

HETA 89-100-2040
MAY 1990
MINISTRY OF HEALTH - ST. LUCIA
ST. LUCIA, WEST INDIES

NIOSH INVESTIGATOR:
Randy L. Tubbs, Ph.D.

I. SUMMARY

In January, 1989, the National Institute for Occupational Safety and Health (NIOSH) was requested by the Ministry of Health to conduct audiometric testing on selected employees from several industries in St. Lucia, West Indies. This testing was a follow up on the initial effort of NIOSH to help in the development of a hearing conservation program for the Ministry of Health, Housing, and Labour (HETA 87-413).⁽¹⁾ Audiometric testing was conducted at 11 of the original 12 industries surveyed for worker noise exposure in November, 1987 and also at the international airport located in View Fort. The original industries included paper converting and cardboard box manufacturing, electrical power generator stations, cigarette manufacturing, beer brewing, clothing manufacturing, electrical component assembly, printing, and soft drink bottling facilities.

During April 2-13, 1989, a total of 302 audiometric examinations were conducted on employees currently working at the above mentioned factories. The audiometric tests were screening hearing tests of the type prescribed by the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) in their hearing conservation amendment.⁽²⁾ The overall results from the screening examinations revealed that these St. Lucian workers did not exhibit any significant hearing impairment. The hearing tests did, however, show a pattern consistent with the beginnings of noise-induced permanent threshold shifts.

The beginning pattern of noise-induced permanent threshold shifts in workers from all of the industries show that the Ministry of Health should continue in its efforts to establish hearing conservation programs for the employees of the country. Recommendations for establishing these programs are given in Section VIII of this report.

KEYWORDS: SIC 2111 (Cigarettes), 2082 (Malt Beverages), 2086 (Bottled and Canned Soft Drinks and Carbonated Waters), 2342 (Brassieres, Girdles, and Allied Garments), 2381 (Dress and Work Gloves), 2676 (Sanitary Paper Products), 2653 (Corrugated and Solid Fiber Boxes), 2741 (Miscellaneous Publishing), 3674 (Semiconductors and Related Devices), 4581 (Airports, Flying Fields, and Airport Terminal Services), 4911 (Electric Services), noise, hearing loss, audiograms, Caribbean.

II. INTRODUCTION

In September, 1987, the St. Lucia Ministry of Health, Housing, and Labour contacted the National Institute for Occupational Safety and Health (NIOSH) and requested technical assistance in support of a hearing conservation program which the Ministry had developed. A NIOSH investigator visited St. Lucia for two weeks in November, 1987 to survey the country's industries for the amount of noise to which their workers were exposed. The original visit was also to include audiometric testing of the employees at these industries with equipment which was being sent from the United States. However, a series of errors by an air freight company prevented the arrival of a portable attenuation chamber needed for the audiometric testing. Thus, a report of the initial survey issued in August, 1988 contained only information concerning the noise levels found in the various factories and recommendations for future audiometric testing.

Subsequent to the NIOSH noise survey, the Ministry was able to obtain from the Canadian Government a portable attenuation chamber and audiometer to conduct hearing tests in conjunction with the hearing conservation program. In January, 1989, NIOSH was requested to return to St. Lucia to complete the evaluation of the industries. From April 2 - 13, 1989, the NIOSH investigator returned to conduct audiometric testing on employees from nine of the originally surveyed factories and to train Ministry employees in audiometric screening techniques needed to continue testing at other industries in the country. In the latter part of April, 1989, the St. Lucia personnel were able to visit two additional facilities (Data Delay Electronics and Hewanorra Airport) and test workers' hearing abilities. These results were sent to NIOSH for inclusion in the analyses for this final report. Finally, a one-day informational session was held for any of the factory managers from the country's industries who wished to attend and learn about the Ministry's Hearing Conservation Programme.

III. BACKGROUND

St. Lucia is one of the windward islands located in the Lesser Antilles island chain of the Eastern Caribbean. It is situated between the islands of Martinique to the north and St. Vincent to the south. The island covers 238 square miles and has a population of 140,000 people. While the main industries of the country are agriculture (bananas and coconuts) and tourism, there are several manufacturing industries on the island. These range from small, single-product firms to a very modern brewery. Most of the industrial facilities are located in the capital city of Castries in the northern portion of the island or in an industrial park near Vieux Fort on the southern tip of the island.

A total of 12 of these manufacturing industries were surveyed for employee noise exposures. With the one exception of a tobacco factory, all noise surveys were for 6-8 hours. The tobacco plant was only surveyed for 3 hours because of a reduced workshift on the day surveyed. Only one day of noise sampling was conducted at each location because of a decision to maximize the number of different locations which could be tested during the two-week survey period. A brief description of the industrial process for each of the surveyed facilities follows.

Winera Box Plant: This facility manufactures corrugated cardboard boxes from cardboard purchased from other companies. The factory has one corrugating machine, a glue mixing machine, a box folding machine, and a printing machine (ZLG Machine). Additionally, there is a cardboard compactor and scrap collector located in a corner of the facility where the scrap cardboard is compacted into bales. The facility also has storage areas for the rolls of cardboard material used in box making, storage for the finished product, offices, and a separate boiler room used to produce steam. There were 35 - 40 production workers and other support personnel (e.g., maintenance and forklift operators) in the manufacturing area during the time of the survey. The noise exposures measured at this factory ranged from 83-98 decibels on the A-weighted (dB[A]), slow scale.

LUCELEC - Vieux Fort: The electrical power for the southern portion of the island is generated by diesel generators at this station. The building houses four diesel-powered electrical generators, arranged with two generators on each side of the building with a central aisle. The operators have the opportunity to sit in a wood and glass enclosure built in the center of the generator floor. Approximately 5 operators and mechanics staffed this electrical generator station. Noise levels ranged from 91-99 dB[A] at this facility.

Belles Fashions: This garment assembly facility is located in the central coastal town of Dennery. It is comprised of two large buildings which house numerous sewing machines and work stations. Over 100 women are employed in the assembly of brassieres and panties which are sold in U.S. stores. The materials are manufactured in the U.S. and shipped to Belles Fashions for assembly and packaging and then returned to the U.S. for sale. The employees are stationed at long rows of sewing machines situated fairly close together and perform the piecework assembly job to which they are assigned. Worker noise exposures ranged from 82-89 dB[A].

Tolyn Paper Company: This company produces toilet paper rolls, dinner napkins, and facial tissue. The paper is shipped from Venezuela to Tolyn for packaging. The building houses machines for making toilet paper cardboard core rolls, for rolling paper onto these rolls, and for cutting the long rolls into the proper size of the finished product. Another machine folds paper into dinner napkins. Two other machines cut, fold, and package paper into facial tissue boxes for distribution. The remainder of the building is used for storage and for office space. Approximately 10-12 people were present during the survey. Measured noise levels ranged between 83 and 88 dB[A] at this factory.

Heineken Brewery: This modern brewery had extremely clean working conditions and an immediately apparent enforced safety glasses program. The brewery is composed of a brew house, bottling hall, power plant, and storage facilities. Approximately 50-75 workers were directly involved with the brewing, bottling, and storage of the beers at the plant. Additional people were employed to distribute the product and work in the large office facilities. Noise exposures ranged from 81-93 dB[A] in the brewery.

NEHOC Gloves: This factory is housed in a large, single room building where white cotton work gloves are manufactured. Stacks of white cotton cloth are placed in a hydraulic press with a cutter die in the shape of a hand. Two pieces of the cut cloth are sewn together by workers with small sewing machines. The gloves, which are sewn inside out, are given to workers who reverse the inside and outside of the glove with a metal rod and a hollow fingered hand form. The gloves are then moved to another table where they are bundled together and packaged for shipment. The work force at this facility is predominantly female, with approximately 50-75 total employees. Worker noise exposures were measured between 77-85 dB[A] during the survey.

Data Delay Devices: This electronic components assembly firm is housed in a large, one-roomed building. The major products were printed circuit boards, integrated circuit chip assembly, and wire wound rheostat and potentiometers. The predominately female workforce is involved with wire winding, soldering, and packing of finished materials. There was also a small quality control laboratory on the work floor. Approximately 50 workers were at the facility on the day of testing. Noise exposures ranged from 73-74 dB[A].

LUCELEC - Union Station: This electrical power plant is similar to the station located in the southern part of the island. Union Station supplies electrical power to the capital city of Castries and the surrounding area in the northern portion of the country. This generator station has two more diesel generators than Vieux Fort and a more elaborate control system. There are also small mechanics' and electricians' workshops located at this facility. Approximately 25-30 operators, mechanics, electricians, housekeeping, and office personnel are employed at this station. Noise levels at this facility were found to range from 88-106 dB[A].

