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RMC LONESTAR
San Francisco, California

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PREFACE

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

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Health Hazard Evaluation Report 98–0289–2742
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SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) responded to a joint request from the Building Material & Construction Teamster's Union Local 216 and the management at RMC LONESTAR to investigate noise exposures to the drivers of the company's ready-mix concrete trucks. Of particular concern was noise from a data telemetry system in the cab of the trucks that tracked the driver's location.

On October 5–9, 1998, investigators from NIOSH traveled to San Francisco, California, to conduct a noise survey at the company's ready-mix plants. Three days of personal noise dosimetry were obtained along with area noise measurements in the cab of the trucks and the cement plant to characterize the spectral make up of the noise. The RMC LONESTAR hearing conservation program was also reviewed by NIOSH investigators.

The analysis of the results determined that the Occupational Safety and Health Administration (OSHA) action level for the implementation of a hearing conservation program was exceeded in most of the sampled truck drivers. The NIOSH recommended exposure limit was surpassed in all personal noise measurements. The specific analysis of the data telemetry system found that the beeps emitted by the device were pure-tone in nature, but not of sufficient intensity to damage the drivers' hearing. However, the device did produce many unneeded sounds that could be perceived by the employees as annoying.

Based on the measurements and observations made during the evaluation, NIOSH investigators determined that the noise exposures experienced by the ready-mix cement truck drivers were of sufficient intensity to cause a risk of hearing loss. A hearing conservation program was in place for the employees and it should be continued. The data telemetry system did not pose a risk for hearing loss, but could be perceived as a source of annoyance to the drivers. Recommendations are offered to reduce the risk of hearing loss and to improve the working conditions for the employees.

Keywords: SIC 3273 (Ready-Mixed Concrete, Production and Distribution), noise, truck drivers, data telemetry system, stress, hearing protection devices.

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INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from the Building Material & Construction Teamster's Union Local 216 on July 27, 1998. The request concerned the ready-mix cement truck drivers at RMC LONESTAR in San Francisco, California, that the union represented. A similar request from management at RMC LONESTAR for an HHE was received on August 28, 1998. The joint request was concerned about the exposure to noise that drivers experienced during the loading, dumping, and transporting of concrete to construction sites. Of particular concern were the beeps produced by a radio data telemetry system in the cement trucks that tracked the driver's location for the company dispatcher. At least two drivers have filed workers' compensation claims over the noise produced by this device.

NIOSH investigators traveled on October 5–9, 1998, to conduct a site visit at the ready-mix plants in San Francisco and San Carlos, California. An opening conference was held with RMC LONESTAR management representatives from the corporate office and ready-mix plants, and with a Teamster's Union Local 216 representative on the afternoon of October 5. Three days of noise surveys were done from October 6–8, 1998, on cement truck drivers assigned to the San Francisco plant.

A closing conference was held on October 8 at the corporate safety office of RMC LONESTAR in Pleasanton with a management representative present. The union representative was connected to the conference by telephone. An interim letter with preliminary results was sent to all parties on October 26, 1998.

BACKGROUND

RMC LONESTAR is a manufacturer and supplier of concrete, cement, sand, gravel, and asphalt to the Northern California area. Its headquarters are in Pleasanton, California, with ready-mix concrete and sand aggregate facilities, cement plants and terminals, and asphalt plants throughout the area. The 19 ready-mix concrete facilities have a truck fleet of more than 250 vehicles to deliver their products. The San Francisco ready-mix concrete facility is on Mariposa Street, near the southern downtown waterfront.

Truck drivers at the San Francisco facility may deliver concrete to construction sites up to 30–45 minutes away from the plant. They may also be diverted to other ready-mix facilities near San Francisco to load materials. To track their location, the dispatcher is in contact with the vehicle by 2-way radio or by a DATA MATE 1013 MDT data telemetry system. The data system is hard wired with activities (e.g., pour load, clean out) or locations (e.g., arrive site, leave plant) on buttons on the face of the unit. Whenever a driver completes a task, he or she will press the appropriate button notifying the dispatcher. When the button is pushed, the data telemetry system will emit an audible signal or beep. The unit will beep when the signal has been successfully transmitted to the dispatcher. This can take some time and multiple attempts if the radio frequency on which they transmit is busy. There will also be audible beeps whenever other data systems are transmitting to the central dispatch unit. As early as August 1995, one driver began to have problems with the data telemetry system because he felt that the sounds made for an intolerable working condition. The driver eventually filed for workers' compensation and ceased to drive a cement truck for RMC LONESTAR. A second employee has also filed for workers' compensation stating that the beeps and squawking noises are causing him to become ill.

The company hired an environmental consultant in October 1996, to investigate the noise exposures that the drivers experienced on the job. A consultant rode with one of the concerned drivers for one work shift and measured the driver's personal noise exposure with a dosimeter. Additional area noise measurements were made with a second dosimeter in the sound level meter mode. The consultant determined that the driver had personal noise exposures that exceeded the California Occupational Safety and Health Administration's action level for the implementation of a hearing conservation program, but did not exceed the permissible exposure limit (PEL) of 90 decibels on the A-weighted scale [dB(A)] for an 8-hour work day. Individual events were measured between 83 to 103 dB(A) in the cab and at the construction sites. Noise emitted by the data telemetry system was measured at 83 dB(A) in the truck cab and at 103 dB(A) when the microphone of the meter was 1 inch (") away from the amplifier used to transmit the beeps. The consultant's report recommended that the company continue to include drivers in its hearing conservation program and provide hearing protective devices to the employees. The report offered no recommendation specific to the DATA MATE 1013 MDT system.

METHODS

Quest® Electronics Model M-27 Noise Logging Dosimeters were worn by employees during their shift while they drove cement trucks from the ready-mix plant to the job sites on three successive days. On two of the days, a NIOSH investigator rode with three of the selected drivers and on the third day, two drivers were accompanied by NIOSH investigators. The investigator logged the activities of the driver and the times they occurred in a notebook for later comparison to the noise levels measured by the dosimeters. The noise dosimeters were attached to the wearer's belt and a small remote microphone was fastened to the wearer's shirt at a point midway between the ear and the outside of the employee's shoulder. At the end of the shift, the dosimeters were removed and paused to stop data collection. The information was downloaded to a personal computer for interpretation with QuestSuite for Windows® computer software. The dosimeters were calibrated before and after the work shift according to the manufacturer's instructions.

