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

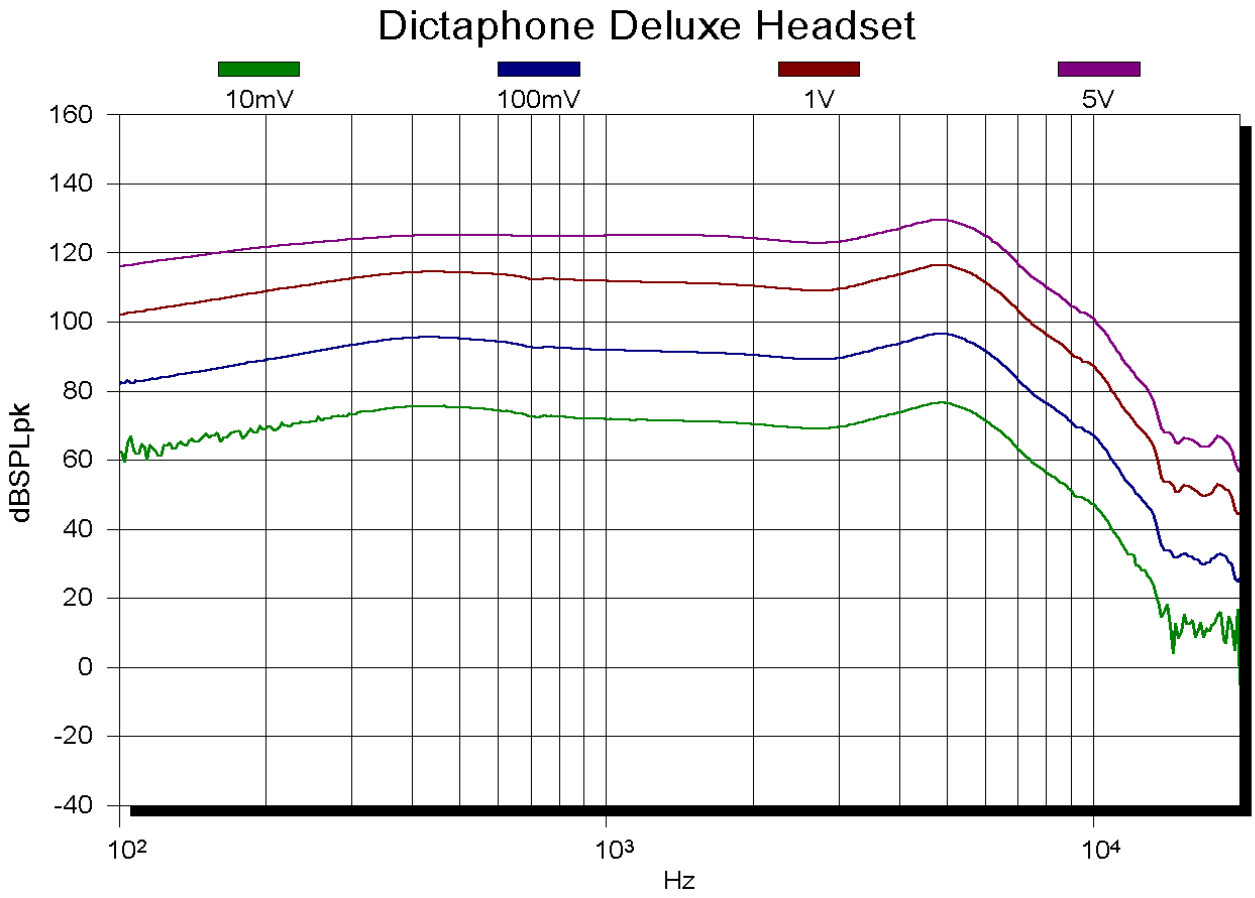


Figure 11
Frequency Response of the Dictaphone Light Headset
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