N.Y. Daher Tobacco Co.: This small company located in downtown Castries produced one brand of local cigarettes. The crowded, one-room factory has a tobacco storage area, a tobacco cutting machine and drying machine, a machine for making filtered cigarettes, a cigarette packaging machine, and a bench where individual packs of cigarettes are bundled into brown paper cartons for retail sale. Approximately 10-12 workers are involved in the production of the cigarettes. On the day when the noise survey was planned, the company only had enough orders for the factory to operate for 3 hours in the morning. This three-hour survey yielded noise levels ranging from 86-89 dB[A].

DuBoulay's Bottling Co.: This bottling plant, located in downtown Castries, bottles soft drinks for distribution on the island. The production process starts with the washing of empty bottles which are conveyed into the bottle filling area. Here the product is put into the bottles, capped, and sent to the case packing area. Once the bottles are packed into cases, they are stored in warehouse facilities. Approximately 15 employees were involved in this process during the survey period. Noise levels ranged between 85 and 92 dB[A] during the dosimetry survey.

Government's Printery: The Government's printing presses used to print official publications are housed in a two-story building in Castries. Hand typesetters and monotype setters are located in the upstairs portion of the building. The first floor has linotype, monotype, and cylinder printing presses. Approximately 12 employees run the printing operations. The workers' noise exposures were found to range from 77-89 dB[A].

Hewanorra International Airport: The international airport is a commercial airport located in View Fort. The open-air building houses airline offices and reservation counters, baggage handling facilities, customs officials, a restaurant, and gift shops. The airport was not included in the initial noise exposure survey report. However, sound level meter readings made near the airport's tarmac during the second visit to St. Lucia ranged from 82-104 dB[A] for baggage handling operations, aircraft taxiing, takeoffs, and landings.

IV. METHODS

Audiometric testing was conducted at either the work site or at the Ministry of Labour's offices in Castries. A single-person audiometric test booth (Eckel Industries of Canada, Model SB-1500) was transported to the test locations in a pickup truck and placed in the quietest location which would accommodate the booth. Noise levels inside of the booth were measured prior to testing and compared to the maximum allowable octave-band sound pressure levels for audiometric test rooms prescribed in Appendix D of the OSHA noise regulation⁽²⁾ to assure that the ambient noise levels would not interfere with the hearing tests. A manual audiometer (Maico, Model MA-19), calibrated just prior to the survey, was brought from the United States to use in testing the workers.

The audiometric testing protocol called for the testing of as many workers at a facility as was possible. At the smaller factories, this strategy allowed for the examination of all workers who were at work on the day the factory was visited. At the larger facilities, the manager was allowed to choose which workers would be examined. Audiometric testing was conducted by NIOSH and Ministry personnel who had completed an audiometric technician training course, or by Ministry personnel who were under the direct supervision of a certified audiometric technician. The guidelines set forth in the OSHA regulations⁽²⁾ were followed in the testing protocol. Pure-tone thresholds were obtained from each worker at the test frequencies of 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hertz (Hz). A short questionnaire developed by the Ministry of Health was administered to the workers prior to the audiometric testing. The questionnaire inquired into an employee's work history, use of hearing protection, medical problems related to hearing, and the age and sex of the person. These questionnaire data were used to further describe the factories' employees' work histories and hearing protection usage.

V. EVALUATION CRITERIA

Exposure to high levels of noise may cause temporary or permanent hearing loss. The extent of damage depends primarily upon the intensity of the noise and the duration of the exposure. There is abundant epidemiological and laboratory evidence that protracted noise exposure above 90 dB[A] causes hearing loss in a portion of the exposed population.^(3,4)

The audiometric test results were evaluated according to two different criteria to determine the degree of hearing handicap that had been sustained. A criterion proposed by Eagles, et al.⁽⁵⁾ uses a hearing impairment scale which evaluates hearing at each frequency on a nominal scale from normal hearing to profound impairment. Specifically, the scale categories and the respective decibels of hearing threshold level (dB HL)⁽⁶⁾ are as follows:

<u>Hearing Impairment Category</u>	<u>Hearing Threshold Level</u>
Normal	0 - 25 dB HL
Mild	26 - 40 dB HL
Moderate	41 - 55 dB HL
Moderately Severe	56 - 70 dB HL
Severe	71 - 90 dB HL
Profound	> 90 db HL

A second criterion was proposed by NIOSH in its criteria document for occupational noise exposure.⁽⁷⁾ This criterion, which is intended to determine the amount of handicap in speech perception and communication abilities, averages the pure-tone test frequencies of 1000, 2000, and 3000 Hz for each ear. This criterion also uses a 25 dB HL lower impairment fence for determining handicap. Any averaged value less than 25 dB HL is considered normal hearing with no impairment. Values in excess of 25 db HL have an impairment percentage of 1.5% for each db HL. Thus, a person who had an average hearing threshold level of 40 dB HL would have a 22.5% hearing impairment for that ear.

VI. RESULTS

A total of 302 workers received audiometric examinations during the survey period. The population was 55% male and 45% female, with an average age of 34 years. The average St. Lucian worker was employed by his/her employer for 8.5 years and had an average of 1.5 years of other employment. The use of hearing protection devices for this group was limited, with only 13% reporting that they used hearing protection devices to some degree on their job. The majority (31 of 39) of workers who responded in the affirmative to hearing protection usage were from the LUCELEC power stations.

The results from the two power generation stations, LUCELEC, were combined in this report, making a total of 11 industries which were surveyed. The summary results from each of these industries are given in Table 1. The table shows that the St. Lucian industries usually had a workforce composed primarily of one sex, with the sewing and electronic industries having a female work force, and the power, bottling, and printing industries being male-dominated. The two paper industries surveyed had a more mixed worker population. The work force was fairly young, with 8 of the 11 industries having an average age of 35 years or less. The exception to this was the tobacco factory, which had a worker population with an average age of nearly 55 years. The workers tended to stay at the companies as evidenced by the low amount of time spent at other employment.

The mean hearing levels for the entire 302 workers are given in Figure 1. The figure shows the mean hearing levels (dB HL) for each ear at the seven test frequencies. This audiogram is characterized as having a relatively flat pattern with losses in the "mild" category⁶⁾ at 500 Hz and losses which approach the mild category at 4000 and 6000 Hz. Both the left and right ear follow this pattern. The hearing levels for the workers at each of the 11 industries surveyed were plotted in a similar fashion to Figure 1 and are presented in Figures 2-12.

None of the 11 industries had hearing losses greater than the "mild" impairment category. Belles Fashions, NEHOC Gloves, and the Government printery had average hearing levels that fell in the normal category. DuBoulay's Bottling Co., LUCELEC Electric Co., and the N. Y. Daher Tobacco Co. showed average hearing losses of a mild categorization in at least one of the noise sensitive frequencies of 2000, 3000, or 6000 Hz. Workers at LUCELEC had the greatest amount of loss in the noise-sensitive frequencies. The remaining five industries were characterized as having mild hearing losses in the noise-sensitive frequencies, as well as a mild loss at 500 Hz. It must be noted that of the six industries with no hearing loss or losses in the noise sensitive frequencies, all but one of the factories had audiometric testing conducted at an off-site location. In all of the five factories which had mild hearing losses at 500 Hz, audiometric testing was conducted on the factory's premises. This relationship between test location and low-frequency hearing is discussed in the next section.

The hearing data were combined and analyzed according to the NIOSH hearing impairment criterion⁷⁾ to assess the amount of hearing handicap, if any, which was present in the average hearing level figures for the 11 industries. These calculations (Table 1) show that only one industry, Data Delay Electronics, had a criterion score which exceeded the 25 dB lower impairment fence. The 27 dB score for this facility represents a 3.5% hearing handicap. All of the other industries had NIOSH criterion scores which fell in the no-handicap range of hearing. However, most of the figures presented in this report do show a slight hearing loss at 4 and 6 kHz, characteristic of early, noise-induced hearing loss.

VII. DISCUSSION AND CONCLUSIONS

The audiometric results collected during the NIOSH survey show that the workers who were tested generally exhibit a normal pattern of hearing according to the Eagles, et al. criterion.⁽⁵⁾ Any impact on hearing from occupational noise on the workers of St. Lucia had not reached the impairment stage at the time of this survey. The handicap scores calculated according to the NIOSH criterion show that there has been little or no affect on workers' speech perception and communication abilities.

