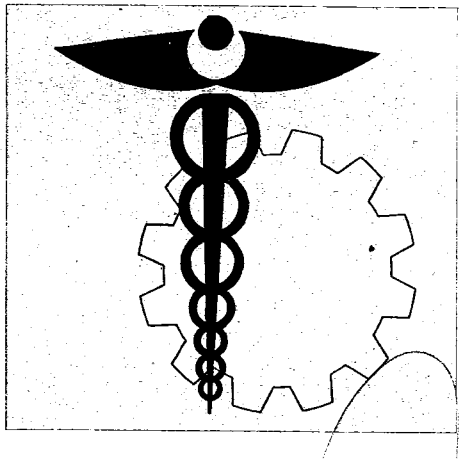

Survey of Hearing Conservation Programs in Industry

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SURVEY OF HEARING CONSERVATION PROGRAMS IN INDUSTRY

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ABSTRACT

Industrial hearing conservation programs are assessed in terms of the extent of existence, standard practices, problems encountered, and apparent measures of effectiveness. A survey questionnaire was used and site visits were made in order to elicit responses from individual companies in four major industrial categories: manufacturing, construction, transportation and mining.

The results indicate that many industries are responding to the need for establishment of hearing conservation programs. Of those companies claiming to have noise problems, the majority have noise reduction programs and a large percentage are planning such programs. Engineering noise control seems to pose the greatest problem for industry, and most companies deal with controlling noise exposure through the use of ear protectors. Tolerances on audiometers and on background noise levels in test rooms as established by the American National Standards Institute were frequently exceeded at one or more frequencies, indicating a need for more precise calibration check procedures.

Forms and specification sheets provided by some of the companies which were interviewed are presented in several of the appendices to this report. Also, the contents of the questionnaire and data from the calibration checks are included.

INTRODUCTION

Hearing conservation has become an integral part of the safety program in many industries which must comply with regulations established by the Occupational Safety and Health Administration. Most established hearing conservation programs include: 1) periodic noise measurements; 2) engineering and/or administrative controls; 3) personal ear protection; and 4) audiometric monitoring. The National Institute for Occupational Safety and Health has conducted a survey to 1) find ongoing industrial hearing conservation programs, 2) assess the extent and nature of the variability in these existing conservation efforts, 3) learn the range of problems involved in establishing such programs, and 4) determine apparent measures of effectiveness. Information relating to the first two purposes was requested in a questionnaire which was mailed to over 4000 selected companies representative of manufacturing, construction, transportation and mining industries. The third and fourth purposes of the survey were achieved by meeting with personnel from companies who were directly involved in hearing conservation programs that had existed for five or more years and by evaluating audiometric monitoring facilities with respect to American National Standards Institute (ANSI) recommendations. During these visits information was obtained on techniques related to noise measurement, engineering noise control, administrative noise control, equipment calibration, personal ear protection and hearing testing.

Results of the survey indicate that many industries were responding to the need for well planned, comprehensive hearing conservation programs. Of the 2074 companies that returned completed questionnaires (48% of those sent), 44% claimed to have noise problems, 27% had noise reduction programs, and 23.5% indicated that they had programs concerned with hearing conservation.

Most industries surveyed indicated that the thrust of their hearing conservation effort was the use of engineering procedures to reduce noise exposure. Of the engineering procedures used, noise control at the source reportedly posed the greatest problems. Often there were not enough funds to implement engineering controls, and sometimes when funds were available, technical expertise was lacking. Nevertheless, many companies had developed a number of innovative engineering methods which helped to reduce noise levels. In addition, there were cases of noise reduction achievements through redesign of machinery to meet other OSHA requirements.

It is the general opinion of those interviewed that responsibility for engineering control of noise should be placed on manufacturers of equipment. Although installation of new, quiet equipment in areas with existing old, noisy equipment would not necessarily solve noise problems, it was thought that the new, quiet equipment would give industry a baseline from which they could institute additional corrective procedures.

Apparently administative controls had seldom been used with much success, primarily due to the complications which arise when a worker must be shifted to a job which has a different pay rate or classification. Frequently, there were also objections raised by the unions. However, at least two of the companies did indicate success with administrative controls, through cooperation between management and union.

Personal ear protectors were the most widely used single method for controlling employee exposure to noise. Personal ear protector programs were reported to be most effective when proper use, care, and importance of wearing the ear protector have been demonstrated to the employee. Often this type of program eliminated the need for harsh disciplinary measures for infractions and also improved employee cooperation in the program. Another factor which seemed to affect the willingness of the employee to wear ear protectors was the variety of items offered to him. Many companies supplied a wide range of personal ear protector devices and permitted the employee a trial period to select the one he liked best.

Audiometric testing in companies was usually under the auspices of an existing medical department. Audiometric testing on a periodic basis, although not routine, was being used in many instances as a means of monitoring the effects of noise on the worker. In most places visited, audiometry was done by company nurses who performed many other duties besides the administration of audiometric testing programs. Company personnel also indicated that they recognized the need for sound attenuating enclosures for audiometric testing. When the purchase of a prefabricated booth was not feasible, efforts were often made to treat or sound deaden the testing area in any way possible.

As a result of measurements made by NIOSH personnel during on-site visits, it was discovered that 80% of the hearing test facilities failed to meet the ANSI criteria for audiometer performance or limits for background noise levels. In general, the results show that automatic audiometers met the criteria more frequently than manual audiometers and that audiometers calibrated re. ANSI S3.6-1969 met the criteria more frequently than those calibrated re. ASA Z24.5-1951. All hearing test rooms met the ambient noise level criteria at 2000 Hz and above, but significant percentages exceeded the limits below 1000 Hz. These results, coupled with other observations made during the on-site visits, would seem to suggest the need for a better training program for audiometric technicians, which includes not only proper standardized procedures for obtaining thresholds but also such factors as 1) importance of various calibration check techniques, 2) effect of extraneous noise on the audiometric test, 3) importance of an appropriate case history, 4) use and care of ear protectors, and 5) procedures for referring employees for further tests and counseling.

QUESTIONNAIRE SURVEY

SELECTION OF COMPANIES SENT QUESTIONNAIRES

Three different procedures were used for choosing individual companies to be included in the questionnaire survey. These procedures are given below for manufacturing, transportation and construction, and mining samples. It should be noted that the selection procedure was not designed to provide a statistically valid sample of American industry, but instead was intended to provide a manageable mailing list which would hopefully include the vast majority of companies having substantial hearing conservation programs, from which a subsample could later be selected for on-site visits.

Manufacturing Sample

The manufacturing sample included companies representative of 177 of 220 Standard Industrial Classification codes.* These 177 industries were selected to maximize the probability of existing noise problems. Companies for this sample were chosen on the basis of their worker population and geographic location (see Figure 1). Companies listed as having a worker population of less than 100 employees were not selected. These criteria assured the inclusion of key manufacturing areas such as textile industries from the southeast and paper and wood products industries from the northeast, and facilitated travel to those companies where on-site interviews were later made. In addition, no more than four plants owned by a given company were sent questionnaires. Addresses were obtained from computer cards listed in Market Statistics: Key Plants 1970-71 (available from Market Statistics, 144 E. 44th Street, New York, New York 10017).

Following preliminary selection of a manufacturing sample, meetings were held with representatives of government agencies and trade associations representing over 30 industries. The resulting discussions were concerned with the content of the questionnaire and a method for informing selected companies about the survey.

Transportation and Construction Samples

Companies involved in air, rail, bus, or trucking transport were included in the transportation sample. The construction sample was representative of companies involved in industrial, commercial and apartment construction.

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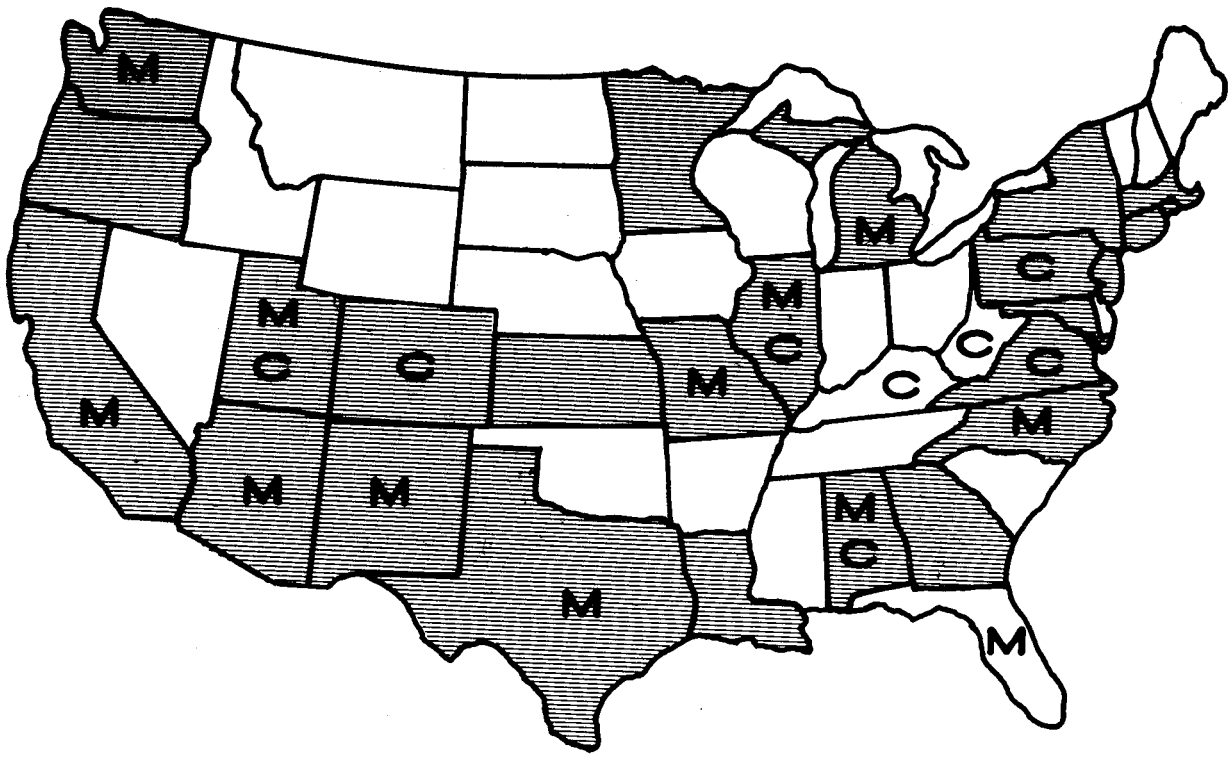
* The Standard Industrial Classification Code (SIC) was utilized in choosing the types of operations included in the survey (see Appendix A).



▭ — MANUFACTURING, CONSTRUCTION OR TRANSPORTATION

C — COAL MINING

M — OTHER MINING

Figure 1. Nationwide Sample Distribution

These samples were taken from twenty-eight key cities located in the same geographic areas from which the manufacturing sample was selected. These cities were rank ordered by population and the individual companies were then randomly selected from city telephone directories. The number of companies chosen from each city for the samples was proportional to the population of that city.

Mining Sample

The mining sample included companies representative of metal, non-metal, quarry, gravel and coal mining industries. The mines included in the survey were selected primarily on the basis of geographical location and without consideration of specific worker population. The selection was made from a list provided by the Bureau of Mines, of mines from 18 states.

Table 1 shows the list of states represented in the survey and the number of companies which were sent questionnaires in each of the four industrial categories.

DESCRIPTION OF THE QUESTIONNAIRE

The questionnaire (Appendix B) was divided into three sections. Section A requested general information about the company, such as total number of employees and information regarding any personnel working in an industrial safety and health capacity. If there was no hearing conservation program presently in effect and if no program was being planned, the company was requested to complete only Section A of the questionnaire. Section B was to be completed by any industries in the process of planning a hearing conservation program. Questions dealt with the type of program being planned and the personnel who would be establishing and maintaining the program. Section C was to be completed only by those companies who already had an ongoing hearing conservation program. Questions were designed to provide information on occupational noise levels, personal ear protectors, hearing testing, and personnel responsible for the program.

QUESTIONNAIRE RESULTS

A total of 4,299 questionnaires were sent to companies with SIC codes corresponding to manufacturing, construction, transportation and mining industries; 48% were returned. Tables 2 and 3 present the response to the questionnaire by sample group.

Appendix B contains a comprehensive breakdown of the responses for each question. Responses are categorized by major industrial groups and are tabulated as percentages. Question 1 from Section C is shown below to illustrate the format of presentation.

TABLE 1

DISTRIBUTION BY STATES AND INDUSTRIES OF
NUMBER OF COMPANIES SENT QUESTIONNAIRES

	Mfg.	Mines		Constr.	Transp.	TOTAL
		Other	Coal			
Alabama	59	8	5	15	11	98
Arizona	23	23	0	20	12	78
California	472	16	0	60	47	595
Colorado	20	0	5	30	22	77
Connecticut	128	0	0	10	6	144
Florida	0	23	0	0	0	23
Georgia	66	0	0	25	16	107
Hawaii	13	3	0	0	0	16
Illinois	530	4	5	148	93	780
Kansas	22	0	0	15	12	49
Kentucky	0	0	27	0	0	27
Louisiana	56	4	0	30	21	111
Maryland	28	1	0	63	31	123
Massachusetts	103	0	0	73	22	198
Michigan	193	2	0	86	35	316
Minnesota	83	0	0	15	10	108
Missouri	39	4	0	40	31	114
New Jersey	103	0	0	29	10	142
New Mexico	0	10	0	0	0	10
New York	148	4	0	31	21	204
North Carolina	150	1	0	0	0	151
Oregon	75	1	0	22	14	112
Pennsylvania	144	4	20	33	26	227
Texas	156	6	0	45	34	241
Utah	20	8	2	10	5	45
Virginia	8	0	12	15	7	42
Washington	70	5	0	25	19	119
West Virginia	0	0	42	0	0	42
TOTAL	2709	127	118	840	505	4299

TABLE 2

HEARING CONSERVATION SURVEY QUESTIONNAIRE RETURN

Sample Group	Number Sent	Number Returned Completed	Number Returned Blank	Percentage Returned Completed
Manufacturing	2709	1410	149	52.0%
Construction	840	284	53	33.8%
Transportation	505	241	34	47.7%
Mining	245	139	15	56.7%
TOTAL	4299	2074	251	48.2%

TABLE 3

NUMBER OF RESPONSIVE COMPANIES
CATEGORIZED BY SIZE OF WORK FORCE AND INDUSTRY

	Number of Companies			
Number of Employees	Manufacturing	Construction	Transportation	Mining
Less than 10	5	157	100	16
10 to 50	50	89	74	10
50 to 250	652	28	36	62
250 to 500	366	6	7	27
Above 500	337	4	24	24
TOTAL	1,410	284	241	139
Largest Population:	37,500	1,400	35,000	5,429
Total Work Force:	947,393	11,857	116,034	57,562

SECTION C

Mfg.	Const.	Trans.	Mng.	All		
					1.	Who developed this hearing conservation program?
19.5%	0.0%	0.0%	27.1%	19.2%		a. industrial hygienist
39.7	80.0	50.0	45.8	41.2		b. safety engineer
4.6	0.0	10.0	4.2	4.7		c. physician
4.1	0.0	5.0	0.0	3.6		d. nurse
13.4	20.0	5.0	2.1	12.0		e. insurance underwriter
3.0	0.0	0.0	2.1	2.8		f. consultant
5.3	0.0	30.0	18.8	7.7		(g.) personnel manager
3.5	0.0	0.0	0.0	3.0		(h.) plant mgr.; superintendent
2.8	0.0	0.0	0.0	2.4		(i.) safety supervisor
3.0	0.0	0.0	0.0	2.6		(j.) industrial relations
1.0	0.0	0.0	0.0	1.0		(k.) other
395*	5*	20*	48*	468*		

* Total number of companies responding

The following examples show how to interpret the tabulated values:

- under the column heading "All" it is shown that 41.2% of the 468 companies who answered this question gave letter b, safety engineer, as the answer.