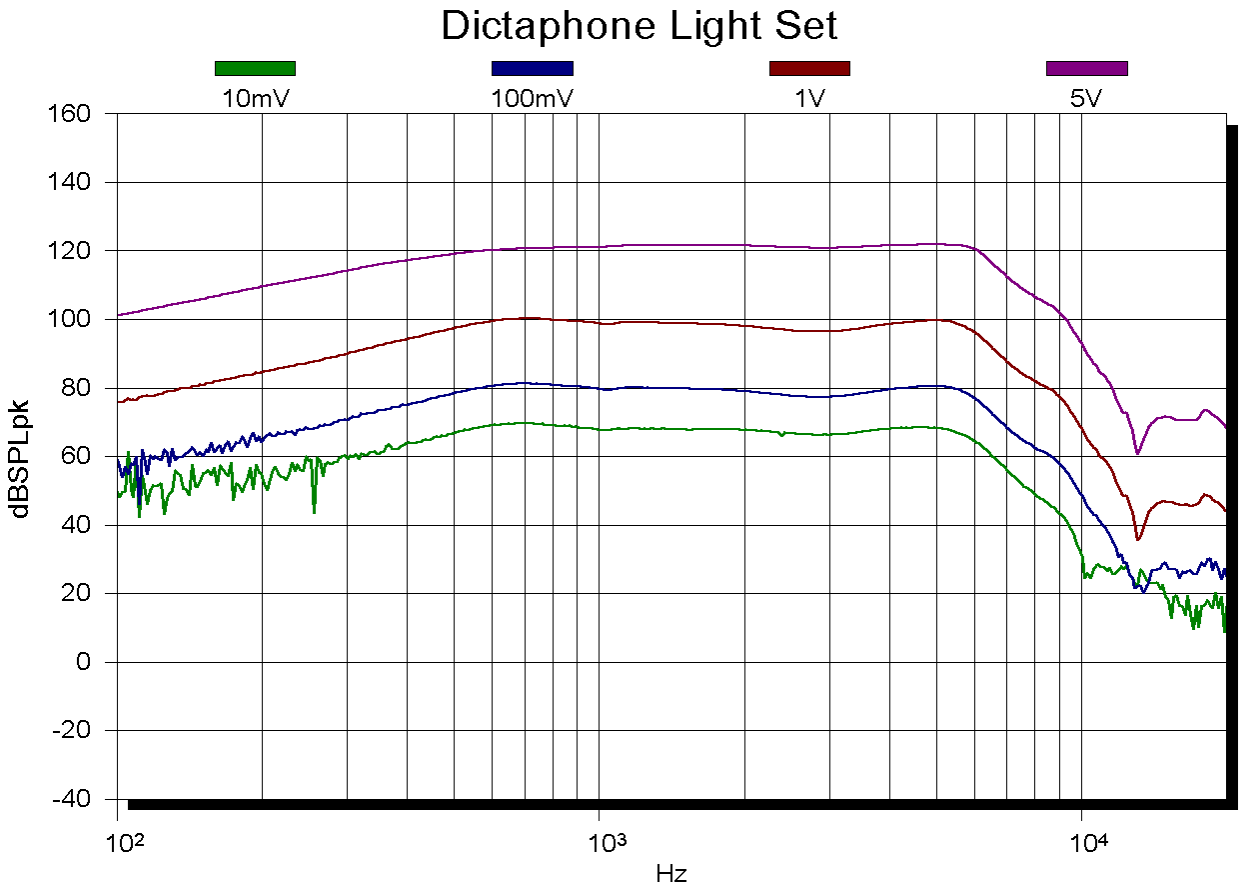


Figure 12
Frequency Response of the Dictaphone Sound Band Headset
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287