Real-time area noise sampling was conducted 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 20 Hz to 20 kHz were integrated and stored in the analyzer. The analyzer was mounted on a tripod placed at various locations at the San Francisco ready-mix plant with the microphone at approximately what would have been the level of employees' ears if they had been in the area. Employees were generally not present while sampling took place. Additionally, real-time measurements were made inside a cement truck that was out of service for repairs. Here, an 800-line Fast Fourier Transform (FFT) spectrum of the DATA MATE 1031 MDT data telemetry system was collected when it signaled it was transmitting data. More detailed analysis of the spectrum was done to determine the frequency and intensity of the tone emitted by the system.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[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) PELs.[3] NIOSH encourages employers to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria. The OSHA PELs reflect the feasibility of controlling exposures in various industries where the agents are used, whereas NIOSH RELs are based primarily on concerns relating to the prevention of occupational disease. It should be noted when reviewing this report that employers are legally required to meet those levels specified by an OSHA standard.

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

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

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

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

The OSHA regulation has an additional action level (AL) of 85 dB(A); an employer shall administer a continuing, effective hearing conservation program when the 8-hour TWA value exceeds the AL. The program must include monitoring, employee notification, observation, audiometric testing, hearing protectors, training, and record keeping. All of these requirements are included in 29 CFR 1910.95, paragraphs (c) through (o). Finally, the OSHA noise standard states that when workers are exposed to noise levels in excess of the OSHA PEL of 90 dB(A), feasible engineering or administrative controls shall be implemented to reduce the workers' exposure levels.

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

RESULTS

RMC LONESTAR cement truck drivers were monitored for noise on three consecutive days. Sixteen separate full-shift, personal noise samples were obtained during the survey. Three of these drivers were also accompanied by NIOSH personnel on the first two days; two drivers were observed on the third day. The vehicle types driven during the survey were manufactured either by Mack or Kenworth in 1986, 1988, 1990, or 1996. The trucks were powered by diesel engines having 270, 285, or 300 horsepower. All of the vehicles at the RMC LONESTAR San Francisco cement plant were configured with the cab forward of the cement tumbler and a rear discharge chute. Many ready-mix cement truck drivers were observed wearing expandable, foam earplugs during the work shift.

The results obtained from the noise dosimeters are given in Table 1. The Quest dosimeters collect data in a way that allows one to directly compare the noise levels with the OSHA PEL and AL, and to the NIOSH REL, i.e., three different criteria are simultaneously used in the calculation of the employee's noise dose. The OSHA criteria use a 90-dB(A) criterion and 5 dB exchange rate for both the PEL and AL. The difference between the two is the threshold level employed, with a 90 dB(A) threshold used for the PEL and a 80 dB(A) threshold for the AL. Threshold level is the lower limit of noise values included in the calculation of the criteria; values less than the threshold are ignored by the dosimeter. The NIOSH criterion differs in that the criterion is 85 dB(A), the threshold is 80 dB(A) and it uses a 3-dB exchange rate. The table also displays the maximum, slow-response noise level measured during the sampling period to show the extreme noise levels to which a worker can be exposed. When the personal exposure data were compared with the PEL, it was found that none of the 16 samples exceeded the limit, ranging from 77 to 88 dB(A). However, 14 of the 16 drivers did exceed the OSHA action level of 85 dB(A), which requires that the company offer the employees all of the elements of an occupational hearing conservation program. When the noise dosimeter data are compared with the more conservative and protective NIOSH REL, all 16 samples exceed the 85 dB(A) limit, ranging from 87 to 92 dB(A).

The work shift times at RMC LONESTAR vary considerably. During the NIOSH evaluation, drivers were in their vehicles for 8.5 hours (hrs) to nearly 13 hrs. The one sample time of 7 hr : 13 minutes was the result of putting the dosimeter into the pause mode inadvertently before the end of the shift. The environmental consultant's report also documented work shifts of 8 to 15 hrs. Because of this variable work shift time, projected noise dose percentages were calculated according to the PEL criterion for 8, 10, 12, and 15-hour workdays (Table 2). As can be seen in the table, only the 1986 Mack and 1988 Kenworth cement trucks had a projected noise dose in excess of 100% for a 15-hour workday. All other vehicles and shift times did not exceed the PEL.

Since a NIOSH investigator rode with a cement truck driver and maintained an activity log, an analysis of the noise levels associated with the various activities performed during the day by the truck driver was possible. The drivers' activities were composed of loading concrete at the plant, driving to the construction site, and returning to the plant for additional concrete. The construction sites visited were characterized as both commercial and residential, and driving was done on interstate highways and business/residential streets. In reviewing the data, it makes sense to segment the activities into plant, construction site, transit, and break times. The dosimeter's storage of the noise data allows for a real-time representation of the dB(A) values for the entire sampling period. The results for each of the three drivers monitored on the first day of the evaluation are presented in Figures 1–3. The times of day for each of the four driver activities are also given in chronological order in a table at the bottom of each figure. Each of the three figures is portrayed as being fairly consistent, with the noise levels generally between 80–100 dB(A). Inspection of the tables for each figure does not reveal a clear pattern of noise exposure associated with a particular event. The only exception is the one break period taken by the driver. Discerning the break period from the rest of the day's activities is possible. The median sound levels associated with these activities substantiate this finding of little difference between events. The median values are 86.3, 85.6, 83.8, and 79.1 dB(A) for the cement plant, time in transit, construction site, and break period, respectively.