The results presented in this report represent the first hearing tests these workers had ever been given. Research has shown that there is a learning effect associated with repeated audiometric tests.⁽⁴⁾ The effect is a gradually lowering of hearing level scores until a stable level is reached. Thus, if no other factors are influencing the workers' hearing, they should be expected to have an improvement in their hearing test results over their next several audiograms as a function of learning to take an audiometric examination.

There appears to be a relationship in these data between the location of the audiometric testing and the amount of low-frequency hearing loss. As was stated earlier, all tests were conducted in a audiometric isolation booth which met the requirements for test enclosures in the OSHA noise regulation.⁽²⁾ This stipulation caused testing to be suspended at Belles Fashion and moved across the street from the facility to a quiet garage owned by a private citizen. Once moved away from the factory, the noise levels in the booth fell to an acceptable level, and there was no low frequency hearing loss found in this population. Heineken Brewery and Toyln Paper Co. had audiometric testing done at the factory location in an area which barely met the OSHA enclosure requirements. Also, there were numerous workers in the area of testing which may have intimidated and interfered with the person while the hearing test was being taken. The hearing tests conducted at the Labour Office in Castries consistently had the least amount of losses at 500 Hz.

The one facility which had values which exceeded the NIOSH criterion for hearing impairment was Data Delay Electronics (Figure 4), with a score of 27 dB. When one compares the average hearing levels from this company with other companies, it becomes evident that the entire hearing pattern is poorer for Data Delay Electronics. All of the average hearing levels fall in the mild impairment category of Eagles, et al.⁽⁵⁾ This pattern can be the result of conductive hearing losses which are the result of a mechanical malfunction of the ear, such as a broken or scarred eardrum, excessive wax build-up, or a disease of the middle ear. Given the young age of this worker population (25.5 years) and that these workers did not report anything excessively different on the worker questionnaire than the other groups of workers would tend to rule out widespread conductive hearing losses

in this group. A more likely explanation, considering the relatively low noise exposures at Data Delay Electronics, would be the testing conditions, either the equipment used or the procedures employed. This factory was one of those tested after the NIOSH investigator had returned to the United States with the audiometer which was used for the majority of the examinations. Thus, any conclusive rationale to explain these discrepant results can not be offered in this report. However, it does point to the need to calibrate all equipment to external standards on a routine basis and to maintain a common procedure for all of the audiometric testing done in a hearing conservation program.

The pattern of hearing levels found in this worker population does show that they are being influenced by noise, but not to the extent of causing hearing handicap in the population. The industry which shows the greatest influence in the noise-sensitive audiometric test frequencies is LUCELEC Electric Co. The noise survey revealed average TWA noise exposures of 99 dB(A) for full-shift samples. The levels ranged up to a value of 106 dB(A). This industry was the loudest of those surveyed. However, 94% of the tested workers reported the use of hearing protection on the job. It is likely that this worker population could exhibit greater hearing losses and hearing impairment in the future if not adequately protected from the noise through engineering controls or personal protective equipment. The fact that workers employed in the other industries also show the beginnings of a noise "notch", or noise-induced hearing loss, emphasizes that an education program concerning the harmful effects of noise exposure from both occupational and recreational sources is needed before the losses become great enough to cause hearing impairment in this population.

VIII. RECOMMENDATIONS

The finding of beginning noise-induced permanent threshold shifts in several of the workers who had their hearing tested leads to the following recommendations to the Ministry of Health. Some of these recommendations were included in the first NIOSH report⁽¹⁾, but since they are still relevant to this survey, they will be repeated.

1. The Ministry of Health, Housing, and Labour should begin to formalize their hearing conservation program. Discussions should begin concerning what type of noise regulations would be necessary and enforceable for the country's newly emerging industries. Consultation with the U. S. Department of Labor (OSHA), the International Labour Organization (ILO), the World Health Organization (WHO), the Pan American Health Organization (PAHO), and the International Standardization Organization (ISO) will help in drafting a workable, economically feasible noise regulation that will protect workers' hearing. NIOSH recommends an 85 dB(A) daily noise exposure limit based on a 5 dB time/intensity trading relationship in order to protect the workers' hearing ability.

Also, any employee who was exposed to noise levels exceeding 85 dB(A) or who is required to wear hearing protection would be included in a periodic audiometric testing program. The emergence of noise regulations in newly industrialized countries is illustrated in a recent newsletter from East Africa which devotes the entire issue to noise concerns.⁽⁸⁾

2. The audiometric testing program which was begun with this survey should be continued by Ministry personnel. The personnel involved with the survey are very capable of continuing the audiometric testing of the workers. The testing should be conducted at locations which are removed from the work site to avoid

the masking of test tones by the background noises, particularly in the lower frequencies. If central locations could be found in Castries, View Fort, and Dennery, then the workers could be brought to these locations for audiometric testing. This would reduce the ambient noise, the interference from too many workers waiting for testing, and the number of times which the audiometric booth must be transported from location to location. The repeated movement of the booth in the bed of the Ministry's pickup truck will eventually cause the booth to lose its attenuation capabilities. Because of the difficulty in obtaining this equipment, it must be treated as gently as is possible.

3. The lower overall hearing patterns found in the Data Delay Electronics' workers points to the need for calibration of the audiometric instrumentation. To effectively monitor the workers' hearing, the reliability and validity of the test results can not be in question. Periodic calibration of equipment helps to maintain a quality assurance over the hearing conservation program.
4. Personnel from the Ministry should return to the industries where this survey was conducted with copies of the report to be distributed to both management and labor representatives. The Ministry personnel involved in the survey should explain in detail what the results mean for that company and its employees. It is only with this type of feedback that any program of hearing conservation will have a chance at being effectively implemented.
5. Academic programs concerning hearing, auditory anatomy and physiology, and reasons for hearing losses should be developed for inclusion in the schools' science curriculums. Several instances of very loud noise exposures were observed during both survey periods. These exposures may have been avoided if the people were aware of the effects that this level of sound will have on hearing. Knowledge about the problems associated with hearing loss may increase the awareness of industrial and recreational noise and help to alleviate it.
6. Copies of this report should be posted in an accessible location at each of the surveyed industries for the purpose of informing the affected employees. Also, a copy of the individual's audiometric examination, with a written or verbal explanation from the Ministry's Family Nurse Practitioner, needs to be given to each of the 302 workers who participated in this survey. The information they gain from these reports may make the implementation of the hearing conservation program easier.
7. Hearing protection devices should be used by workers who are involved in jobs which have a noise exposure level in excess of 85 dB(A) for a time-weighted average. Different types of protectors, i.e., plugs and muffs, should be purchased by the companies for distribution to their employees. Detailed information on hearing protection devices was included as an appendix to the first survey report.⁽¹⁾
8. A recordkeeping system for the noise exposure data, audiometric results, and hearing protection device usage needs to be maintained by the companies. These records should be accessible to the Ministry personnel and be put in a format that is understandable to all parties concerned with the hearing conservation program so that evaluation of the effectiveness of a company's program can be accomplished.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Evaluation Conducted and
Report Prepared By:

Randy L. Tubbs, Ph.D.
Psychoacoustician
Industrial Hygiene Section

Field Assistance:

Edward G. Emmanuel, M.P.H.
Environmental Health Officer
Ministry of Health - St. Lucia

Nerissa Jn. Baptiste
Family Nurse Practitioner
and Certified Audiometric Technician
Ministry of Health - St. Lucia

David Joseph
Environmental Health Officer
Ministry of Health - St. Lucia

Julian Charlery
Labor Inspector
Ministry of Labour - St. Lucia

Nicholas Moffat
Environmental Health Aide
Ministry of Health - St. Lucia

Originating Office:

Hazard Evaluations and Technical
Assistance Branch
Division of Surveillance, Hazard
Evaluations, and Field Studies
National Institute for Occupational
Safety and Health
Cincinnati, Ohio

Report Typed By:

Linda Monis
Clerk-Typist

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluation and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Ministry of Health, Housing, and Labour, Castries, St. Lucia W.I.
2. Caribbean Epidemiology Centre, Port of Spain, Trinidad W.I.