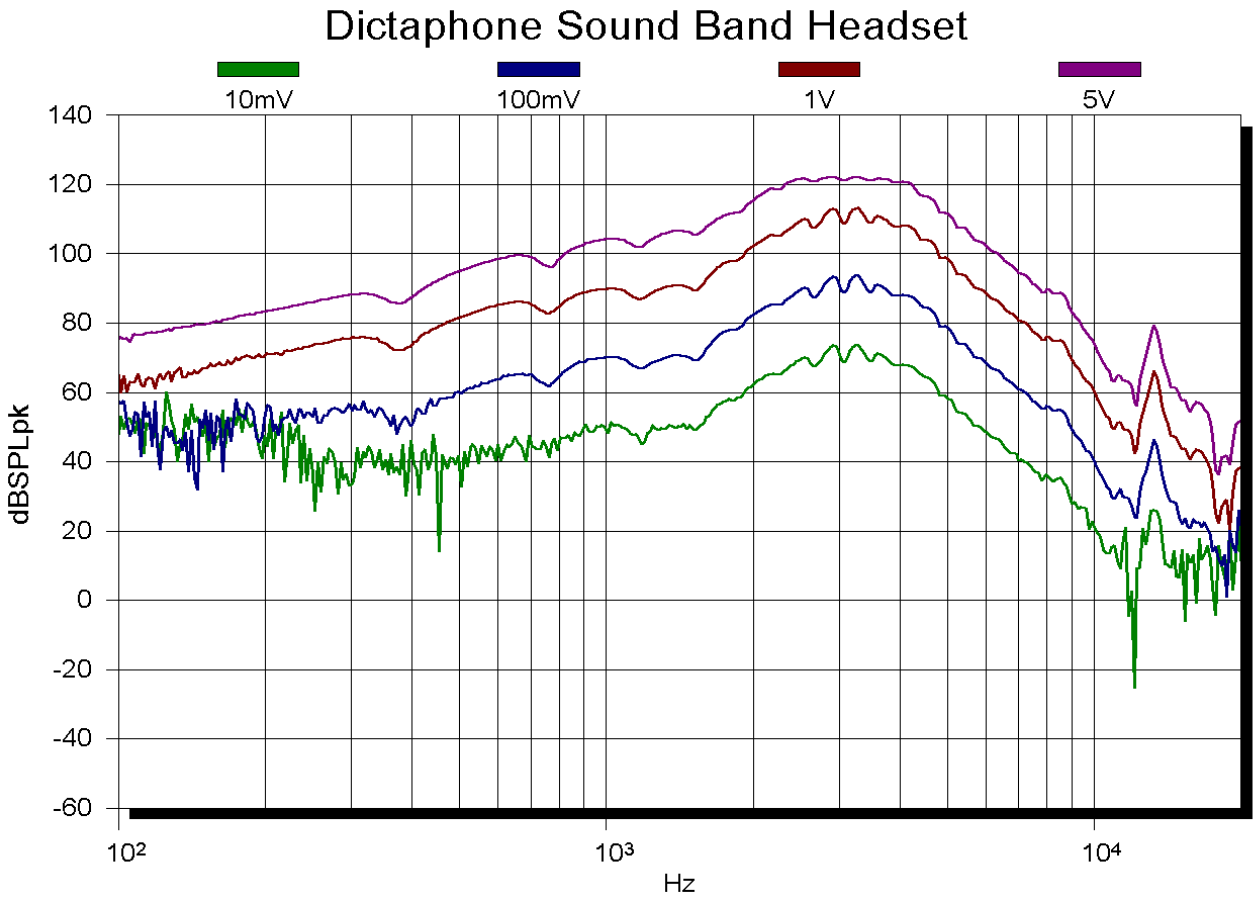