One reason that this HHE was requested was to document the noise levels produced by the data telemetry system in the truck cabs. An 800-line FFT spectrum analysis of a DATA MATE 1013 MDT system was done on a cement truck that was in the repair shop. Measurement of the beep made when the system transmitted data to the dispatcher was made in a quiet, stationary truck cab next to the repair shop. The FFT spectrum is presented in Figure 4. The analysis revealed a very distinct sound peak at 2850 Hz with a sound pressure level of 72 dB. The sound pressure next to the peak fell to 57 and 47 dB at 2800 and 2900 Hz. There are no other major sound pressure peaks in the overall spectrum. Thus, the beep emitted by the data telemetry system can be generally characterized as a single, pure tone. All of the NIOSH investigators noted that the tone was very audible while sitting in the truck cab, despite the driver's activity. They also noted that the cab's sound environment had many rattling, banging, and squeaking sounds along with the diesel engine noise and radio transmissions.

Finally, measurements of locations at the cement plant identified as noisy were made with the real-time spectrum analyzer. One of the more noticeable events at the plant was the unloading of the bulk cement trucks. This activity occurs very near the area where the delivery cement truck drivers line up waiting for their load of concrete. The large bulk tank trucks park two abreast and connect the discharge port to a flexible hose that conveys the material to a storage bin. A large blower moves the dry material to the bin. The noise levels associated with this event are shown in Figure 5. The peak sound energy is at 100 Hz; the overall sound intensity was captured at 102 dB(A). Another loud area at the cement plant is the loading platform where the cement trucks back into position for the mixer to drop its load of concrete (Figure 6). The drivers routinely leave the truck cab to spray water during loading and to pick up the paperwork from the dispatcher. This area was measured at 95 dB(A). The drivers' break room is across the driveway from these two noisy areas. This area was used by all of the drivers monitored by the NIOSH investigator for the midday break period. The noise levels measured inside the break room were 80 and 72 dB(A) with the door open and closed, respectively (Figure 7). The effect on the noise levels from the door is a reduction in the higher frequencies entering the room. The noise levels measured by the dosimeters found a median value of 79 dB(A) which implies that the door of the room must have been open for much of the break period. The last area noise measurements were made close to the vehicle repair shop (Figures 8–9). The overall levels were measured between 85 and 88 dB(A) while a front loader was operating in the immediate area. Also, the effects of a telephone buzzer can be seen in a comparison of the two figures. There are discernible increases in sound pressures around 2500 Hz because of the telephone ringing.

DISCUSSION

The daily noise exposures for ready-mix cement truck drivers do not exceed the limits imposed by OSHA. All of the personal noise samples were less than the PEL of 90 dB(A). Even when the data were extrapolated to a 15-hour work day, only two vehicles exceeded a 100% daily noise dose for an extended work shift. However, when the personal noise measurements were compared with the action level mandated by OSHA, 14 of the 16 drivers did exceed the OSHA action level of 85 dB(A), which requires that the company offer the employees all of the elements of an occupational hearing conservation program. This would include audiometric testing, noise monitoring, availability of hearing protection devices, employee training, and record keeping. When the noise dosimeter data are compared with the more conservative and protective NIOSH REL, all 16 samples exceed the 85 dB(A) limit, ranging from 87.1 to 92.5 dB(A). Inspection of the daily activity logs collected by the NIOSH investigators did not reveal any specific event that was noisier than the others. The median exposures for the cement plants, construction sites, and transit between sites only ranged from 84 to 86 dB(A).

The major exposure that triggered the NIOSH evaluation was the signal produced by the data telemetry system in the cabs of the cement trucks. The tones emitted by the device throughout the day are not hazardous to the drivers' hearing. The levels measured in the center of the cab were less than 75 dB. However, they are clearly audible to the drivers and are very unpredictable in their occurrence. The non-auditory effects of noise on workers' health and performance have been investigated by researchers for many years.[8,9] Tests of human performance and sleep in noise environments and the effects of chronic noise on the cardiac, neuroendocrine, immunologic, and gastrointestinal systems have been studied.[10,11,12,13] Most of these effects are measured when the noise levels are of high intensity and are unpredictable and uncontrollable.[14] The measured noise levels from the DATA MATE system in use at RMC LONESTAR are not high intensity, but they are unpredictable and uncontrollable. A research study reported by Melamed, Luz, and Green on the effects of noise on distress, accidents, and absence from work for blue collar workers found that even moderate levels of noise can have adverse, non-auditory effects on workers if they perceive the noise annoyance to be high. Increased frequencies of accidents and sick leave were found in male blue collar workers in this study.[15]

Several drivers were observed wearing expandable, foam earplugs during their work shift, including the times they were at construction sites or the cement plant and while they were driving. These particular earplugs have a noise reduction rating (NRR) published by the manufacturer of 29 dB. This level of protection from a properly inserted earplug is most likely more than is needed for the noise environments that the cement truck drivers encounter during work. The California vehicle code (Division

12, Chapter 5, Article 3.5, "Headsets and Earplugs," Section 27400) states that no person operating a motor vehicle shall wear any earplugs in both ears. There is an exception for persons to wear personal hearing protectors in the form of custom earplugs or molds that are designed to attenuate injurious noise levels. The custom plugs or molds shall be designed in a manner so as to not inhibit the wearer's ability to hear a siren or horn from an emergency vehicle or a horn from another motor vehicle. There are earplugs on the market that have lower NRR values in the range of 12–16 dB and also are more linear in their attenuation of noise reaching the ear. That is, the earplug tends to reduce the sound at all octave-band frequencies more equally so that the wearer perceives that the volume of noise is reduced. It could be easily argued that these kinds of earplugs meet the definition of the California vehicle code as a custom plug or mold.

RMC LONESTAR has a hearing conservation program in place for the ready-mix cement truck drivers and other employees who are exposed to noise. Their provider of audiometric testing is a reputable, national firm. The company is a commercial member of the National Hearing Conservation Association and meets their standards of excellence in order to maintain their membership in the association. The records reviewed during the evaluation were complete and up-to-date. One deficiency noted was the high number of drivers who missed the hearing tests from year to year. There was never a year when all drivers were given audiometric tests at the San Francisco ready-mix cement plant.

CONCLUSIONS

The personal noise exposures measured during the NIOSH evaluation are of sufficient intensity to pose a risk of hearing loss to the cement truck drivers. All of the personal noise samples exceeded the NIOSH criterion for occupational noise exposure. RMC LONESTAR has already implemented a hearing conservation program to reduce this risk of hearing loss. The data collected during this survey confirm that the program should be continued.