TABLE 1
SUMMARY STATISTICS FROM THE 11 INDUSTRIES
HETA 89-100 St. Lucia Ministry of Health, St. Lucia, West Indies
April 2-13, 1989

Company	No. Tested	Sex of Employees	Average Age (yrs)	Years of Employment	Yrs of Other Employment	Average Noise TWA ^A	NIOSH HL Criterion ^B
Belle Fashions	32	97% female	28.7	5.3	1.1	84 dB(A)	15 dB HL
Data Delay Electronics	33	97% female	25.5	1.6	0.6	73 dB(A)	27 dB HL
DuBoulay's Bottling	28	89% male	32.1	6.2	1.6	89 dB(A)	17 dB HL
Government Printery	22	86% male	35.0	15.0	2.2	82 dB(A)	13 dB HL
Heineken Brewery	31	97% male	34.3	6.2	1.4	88 dB(A)	22 dB HL
Hewanorra Airport	31	77% male	33.9	6.0	3.2	*	18 dB HL
LUCELEC	33	97% male	39.0	11.3	3.9	99 dB(A)	25 dB HL
NEHOC Glove Co.	23	96% female	22.5	1.6	0.4	82 dB(A)	12 dB HL
N.Y. Daher Tobacco Co.	20	80% female	54.7	27.8	0.3	88 dB(A)	20 dB HL
Toyln Paper Co.	13	77% female	29.2	2.7	1.2	86 dB(A)	25 dB HL
Winera Cardboard Box	36	69% male	36.0	12.4	1.1	92 dB(A)	19 dB HL

^A All TWA values calculated according to U.S. Department of Labor's OSHA regulation stipulating a 5 dB time/intensity trading relationship.⁽²⁾

^B Average hearing level for both ears at 1000, 2000, and 3000 Hz ⁽⁷⁾

* Full-shift noise samples were not obtained during the initial noise survey at this facility. Sound level meter readings are given in the body of the report.

Figure 1
AVERAGE HEARING LEVELS
St. Lucia Ministry of Health
HETA 89-100
April, 1989