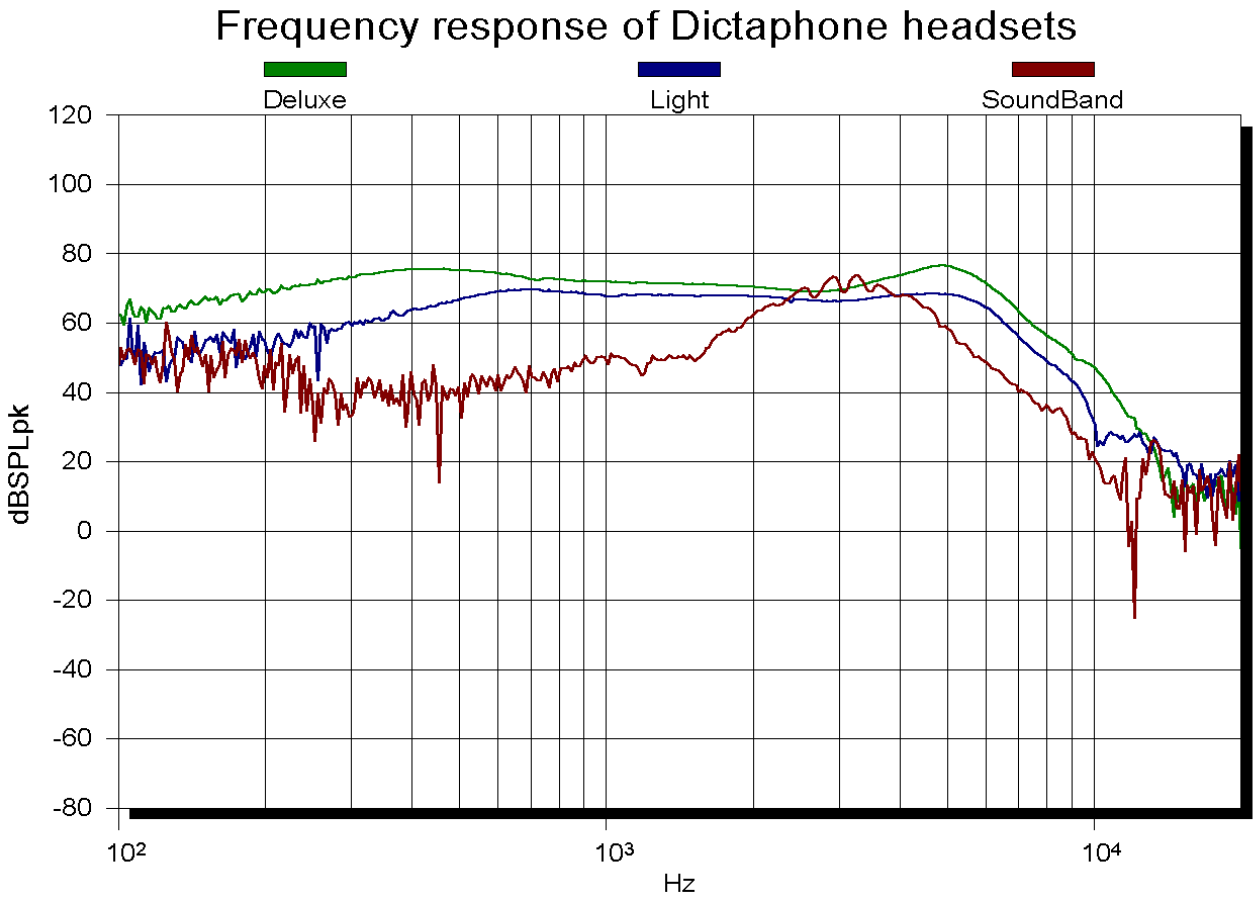