The intensity levels of the tones produced by the DATA MATE 1013 MDT data telemetry system is not enough to produce damage to the ear. However, the tones are unpredictable and uncontrollable for the driver and, thus, might be perceived as having a high level of annoyance. Some research has shown that these kinds of signals may lead to psychological distress, increased absenteeism, and increased accident rates.[14,15] The management at RMC LONESTAR should continue to work with the manufacturer of this data telemetry system to reduce or eliminate the number of sounds produced by the device, particularly sounds that convey no needed information to the drivers.

RECOMMENDATIONS

Based on the measurements and observations made during the evaluation, NIOSH investigators offer the following recommendations to reduce noise exposures to RMC LONESTAR employees and improve the working conditions at the San Francisco ready-mix cement plant.

1. The personal noise measurements obtained during the survey justify continuation of the hearing conservation program at RMC LONESTAR. Fourteen of the 16 noise samples exceeded the OSHA action level for noise.[6] Additionally, the NIOSH REL was exceeded in all cases, meaning that the drivers are at risk for hearing loss from occupational noise.[7]

2. Inspection of the records provided by the audiometric test provider revealed that many drivers at the San Francisco ready-mix cement plant were absent from annual hearing tests. This absenteeism adversely affects the hearing conservation program. Workers must wait more than a year before they receive feedback on whether they are adequately protected from noise. Also, any kind of program effectiveness analysis will be hampered because of missing data. It is important that employees are

tested annually and they should try to make sure this happens. The management of RMC LONESTAR should track employee participation to ensure that employees are tested every year.

3. The data telemetry system's tones are not intense enough to cause hearing damage to the cement truck drivers. However, in the opinion of the NIOSH investigator, the number of tones emitted by the device is excessive. Sounding a tone every time that a button is pushed or data transmitted, either successfully or unsuccessfully, is not providing needed information to the driver and is therefore only noise. It seems that only when the dispatcher is attempting to pass information to the driver through this system is an alerting tone necessary. Management should work with the supplier of the data telemetry system to see if there is a possible alteration to the device.

4. Many drivers were observed wearing hearing protection devices while on the job, specifically expandable, foam earplugs. This device is very effective in reducing noise exposure, maybe too effective in this situation. The noise is consistently between 80 to 100 dB(A). The foam earplug, when worn properly, will reduce the noise by 25–30 dB. The reduction is also more predominant for high frequency sounds which may interfere with communication. There are linear noise reduction ear plugs on the market that do not offer as much attenuation, but would be sufficient for the drivers to reduce noise to a safe level and not degrade the communication and traffic signals as much as the foam plugs. The information on this type of device has been given to RMC LONESTAR's safety manager.

5. The NIOSH investigators who rode with the drivers reported many rattles, squeaks, and banging noises inside the vehicle. A routine, preventive maintenance program should be designed that looks at tightening loose fasteners and handles. Also, if softer objects can replace the hard noisy objects in the vehicle, then they should be replaced. An example of this would be plastic clipboards to hold the delivery paperwork rather than the metal ones observed during the survey.

6. The telephone buzzer in the repair shop is more than loud enough to alert the mechanic that a telephone call is waiting. The comparison of the two figures (8 and 9) displaying the spectral characteristics of the sound at the vehicle repair shop clearly shows the buzzer above the background of noise in the area. The intensity of the buzzer can be reduced and the mechanic will still hear it.

7. One of the noisier operations at the San Francisco ready-mix plant is the unloading of the bulk cement trucks. The operation occurs near the line-up of trucks and drivers waiting to load concrete for delivery. A company profile obtained on the Internet states that a new facility is proposed to replace the current one. Management should attempt to move this operation away from the drivers or build noise blocking structures to eliminate this exposure to the drivers in the new facility. In the interim, drivers should be warned of the high noise levels associated with this operation.

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Table 1

Personal Noise Dosimeter Results
RMC LONESTAR
San Francisco, CA
HETA 98–0289
October 6–8, 1998

Truck #	Date	Sample Time	OSHA PEL [a]	OSHA AL [b]	NIOSH REL [c]	Maximum Level [d]
0482	10/6/98	9hr : 16m	79.0 dB(A)	86.0 dB(A)	87.7 dB(A)	106.9 dB(A)
0564	10/6/98	9hr : 24m	77.1 dB(A)	85.4 dB(A)	87.1 dB(A)	107.3 dB(A)
0471	10/6/98	9hr : 28m	85.6 dB(A)	89.2 dB(A)	91.6 dB(A)	118.9 dB(A)
0489	10/6/98	9hr : 38m	86.8 dB(A)	90.3 dB(A)	92.5 dB(A)	120.8 dB(A)
0421	10/6/98	10hr : 22m	86.9 dB(A)	90.5 dB(A)	91.8 dB(A)	123.4 dB(A)
0415	10/6/98	12hr : 43m	85.7 dB(A)	90.0 dB(A)	90.6 dB(A)	115.1 dB(A)
0564	10/7/98	9hr : 23m	77.4 dB(A)	84.6 dB(A)	87.3 dB(A)	111.0 dB(A)
0466	10/7/98	9hr : 4m	81.3 dB(A)	86.8 dB(A)	89.2 dB(A)	113.6 dB(A)
0423	10/7/98	9hr : 3m	83.4 dB(A)	87.5 dB(A)	91.5 dB(A)	126.0 dB(A)
0421	10/7/98	8hr : 37m	88.5 dB(A)	90.7 dB(A)	92.2 dB(A)	115.5 dB(A)
0489	10/7/98	8hr : 37m	83.1 dB(A)	87.2 dB(A)	89.3 dB(A)	110.6 dB(A)
0482	10/7/98	9hr : 58m	79.0 dB(A)	86.0 dB(A)	87.7 dB(A)	109.1 dB(A)
0564	10/8/98	9hr : 19m	83.5 dB(A)	87.9 dB(A)	89.5 dB(A)	110.3 dB(A)
0482	10/8/98	9hr : 36m	81.6 dB(A)	87.1 dB(A)	88.8 dB(A)	107.3 dB(A)
0644	10/8/98	8hr : 49m	79.0 dB(A)	83.9 dB(A)	87.8 dB(A)	115.1 dB(A)
0465	10/8/98	7hr :13m	85.8 dB(A)	88.3 dB(A)	91.3 dB(A)	112.9 dB(A)
Evaluation Criteria			90 dB(A)	85 dB(A)	85 dB(A)	

