



NIOSH HEALTH HAZARD EVALUATION REPORT

**HETA #2003-0157-2934
Spirit Mountain Casino
Grand Ronde, Oregon**

April 2004

**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). Desktop publishing was performed by Shawna Watts. Review and preparation for printing were performed by Penny Arthur.

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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 Employee Noise Exposures at a Casino

The National Institute for Occupational Safety and Health conducted an evaluation of noise exposures for employees who worked in the non-smoking casino, children's daycare and arcade, and other locations at the casino during busy weekend afternoons and evenings to see if there was a risk of hearing loss from their jobs.

What NIOSH Did

- # Measured noise exposures that workers had during their full work shift
- # Measured area noise levels throughout the casino during busy and not so busy periods

What NIOSH Found

- # All noise exposures were well below any exposure limit for increased risk for hearing loss
- # None of the area noise samples were loud enough to be of any concern

What Spirit Mountain Casino Managers Can Do

- # Monitor employee and customer complaints about noise in the casino
- # Re-measure noise exposure whenever new slot machines or casino renovations result in a perceived increase in noise levels

What the Spirit Mountain Casino Employees Can Do

- # Report slot machines that seem to be louder than others
- # Be aware of any changes in the casino that seem to make it louder



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 #2003-0157-2934



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Spirit Mountain Casino
Grand Ronde, Oregon
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Randy L. Tubbs, Ph.D.

SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from employees at the Spirit Mountain Casino in Grand Ronde, Oregon. In the request, the employees expressed a concern about noise levels generated in the non-smoking casino area and in the children's arcade. To evaluate their exposures, dosimeters were used to collect personal noise exposure data from slot machine attendants, beverage servers, and pit bosses during weekend afternoon and evening hours which were thought to be the busiest periods. Additional dosimeter measurements were made on employees working in the casino's cashier cages, children's daycare and arcade, and on the ground keeping staff. Area noise samples were collected throughout the casino during customer peak and off-peak hours.

The results of the noise evaluation found no employees exposed to occupational noise at levels that are above the evaluation criteria used to assess workers' risk of hearing loss from occupational sources. All dosimeter readings were far below the daily allowable dose regulated by the Occupational Safety and Health Administration for noise or for the implementation of hearing conservation programs nor the NIOSH recommended exposure limits by any employee sampled in this investigation. The area noise samples found no noise source that was potentially harmful to the employees' hearing.

No occupational exposure to noise that would harm the hearing of employees at Spirit Mountain Casino was discovered during this evaluation. Because of this, no specific recommendations are offered to alter the workplace. However, it is noted in the report that any addition of slot machines or other renovations that increase the perceived noise levels warrant evaluation of the employees' exposures.

Keywords: SIC7011 (Casino hotels), noise, slot machines, arcades, noise dosimetry, spectral analysis

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INTRODUCTION

On June 19, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from employees at the Spirit Mountain Casino in Grand Ronde, Oregon. In the request, the employees expressed a concern about noise levels generated in the non-smoking casino area and in the children's arcade. The identified source of the noise was the video slot machines with their bells, sirens, and whistles and the games in the arcade. It was reported that customer comment cards often complained about the noise at the casino.

A NIOSH investigator visited Spirit Mountain Casino from August 6-9, 2003, to conduct an opening conference with management and employee representatives followed by a noise survey of the casino. During the opening conference, it was decided to conduct a dosimeter survey of employees in the following locations: non-smoking area of the casino, children's arcade, near the security desk, island cashier cage during a casino slot tournament, Playland (child care center), and grounds keeping. Additional area noise measurements of much of the casino floor were also planned at the opening conference.

BACKGROUND

Spirit Mountain Casino, under the direction of the Confederated Tribes of Grand Ronde, opened in 1995. It has undergone five renovations and expansions, with the non-smoking casino opening in August 2001. The casino offers 90,000 square feet of gaming area with 1,500 slot machines and 40 gaming tables. The slot machines throughout the casino do not dispense coins when paying jackpots. Rather, a paper ticket is printed which the patron takes to the cashier for reimbursement. The casino is open 24 hours per day, seven days a week. The casino and lodge employ 1,500 full- and part-time employees. The 30-acre site is maintained by the casino's grounds keeping staff. The non-smoking casino is located off the main casino

floor. An archway leads from the main casino to the non-smoking area along with an additional walkway from the main entrance lobby and a separate outdoor entrance. The ceiling in the non-smoking casino is lower than in the main casino area. All casino floors are carpeted.