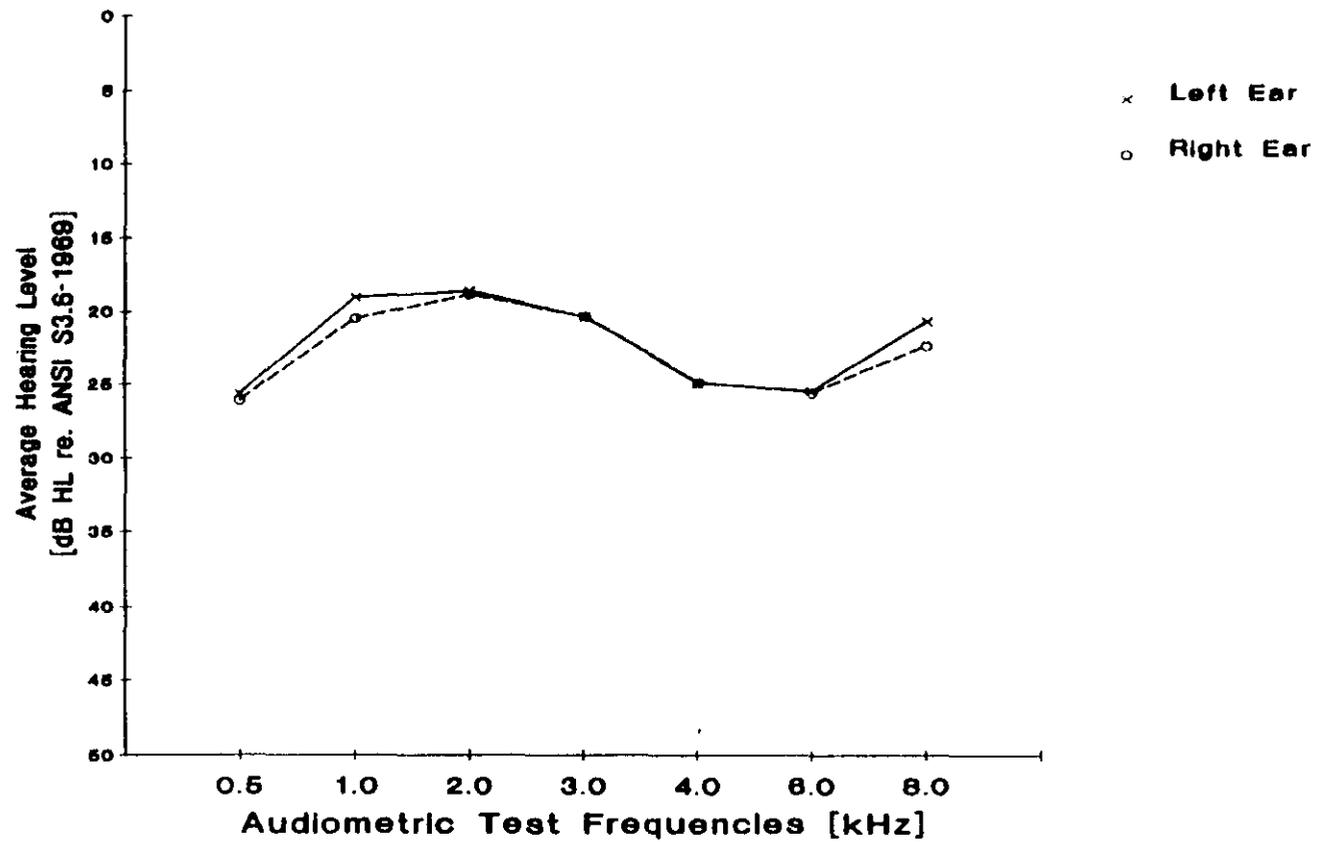


Figure 2
AVERAGE HEARING LEVELS
Belles Fashions
HETA 89-100
April, 1989

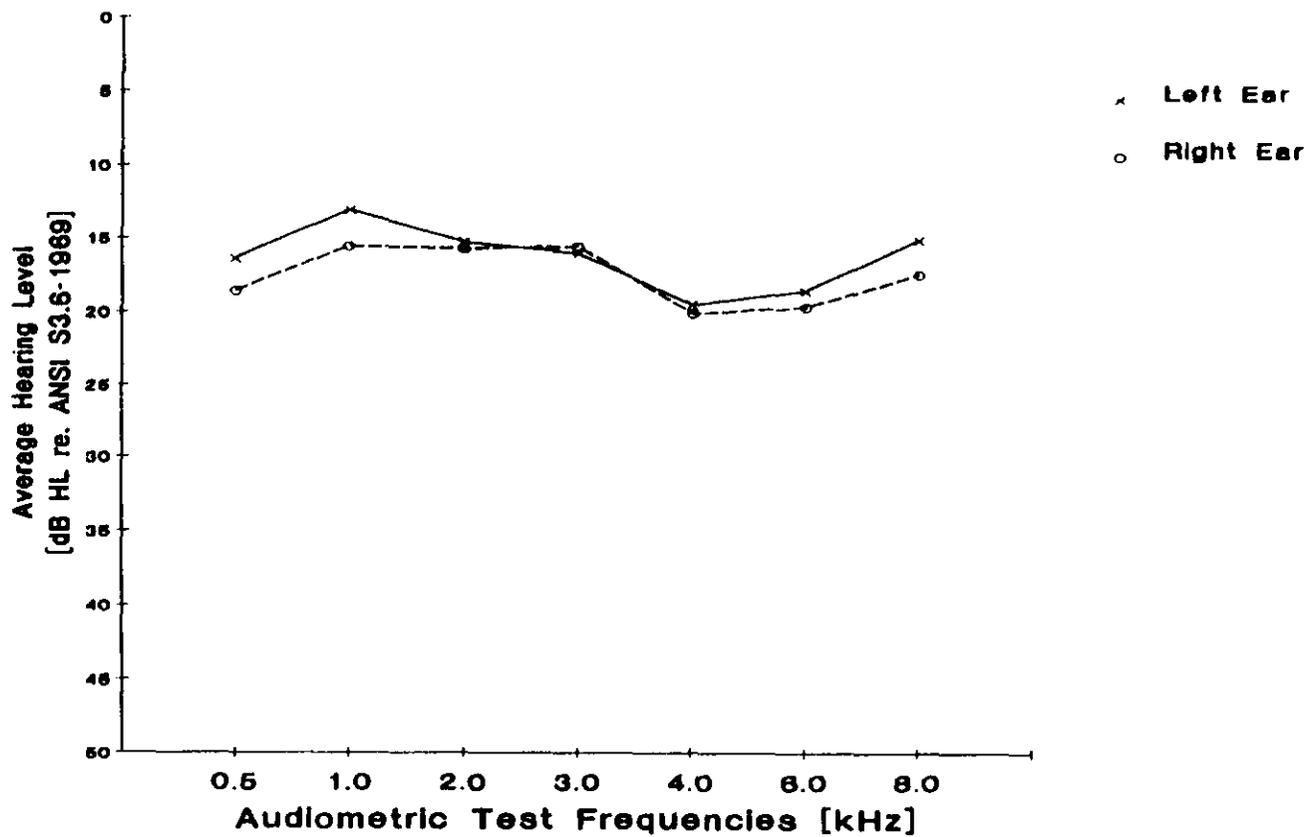


Figure 3
AVERAGE HEARING LEVELS
Heineken Brewery
HETA 89-100
April, 1989

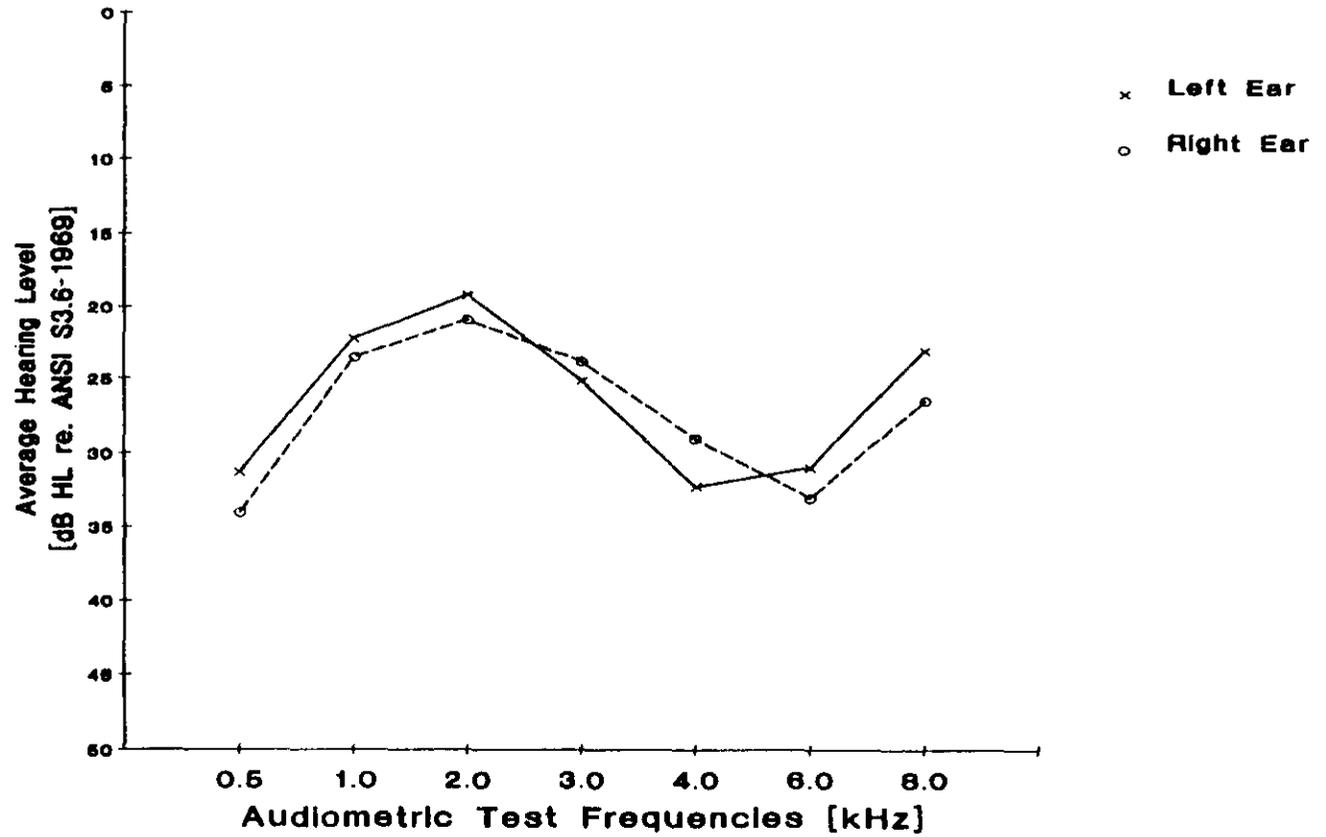


Figure 4
AVERAGE HEARING LEVELS