a = Data collected with a 90 dB criterion, 90 dB threshold, and 5 dB exchange rate.
b = Data collected with a 90 dB criterion, 80 dB threshold, and 5 dB exchange rate. [$\mathbf{L_{avg}}$]
c = Data collected with a 85 dB criterion, 80 dB threshold, and 3 dB exchange rate. [$\mathbf{L_{eq}}$]
d = Maximum slow-response level measured during sampling period

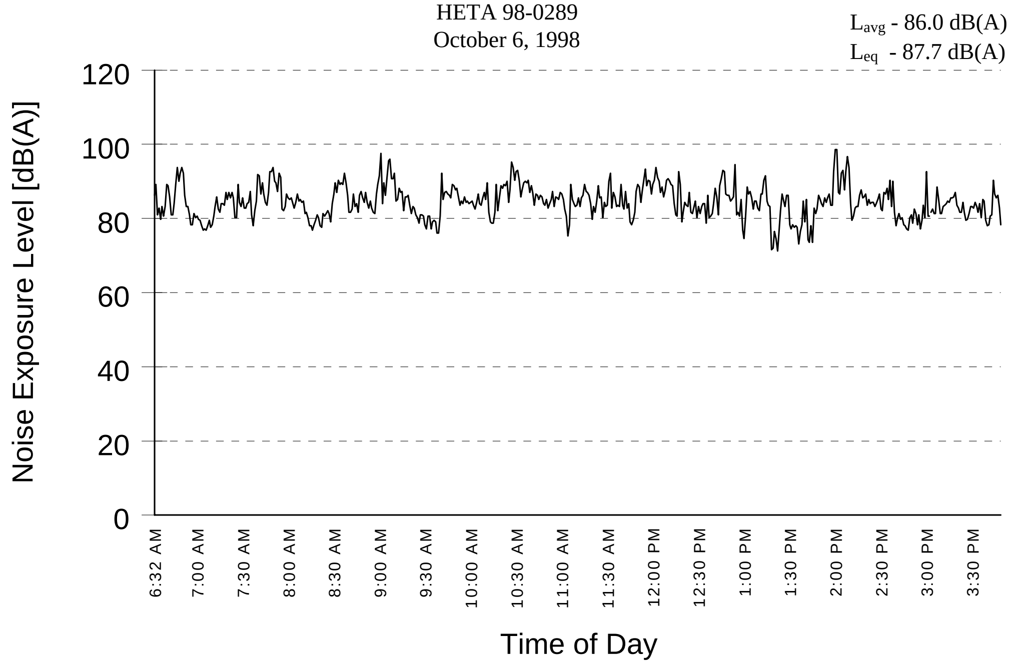
Table 2

Cement Trucks' Projected Daily Noise Doses for Variable Work Shifts
RMC LONESTAR
San Francisco, CA
HETA 98–0289
October 6–8, 1998

Truck #	Vehicle Type	Samples	Avg. 8-hr Dose	10-hr Dose	12-hr Dose	15-hr Dose
0415	1986 Mack	1	34.5%	43.1%	51.8%	64.6%
0421	1986 Mack	2	62.6%	78.3%	94.0%	117.5%
0423	1986 Mack	1	35.2%	43.9%	52.7%	65.9%
0465	1988 Kenworth	1	62.2%	77.7%	93.2%	116.6%
0466	1988 Kenworth	1	26.2%	32.8%	39.4%	49.2%
0471	1988 Kenworth	1	45.9%	57.4%	68.8%	86.0%
0482	1988 Kenworth	3	20.7%	25.9%	31.1%	38.9%
0489	1988 Kenworth	2	44.3%	55.4%	66.5%	83.1%
0564	1990 Kenworth	3	21.3%	26.6%	31.9%	39.9%
0644	1996 Kenworth	1	19.7%	24.7%	29.6%	37.0%