METHODS

From discussions during the opening conference on August 6, 2003, it was noted that the busiest times in the non-smoking casino were on Friday and Saturday evenings. Therefore, the noise dosimetry for this area would be conducted during this period. Also, there were slot tournaments held on Thursdays, during the day and early evening in the main casino. Special slot machines are moved to the wall next to the security desk and patrons sign up to compete. A casino employee acts as a master of ceremonies with an amplified microphone to announce the tournament. Dosimeters were placed at the security desk and on an island cashier who worked across an aisle from the slot tournament. Finally, management of the casino wanted to document noise exposures for the grounds keeping staff.

Quest® Electronics Model Q-300 Noise Dosimeters were used to collect the daily noise exposure measurements from the employees that had volunteered to be in the NIOSH evaluation. The dosimeter was secured on the worker's belt and the dosimeter's microphone attached to their shirt, halfway between the collar and the point of their shoulder. A windscreen provided by the manufacturer of the dosimeter was placed over the microphone during recordings. The dosimeters were worn for the entire work shift. The noise information was downloaded to a personal computer for interpretation with QuestSuite® Professional computer software and the dosimeters reset for the next day. The dosimeters were calibrated before and after the work shift according to the manufacturer's instructions.

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. Measurements were made on Wednesday during the early afternoon when the number of patrons in the casino was low and on Saturday evening when the casino was busy.

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) 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 [dB(A)] is the preferred unit for measuring sound levels to assess worker noise exposures. The dB(A) scale is weighted to approximate the sensory response of the human ear to sound frequencies near the threshold of hearing. The decibel unit is dimensionless, and represents the logarithmic relationship of the measured sound pressure level to an arbitrary reference sound pressure (20 micropascals, the normal threshold of human hearing at a frequency of 1000 Hz). Decibel units are used because of the very large range of sound pressure levels which are audible to the human ear. Because the dB(A) scale is logarithmic, increases of 3 dB(A), 10 dB(A), and 20 dB(A) represent a doubling, tenfold increase, and 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 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:

$$\text{Dose} = 100 \times (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n),$$

where C_n indicates the total time of exposure at a specific noise level and T_n 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 time-weighted average (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. Twelve-hour exposures have to be 83 dB(A) or less according to the NIOSH REL.

RESULTS

The Quest dosimeters collect data so that one can directly compare the information with the three different noise criteria used in this survey, the OSHA PEL and AL, and the NIOSH REL. The OSHA criteria use a 90 dBA criterion and 5-dB exchange rate for the PEL and AL. The difference between the two is the threshold level employed, with a 90 dBA threshold for the PEL

and an 80 dBA threshold for the AL. The 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 from OSHA in that the criterion is 85 dBA, the threshold is 80 dBA, and it uses a 3-dB exchange rate.

Dosimeter results for the three days of sampling are shown in Table 1 as a percent of the daily allowable noise dose. All of the sampled employees had noise doses that were much less than the daily allowable value of 100%. Noise exposures sampled according to both OSHA criteria were well below any regulated limit. Even the more conservative NIOSH criterion calculated noise levels less than the REL, with the highest 8-hr TWA value equal to 83 dBA for the employee working in the children's arcade. In the non-smoking casino, the 8-hr TWAs over the two evenings of data collection ranged from 76.4 dBA to 81.8 dBA. A beverage server in the non-smoking casino did have a relatively high noise exposure in her raw dosimeter data. However, she did report that another employee had screamed intensely into the dosimeter microphone for a period of time during the evening work shift. Inspection of the data revealed two, one-minute averages of 123 and 97 dBA that were clearly much higher than any other exposures during the evening and occurred in consecutive recording periods. When these two values were reduced to the third highest intensity level of 93 dBA, the recalculated daily dose was reduced below all the evaluation criteria as shown in Table 1. Initially, two groundskeepers were chosen to wear dosimeters for their shift. However, one of the meters failed to store the noise exposures. The other groundskeeper had a 32.3% noise dose which equates to an 8-hr TWA of 79.4 dBA.