Data Delay Electronics
HETA 89-100
April, 1989

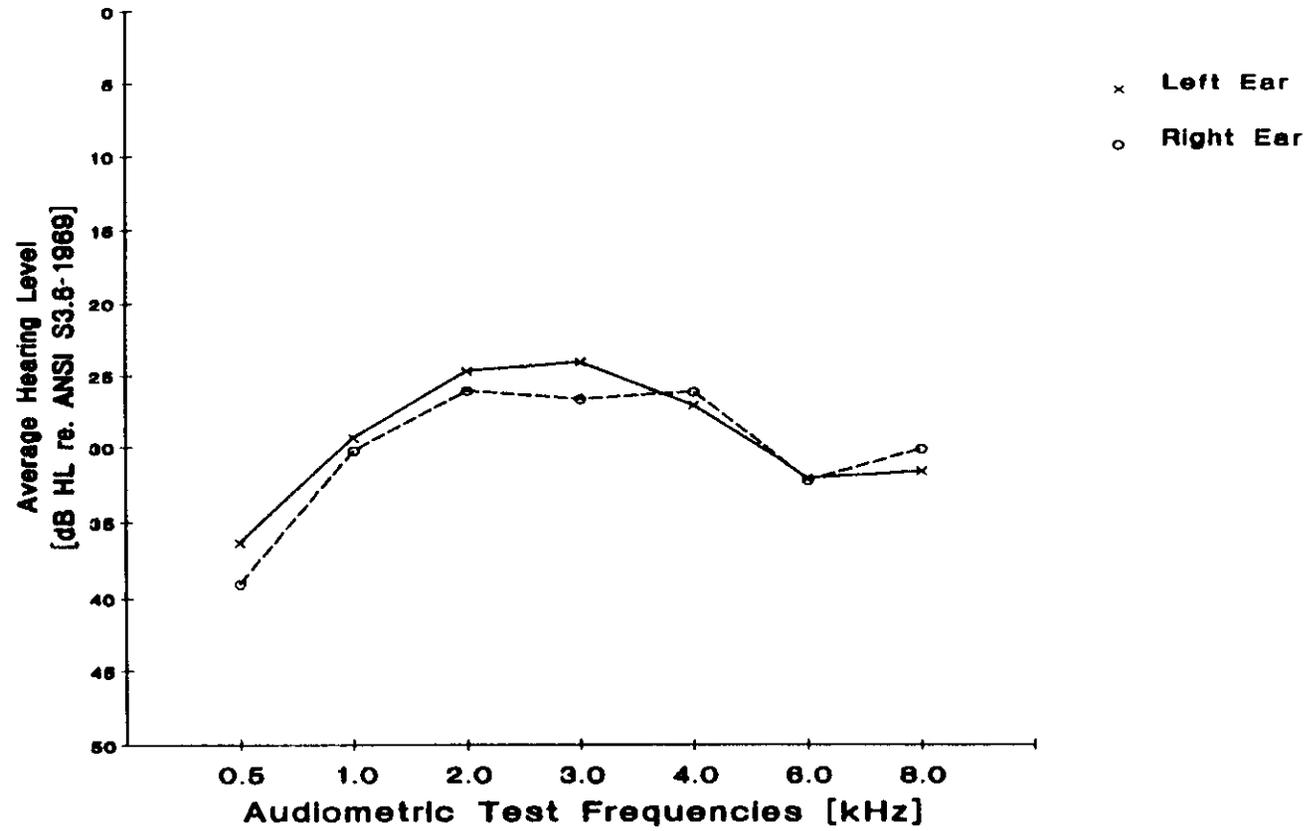


Figure 5
AVERAGE HEARING LEVELS
DuBoulay's Bottling Co.
HETA 89-100
April, 1989

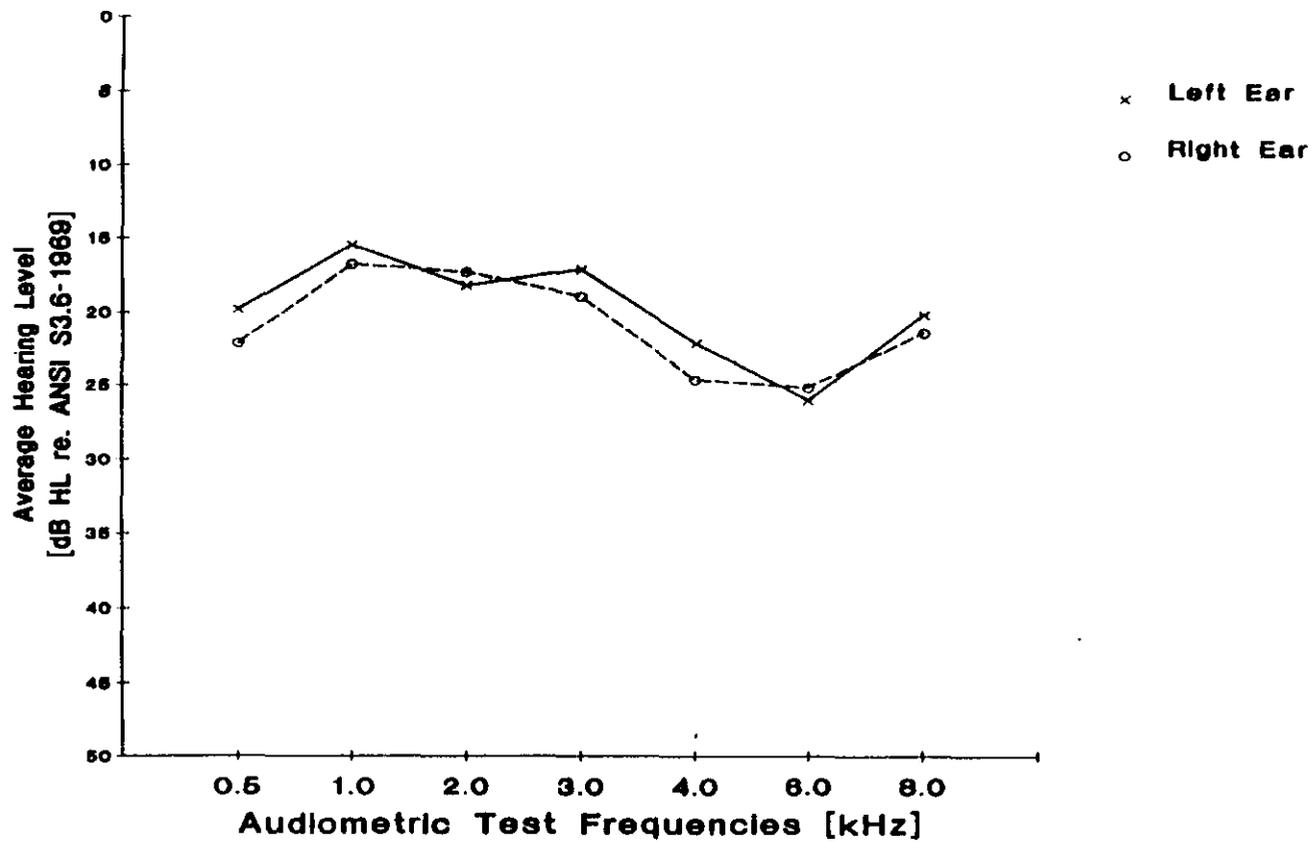


Figure 6
AVERAGE HEARING LEVELS
Hewanorra International Airport
HETA 89-100
April, 1989