Figure 13
Frequency Response of the Three Dictaphone Headsets at 10 mV
Kaiser-Permanente
California
HETA 2003-0273;-0280;-0287



APPENDIX A
OSHA Salt Lake Technical Center Report

U. S. Department of Labor
Occupational Safety & Health Administration
Salt Lake Technical Center

- **Health Response Team**
- **8860 South Sandy Parkway**
- **Sandy, UT 84070**

Phone: 801-233-4900

DATE: March 5, 2004

MEMO FOR: SUSAN ECKHARDT
Industrial Hygienist
State of California OSHA

THROUGH: ALAN TRAENKNER
Deputy Regional Administrator Region 9
San Francisco, CA Regional Office

FROM: EMIL GOLIAS, MS, MPH, CSP
OSHA Health Response Team
Salt Lake Technical Center (SLTC)

SUBJECT: Sound level evaluation at Kaiser Permanente Santa Teresa Medical Center and Santa Clara Medical Center in California.

INTRODUCTION

On January 27, 28, and 29 Emil Golias of the OSHA Health Response Team and Allen Woo, an acoustics engineer, conducted sound level sampling on three Kaiser Permanente medical secretaries (medical transcriptionist's) who perform transcription services for outpatient and inpatient records at their Santa Teresa and Santa Clara medical facilities. Sampling was conducted for the employees entire work shift and the sampling equipment was removed during the employees break periods. Observations and back up measurements of employee exposures and work practices were made during the entire sampling period. Sound level readings were taken for ambient noise background levels in the office areas and the levels recorded were well below 70 dBA. This ambient noise would not contribute to the employee exposure levels monitored. The sampled employee's were utilizing Dictaphone Corporation C phone dictation and transcription systems with various headset styles. This report summarizes the sampling method used, sampling results and recommendations of feasible engineering and work practice controls that may be implemented to reduce employee occupational noise exposure. If I can be of further assistance, or if you have any questions, please contact me at 801-233-4910.

Test Equipment and Procedure

During the week of Jan 26, 2004 noise sampling was conducted utilizing the following methodology and equipment:

1. Signal from the dicta-phone system was diverted to a signal splitting box. The box consists of a unity-gain non-inverting Op-amp (high input impedance and low output impedance with 2 nine volt battery power sources). It is capable of providing plus/minus 9 volt output. The purpose of the box is to split the signal from the phone to the operator's headset and the monitoring headset without reducing the signal strength from the phone to either headset.

2. The monitoring headset then is placed on the Head and Torso Simulator (B&K 4128 HATS) in the manner similar to how it is worn by the operator. The HATS simulates the average human head with a microphone positioned at the eardrum.
3. The eardrum microphone is powered and by a B&K microphone power supply, B&K 2807. The acoustic signal received by the microphone is fed into the power supply and amplified.
4. The amplified signal from the power supply is then fed into an ART IEQ 1/3 Octave Programmable Equalizer. The equalizer carries out the transfer function of the HATS eardrum sound pressure level to the diffuse field sound pressure level, so the sound level can be compared to the OSHA noise standard.
5. The output from the equalizer is then fed to a B&K 4434 Noise Dosimeter which records the percent exposure to the OSHA noise standard.

Results

1. January 27, 2004, sampling the morning shift at Santa Teresa starting at 6:45 am and finishing at 3:00pm. The dose for 7 hours of sampling was 1%.
2. January 28, 2004, sampling the afternoon shift at Santa Teresa starting at 3:45 pm and finishing at 11:10 pm. The dose for 6 hours of sampling was 33%. It was noted that 18% of the 33% dose was obtained in a rather short period of time about 45 minutes.
3. January 29, 2004, sampling the afternoon shift at Santa Clara starting at 12:15 pm and finishing at 8:15 pm. The dose for 6 hours of sampling was10%.

Recommendation

1. Evaluate the soft and/or hard wear that provides the prompt to the employees. It was observed that the sound pressure level between the prompt and the beep at the beginning and the end of the each transcription can be accessibly loud and annoying. Modify the soft and/or hard wear of the Dictaphone to reduce the difference between the transcription sound signal and the prompt sound signal.
2. Insert a pair of electrical diodes, back to back across the speaker transducer, to put a limit to the acoustic output.
3. Evaluate the existing headsets to determine if they are adequate for the purpose intended. Medical secretaries utilize numerous headsets the quality of which has not been evaluated in relation to the task being performed. Using poor quality headsets can expose the operators to higher sound levels and inferior sound quality than needed to complete the task. Provide headsets with limiting devices that are suitable for the task being done which will keep employees exposure to sound as low as possible.
4. Require that the medical personal provide higher quality dictation. If the material to be transcribed is of poor quality with poor dictation, low sound level or garbled speech this causes the operators to increase the volume on the headsets to enable them to understand the material. This increases the employee exposure to sound.
5. For those employees who suffer from impaired hearing a system should be developed where dictation that is garbled or of an excessively low volume will be passed on and handled in a different manner.
6. If needed, contract with a consultation service which will provide the required workplace evaluations.