- similarly, within the Manufacturing (Mfg.) category, 3.0% of 395 companies gave letter f, consultant, as the answer.

In general, the five columns of numbers to the left of the questions show the results for the four industrial categories and the combined results for all respondents. The percentage values in each column are the percentages of companies giving the corresponding answers. At the bottom of each column is the total number of companies answering the question. These numbers are not always the same for every question since a few companies did not answer all questions in a given section. Parentheses around some of the answers indicate that these choices were not listed in the questionnaire that was mailed out, but were created during the process of data tabulation, based on "write-in" answers given by many of the respondents.

Responses to questions 6 and 7 (Section A) of the questionnaire were compiled and divided into two groups: those claiming noise problems and those claiming no noise problems. The responses were then further divided into three groups depending on whether the company had a hearing conservation program, was in the process of planning one, or neither has nor was planning a hearing conservation program. These results are presented in Tables 4 and 5. Of the companies claiming noise problems, only 52% have a program for noise reduction, and 19% are not planning any type of noise control program.

TABLE 4

RESPONSE DISTRIBUTION OF COMPANIES CLAIMING NOISE PROBLEMS

Industry	Companies with Noise Reduction Program		Companies Planning Noise Reduction Program		Companies with No Program or Plan for Noise Reduction	
	No.	Percentage	No.	Percentage	No.	Percentage
Manufacturing	404	56%	216	30%	100	14%
Construction	6	10%	9	14%	48	76%
Transportation	20	44%	8	18%	17	38%
Mining	47	50%	37	41%	8	9%
TOTAL	477	52%	270	29%	173	19%

TABLE 5

RESPONSE DISTRIBUTION OF COMPANIES CLAIMING NO NOISE PROBLEMS

Industry	Companies with Noise Reduction Program		Companies Planning Noise Reduction Program		Companies with No Program or Plan for Noise Reduction	
	No.	Percentage	No.	Percentage	No.	Percentage
Manufacturing	66	10.0%	46	7.0%	578	83.0%
Construction	3	1.5%	1	0.5%	217	98.0%
Transportation	6	3.0%	2	1.0%	188	96.0%
Mining	10	21.0%	6	13.0%	31	66.0%
TOTAL	85	7.0%	55	5.0%	1014	88.0%

Figure 2 shows questionnaire results based on responses from companies with an existing hearing conservation program. Results were divided into four categories: noise measurement, exposure control (engineering or administrative controls), audiometric monitoring and ear protectors. The majority (76%) of companies returning the questionnaire had no hearing conservation program, but 18% of these companies are in the process of planning such a program.

The responses from companies planning hearing conservation programs (Section B) are very similar to the responses of companies who already had hearing conservation programs. The most outstanding difference is in the area of noise measurement where 83% were planning to measure noise only in dBA and 16% were planning to use both dBA and octave band measurements compared to 65% and 34%, respectively.

A question about worker noise exposure to 90 dBA or more was included in Section C. Table 6 lists information reported by 430 of the 502 respondents claiming to have hearing conservation programs. The other 72 companies elected not to respond to the question.

The number of employees reported to be exposed to noise levels of 90 dBA or above are shown in Table 7 for the four major industries in the survey: manufacturing, construction, transportation, and mining. In addition, manufacturing companies were separated by the individual SIC codes and the results are shown in Table 8. These tables are not an attempt to present exact figures as to how many workers are exposed to hazardous noise levels; rather, they substantiate the fact that noise is indeed a common occupational hazard which could affect a large number of workers. However, in interpreting the results which appear in the tables, the following points must also be considered:

1. The answers from this question cannot be used to accurately determine how many workers are incurring hazardous noise exposures because information concerned with length of the exposure is not available.

2. Each plant made its own noise level evaluations and it is unlikely that a single standard procedure was used universally.

3. Many other plants involved in this questionnaire survey could not or did not answer this question.

4. The projections in the last column of Table 8 are not based on a statistically valid sample.

Other information obtained in Section C of the questionnaire concerned audiometric monitoring. Tables 9, 10, and 11 provide information about pre-employment tests, frequency of tests, and bone conduction tests.

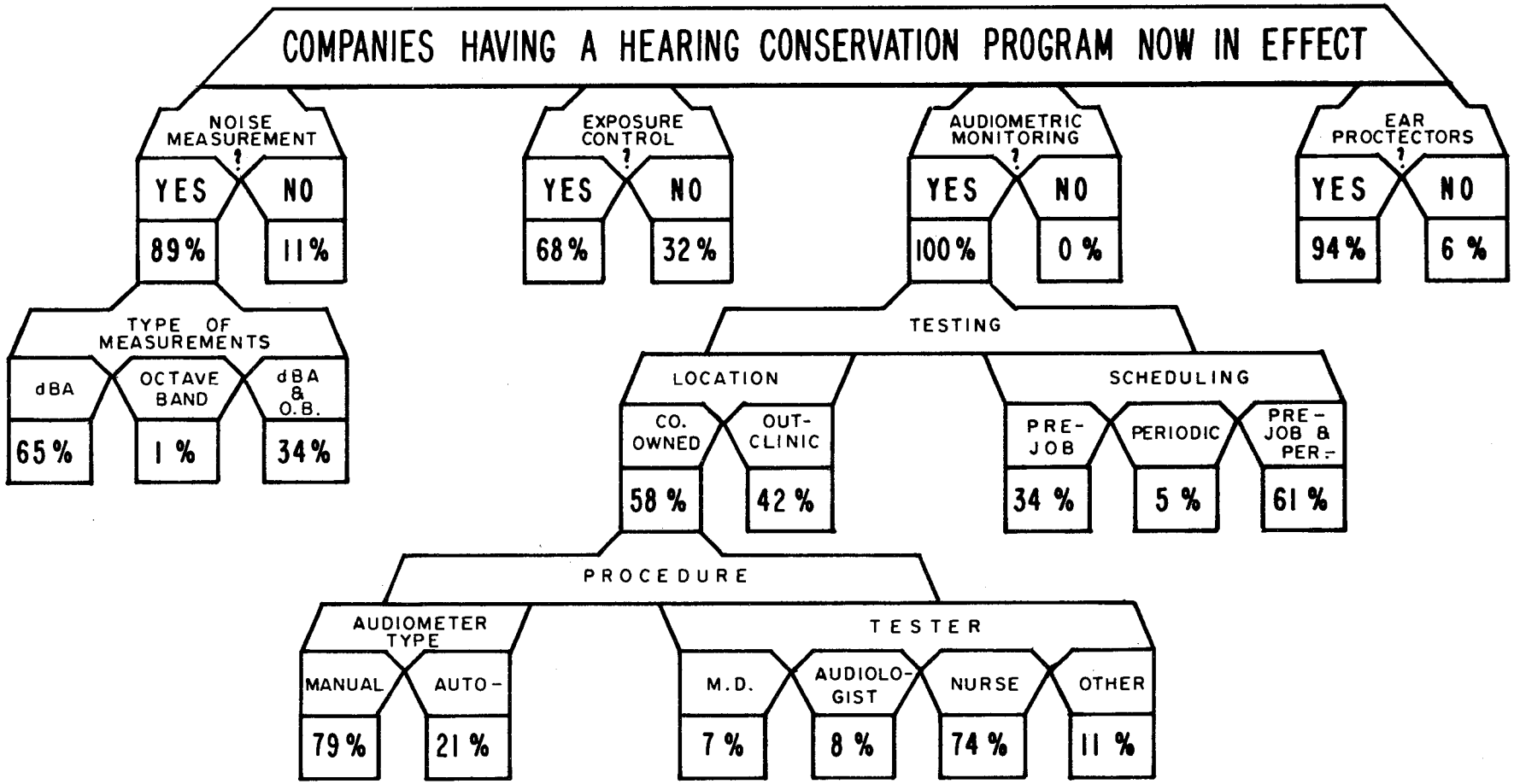


Figure 2. Summary of Hearing Conservation Practices

TABLE 6

NUMBER OF COMPANIES* WITH NOISE LEVELS OF 90 dBA OR ABOVE

Number of Employees Exposed to 90 dBA or Above	Number of Companies			
	Manufacturing	Construction	Transportation	Mining
None	39	3	12	16
Less than 10	48	1	4	6
10 to 50	107	2	--	13
50 to 250	71	--	1	10
Above 250	86	--	7	4
TOTAL	351	6	24	49

* This table illustrates the response to Question 3, Section C of the questionnaire and therefore only represents responses of companies who claimed to have a hearing conservation program.

TABLE 7

NUMBER OF EMPLOYEES REPORTED TO BE EXPOSED TO NOISE LEVELS OF 90 dBA OR ABOVE

	Number of Plants Included in Sample	Total Number of Employees in Sample	Number Located in Areas 90 dBA or Above	Estimated % of Workforce Exposed*	Total Work Force	No. Projected to be in Areas 90 dB
Manufacturing	351	513,166	72,188	14.9	16,546,400	2,470,681
Construction	6	755	82	10.9	3,480,000	377,960
Transportation	24	86,640	16,936	19.5	2,193,600	427,752
Mining	49	26,455	3,994	15.0	378,545	56,732
TOTAL	430	627,016	93,200	14.7	22,598,545	3,333,125

* These percentages are calculated by dividing Total Work Force into No. Projected.

TABLE 8

NUMBER OF EMPLOYEES REPORTED TO BE EXPOSED TO NOISE LEVELS OF 90 dBA OR ABOVE IN MANUFACTURING

SIC CODE		No. of Plants in Sample	Total No. of Empl. in Sample	No. Located in Areas 90 dBA and Above	Percentage of Work Force Exposed in Sample	Total Work Force	No. Projected to be Located in Areas 90 dBA and Over
22	Textile Mill Products	23	12,764	5,634	44.1	963,300	424,815
29	Petroleum & Coal Products	17	24,193	6,675	27.6	192,800	53,212
24	Lumber & Wood Products	14	5,654	1,460	25.8	601,000	155,058
20	Wood & Kindred Products	16	22,433	5,769	25.7	1,898,600	487,940
25	Furniture & Fixtures	11	10,374	1,849	17.8	465,400	82,841
34	Fabricated Metal Products	58	41,428	7,079	17.1	1,335,000	228,285
32	Stone, Clay & Glass Products	5	2,502	416	16.6	643,800	106,870
33	Primary Metal Industries	54	74,736	11,081	14.8	1,190,000	176,120
30	Rubber & Plastic Products	5	8,691	1,105	12.7	589,500	74,867
37	Transportation Equipment	46	199,212	23,445	11.8	1,705,500	201,249
36	Electrical Equip. & Supplies	7	8,790	973	11.1	1,778,100	197,369
28	Chemicals & Allied Products	9	3,851	324	8.4	1,014,400	85,210
23	Apparel & Other Textile Products	1	50	5	10.0*	(1,353,100)	
26	Paper & Allied Products	22	15,277	1,400	9.2	687,300	63,240
19	Ordnance & Accessories	12	39,403	3,480	8.8	193,900	17,063
38	Instruments & Related Products	6	3,254	193	5.9	433,800	25,594
35	Machinery Except Electrical	39	25,327	1,043	4.1	1,768,000	72,488
27	Printing & Publishing	6	15,227	257	1.7	1,085,900	18,460
	TOTAL:	351	513,166	72,188	**	16,546,400	2,470,681

* Insufficient data for projection

** Based on No. Projected and Total Work Force, the estimated percentage of total work force exposed is 14.9%

TABLE 9

NUMBER OF COMPANIES GIVING PRE-EMPLOYMENT HEARING TESTS

Number of Years Practice Followed	Number of Companies		
	Manufacturing	Transportation	Mining
0 to 1	103	5	8
1 to 5	55	2	11
5 to 10	63	5	12
10 or more	68	7	6
TOTAL	289	19	37
Longest reported time for giving this test	30 years	37 years	20 years

TABLE 10

NUMBER OF COMPANIES GIVING HEARING TESTS AT LEAST ONCE EVERY TWO YEARS

Number of Years Practice Followed	Number of Companies		
	Manufacturing	Transportation	Mining
0 to 1	88	3	5
1 to 5	41	3	4
5 to 10	38	4	6
10 or more	35	7	3
TOTAL	202	17	18
Longest reported time for giving this test	25 years	37 years	17 years

TABLE 11

NUMBER OF COMPANIES GIVING BONE CONDUCTION TESTS

Number of Years Practice Followed	Number of Companies		
	Manufacturing	Transportation	Mining
0 to 1	14	1	3
1 to 5	10	--	--
5 to 10	4	--	1
10 or more	9	--	1
TOTAL	37	1	6
Longest reported time for giving this test	19 years	--	17 years

ON-SITE INTERVIEWS

SELECTION OF COMPANIES TO BE VISITED

Following the questionnaire survey on-site interviews were made with personnel of 80 companies from among the 2074 respondents. These companies were representative of transportation, manufacturing, and mining industries, with the bulk of the interviews being conducted with manufacturing companies. Construction companies were not included in this on-site survey due to their poor response to the questionnaire survey (possibly due to their high mobility). The criterion for selection of companies for visits was that they had conducted, for over five years, on-going hearing conservation programs, including audiometric monitoring. Only companies having long term experience in the area of hearing conservation were selected because of their unique ability to provide data concerning the problems and solutions related to the maintenance of such programs. Information relevant to noise control and audiometric monitoring in each hearing conservation program was requested, calibration of the companies' audiometers was checked, and measurements of background noise in the audiometric test rooms were taken.

THE INTERVIEW

Initial contact for the interview was made by letter and always was addressed to the person indicated on the questionnaire as having involvement with the formulation or maintenance of the hearing conservation program. Those interviewed usually consisted of an industrial hygienist, a safety director, a physician, a personnel representative, or any combination of these; however, occasionally management representatives were present. The visits were approximately 2 hours in duration with about 1 1/2 hours devoted to a discussion of the aspects of the hearing conservation program and 1/2 hour for the calibration check of audiometric equipment, ambient noise measurements in the test area, and subsequent explanation of the results.