Figure 1

Truck #0482 Driver
RMC / Lonestar
San Francisco, CA
HETA 98-0289
October 6, 1998

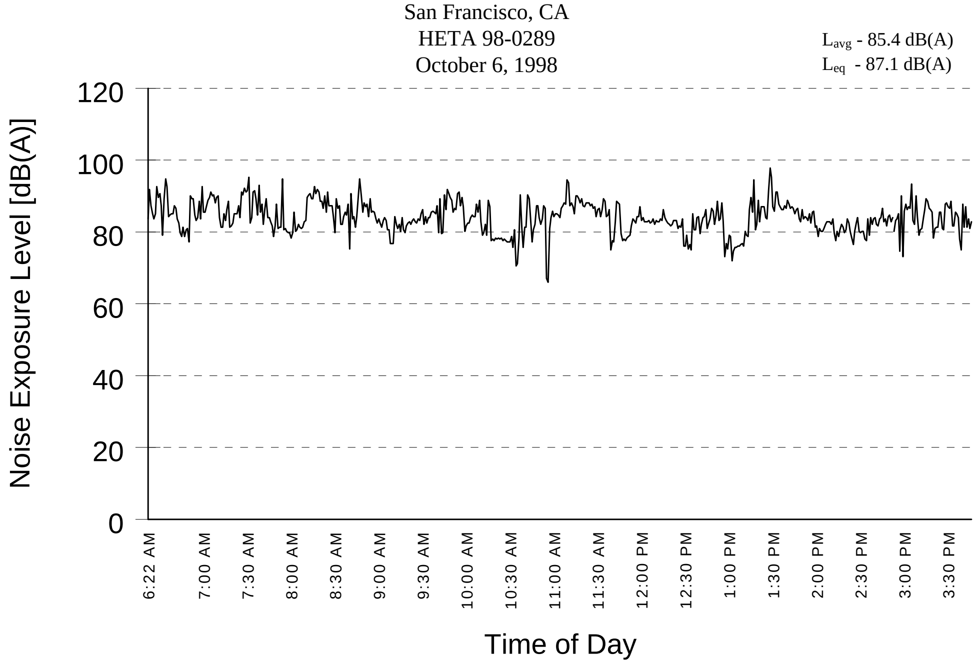


Activity Times for Truck #0482 Driver

Time	Activity	Time	Activity	Time	Activity
6:32 – 6:50 a.m.	at plant	9:10 – 9:22 a.m.	in transit	12:12 – 1:00 p.m.	at site
6:51 – 6:54 a.m.	in transit	9:23 – 9:49 a.m.	at site	1:01 – 1:25 p.m.	in transit
6:55 – 7:23 a.m.	at site	9:50 – 10:06 a.m.	in transit	1:26 – 1:46 p.m.	break
7:24 – 7:30 a.m.	in transit	10:07 – 10:25 a.m.	at plant	1:47 – 2:08 p.m.	at plant
7:31 – 7:54 a.m.	at plant	10:26 – 10:49 a.m.	in transit	2:09 – 2:34 p.m.	in transit
7:55 – 8:09 a.m.	in transit	10:50 – 11:04 a.m.	at site	2:35 – 2:59 p.m.	at site
8:10 – 8:37 a.m.	at site	11:05 – 11:29 a.m.	in transit	3:00 – 3:19 p.m.	in transit
8:38 – 8:53 a.m.	in transit	11:30 – 11:53 a.m.	at plant	3:20 – 3:49 p.m.	at plant
8:54 – 9:09 a.m.	at plant	11:54 – 12:11 p.m.	in transit		

Figure 2

Truck #0564 Driver
RMC / Lonestar
San Francisco, CA
HETA 98-0289
October 6, 1998

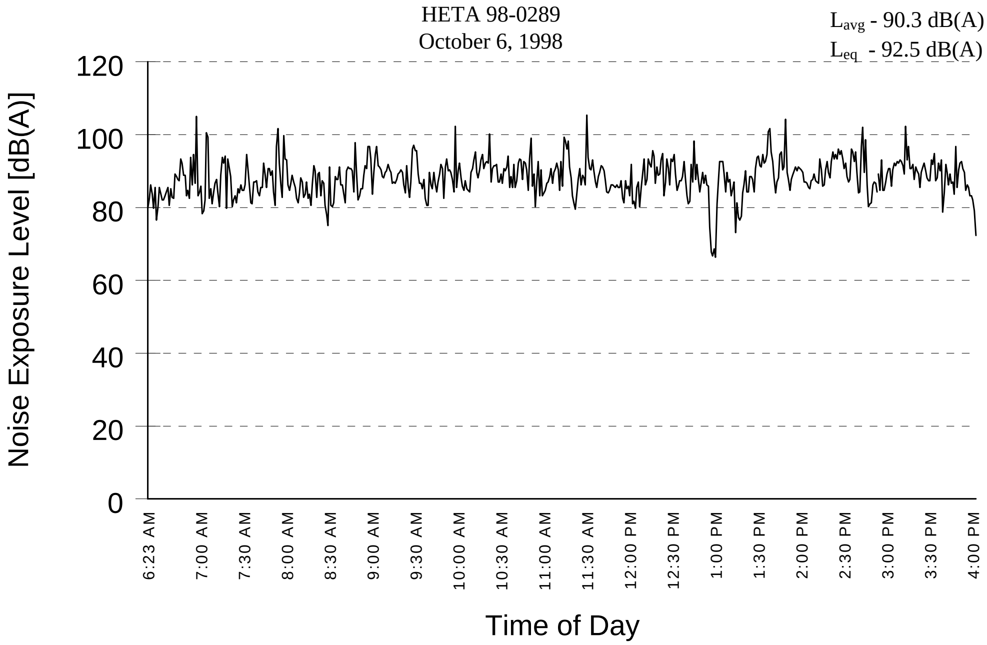


Activity Times for Truck #0564 Driver

Time	Activity	Time	Activity	Time	Activity
6:22 – 6:37 a.m.	at plant	8:51 – 9:00 a.m.	in transit	11:35 – 12:34 p.m.	at site
6:38 – 6:40 a.m.	in transit	9:01 – 9:25 a.m.	at site	12:35 – 12:52 p.m.	in transit
6:41 – 7:09 a.m.	at site	9:26 – 9:30 a.m.	in transit	12:53 – 1:29 p.m.	break
7:10 – 7:15 a.m.	in transit	9:31 – 9:53 a.m.	at plant	1:30 – 1:36 p.m.	at plant
7:16 – 7:36 a.m.	at plant	9:54 – 10:12 a.m.	in transit	1:37 – 1:56 p.m.	in transit
7:37 – 7:41 a.m.	in transit	10:13 – 10:39 a.m.	at site	1:57 – 2:38 p.m.	at site
7:42 – 8:28 a.m.	at site	10:40 – 10:55 a.m.	in transit	2:39 – 2:54 p.m.	in transit
8:29 – 8:34 a.m.	in transit	10:56 – 11:19 a.m.	at plant	2:55 – 3:46 p.m.	at plant
8:35 – 8:50 a.m.	at plant	11:20 – 11:34 a.m.	in transit		