A floor plan of the casino was provided to the NIOSH investigator to map the locations where the area noise samples were obtained. The main smoking casino has four sections of slot machines (Section 1 through Section 4), gaming tables in the center of the floor, two cashier cages, a poker room, and a sports book along the perimeter of the casino. Section 5 of slot

machines is a high roller area separate from the smoking casino. The non-smoking casino has a section of slot machines (Section 6), gaming tables, a cashier cage, and a beverage area. The gaming tables are located in the center of the casino, surrounded by slot machines. The cashier cage and beverage area are along the walls. Area noise measurements were made in numerous areas throughout the casino with a real-time analyzer during an afternoon period when the casino was less busy and repeated in the late evening when the casino was full. The overall A-weighted noise levels are presented in Table 2. Only the area noise sample taken in the children's arcade during the evening measurement approached the NIOSH REL of 85 dBA. The noise levels consistently increased in the evening as compared to the afternoon levels by 2-5 dB, with the exceptions of the Poker Room which did not vary and Playworld which increased by more than 10 dB. One bank of slot machines located at position 4DD was noted to have very audible music and bells. A graph of the spectral content of this area measurement is shown in Figure 1. The peak at the 1 kHz band is nearly 10 dB higher than the next highest band and is most likely the result of the audible bells and music.

The casino routinely does a player count on customers playing the slot machines in each of the six sections. The results from Friday and Saturday during the NIOSH investigation showed that the four smoking sections of the main casino had the most business, ranging from 168 to 270 players in section 1 and 2, respectively at 10:00 pm on Friday night. On Saturday night, the number of players ranged from 168 to 276 in the same sections at 8:00 pm. In the non-smoking area, there were 141 slot players at midnight on Friday and 138 players at 8:00 pm on Saturday. For the total number of slot players in the entire casino, the counts peaked at 1043 at midnight on Friday and 1076 at 8:00 pm on Saturday. Although the player count was not obtained for Wednesday afternoon when the first set of area noise measurements were made, the Friday afternoon counts were 594 and 652 at 2:00 pm and 4:00 pm, respectively showing that business is greater

in the late evening as opposed to the early afternoon.

DISCUSSION

The personal noise dosimeter data collected in this investigation were found to have accumulated only small percentages of the employees' daily allowable dose. None of the data collected according to the two OSHA evaluation criteria began to approach a regulated level, even during busy periods in the casino. In only one instance did the noise exposures reach a 50% value for a daily noise dose calculated according to the NIOSH criterion for an employee who worked in the children's arcade and not on the casino floor. Also, the area noise samples collected in the casino on two separate days did not reveal any location that may potentially be hazardous to the employees' hearing. The area noise results show that the non-smoking area is not any louder than other areas of the casino.

CONCLUSIONS

With the exception of the children's arcade, there were no data collected during this investigation that point to an increased risk to employees' hearing from occupational noise exposures. For the children's arcade, the daily noise dose was measured at 47 – 50% of the allowable amount according to the NIOSH criterion on two consecutive evenings. The area noise level was also measured at 78 – 84 dBA. This latter value does approach the OSHA action level if the employee were subjected to this noise for an entire 8-hr work shift. Most of the noise is the result of children playing games, especially air hockey and ski-ball, and people noise (talking and shouting). The arcade has an open ceiling design with heating, ventilating, and air conditioning ducts and support beams visible. The addition of an acoustic drop ceiling would help to "soften" the room and eliminate some of the reverberant noise that bounces off the hard ceiling fixtures. However, this change will only minimally reduce noise levels.

The use of slot machines that do not dispense coins or metal tokens has taken a noise source out of Spirit Mountain Casino that is observed in most other casinos. Coins dropping into metal bins make a lot of noise. The bank of slot machines located at 4DD did have noticeable noise that set it apart from other slot machines in the area. The music and bells emitted by these machines could be reduced so that they are not so obvious and would blend more into the background noise from the other machines and people in the vicinity.