The interview was divided into four parts: noise measurement, noise control, hearing testing and monitoring, and personal ear protection. The following sections provide a more detailed explanation of each part in addition to the general results obtained. Due to variability encountered with each program, it was not possible to obtain exactly the same types of information from all plants for each part of the interview.

Noise Measurement

In obtaining information relating to environmental noise measurements, three basic areas were investigated: (1) background and training of persons taking the noise measurements, (2) instrumentation and calibration procedures used, and (3) number and type of noise survey made each year. Six questions were asked concerning these areas. Results of the first

three questions are shown in Figures 3, 4, and 5, which illustrate who makes noise measurements, methods of training for those people, and types of instrumentation used. The majority of people are safety personnel or industrial hygienists, are self-taught or trained by university or government sponsored seminars, and use general purpose sound level meters with A-weighting networks. Not included in Figure 5 is the percentage of those who also have access to more elaborate equipment systems. Some of this additional equipment included graphic level recorders, oscilloscopes, and third octave band analyzers.

The fourth question related to methods of calibration. Seventy-four percent of those interviewed stated that calibration was done with a calibrator purchased with the sound level meter, while 23% had access to a calibrating unit either through corporate headquarters or the equipment supplier. Three percent had no means of calibrating their instruments. Calibration was performed before each use or before and after each use, except on those instruments which had to be sent out for calibration. In these instances, calibration was generally performed on an annual or semi-annual basis.

The fifth question asked about the use of dosimeters. Results show that 22% use personal dosimeters to define exposure to hazardous noise, and 3% use some type of stationary monitor. In most instances, use of dosimeters was in an incipient stage, and many comments were noted questioning the validity of the measurements based on calibration difficulties, possible temperature sensitivity, and use in intermittent noise.

The sixth question requested information on how often noise surveys were conducted. In general, companies conduct noise surveys at the request of an employee or when new equipment is purchased and installed. However, some of the companies take complete noise surveys on an annual or biannual basis. Included in Appendix C is a collection of noise measurement forms which were provided by several of these companies.

Noise Control

Companies were asked if they used written noise specifications in the purchase of new equipment. Of the 80 companies interviewed, 61 stated that some sort of written specification was used. In most cases the specifications were a part of the purchase orders, but sometimes a separate publication would be attached to the purchase orders. The majority of written noise specifications simply state that noise levels should not be in excess of Federal regulations. Some specified a particular dBA level as a maximum acceptable limit. This level was usually 90 dBA although in one instance a company had written an 80 dBA specification, but it had not yet been used. Appendix D contains several noise level specifications forms generously supplied by several of the companies.

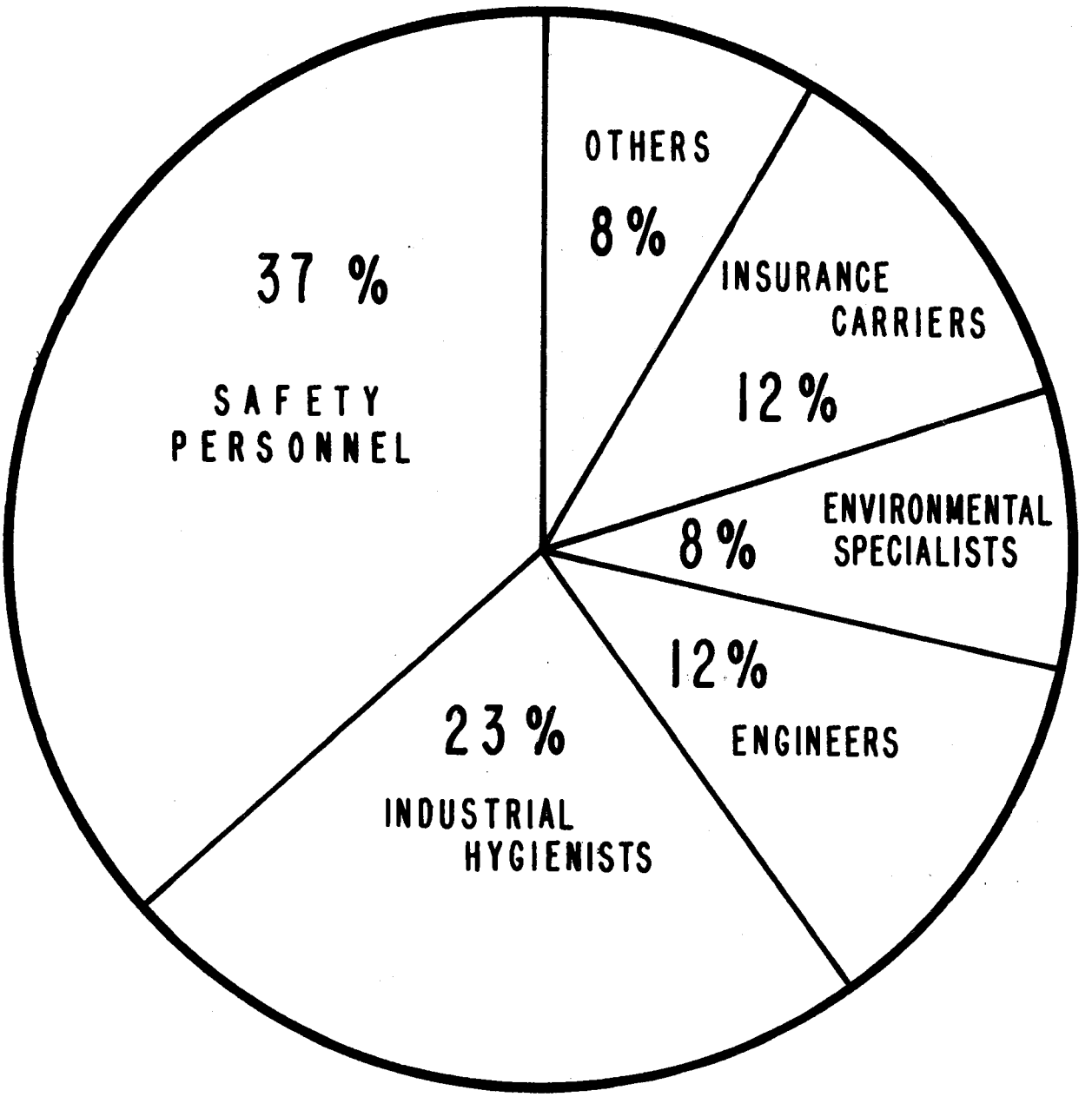


Figure 3. Personnel Making Noise Measurements

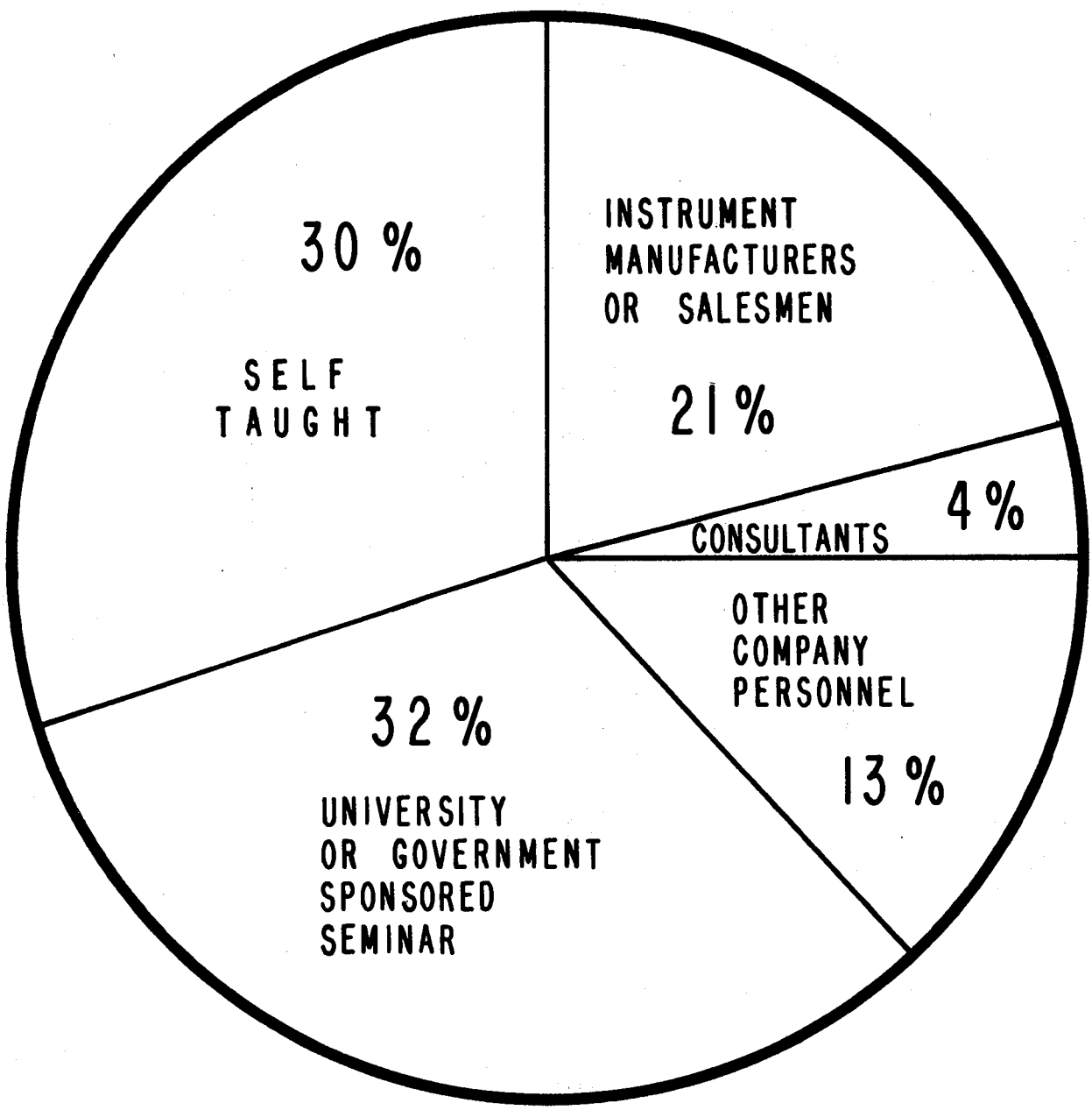


Figure 4. Training of Personnel Making Noise Measurements

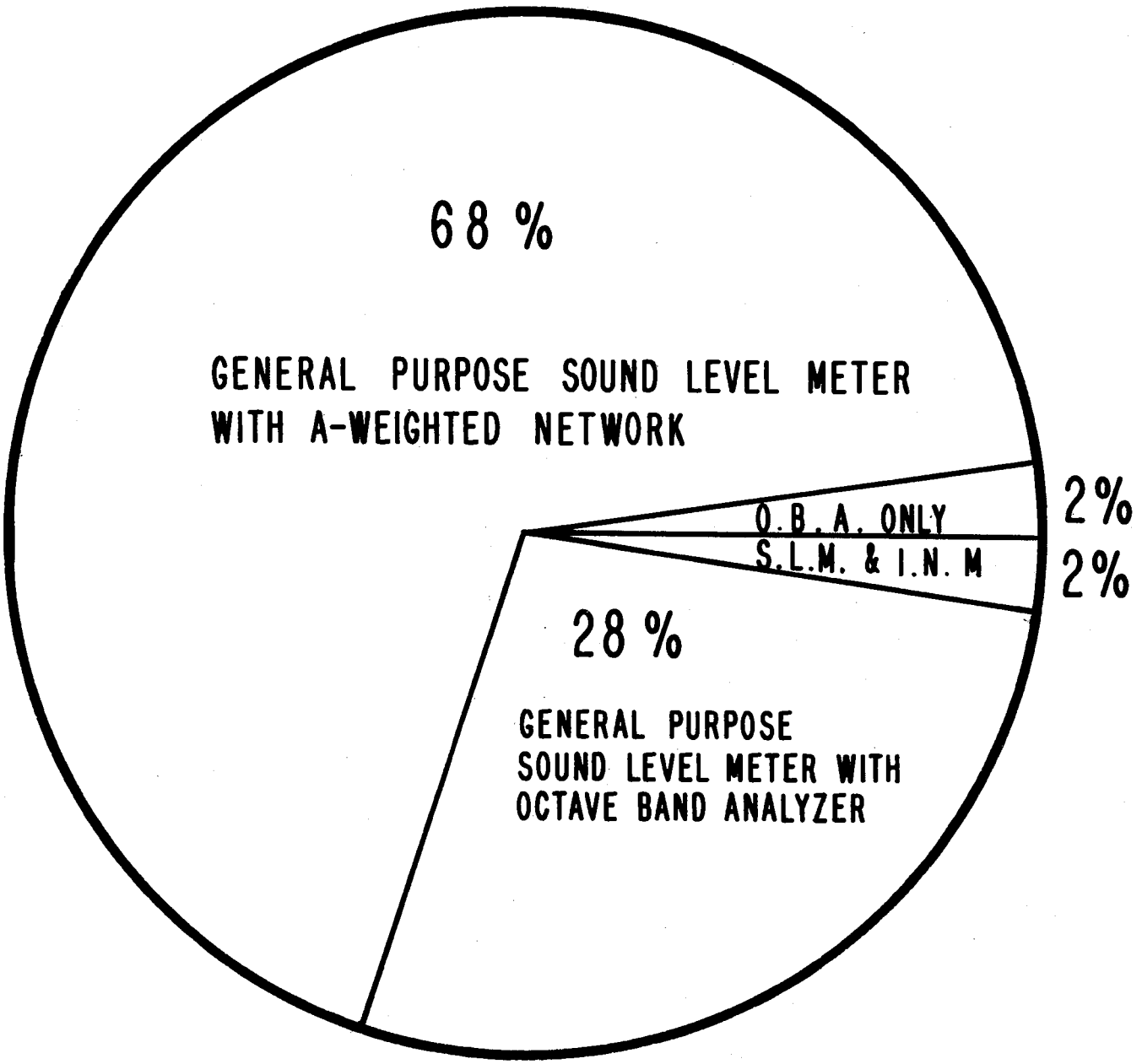


Figure 5. Instrumentation Used to Make Noise Measurements

Although most did specify noise level limits, the general opinion seemed to be that such specifications were of little value at this time because they were unenforceable, due to the fact that no equipment was available which met the specifications or because the manufacturing market was non-competitive. Another frequent comment was that when manufacturers did meet the specified level, often the machine would still contribute to the noise problems when placed in a noisy area. One company preferred to order machinery without regard to its noise level and concentrate efforts on noise reduction after installment. If machinery not meeting specifications was delivered, it was never refused, but several companies did delay acceptance of a product until noise levels conformed with the specifications.