Figure 3

Truck #0489 Driver
RMC / Lonestar
San Francisco, CA
HETA 98-0289
October 6, 1998



Activity Times for Truck #0489 Driver

Time	Activity	Time	Activity	Time	Activity
6:23 – 6:57 a.m.	at plant	9:08 – 9:23 a.m.	in transit	11:55 – 12:44 p.m.	at site
6:58 – 7:01 a.m.	in transit	9:24 – 9:41 a.m.	at site	12:45 – 1:08 p.m.	in transit
7:02 – 7:32 a.m.	at site	9:42 – 9:58 a.m.	in transit	1:09 – 1:30 p.m.	break
7:33 – 7:37 a.m.	in transit	9:59 – 10:21 a.m.	at plant	1:31 – 1:51 p.m.	at plant
7:38 – 8:00 a.m.	at plant	10:22 – 10:39 a.m.	in transit	1:52 – 2:13 p.m.	in transit
8:01 – 8:17 a.m.	in transit	10:40 – 10:57 a.m.	at site	2:14 – 2:53 p.m.	at site
8:18 – 8:31 a.m.	at site	10:58 – 11:13 a.m.	in transit	2:54 – 3:13 p.m.	in transit
8:32 – 8:49 a.m.	in transit	11:14 – 11:36 a.m.	at plant	3:14 – 4:02 p.m.	at plant
8:50 – 9:07 a.m.	at plant	11:37 – 11:54 a.m.	in transit		

Figure 4

DATA MATE 1013 MDT Sound Spectrum
RMC / Lonestar
San Francisco, CA
HETA 98-0289
October 8, 1998

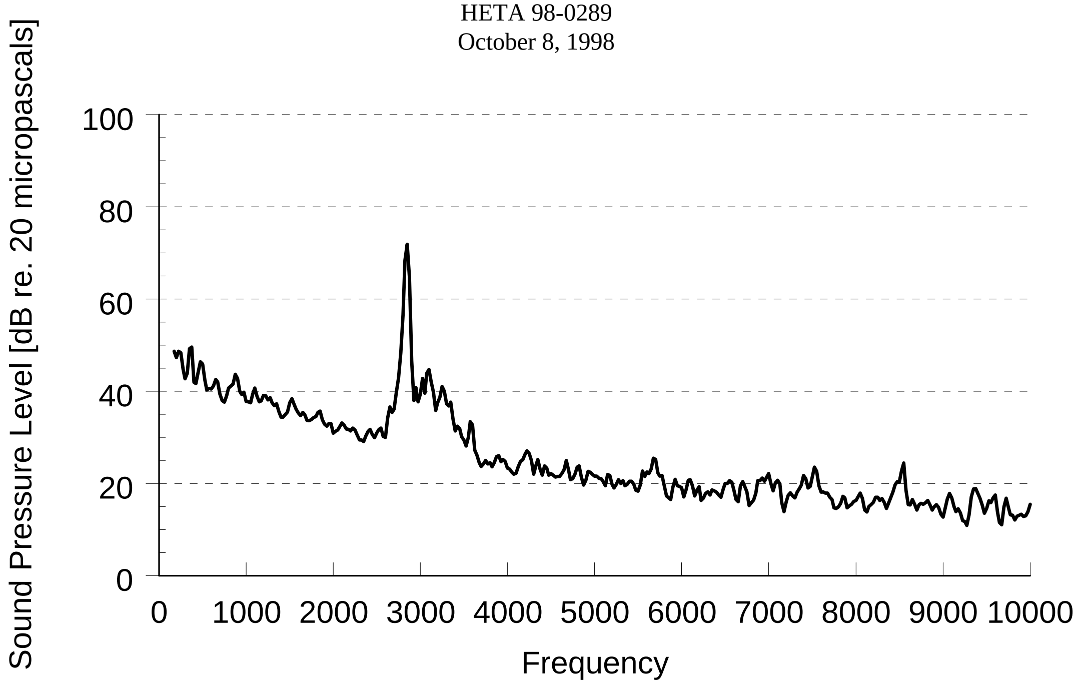


Figure 5

Bulk Trucks Unloading – In Front of Cabs
RMC / Lonestar
San Francisco, CA
HETA 98–0289
October 8, 1998

dB(A) – 102.3

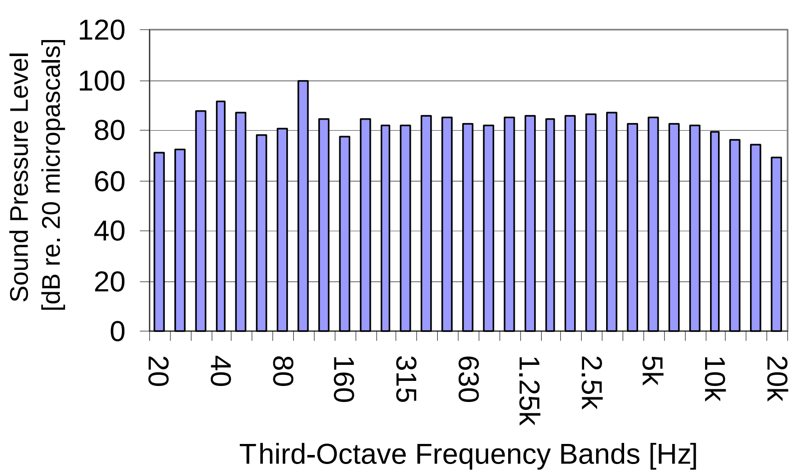


Figure 6

Cement Loading Platform
RMC / Lonestar
San Francisco, CA
HETA 98–0289
October 8, 1998