RECOMMENDATIONS

The results of this investigation found no hazard to employees from occupational noise exposures from their work duties. All of the employees in the no-smoking casino were found to be exposed to noise levels that are below any evaluation criteria used by NIOSH to assess the risk to hearing from occupational noise. Employees working near the casino's slot tournament, employees working in the daycare center and arcade, and employees on the ground keeping staff were all found to have occupational noise exposures that would not put them at risk for hearing loss. Therefore, no recommendations are offered in this report to lower noise exposures. However, if different gaming machines are added to the casino or renovations are made that result in a perceived increase in noise through customer or employee complaints, then Spirit Mountain Casino should re-evaluate employee exposures to document the new noise environment.

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Table 1
 Noise Dosimeter Results
 Spirit Mountain Casino
 Grand Ronde, OR
 August 7-9, 2003
 HETA 2003-0157-2934

Job Title	Run Time hh:mm	OSHA PEL % Dose	OSHA AL % Dose	NIOSH REL % Dose
Aug. 7, 2003				
Groundskeeper	09:31	0.8	12.8	32.3
Island Cage	07:31	0.2	1.1	7.8
Security Desk [Area]	10:16	0.0	0.2	7.4
Aug. 8, 2003				
Slot Attendant	09:04	0.5	6.9	22.0
Beverage Server	06:08	0.1	2.7	10.6
Pit Boss	06:14	3.2	10.7	37.1
Daycare Center	07:43	1.5	6.5	26.6
Children's Arcade	06:39	2.4	18.7	46.9
Aug. 9, 2003				
Slot Attendant	08:01	1.1	8.8	26.9
Beverage Server	08:03	1.6*	7.9*	27.2*
Pit Boss	06:29	0.6	2.4	11.9
Daycare Center	07:12	1.7	8.2	31.0
Children's Arcade	06:28	2.2	22.8	50.5

* - Employee reported that someone shouted into the dosimeter microphone during the shift. Two data points were clipped at the third highest noise level seen in the dosimeter data to eliminate the effect of the shout. Unclipped **% Dose** values were 8.5, 14.9, and 1472.1, respectively.

Table 1. – Dosimeter data collected during the evaluation. The percent dose values are calculated according to the three evaluation criteria described in the report as the OSHA Permissible Exposure Limit (PEL), the OSHA Action Level (AL), and the NIOSH Recommended Exposure Limit (REL) with 100% being the maximum dose allowed per day. The % dose is the actual dose for the time (hours: minutes [hh:mm]) each dosimeter was collecting noise data and not an extrapolated 8-hr dose. The Security Desk values are from a dosimeter with its microphone mounted on the desk, six inches above the surface and not a personal sample worn by an officer.

Table 2
 Median Area Noise Results
 Spirit Mountain Casino
 Grand Ronde, OR
 August 7-9, 2003
 HETA 2003-0157-2934

Slot Areas	<u>Number Samples</u>	<u>Afternoon</u>	<u>Evening</u>
1	6	74.0 dBA	76.4 dBA
2	5	72.4 dBA	76.4 dBA
3	5	69.4 dBA	73.2 dBA
4	5	73.0 dBA	76.3 dBA
5	1	66.9 dBA	71.0 dBA
6	3	69.4 dBA	73.4 dBA
Smoking Casino Table Games	2	68.2 dBA	74.7 dBA
Poker Room	1	67.0 dBA	67.8 dBA
Security Desk	1	67.5 dBA	71.4 dBA
Island Cashier	1	68.1 dBA	70.2 dBA
Children's Arcade	1	77.6 dBA	83.7 dBA
Playworld	1	63.2 dBA	75.4 dBA

Table 2. – Results of the area noise samples taken during times when the casino was busy (**Evening**) and when it was not as busy (**Afternoon**). All values are given in decibels on an A-weighted scale (**dBA**). Median levels were calculated in areas where more than one sample was obtained. Actual levels are presented in areas where only one sample was taken. The numbered slot areas correspond to the casino floor plan furnished by facility management.