After machinery is installed, there are three basic methods of controlling noise exposure: (1) engineering procedures; (2) administrative procedures; and (3) issuance and use of personal ear protection. Prior to discussing these specific procedures, information regarding noisy areas (over 90 dBA) was obtained. Questions concerned: (1) type of operation creating the noise; (2) average dBA level in these areas; (3) duration of excessively high levels per 8-hour day; (4) type of noise generally encountered (i.e., continuous, intermittent, or impact); (5) number of employees exposed on a routine basis to this noise; and (6) methods employed to remedy these situations. Answers were not obtained for all of the questions from each company because of the differences in programs. However, considerable information was furnished concerning the methodologies employed in handling noise problems and the number of employees in the general workplace who are exposed routinely to levels greater than 90 dBA. All information relating to the six questions is presented in Appendix E.

Engineering controls were reportedly tried by almost every company before any other procedures were instituted. The engineering procedures ranged from replacing worn machinery parts to changing the process. The main complaints about use of engineering procedures were difficulty in finding qualified consultants to solve difficult noise problems, the uncertainty of available technology to solve certain problems, and the expense. Cost of successful engineering procedures ranged from minimal (replacement of worn parts) to $40,000 (investment in acoustical screens and curtains). Of the companies which considered substitution of an innovative new process for the older, noisier one, most found it to be too expensive. Companies mentioned that it was difficult to predict accurately the resulting attenuation from engineering controls. In one instance, a $35,000 investment for quieting one noise source only reduced the overall noise level by 2-3 dBA.

In instances where companies find that engineering procedures are not economically feasible or do not sufficiently lower the noise levels, administrative procedures can be implemented. Of the eighty companies visited, only four were effectively making use of these measures to limit exposure by rotating workers in and out of noisy environments.

Several companies have used a type of administrative control which limits extremely noisy operations to Sundays or night shifts in order to minimize the number of exposed workers. However, it was the general consensus of the companies that administrative controls are not often usable because of various pay rates, job classifications and objection to this method by both the employees and the union.

The use of personal ear protectors was the most frequently encountered means of controlling the worker's noise exposure. Most companies interviewed relied heavily on personal ear protectors, realizing that they are a temporary measure and that engineering controls are required where feasible.

Each company visited was requested to supply information concerning type of ear protectors used, reasons for choosing them, and their cost. Most companies made available a variety of personal ear protectors to the employees. These consisted of one or more types of ear muffs, earplugs (including molded and pre-sized types), or ear-stuffing material. In most instances companies let the employees choose their own type of ear protectors. Some companies did stipulate, however, that only ear muffs could be used in high level noise areas, and others required use of a specified type based on the nature of the job. One example of such a restriction was at a company which disallowed the use of earplugs because the work demanded constant use of acids and alkalines. Common problems encountered in use of ear protectors were associated with fit, irritation, worker acceptance, and monitoring difficulty.

Average cost and range of prices for the three basic types of ear protectors are given below. Cost varied greatly depending on the quantity of the purchase and any contract agreements between the company and the supplier.

	Average Cost	Range
Ear Plugs	$0.61/pr.	$0.35 - 0.93
Ear Muffs	$6.12/pr.	$3.40 - 12.85
Individually Molded	$5.50/pr.	Insufficient data

The most common reasons for choosing a particular type of ear protector was the attenuation provided. The attenuation data available to these companies usually consisted of information from state or Federal publications, research done by a corporate or independent research firm, or data supplied by the manufacturers of ear protectors. Other reasons given include discount agreements with the manufacturers of the personal ear protectors, satisfaction with other safety products made by a particular manufacturer, comfort of the various protectors, and cost. It should be noted, however, that there was no uniformity among the companies interviewed as to either

the particular brands or types of ear protectors provided or the reasons given by the companies for their preferences of certain types.

Acceptance of ear protectors by the employees was said to be related mainly to the type of monitoring technique employed, especially when a disciplinary program is in effect, and to the amount of personal attention given in the fitting of protectors. Experience has shown company personnel that acceptance is greater where individual molded earplugs are being used than where ear protectors are distributed without personal fitting. Appendix F shows an employee ear protector rating sheet used for an evaluation of worker attitudes.

Companies use different methods for dispensing different types of ear protectors. Usually ear stuffing material is located at a work area in a bulk dispenser so that there is no means of controlling the amount used. At companies where ear plugs are fitted by a nurse, records of the distribution of plugs is usually kept. In most cases distribution of ear muffs is closely monitored, and often this distribution is controlled through the tool crib.

There was no charge to the employee for an initial set of ear protectors in any of the companies that were visited. Many places, however, charged the employee the replacement cost of any ear muffs which were assigned to him. Most companies reported that although repair was almost never required, ear protectors were frequently misplaced. Occasional "loss" of personal ear protectors was not a major concern, as the companies felt it probably indicated that the employee was protecting his hearing off of the job, also.

Disciplinary actions for not wearing ear protectors were generally the same standard procedures used in the overall safety program (e.g., for the habitual "forgetting" of hard hats or eye protection). The amount and severity of each disciplinary action varied greatly with each company; the least severe being a verbal warning with no provision for any type of follow-up, and the most severe being termination of employment without further warning. Examples of the disciplinary programs used in many industries are listed in Table 12. Ideally, the employee's own regard for his safety and well-being should be the motivation for wearing ear protectors; but, in actual practice, this is seldom the case. Companies which have taken it upon themselves to enforce such programs are doing so not only to protect themselves from any violation of OSHA regulations, but also to protect the employee who will not protect himself, and to protect the company from subsequent compensation claims.

Part of a company's program is education of employees about the importance of wearing personal ear protection. Information was given generally at the regularly scheduled safety meetings. Some program directors showed pamphlets, films and slides which dealt with the function and importance of the total hearing mechanism. This material was provided

TABLE 12

SIX COMPANIES' PROGRAMS OF DISCIPLINARY ACTION FOR NOT WEARING EAR PROTECTORS

1	2	3	4	5	6
Oral Warning	Call to Employee's Attention	Two Verbal Warnings	Verbal Warning	Supervisor Report to Union	Verbal Warning
Letter in Personnel Folder	Notify Foreman of Infraction	Formal Written Warnings	Written Warning if within Six Months of No. 1	Union Responsible for any Disciplinary Action	Formal Letter in Personnel File
Two-Day Suspension	Verbal Warning	Transfer or Termination	Three-Day Suspension if within Six Months of No. 2		Letter to Safety Supervisor
Five-Day Suspension	Written Warning in Personnel Folder	Written Warning in Personnel Folder	Five-Day Suspension if within Six Months of No. 3		Termination of Employment
Ten-Day Suspension			Discharge if within Six Months of No. 4		

by safety concerns or manufacturers of ear protectors. Ear protection fitting was often demonstrated and specific safety rules were presented. One company used their own employees to make a film demonstrating the importance of hearing, and it was well received by the workers. The medical department often played an important role in the education of employees. At the periodic or pre-employment audiometric examination the nurse would remind the employee of the effects of noise on hearing, check the fit of his ear protectors, and instruct him on the proper use of his type of protector.

Hearing Testing and Monitoring

Most of the personnel who administered the audiometric examinations were registered nurses and this activity represented only a portion of their various duties. Other personnel, including audiologists, corporate safety managers or even security guards were found to be responsible for performing the audiometric testing. In the industries surveyed much emphasis seemed to have been placed on training of personnel doing the audiometric testing. An attempt was made to document the various types of training received by each tester, however, it was difficult to ascertain because many did not remember the details of their training program. During the interview each tester was specifically questioned as to his qualifications and educational background. Because of the various types of "certification" existing, it was impossible to determine whether all technicians had received the same amount of training. Seventy-one percent of the audiometric technicians interviewed held some type of certification, and some had more than one certificate. The length of the training courses to obtain this "certification" varied from one day to two weeks. Further discussion and observation revealed that general knowledge and practical experience varied a great deal.

In the interview with each tester, questions were asked regarding testing technique, scheduling, record keeping practices and referral procedures. Actual procedures for performing audiometric tests differed markedly. The more thorough programs included an extensive case history, consistent measuring of audiometric thresholds by an accepted method, indoctrination of the worker to the care and proper use of ear protectors, regular biological and periodic exhaustive calibration of equipment and evaluation of factors capable of affecting consistency and accuracy of patient response. Factors affecting patient response include recent noise exposure, head colds, misunderstanding of instructions, or excessive ambient noise levels in the testing area. Other programs, also administered by "certified" audiometric technicians, consisted of some combination of the above points.

Several inaccuracies were noted during the interviews with the audiometric technicians. In one instance, a tester was unfamiliar with the audiometer and was unable to identify the tone interrupter switch.

This tester obtained most audiograms by using the power switch in lieu of the tone interrupter switch. It is obvious that such procedures would invalidate any tests performed. Another technician reported that better thresholds were obtained when the subject was permitted to sit facing the audiometric dials (no sound treated enclosure was used in this instance). After situating the employee, the technician stood beside the audiometer and manipulated the dials (while being careful not to obstruct the view of the person being tested) until a consistent response was obtained.

Testing technique depended greatly on the type of audiometer used. Equipment used was relatively standard and consisted of portable audiometers for obtaining air conduction thresholds. Seventy percent of these audiometers were manual and thirty percent were self-recording (automatic). Some of these audiometers were equipped to perform bone conduction measurements, however, in no instance was bone conduction testing done as a routine part of a hearing conservation program.

In all instances but one, routine pre-employment audiograms were obtained. The administration of recheck audiograms was highly variable. Some companies did no rechecks while others did them only at the request of the physician. In most companies, rechecks were performed on a periodic schedule. The frequency of these rechecks varied greatly depending upon the size of the industry and the manpower available to obtain them. Table 13 presents a breakdown of the frequency of periodic recheck audiograms.

The audiograms were kept in the general medical file to facilitate comparison between the periodic and pre-employment audiograms. Many technicians commented that they made no reference to the original audiogram until after the recheck audiogram was performed. This actually represents an informal check on the reliability of their testing technique. In Appendix G are presented several types of audiometric recording sheets which were provided by the companies for inclusion in this report.

Referral procedures used by each company were similar, however the criteria on the reference points for referrals, i.e., the magnitude of shift and number of frequencies demonstrating such shifts, appear to be very inconsistent among the companies. In some instances "intuition" appeared to be a determining factor. The standard procedure for referral was to refer to the company physician those persons who showed evidence of a change in hearing acuity according to the company's and/or tester's criteria. If he believed it to be necessary, a further referral to a specialist was made. The service of specialists was usually paid for by the company.

Most of these companies used a small prefabricated sound treated room for testing, however occasionally a quiet room was used. It was the general opinion of these companies, though, that a sound treated booth or acoustically treated room was necessary for obtaining accurate thresholds.

TABLE 13

FREQUENCY OF PERIODIC RECHECK AUDIOGRAMS

Basis for Interval Between Audiograms	Percentage
Annual	23
Biannual	13
Occupational (performed on those in high noise level environments only)	26
Age	10
Other:	28
Every 5 years for those in noisy areas	
Every 6 months	
Annual test for high noise areas, every 6 months for engine testing	
Noisy areas every 6 months; all on reissuance of ear plugs	
Those with medical problems, by request and by departments	

CHECK OF EQUIPMENT AND TEST AREA

The last part of each site visit was used for checking the calibration of audiometers by measuring coupler sound pressure levels* and tonal frequency and for determining the ambient noise levels found in audiometric testing areas. Procedures and instruments used in obtaining these audiometric and environmental data are presented in Appendix H. In Appendix I are complete lists of the actual measurements. The next section in this report presents an analysis and evaluation of these measurements.

*Earphone and coupler attachments conform to Figure 1 in ANSI S3.6-1969.

EVALUATION OF HEARING TEST EQUIPMENT AND ENVIRONMENTS

APPLICABLE TEST STANDARDS

Two standards published by the American National Standards Institute (ANSI) are applicable to the evaluation of hearing test equipment and environments performed in this study: "Specifications for Audiometers" (ANSI S3.6-1969) and "Criteria for Background Noise in Audiometric Rooms" (ANSI S3.1-1960 R-1971). In addition, an earlier standard for audiometers by the American Standards Association, ASA Z24.5-1951, was used prior to ANSI S3.6, and many audiometers were still calibrated to the ASA standard. Reference levels for both audiometer standards are given in Table 14. These standards contain measurement procedures which were followed in making the check of audiometer calibration and in measuring noise levels in hearing test rooms. Also, specifications are given in terms of tolerances in performance and maximum permitted noise levels.

Specifications for Audiometers

Wide range, pure-tone, air conduction audiometers were the only type in use at the companies which were visited. In Section 4, ANSI S3.6, "Requirements for Pure-Tone Audiometers" are presented. The audiometric data was compared against the accuracy requirements of this section for tone frequencies and earphone sound pressure levels. For the indicated tone frequencies 250, 500, 1000, 1500, 2000, 3000, 4000, 6000, and 8000 Hertz (Hz), these requirements are:

a. Each frequency generated shall be within 3 percent of the indicated frequency.

b. The sound pressure produced by an earphone as referred to the standard reference level (see Table 14) shall not differ from the indicated value of sound pressure level at any reading of the hearing threshold level dial by more than 3 dB at the indicated frequencies 250 through 3000 Hz, by more than 4 dB at 4000 Hz, or by more than 5 dB at indicated frequencies above or below this range.

c. The difference between two successive interstep spacing measurements shall be within three-tenths of the dial interval measured in decibels ('interval test'). (This requirement was applied only to manual audiometers.)

Criteria for Background Noise in Audiometric Rooms

As recommended in Section 3 of ANSI S3.1, "Conditions for Sound Pressure Level Measurements," measurements in an audiometric room were made when the worst possible ambient noise conditions presumably existed under which hearing tests might be conducted. These measurements were compared against the octave-band background noise level limits specified for no masking at 0 dB hearing level (re ASA Z24.5) using a standard audiometer. These limits are shown in Table 15.

TABLE 14

REQUIRED OUTPUT LEVELS FOR AUDIOMETERS

Frequency in Hz	Standard Reference Levels Sound Pressure Levels in Decibels Relative to 0.0002 Microbar			Minimum Upper Limit of Hearing Threshold Level in Decibels
	ANSI S3.6-1969 (re WE-709)	ASA Z24.5-1951 (re WE-709)	ANSI S3.6-1969 (re TDH-39)*	
125	45.5	54.5	45.0	70
250	24.5	39.5	25.5	90
500	11.0	25.0	11.5	100
1000	6.5	16.5	7.0	100
1500	6.5	16.5	6.5	100
2000	8.5	17.0	9.0	100
3000	7.5	16.0	10.0	100
4000	9.0	15.0	9.5	100
6000	8.0	17.5	15.5	90
8000	9.5	21.0	13.0	80

* The TDH-39 earphone sound pressure levels represent corresponding reference levels to the WE-709 earphone, as recommended in ANSI S3.6-1969. All data in the table are based on measurements made with the earphones fitted with the MX-41/AR earphone cushion using a NBS 9-A coupler.