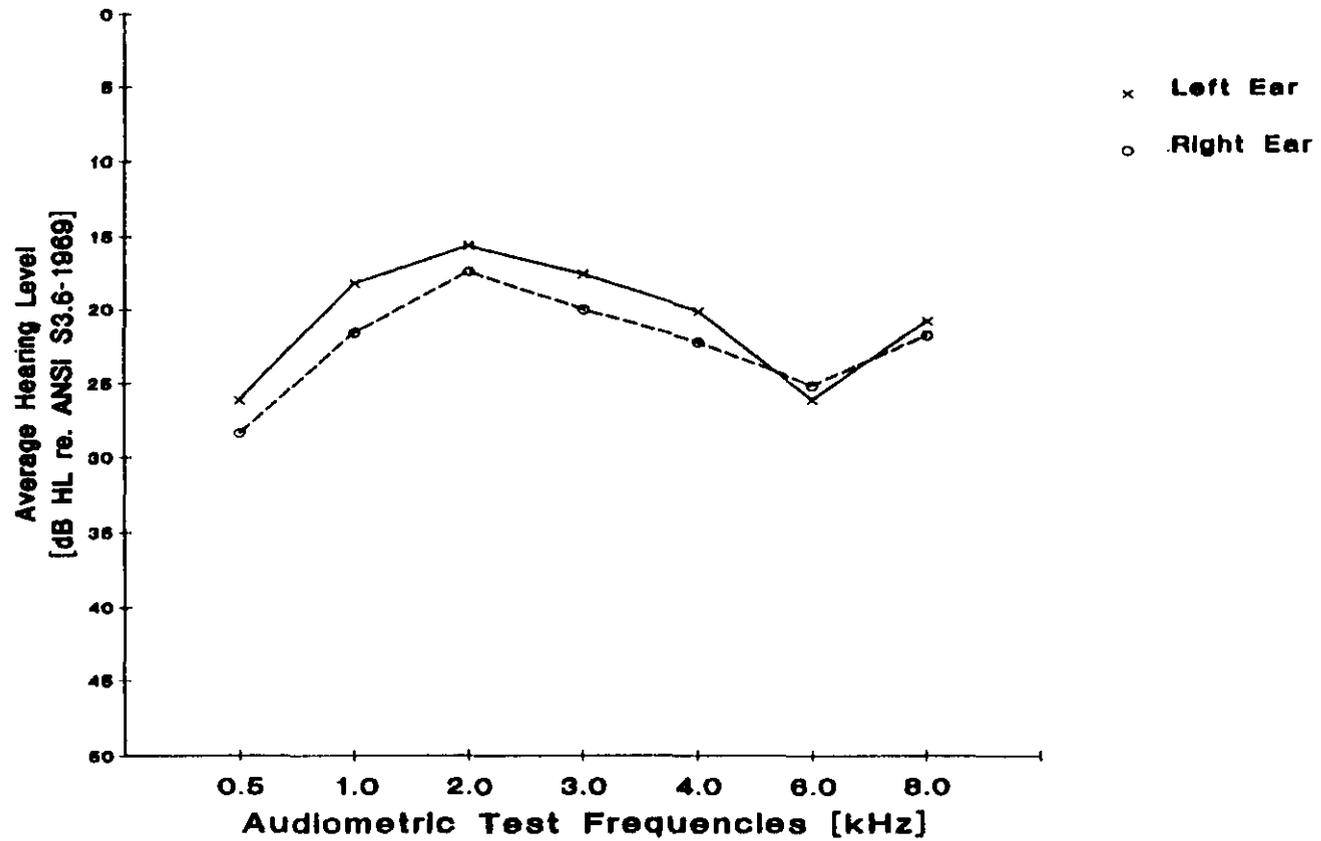


Figure 7
AVERAGE HEARING LEVELS
LUCILEC Electric Co.
HETA 89-100
April, 1989

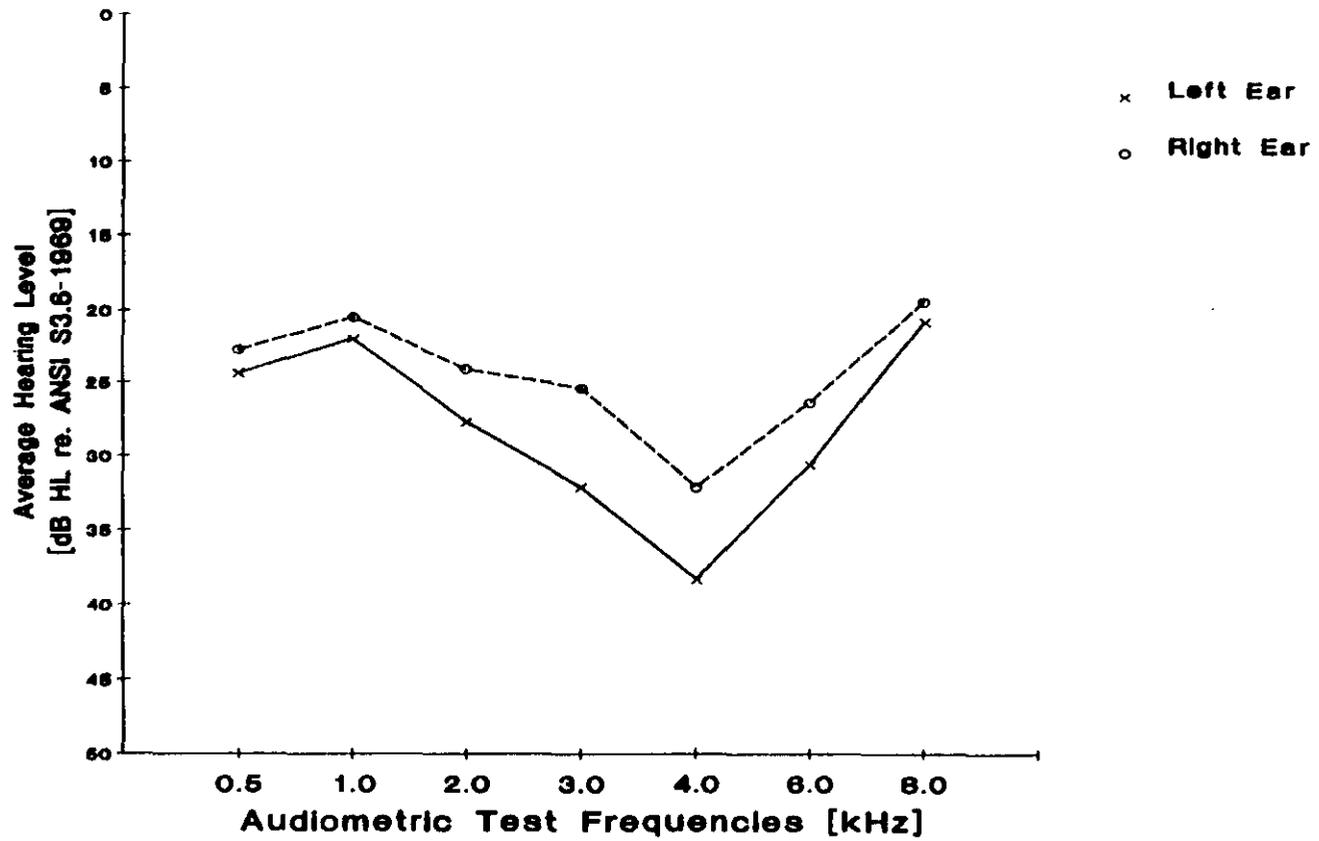


Figure 8
AVERAGE HEARING LEVELS
NEHOC Gloves
HETA 89-100
April, 1989

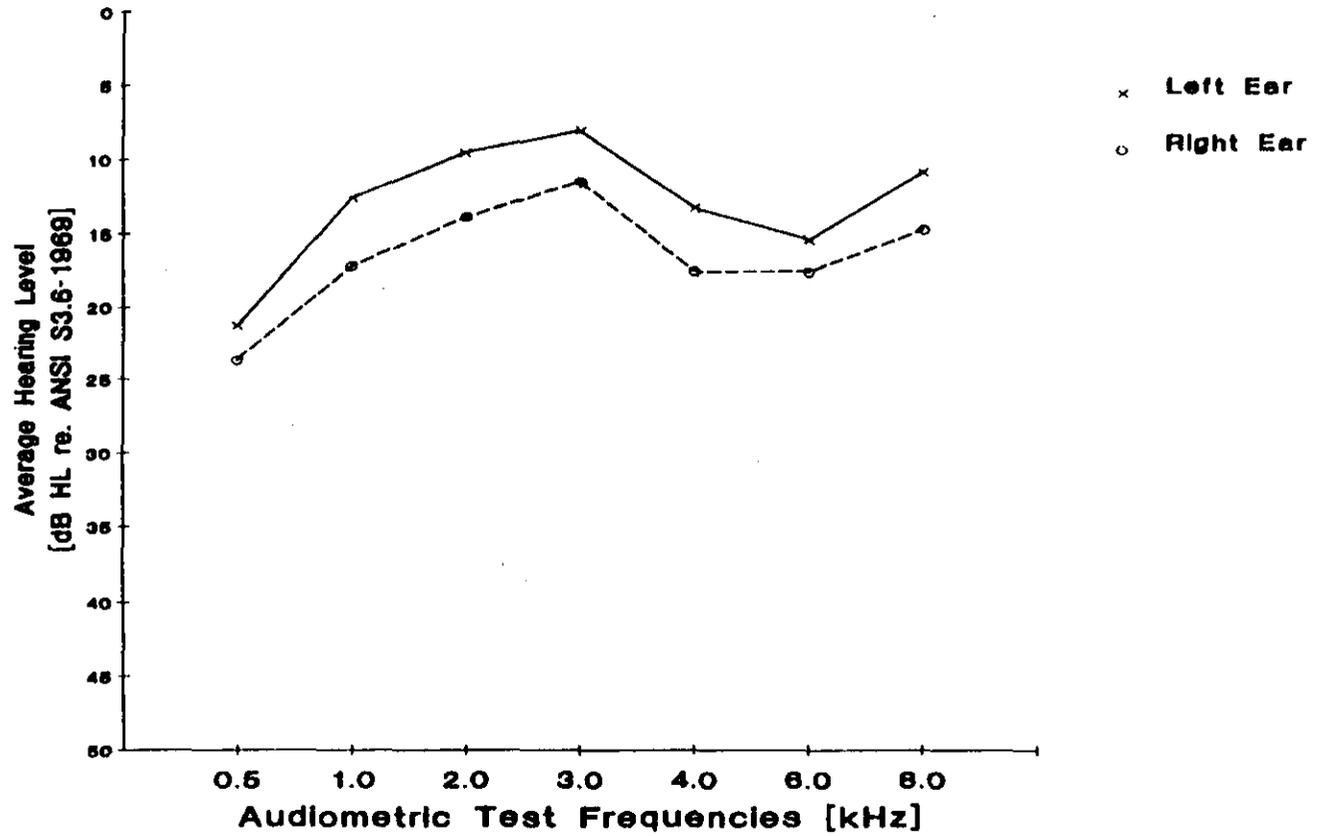


Figure 9
AVERAGE HEARING LEVELS
N. Y. Daher Tobacco Co.
HETA 89-100
April, 1989