Figure 1
 Spectral Noise Levels at Slot Location 4DD
 Spirit Mountain Casino
 Grand Ronde, OR
 August 7-9, 2003
 HETA 2003-0157-2934

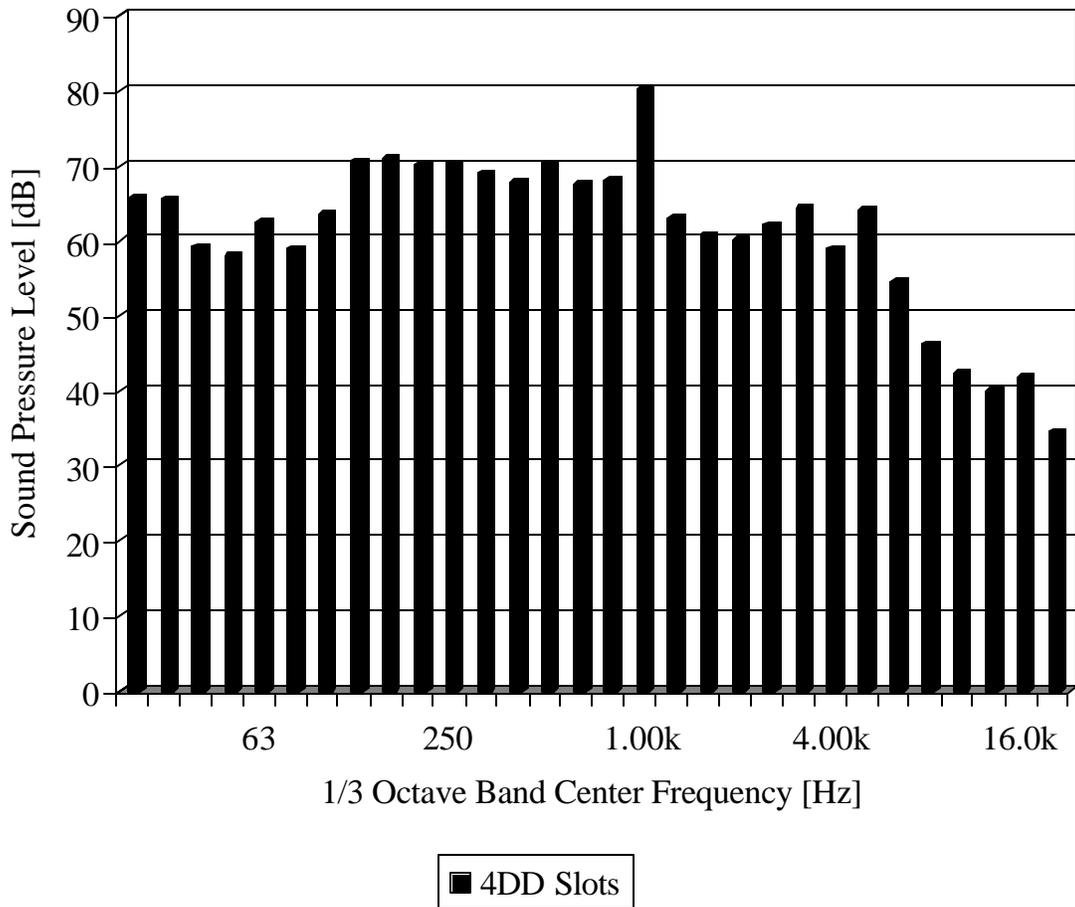
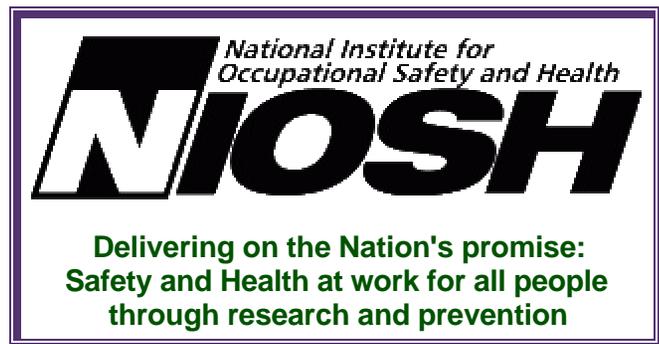


Figure 1. – The one-third octave bands measured for the 4DD bank of slot machines. The unweighted and A-weighted levels for the spectrum are 83.2 dB and 81.4 dBA, respectively. The highest band is at 1000 Hertz (Hz).

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