TABLE 15

BACKGROUND NOISE LEVEL LIMITS (re ANSI S3.1)

Audiometric Test Frequency	125	250	500	750	1000	1500	2000	3000	4000	6000	8000
Octave Band Cutoff Frequencies	75	150	300	600	600	1200	1200	2400	2400	4800	4800
	150	300	600	1200	1200	2400	2400	4800	4800	10000	10000
Maximum Sound Pressure Level	40	40	40	40	40	42	47	52	57	62	67

EVALUATION OF TONE FREQUENCY MEASUREMENTS

The results of tone frequency measurements (see Appendix I, Part 1) are shown in Table 16. Illustrated in Figure 6 are these means and standard deviations of tone frequency measurements expressed as percentage deviations from the indicated values shown on audiometer dial settings. In Figure 7, portions of the bar graph above the abscissa represent the percentage of audiometers whose tone frequencies were within the allowable tolerance specified in ANSI S3.6; those portions falling below the abscissa represent the percentage of audiometers that exceeded allowable tolerance. These results were combined in order to determine the percentage of audiometers which exceeded the specified tolerance at one or more of the test frequencies usually used in a hearing conservation program; that is, 500, 1000, 2000, 3000, 4000, and 6000 Hertz. As shown in Figure 8, 20% (15) of 74 audiometers did exceed this criteria. When test frequencies of 250, 1500, and 8000 Hertz were also included, 32% (24) of 74 audiometers failed the test. Of the 9 additional audiometers exceeding the tolerance test, 7 failed only at 250 Hz, 1 failed only at 1500 Hz, and 1 failed only at 8000 Hz.

EVALUATION OF SOUND PRESSURE LEVEL MEASUREMENTS

Of 74 audiometers tested, 52 were manual (21 calibrated re ASA Z24.5-1951, 31 re ANSI S3.6-1969) and 22 were automatic (8 calibrated re ASA Z24.5, 14 re ANSI S3.6). All but one of these audiometers were matched with TDH-39 earphones. Since the audiometer specifications of ANSI S3.6 can be most conveniently expressed in terms of hearing levels, all measurements of coupler sound pressure levels (see Appendix I, Parts 2 and 3) were converted to earphone sound-pressure-levels-re audiometric zero using the reference threshold levels shown in Table 14 (i.e., sound pressure levels are expressed re audiometric zero rather than re 20 micropascals).

Table 17 shows sound pressure level means and standard deviations for left and right earphones, left earphones only, and right earphones only. Also, percentages of audiometers exceeding ANSI S3.6 sound pressure level range limits are given. For the 'left-and-right earphone' analysis the percentage failing values are representative of the percentage of audiometers from which measurements in either the left or right earphone exceeded ANSI S3.6 range limits. Comparison of 'left earphones only' percent failing versus 'right earphone only' percent failing reveals that right earphone measurements exceeded ANSI S3.6 range limits more frequently than left earphone measurements at all frequency settings except 500 and 8000 Hertz. In general, failure occurred 5% more frequently.

Attenuation accuracy of audiometers was evaluated in terms of means and standard deviations of differences between interstep spacing measurements and corresponding measurements at the 70 dB dial setting of 52 manual audiometers. As shown in Table 18, the mean error of the attenuation

TABLE 16

TONE FREQUENCY ACCURACY

FREQUENCY	MEAN HZ	STANDARD DEVIATION	No.	PERCENTAGE FAILING
125	123.7	2.6	45	16%
250	249.4	11.3	59	24%
500	502.3	23.0	75	11%
750	753.5	13.8	36	6%
1000	1001.9	17.0	74	7%
1500	1491.3	26.2	43	9%
2000	1997.3	40.1	75	7%
3000	3006.1	448.7	74	8%
4000	3991.0	77.8	75	12%
6000	5990.0	123.6	74	9%
8000	7947.1	258.8	58	16%

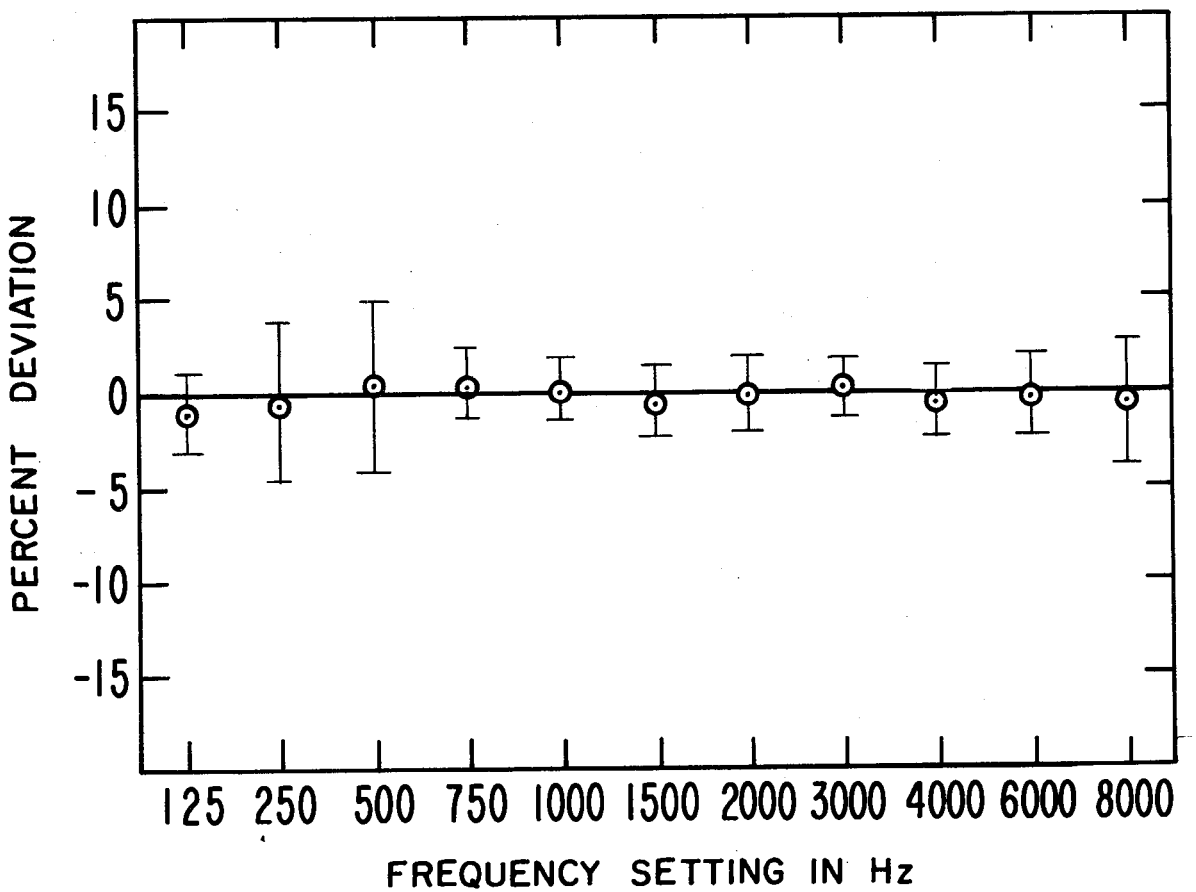


Figure 6. Tone Frequency: Means and Standard Deviations of Percent Deviation from the Indicated Frequency

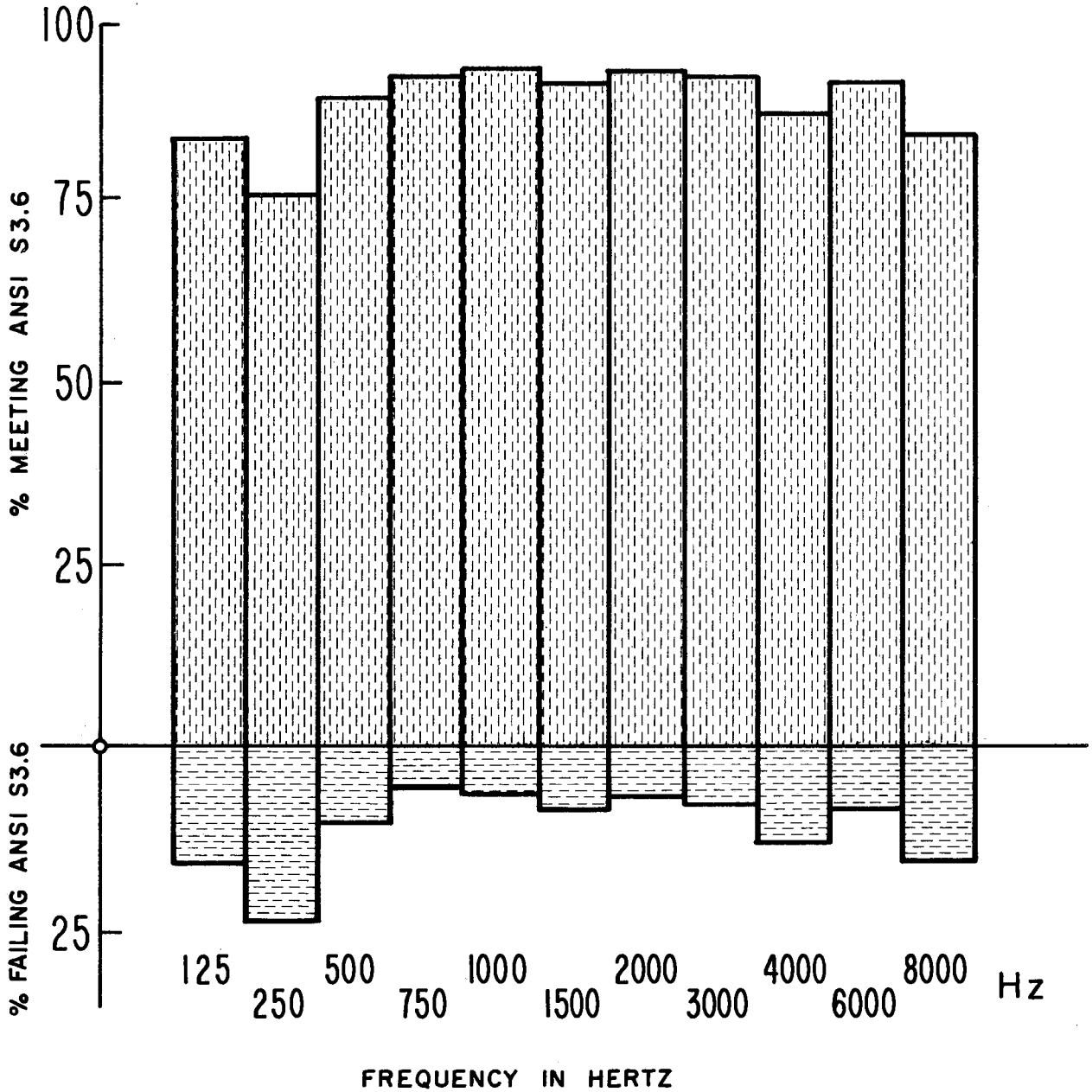


Figure 7. Accuracy of Tone Frequencies Versus Indicated Tone Frequency Setting

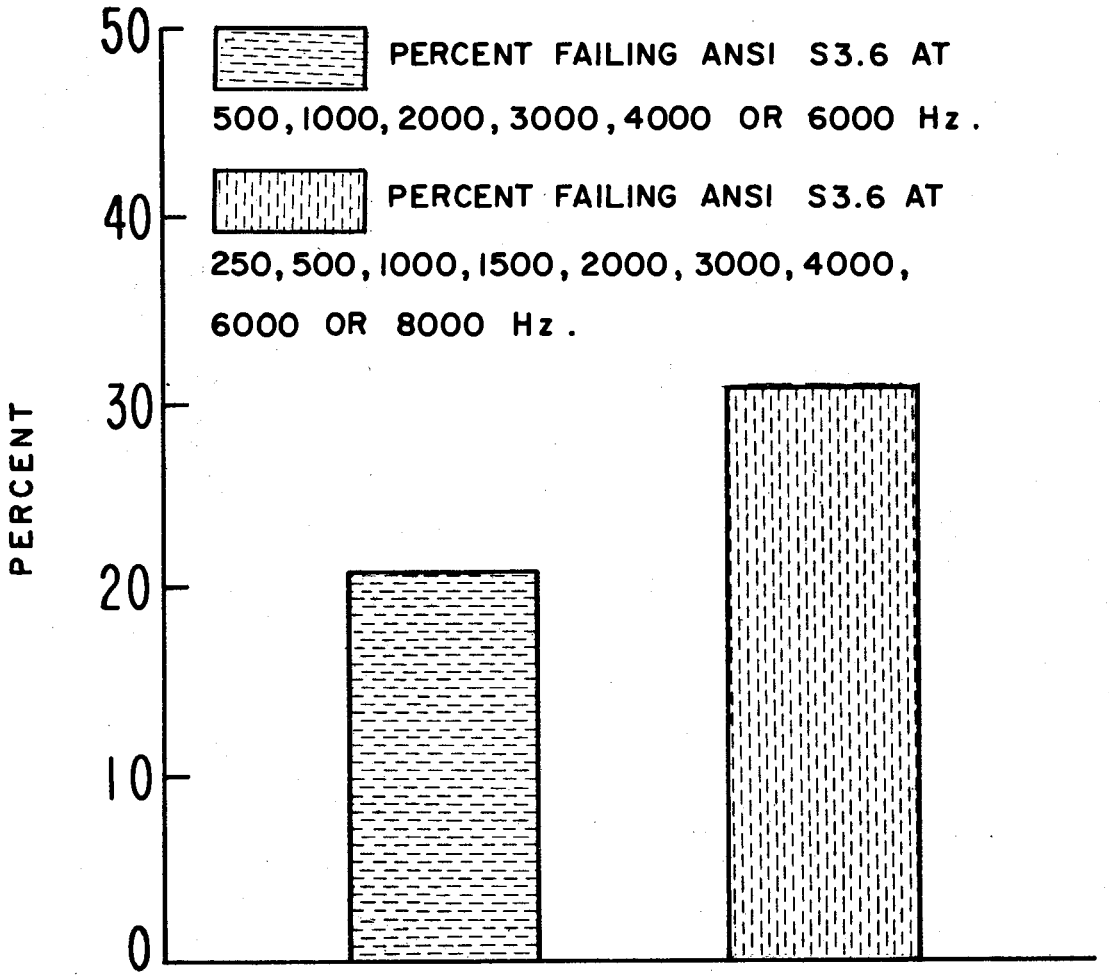


Figure 8. Accuracy of Tone Frequency: NIOSH Recommended Frequencies Compared Against Indicated Frequencies Specified in ANSI - 3.6