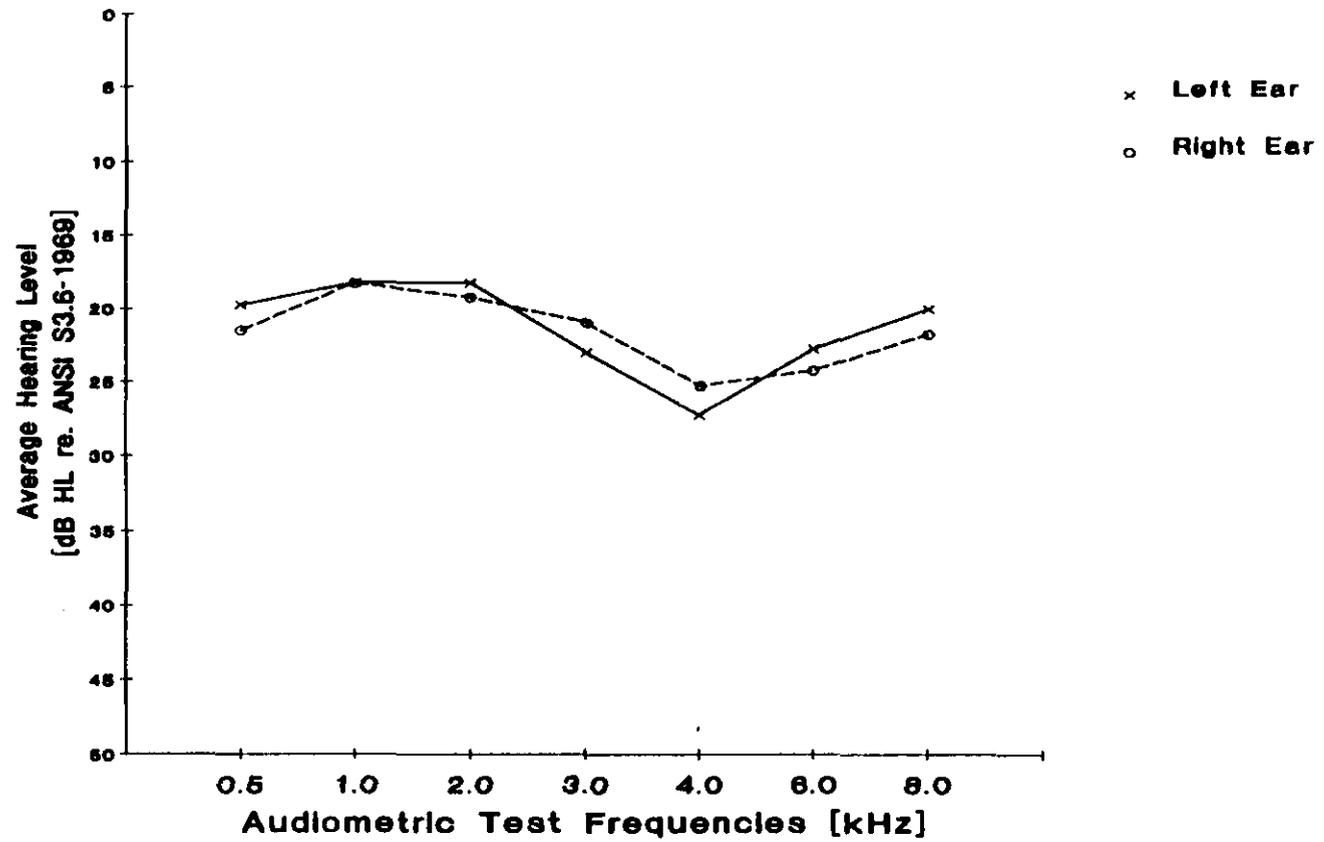


Figure 10
AVERAGE HEARING LEVELS
Government Printery
HETA 89-100
April, 1989

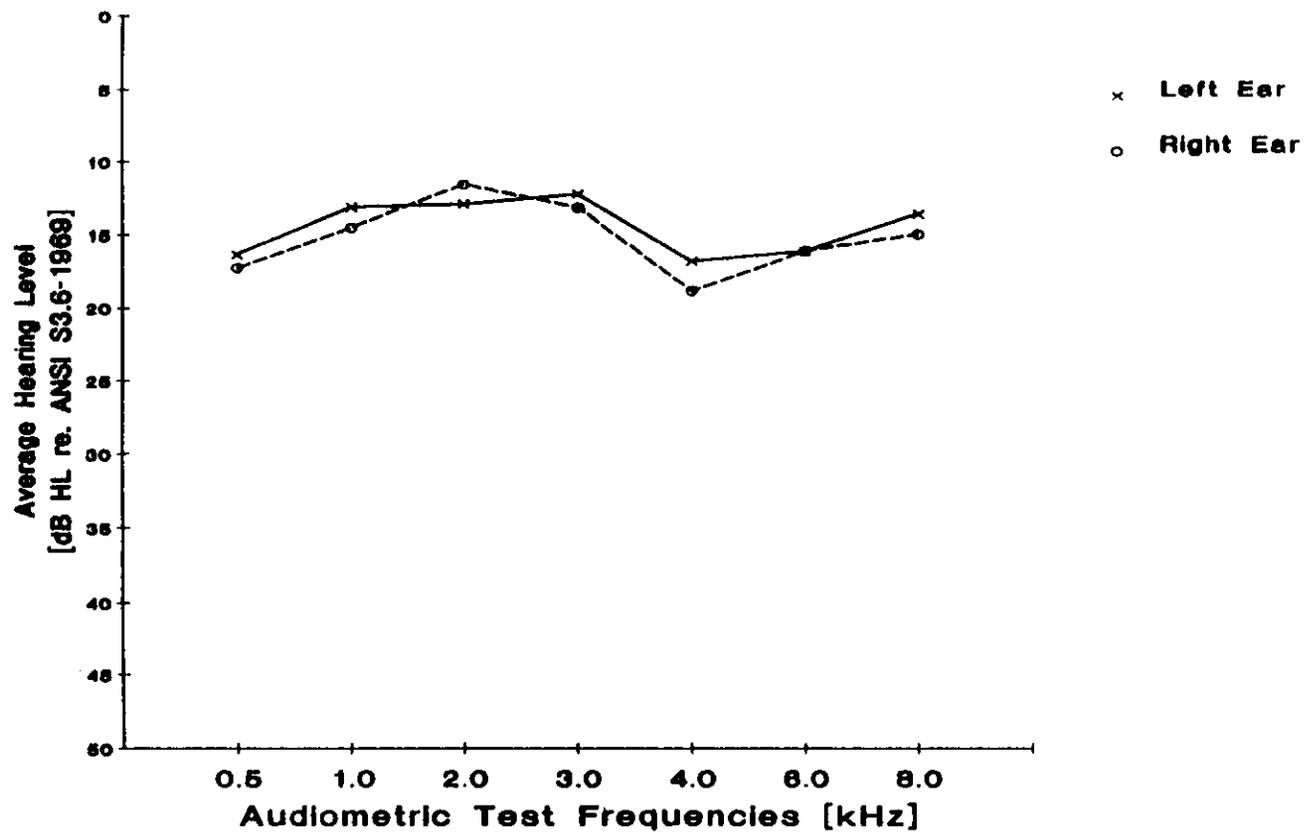


Figure 11
AVERAGE HEARING LEVELS
Toyn Paper Co.
HETA 89-100
April, 1989

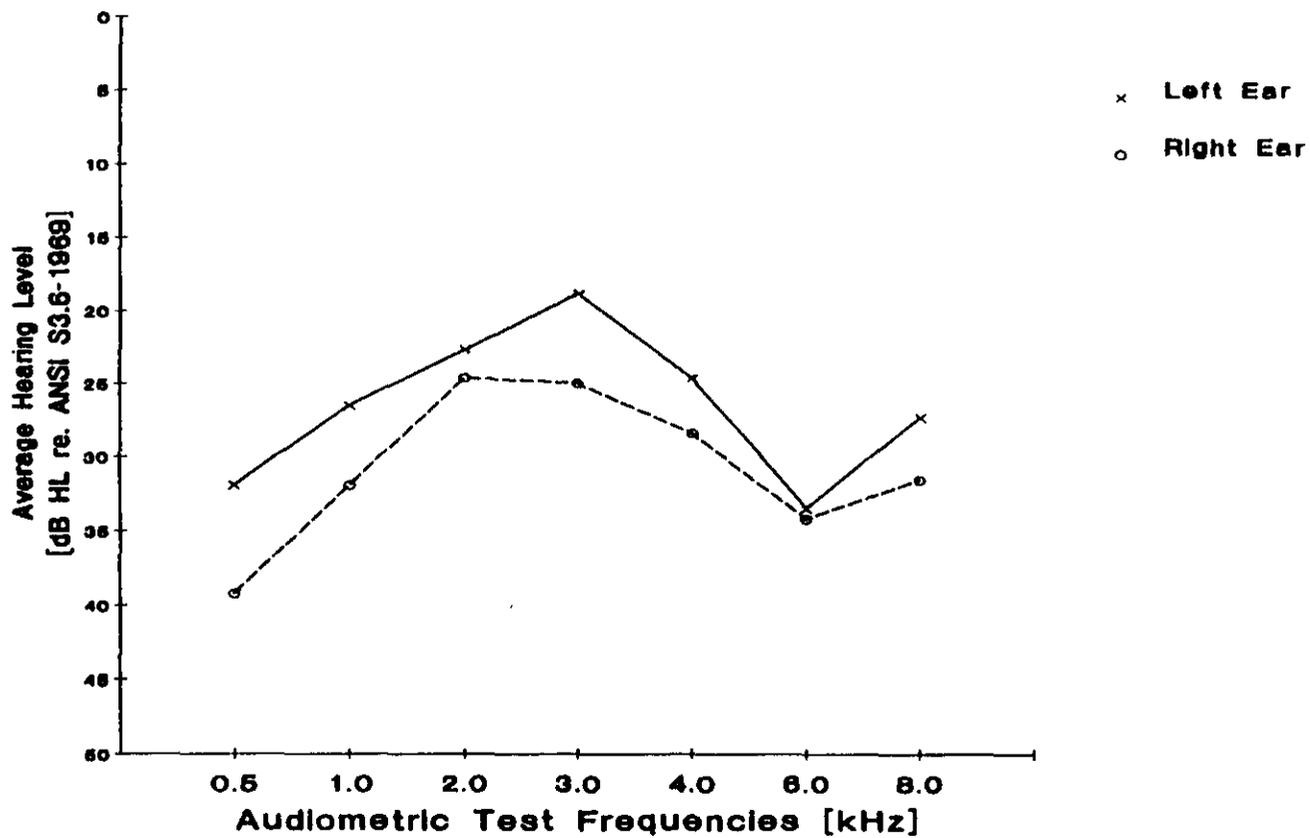


Figure 12
AVERAGE HEARING LEVELS
Winera Cardboard Box Factory
HETA 89-100
April, 1989