dB(A) – 94.6

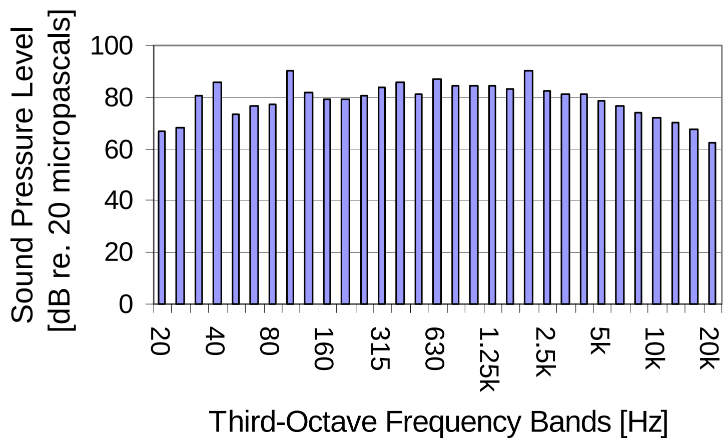


Figure 7

Break Room
RMC / Lonestar
San Francisco, CA
HETA 98–0289
October 8, 1998

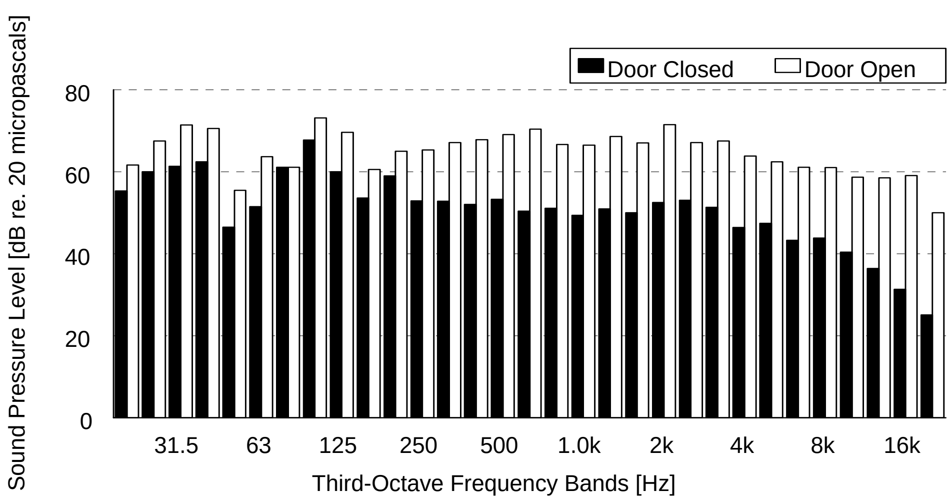


Figure 8

Repair Shop Driveway
RMC / Lonestar
San Francisco, CA
HETA 98–0289
October 8, 1998

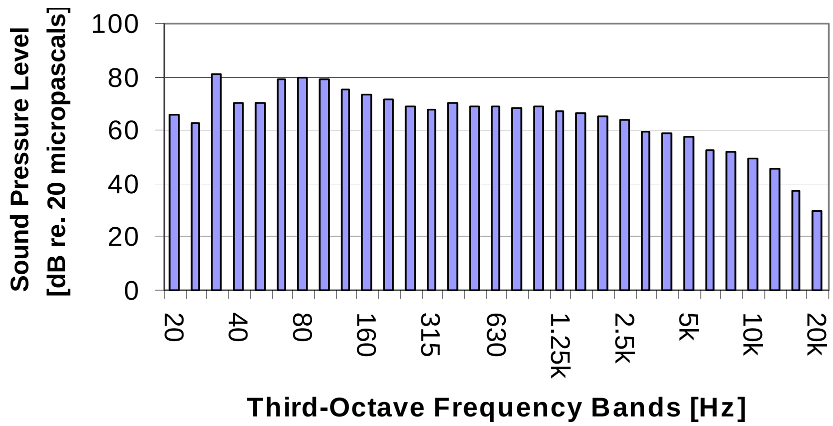
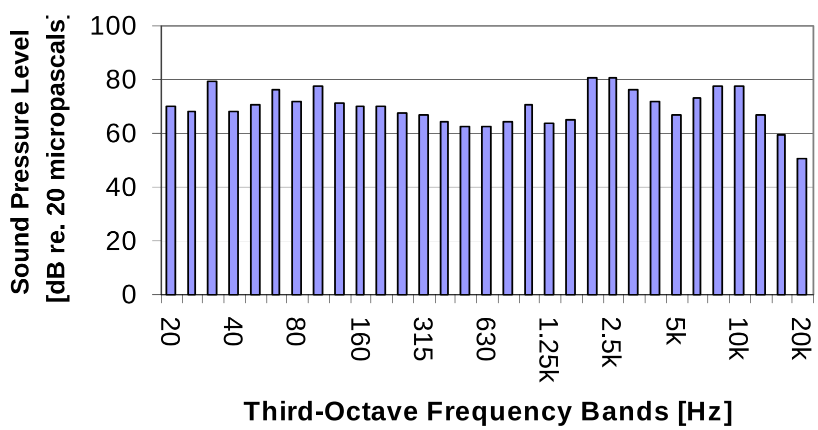


Figure 9

Repair Shop Driveway – Telephone Buzzer Sounded
RMC / Lonestar
San Francisco, CA
HETA 98–0289
October 8, 1998



National Institute for Occupational Safety and Health

Noise Exposures to Ready-Mix Truck Drivers at RMC LONESTAR

NIOSH was asked by management and Teamsters Union Local 216 to look at noise exposures in the ready-mix cement truck drivers during their work shift. Particular attention was paid to the radio data telemetry DATA MATE 1013 MDT System along with other noisy job activities.

What NIOSH Did

Measured personal noise exposures to drivers for three, consecutive days

NIOSH investigators rode in trucks to log activities

Analyzed noise produced by DATA MATE 1013 MDT System

Measured general area noise at San Francisco ready-mix cement plant

Reviewed the hearing conservation program at RMC LONESTAR

What NIOSH Found

Fourteen of 16 daily noise doses were higher than OSHA's action level which requires a hearing conservation program for employees

All drivers' daily noise exposures exceeded the NIOSH limit for noise

The DATA MATE system produces a tone of 72 dB at 2850 Hertz. This is not damaging to hearing but can be annoying.

What RMC LONESTAR Managers Can Do

Continue to provide a hearing conservation program to employees

Make it easy for all employees to have yearly hearing tests

Offer drivers earplugs that do not reduce the noise as much as the foam plugs. These will allow warning signals to be heard and still protect ears from the noise.

Work with maker of DATA MATE system to reduce the number of tones the driver must hear

Plan the new facility with noise reduction as part of the construction

What the RMC LONESTAR Employees Can Do

Report rattles, squeaks, and other noises in truck cabs so that they can be repaired

Make an effort to have a hearing test every year

Use good hearing conservation judgement away from the job

Keep break room door closed to reduce noise

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for
HETA Report # 98-0289–2742

National Institute for Occupational Safety and Health
NIOSH

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Homepage at:
http://www.cdc.gov/niosh/homepage.html

National Institute for Occupational Safety and Health
NIOSH

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