TABLE 17

EARPHONE SOUND PRESSURE LEVELS (RE AUDIOMETRIC ZERO):
LEFT AND RIGHT, LEFT ONLY, RIGHT ONLY - '70 dB' DIAL SETTING

	FREQUENCY IN KHZ									
	(.125)	(.250)	.500	1.0	(1.5)	2.0	3.0	4.0	6.0	(8.0)
LEFT-AND-RIGHT EARPHONES										
Mean	64.6	67.1	68.6	70.7	70.9	70.4	68.5	70.6	66.2	70.6
S.D.	10.0	7.2	4.4	2.3	2.7	2.1	2.9	2.4	4.4	4.5
N =	87	118	148	146	86	148	146	148	146	118
Percentage Failing	36%	36%	31%	23%	28%	20%	39%	11%	42%	22%
* * * * *										
LEFT EARPHONES ONLY										
Mean	66.1	67.3	68.9	70.6	70.8	70.4	68.6	70.7	66.2	70.7
S.D.	8.2	7.3	4.6	2.2	2.4	1.9	3.0	2.1	4.5	4.4
N =	42	59	74	73	43	74	73	74	73	59
Percentage Failing	24%	22%	24%	14%	14%	11%	27%	5%	35%	15%
* * * * *										
RIGHT EARPHONES ONLY										
Mean	63.2	67.0	68.3	70.7	71.1	70.5	68.5	70.5	66.2	70.6
S.D.	11.3	7.2	4.2	2.5	2.9	2.2	2.8	2.6	4.2	4.7
N =	45	59	74	73	43	74	73	74	73	59
Percentage Failing	33%	32%	24%	16%	23%	17%	32%	11%	36%	14%

TABLE 18

ATTENUATION ERROR OF AUDIOMETERS

DIAL SETTING	1000 HZ TEST SETTING			OTHER HZ SETTINGS*			ALL HZ SETTINGS		
	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N
100	-0.1	1.9	31	-0.9	3.4	7	-0.2	2.2	38
95	-0.1	1.8	33	0.0	1.2	7	0.0	1.7	40
90	-0.2	1.5	33	0.5	1.0	9	0.0	1.4	42
85	-0.4	3.1	33	0.5	1.8	7	-0.2	2.9	40
80	-0.2	0.7	34	0.3	0.7	9	-0.1	0.7	43
75	-0.1	0.7	35	0.5	0.8	7	0.0	0.7	42
70	--	--	41	--	--	11	--	--	52
65	0.1	0.8	41	0.2	0.8	9	0.1	0.8	50
60	0.0	0.6	41	0.2	0.4	11	0.0	0.6	52
55	0.1	0.8	41	0.8	2.1	9	0.3	1.1	50
50	0.1	1.2	41	0.6	1.7	11	0.2	1.3	52
45	0.4	2.1	41	0.6	2.2	9	0.5	2.1	50
40	0.4	3.1	41	0.1	1.2	11	0.3	2.8	52
35	0.3	1.5	40	-0.2	2.1	9	0.2	1.6	49
30	0.2	1.8	40	-0.1	2.3	11	0.1	1.9	51
25	0.4	1.9	40	-0.4	3.1	8	0.3	2.1	48

* Other settings include: 50 Hz, N = 1; 1500 Hz, N = 4; 2000 Hz, N = 4; 3000 Hz, N = 2.

(relative to the 70 dB dial setting) is less than 1 dB from the indicated dial setting for 41 audiometers tested at a 1000 Hz frequency setting and for 11 audiometers tested at other frequency settings. Further evaluation of attenuation accuracy indicated that 25% (13) of 52 audiometers failed to meet the ANSI S3.6 specification concerning the difference between successive interstep spacing measurements which should be within three-tenths of the indicated dial interval ('interval test'). Shown in Table 19 are means and standard deviations of the actual earphone sound pressure levels and percentages of audiometers exceeding ANSI S3.6 range limits. The results are given as a function of dial setting for 41 audiometers tested at the frequency setting of 1000 Hz.

The composite review of earphone sound pressure levels, presented in Table 20, was developed using all actual measurements of both left and right earphone sound pressure levels. Most measurements were made at the 70 dB dial setting. In cases where interstep spacing measurements were made, attenuation differences were used to project earphone sound pressure levels at other frequencies as a function of dial setting. The following example shows a typical calculation. Determination of 4000 Hz earphone SPL's using differences between interstep spacing measurements (given that the 4000 Hz earphone is 71 dB at the '70 dB' intensity dial setting).

Intensity Dial Setting (I.D.S.)	Attenuation Difference from the 70 dB I.D.S.	4000 Hz Earphone SPL
100	+29	71 + 29 = 100 dB
90	+20	71 + 20 = 91 dB
80	+10	71 + 10 = 81 dB
70	---	71 dB
60	-10	71 - 10 = 61 dB
50	-21	71 - 21 = 50 dB
40	-30	71 - 30 = 41 dB

Figure 9 illustrated means and standard deviations of earphone sound pressure levels as a function of frequency setting for all actual measurements made at the 70 dB dial setting and as a function of dial setting for all calculated earphone sound pressure levels at 1000 Hz.

Figure 10 illustrates a comparison at each frequency of the percentage of audiometers exceeding ANSI S3.6 range limits only at the 70 dB dial setting versus the percentages of audiometers exceeding range limits at one or more of the dial settings. The differences between percentage calculations indicate that an additional 8% to 17% exceed ANSI S3.6 range limits, depending upon the frequency setting, except at 125 Hz and 1500 Hz which have differences of 4% and 29%, respectively.

TABLE 19

ACCURACY OF INTERSTEP SPACING MEASUREMENTS
AT 1000 HZ TEST SETTING

DIAL SETTING	MEAN	STANDARD DEVIATION	No.	PERCENTAGE FAILING
100	100.6	3.5	31	13%
95	95.6	3.3	33	12%
90	90.5	3.3	33	9%
85	85.3	4.6	33	15%
80	80.5	3.4	34	9%
75	75.6	3.4	35	14%
70	70.5	3.4	41	12%
65	65.6	3.4	41	15%
60	60.5	3.5	41	15%
65	55.6	3.6	41	15%
50	50.6	4.0	41	15%
45	45.9	4.5	41	17%
40	40.8	5.6	41	22%
35	35.6	3.5	40	18%
30	30.5	4.0	40	28%
25	25.7	4.1	40	28%

TABLE 20

EARPHONE SOUND PRESSURE LEVELS (RE AUDIOMETRIC ZERO) -- COMPOSITE TABULATION

EARPHONE SOUND PRESSURE LEVELS RE. AUDIOMETRIC ZERO

DIAL SETTING	DATA	ALL EARS FREQUENCY IN KHZ									
		(.125)	(.250)	.500	1.0	(1.5)	2.0	3.0	4.0	6.0	(8.0)
100.0	MEAN			98.1	100.6	100.8	100.1	98.0	100.6		
	S.D.			5.2	2.7	2.8	2.3	3.5	2.5		
	N=			76	74	60	76	76	76		
95.0	MEAN			93.0	95.7	96.2	95.3	93.1	95.8		
	S.D.			5.9	2.4	2.6	2.4	3.5	2.5		
	N=			80	78	64	80	80	80		
90.0	MEAN		86.0	88.0	90.7	91.1	90.3	88.2	90.8	85.6	
	S.D.		6.9	5.9	2.4	2.6	2.4	3.5	2.5	4.9	
	N=		80	84	82	64	84	84	84	84	
85.0	MEAN		80.8	82.8	85.5	85.9	85.1	82.9	85.6	80.2	
	S.D.		9.0	6.2	3.1	3.3	3.0	4.1	3.2	5.2	
	N=		80	80	78	64	80	80	80	80	
80.0	MEAN		76.1	78.0	80.7	81.1	80.3	78.2	80.8	75.5	80.3
	S.D.		8.4	5.5	2.4	2.9	2.3	3.3	2.4	4.5	5.3
	N=		82	86	84	64	86	86	86	86	82
75.0	MEAN		71.3	73.1	75.8	76.3	75.4	73.1	76.1	70.4	75.6
	S.D.		8.4	5.6	2.3	2.9	2.3	3.4	2.6	4.5	5.2
	N=		84	84	82	64	84	82	84	82	84
**********											
70.0	MEAN	64.6	67.1	68.6	70.7	70.9	70.4	68.5	70.6	65.2	70.6
	S.D.	10.0	7.2	4.4	2.3	2.7	2.1	2.9	2.4	4.4	4.5
	N=	87	118	148	146	86	148	146	148	146	118
**********											
65.0	MEAN	59.4	61.8	63.4	65.7	66.2	65.3	63.2	65.9	60.8	65.6
	S.D.	10.5	7.7	5.0	2.3	2.6	2.1	3.1	2.5	4.3	4.9
	N=	77	100	100	98	80	100	98	100	98	100
60.0	MEAN	54.2	56.6	58.4	60.6	61.0	60.2	58.3	60.9	55.9	60.5
	S.D.	10.5	7.7	5.0	2.3	2.7	2.1	3.1	2.6	4.4	4.9
	N=	77	100	104	102	80	104	102	104	102	100
55.0	MEAN	49.6	51.9	53.6	55.8	56.4	55.4	53.4	56.1	51.0	55.8
	S.D.	10.5	7.8	5.2	2.5	2.7	2.4	3.4	2.7	4.6	4.9
	N=	77	100	100	98	80	100	98	100	98	100
50.0	MEAN	44.5	46.8	48.6	50.7	51.3	50.4	48.4	51.0	46.1	50.7
	S.D.	10.3	7.7	5.2	2.7	2.8	2.5	3.4	2.8	4.7	4.9
	N=	77	100	104	102	80	104	102	104	102	100
45.0	MEAN	39.9	42.1	43.8	46.0	46.7	45.7	43.7	46.3	41.2	46.0
	S.D.	10.3	7.7	5.4	3.0	3.0	2.7	3.6	2.9	4.9	4.9
	N=	77	100	100	98	80	100	98	100	98	100
40.0	MEAN	34.6	36.9	38.7	40.9	41.5	40.5	38.6	41.2	36.2	40.8
	S.D.	10.0	7.5	5.4	3.4	3.7	3.1	3.9	3.3	5.0	5.1
	N=	77	100	104	102	80	104	102	104	102	100
35.0	MEAN	30.0	32.1	33.5	35.7	36.4	35.4	33.3	36.0	30.9	35.8
	S.D.	10.1	7.6	5.1	2.3	2.8	2.4	3.1	2.7	4.4	4.9
	N=	75	98	98	96	78	98	96	98	96	98
30.0	MEAN	24.9	27.0	28.5	30.6	31.2	30.3	28.3	30.9	26.0	30.7
	S.D.	10.1	7.7	5.0	2.7	2.9	2.6	3.4	2.9	4.5	4.9
	N=	75	98	102	100	78	102	100	102	100	98
25.0	MEAN	19.9	22.0	23.5	25.7	26.4	25.4	23.4	26.0	20.9	25.7
	S.D.	10.1	7.5	5.1	2.6	3.2	2.7	3.3	2.9	4.5	4.8
	N=	73	96	96	94	76	96	94	96	94	96

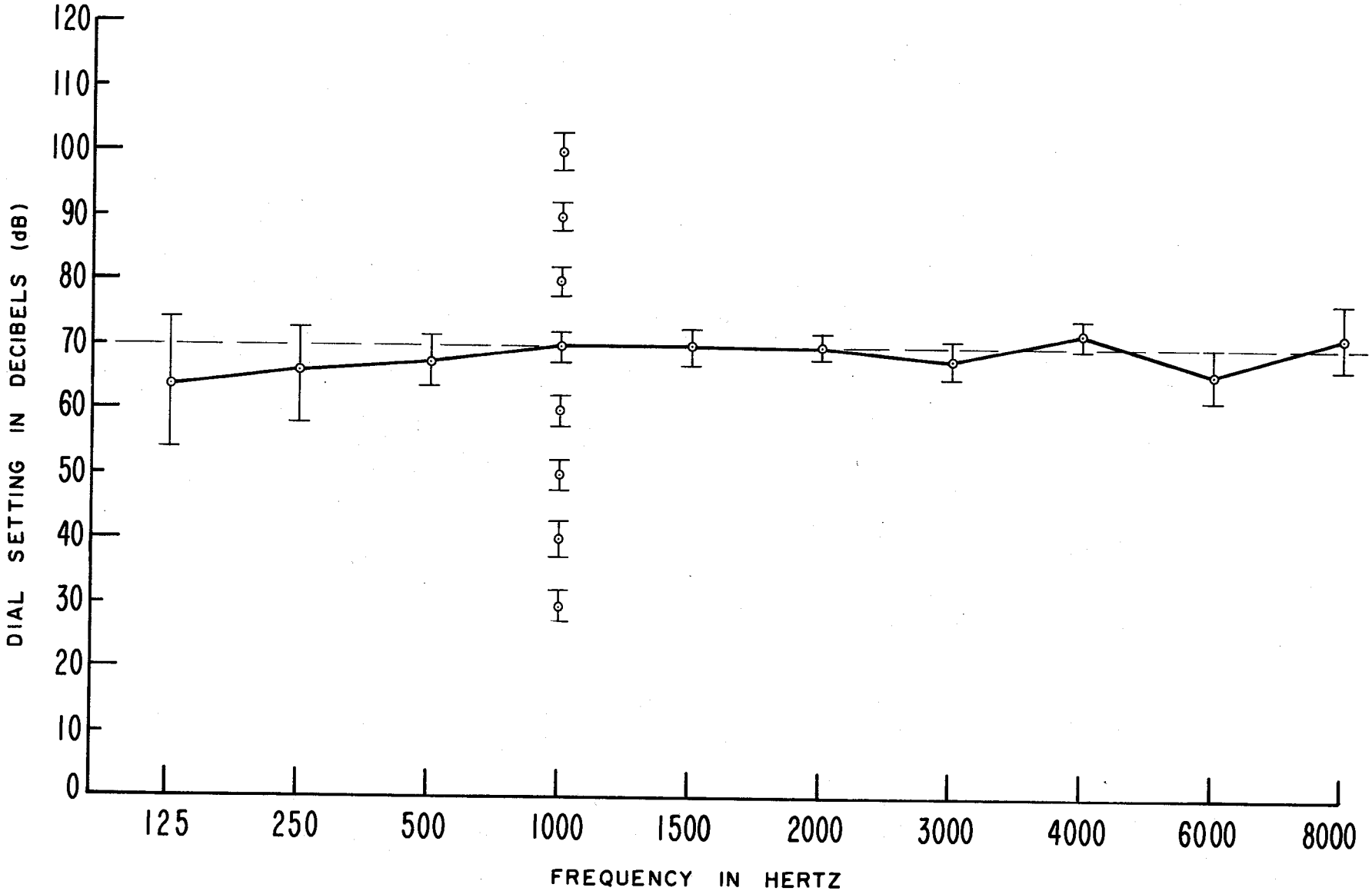


Figure 9. Earphone Sound Pressure Levels: Means and Standard Deviations versus Frequency Setting