APPENDIX B
Cal-OSHA Information Memoranda

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

OFFICE: Fremont District Office
39141 Civic Center Drive, Suite 310
Fremont CA 94538

INFORMATION MEMORANDUM

EMPLOYER: Kaiser Permanente Santa Teresa Medical Center
ADDRESS: 275 Hospital Pkwy., Ste. 365
San Jose CA 95119

FILE COPY

An Inspection or investigation of a place of employment located at 250 Hospital Pkwy. in San Jose was conducted by Susan Eckhardt beginning on 04/21/2003. This Information Memorandum is intended to direct your attention to the following conditions which can be potentially hazardous to the safety and health of employees in the future. If these conditions were not corrected before employees are exposed, violations of safety and health standards would occur and you would receive one or more citations covering these violations, which will entail a civil penalty. In addition, one or more of the citations may be classified as willful based on the information contained in the memorandum.

Item No.	No. of Instances	Description of potential hazard
1	1	Noise monitoring data, collected by Cal/OSHA, indicates that under certain conditions, there is a substantial possibility that employees performing medical transcription work, which includes listening to dictation through headsets, may be exposed to sound levels equal to or exceeding 85 decibels, measured on the A-scale (dBA), as an 8-hour time-weighted average (TWA) or, equivalently, a dose of 50%. If employee exposure to noise equals or exceeds 85 dBA as an 8-hour TWA, then the employer shall administer a continuing, effective hearing conservation program. The hearing conservation program is to include representative personal sampling for noise exposure and an audiometric testing program. A noise sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program. [Ref.: 8 CCR 5097]. In addition, the employer shall institute a noise training program for all employees who are exposed to noise at or above 85 dBA as an 8-hour TWA. [Ref.: 8 CCR 5099]. If employees are exposed to sound levels exceeding 90 dBA as an 8-hour TWA, then feasible administrative or engineering controls shall be utilized. [8 CCR 5096].

Signature _____
Safety Engineer

Signature A. Eckhardt
S. Eckhardt, Industrial Hygienist

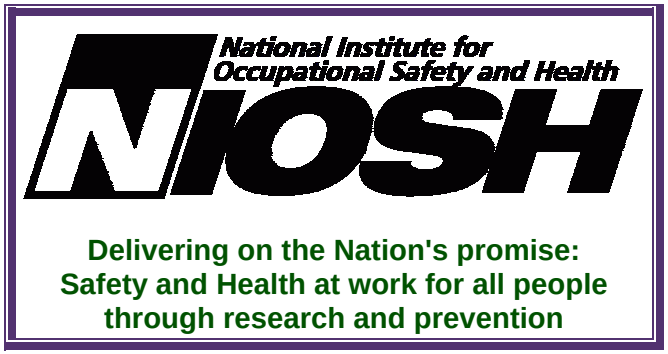
Signature D. Roloff
D. Roloff, District Manager

Date of Issuance 3/5/04

1	2	L6706	013-03	119690782
Region	District	SE/IH Identification No.	Optional Report No.	Cal/OSHA Form 1 Report No.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226-1998

OFFICIAL BUSINESS
Penalty for private use $300



To receive NIOSH documents or information about occupational safety and health topics contact NIOSH at:

1-800-35-NIOSH (356-4674)
Fax: 1-513-533-8573
E-mail: pubstaft@cdc.gov
or visit the NIOSH web site at:
http://www.cdc.gov/niosh

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