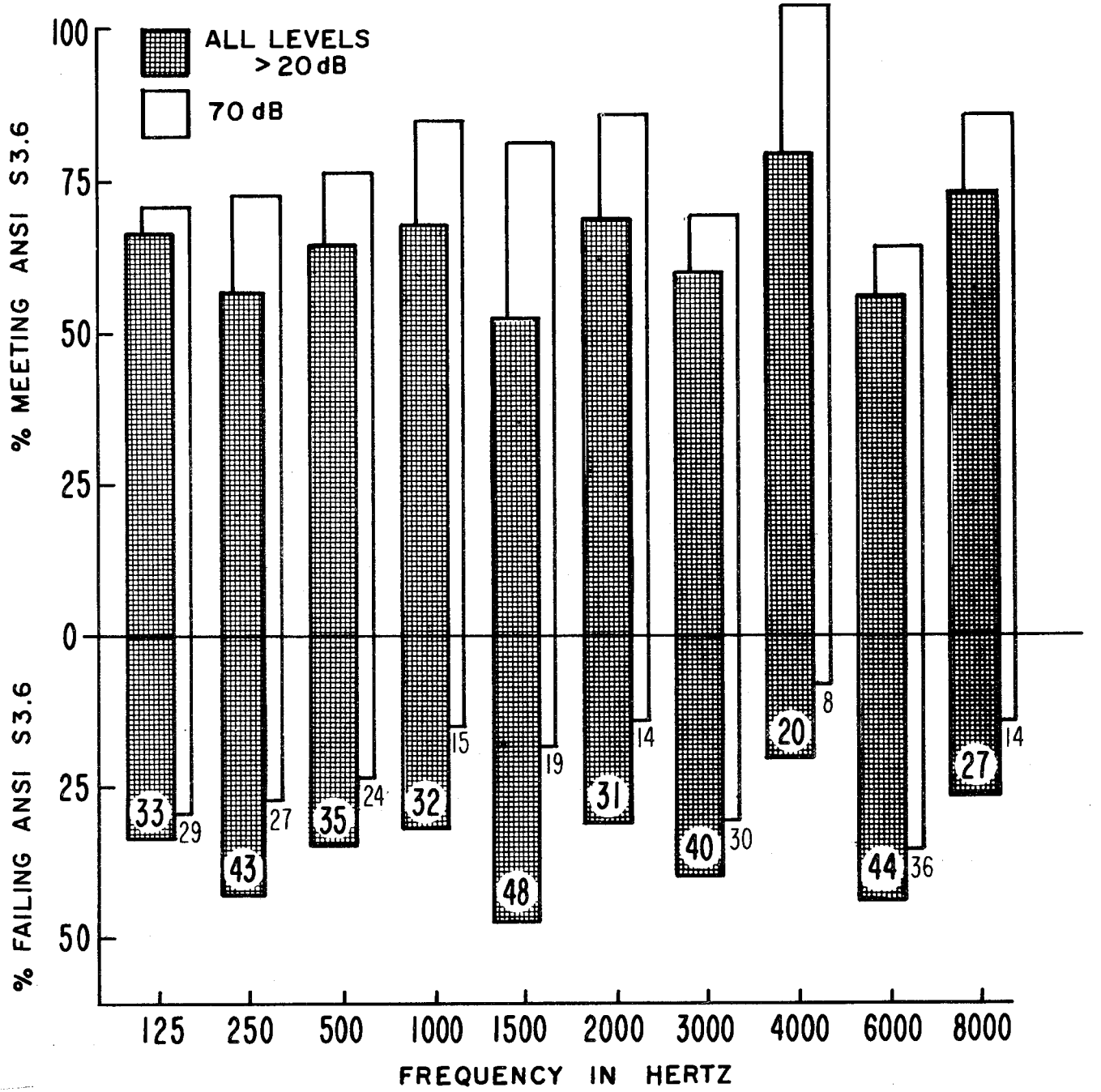


Figure 10. Accuracy of Earphone Sound Pressure Levels Versus Frequency Setting: '70 dB' Dial Setting Compared Against All Calculated Levels

Tables 21 and 22 show two additional comparisons of earphone sound pressure level statistics for left and right ear measurements made at the 70 dB dial setting. Table 21 is a comparison of automatic versus manual audiometers; Table 22 is a comparison of audiometers calibrated re ASA Z24.5 versus audiometers calibrated re ANSI S3.6. The manual audiometers appear to be significantly less accurate with respect to ANSI S3.6 range limits at 125, 250, 3000, and 6000 Hz than automatic audiometers (18% to 29% additional audiometers failing); however, the differences between standard deviations appear to be significantly greater only at 125 and 250 Hz. Similarly, audiometers calibrated re ASA Z24.5 show significantly greater standard deviations only at 125, 250, and 500 Hz when compared to audiometers calibrated re ANSI S3.6, although all frequencies except 1000 Hz show from 10% to 42% more audiometers calibrated re ASA Z24.5 exceeding ANSI S3.6 range limits. Figure 11 illustrates the latter comparison of audiometers. In addition to high percentages failing at each frequency, all audiometers calibrated re ASA Z24.5 exceeded the ANSI S3.6 range limit requirements at one or more frequency settings including 500, 1000, 2000, 3000, 4000, and 6000 Hz. For the purpose of comparison, 53% (24) of 45 audiometers calibrated re ANSI S3.6 exceeded range limit requirements at one or more of these frequency settings; and, with the inclusion of 250, 1500, and 8000 Hz, only one additional audiometer failed. These differences could be explained partially by recognizing that audiometers calibrated re ASA Z24.5-1951 may not have been checked as recently as audiometers calibrated re ANSI S3.6-1969. Also, some of the inaccuracies could be traced to the personnel who periodically perform the calibration check since, in a few cases, audiometers were out of calibration even when they had been checked recently.

EVALUATION OF AMBIENT NOISE LEVEL MEASUREMENTS

The ambient noise level measurements obtained (see Appendix I, Part 4) were compared against octave-band noise level limits of ANSI S3.1-1969 (R-1971). However, this standard is prescribed for no masking at 0 dB hearing level in terms of the audiometer specifications presented in ASA Z24.5-1951; so an adjusted criteria for no masking at 0 dB hearing level was also used, based upon the ANSI S3.6-1969 definition of audiometric zero. To obtain the adjusted criteria, the differences between audiometric zero referenced to ANSI S3.6 and ASA Z24.5, were subtracted from the corresponding octave-band sound pressure level limits of ANSI S3.1 given in Table 15. This adjusted criteria was used because it was considered to be more appropriate in view of the redefinition of audiometric zero. However, recently an ANSI working group has proposed a new standard, and the noise limits for all three criteria are shown in Figure 12.

An evaluation of ambient noise level measurements is shown in Table 23. Figure 12 illustrates the means and standard deviations of ambient noise levels as a function of octave-band frequencies. Figure 13 presents

TABLE 21

EARPHONE SOUND PRESSURE LEVELS (RE AUDIOMETRIC ZERO): AUTOMATIC VERSUS MANUAL AUDIOMETERS -- '70 dB' DIAL SETTING

	FREQUENCY IN KHZ									
	(.125)	(.250)	.500	1.0	(1.5)	2.0	3.0	4.0	6.0	(8.0)
AUTOMATIC AUDIOMETERS										
Mean	67.5	69.9	69.1	70.9	69.6	70.9	69.3	70.1	67.0	71.3
S.D.	3.7	2.0	2.6	2.6	2.4	2.0	2.1	1.9	4.5	2.0
N =	10	18	44	44	6	44	44	44	44	18
Percentage Failing	20%	11%	30%	26%	33%	17%	26%	4%	26%	22%
MANUAL AUDIOMETERS										
Mean	64.2	66.6	68.4	70.5	71.0	70.2	68.2	70.8	65.9	70.5
S.D.	10.5	7.7	4.9	2.3	2.7	2.1	3.1	2.5	4.3	4.9
N =	77	100	104	102	80	104	102	104	102	100
Percentage Failing	38%	40%	31%	22%	28%	21%	45%	13%	49%	22%

TABLE 22

EARPHONE SOUND PRESSURE LEVELS (RE AUDIOMETRIC ZERO): AUDIOMETERS CALIBRATED RE ASA Z24.5 VERSUS AUDIOMETERS CALIBRATED RE ANSI S3.6 -- '70 dB' DIAL SETTING

	FREQUENCY IN KHZ									
	(.125)	(.250)	.500	1.0	(1.5)	2.0	3.0	4.0	6.0	(8.0)
AUDIOMETERS CALIBRATED RE ASA Z24.5										
Mean	62.9	64.8	67.0	70.1	71.4	70.2	67.2	70.5	63.6	70.9
S.D.	11.3	9.4	5.6	2.3	3.3	2.5	3.2	3.0	3.6	4.3
N =	34	44	58	56	36	58	56	58	56	44
Percentage Failing	50%	50%	45%	21%	44%	31%	64%	17%	68%	36%
AUDIOMETERS CALIBRATED RE ANSI S3.6										
Mean	65.6	68.5	69.6	71.0	70.6	70.5	69.4	70.7	67.8	70.6
S.D.	8.9	5.0	2.9	2.3	2.1	1.7	2.4	1.9	4.0	4.7
N =	63	74	90	90	50	90	90	90	90	74
Percentage Failing	27%	27%	22%	24%	16%	13%	24%	7%	26%	14%

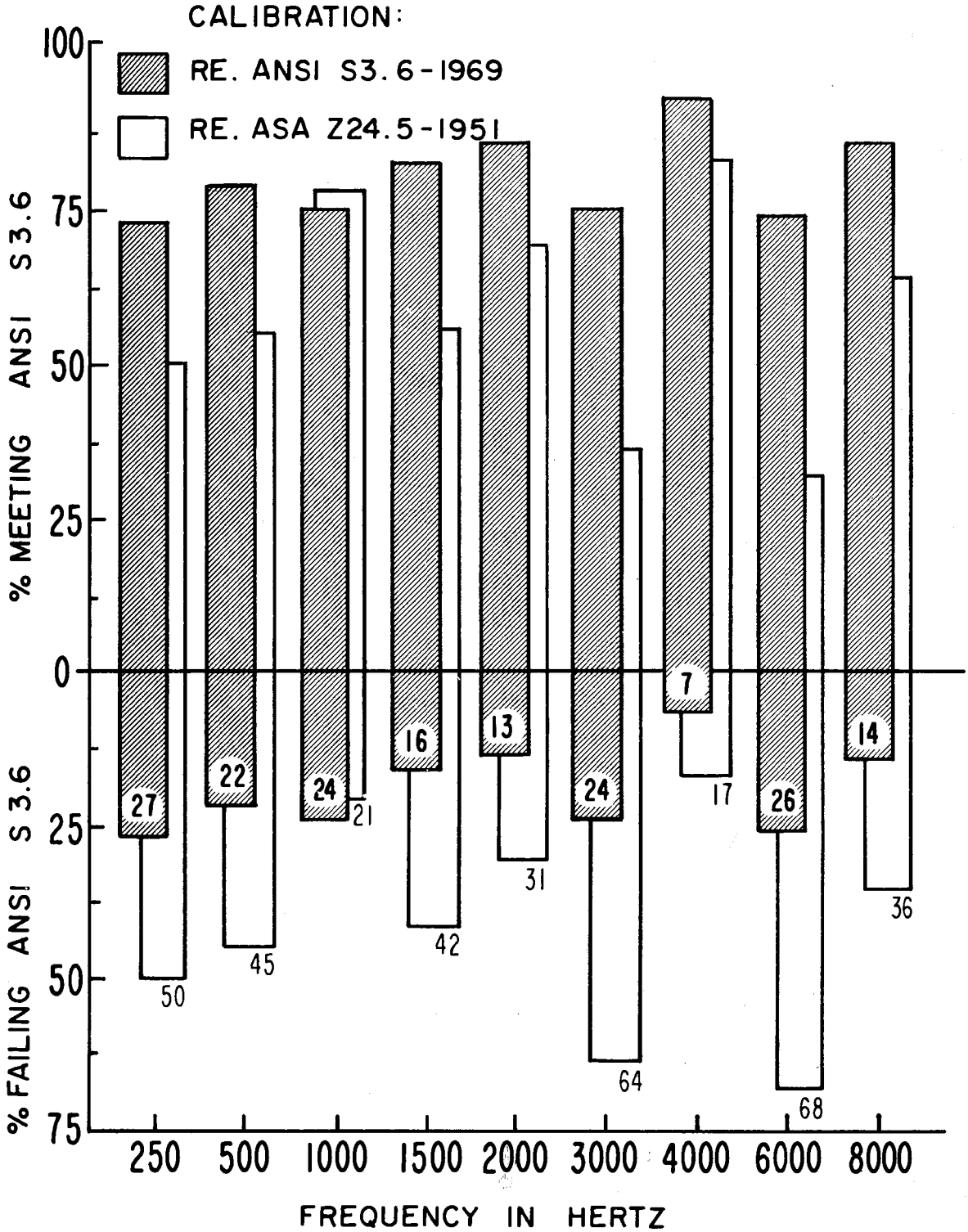


Figure 11. Accuracy of Earphone Sound Pressure Levels at the '70 dB' Dial Setting Versus Frequency Setting: Audiometers Calibrated re ASA Z24.5 Compared to Audiometers Calibrated re ANSI S3.6

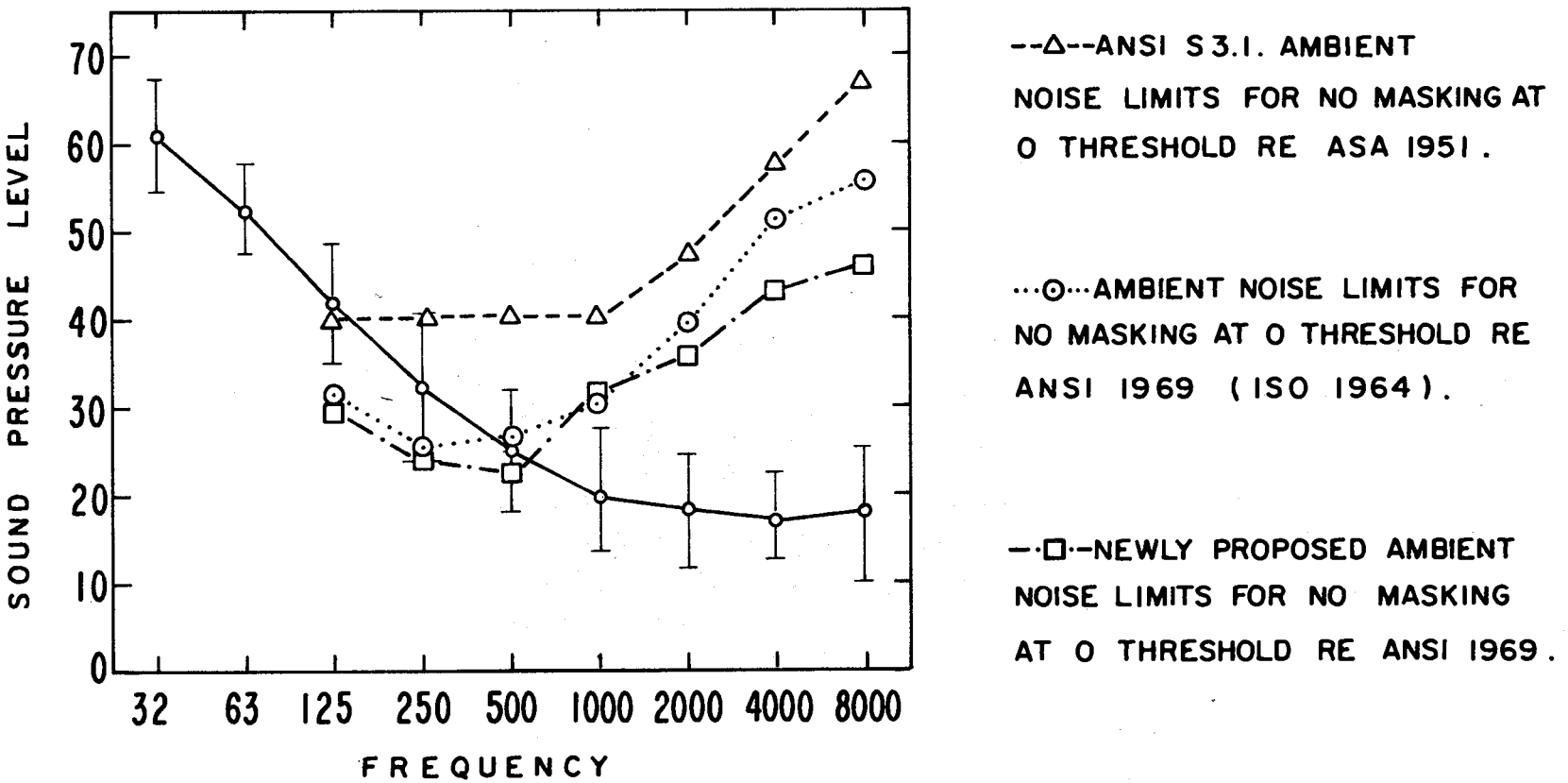


Figure 12. Background Noise Levels: Means and Standard Deviations Versus Frequency Setting

TABLE 23

AMBIENT NOISE LEVEL EVALUATION BY FREQUENCY SETTING

Frequency	Mean SPL	Standard Deviation	No.	Percentage Failing	
				Re. ASA '51	Re. ANSI '69
31	60.9	7.4	19		
63	52.3	6.8	20		
125	42.6	7.7	49	57%	98%
250	32.1	8.2	51	18%	82%
500	24.6	8.6	65	8%	28%
1000	20.3	7.4	65	2%	12%
2000	18.9	6.0	66	0%	0%
4000	17.5	4.4	66	0%	0%
8000	17.5	5.7	64	0%	0%

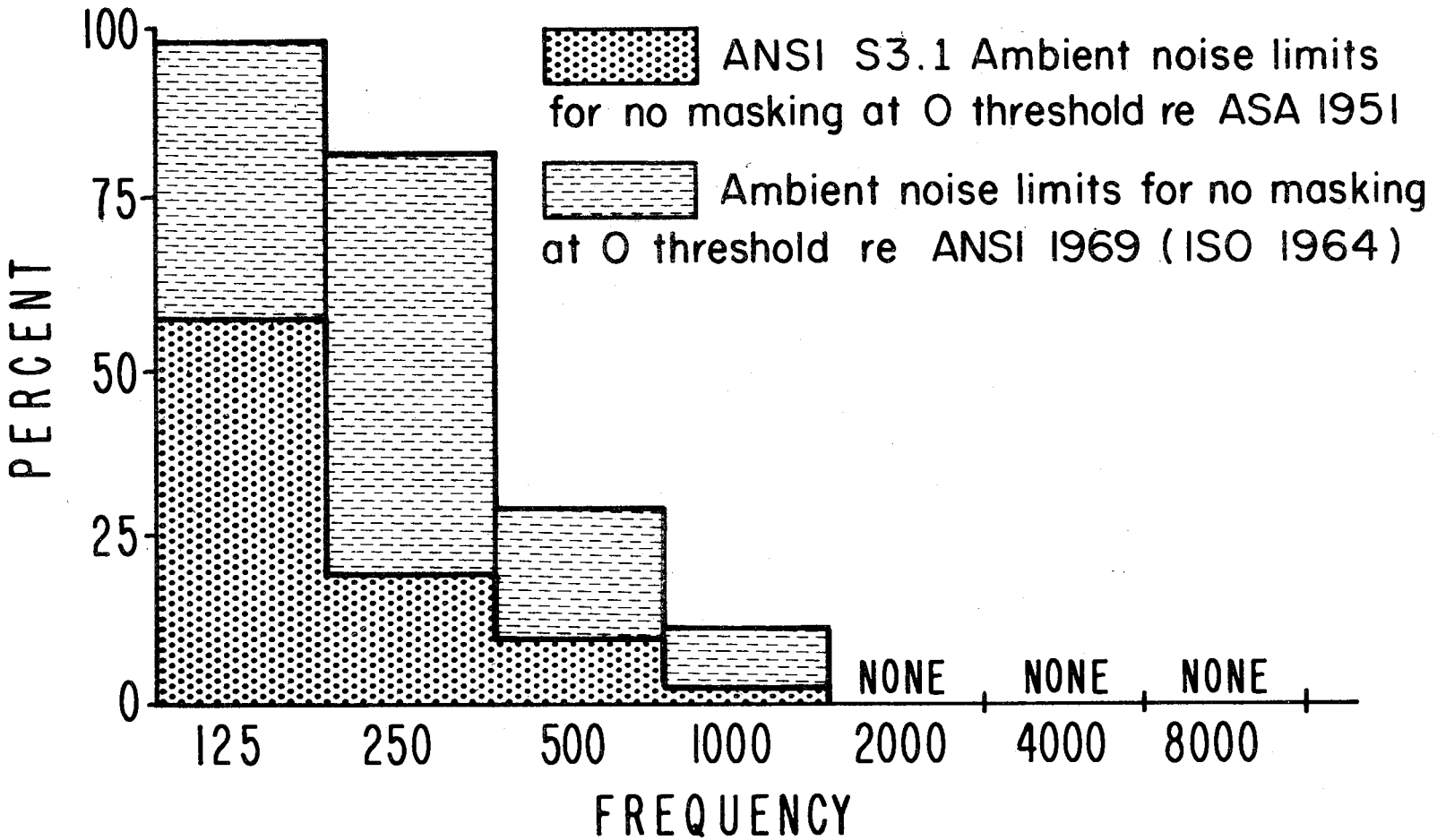


Figure 13. Percentage of Audiometric Test Rooms Exceeding Ambient Noise Limits Versus Frequency Setting

a comparison of the percentage of test rooms exceeding ANSI S3.1 noise level limits versus the percentage exceeding the adjusted limits (modifications as described above) at each frequency.

Of 65 test rooms in which noise levels were measured at frequencies of 500 Hz or greater, 8% exceeded ANSI S3.1 limits at one or more frequency settings, and 28%, when the modified criteria were applied. Likewise, for the 51 test rooms in which noise levels were measured at frequencies of 250 Hz or greater, 18% exceeded ANSI S3.1 limits, and 84%, using the modified criteria. The latter comparison is illustrated in Figure 14. Of the specific 51 rooms mentioned above, 8% (4) exceeded ANSI S3.1 limits at one or more frequency settings including 500 Hz and above.

Comparison of ambient noise level measurements with the noise limits of the newly proposed ANSI standard does not yield significantly different results from those obtained using the modified limits discussed above, with one exception. At 500 Hz, 48% of the ambient noise level measurements exceeded the newly proposed limits versus 28% for the modified limits (see Figure 12 and Table 23).

COMMENTS

Figures 7 and 9 show that tone frequencies and earphone sound pressure levels most frequently exceeded allowable tolerances near the ends of the tone frequency spectrum. This fact should be taken into account when frequencies are chosen for industrial audiometric testing. The use of extreme frequencies can be invalidated by the fact that they are often out of calibration.

Evaluations of the accuracy of sound pressure level measurements at various dial settings shown in Table 19 and Figure 10 indicate that SPL measurements at the 70 dB dial setting may be within ANSI S3.6 SPL range limits while failing to be within tolerances at other dial settings, particularly at the lower intensity dial settings. Based on these results, it is recommended that interstep spacing measurements be included in a calibration check procedure (see Appendix H, Part D).

Results of comparing ambient noise level measurements with respect to ANSI S3.1 versus the modified criteria (as shown in Figures 13 and 14) or versus the recently proposed ANSI criteria indicate the inadequacy of many audiometric test rooms to accurately measure threshold hearing levels of 0 dB or lower at frequency settings of 125, 250 and 500 Hz.

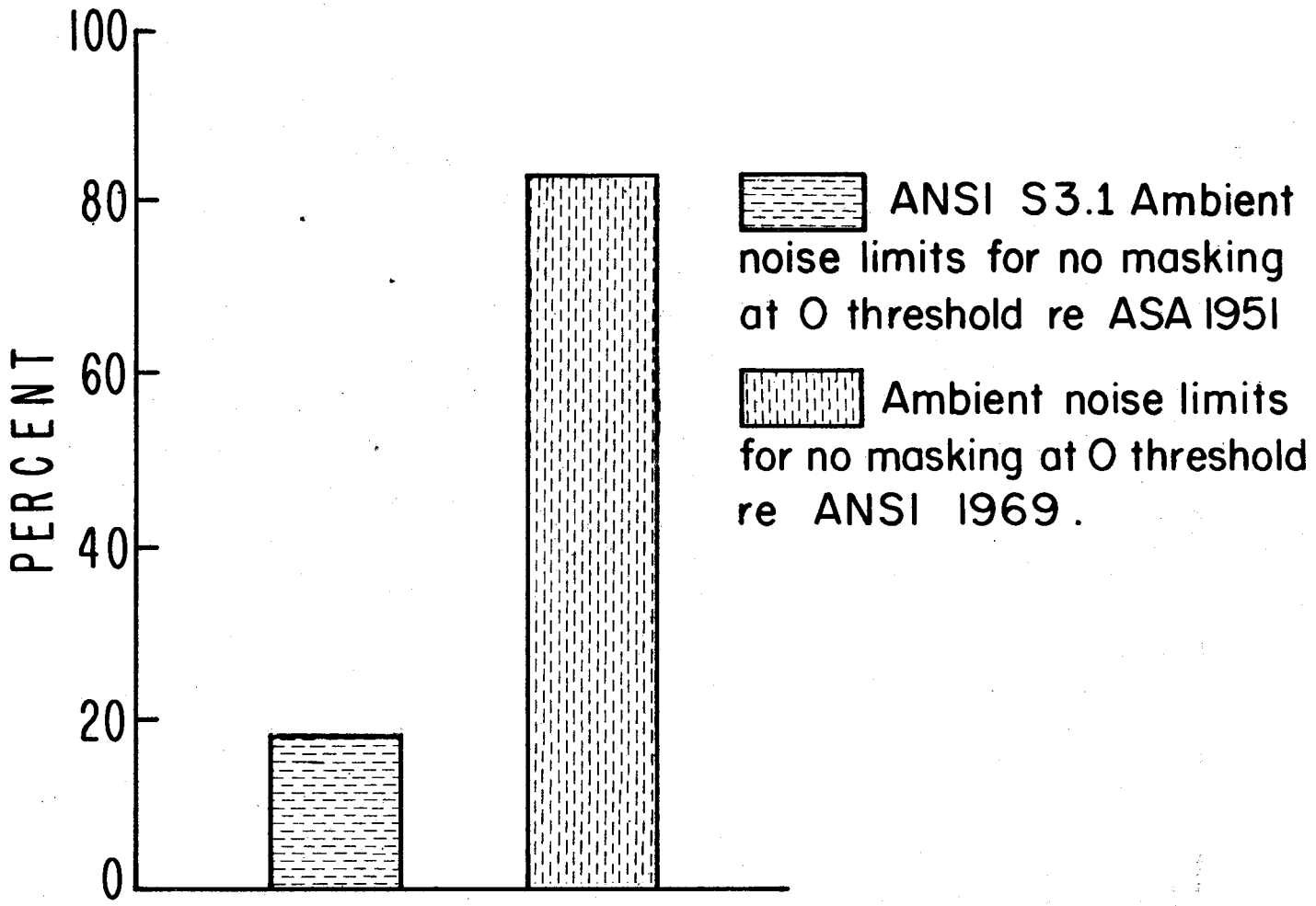


Figure 14. Percentage of Audiometric Test Rooms Exceeding Ambient Noise Limits at One or More of the Frequency Settings Including 250 Hz and Greater

An overall evaluation of similar measurements obtained from 65 companies indicated that for 80% of the companies, one or more of the following criteria was exceeded:

1. ANSI S3.6 tolerance for tone frequencies 500, 1000, 2000, 3000, 4000, and 6000 Hz.

2. ANSI S3.6 earphone sound pressure level range limits at tone frequency settings of 500, 1000, 2000, 3000, 4000, and 6000 Hz.

3. ANSI S3.1 limits for octave-band background noise levels measured at octave-band frequency settings of 500 Hz or greater.

APPENDIX A -- LIST OF SIC CODES

NUMBER OF QUESTIONNAIRES SENT	4 DIGIT SIC CODE	TYPE OF INDUSTRY
7	1925	Complete guided missiles
14	1929	Ammunition, exc. for small arms, nec
1	1931	Tanks and tank components
5	1951	Small arms
3	1961	Small arms ammunition
47	2011	Meat packing
9	2031	Canned and cured sea foods
5	2032	Canned specialties
30	2033	Canned fruits and vegetables
36	2082	Malt liquors
4	2084	Wines, brandy
2	2085	Distilled liquor, except brandy
24	2086	Bottled and canned soft drinks
1	2111	Cigarettes
22	2211	Weaving mills, cotton
21	2221	Weaving mills, synthetics
10	2231	Weaving and finishing mills, wool
9	2241	Narrow fabric mills
28	2251	Womens hosiery, except socks
27	2252	Hosiery, nec
20	2253	Knit outerwear mills
9	2254	Knit underwear mills
6	2256	Knit fabric mills
1	2259	Knitting mills, nec
7	2271	Woven carpets and rugs
3	2272	Tufted carpets and rugs
1	2279	Carpets and rugs
14	2281	Yarn mills, except wool
8	2282	Throwing and winding mills
2	2283	Wool yarn mills
1	2284	Thread mills
43	2311	Mens and boys suits and coats
21	2321	Mens and boys shirts and nightwear
20	2331	Womens and misses dresses
20	2337	Womens and misses suits and coats
14	2342	Corsets and allied garments
6	2381	Fabric dress and work gloves
4	2393	Textile bags
3	2394	Canvas products
2	2395	Pleating and stitching
2	2396	Automotive and apparel trimmings
1	2411	Logging camps and logging contractors
16	2421	Sawmills and planing mills, general
6	2426	Hardwood dimension and flooring

NUMBER OF QUESTIONNAIRES SENT	4 DIGIT SIC CODE	TYPE OF INDUSTRY
18	2431	Millwork
19	2432	Veneer and plywood
7	2433	Prefabricated wood structures
3	2441	Nailed wooden boxes and shook
6	2442	Wire bound boxes and crates
43	2511	Wood household furniture
26	2512	Upholstered household furniture
6	2521	Wood office furniture
9	2522	Metal office furniture
12	2531	Public building furniture
10	2541	Wood partitions and fixtures
7	2542	Metal partitions and fixtures
2	2611	Pulp mills
16	2621	Paper mills, except building paper
8	2631	Paperboard mills
16	2641	Paper coating and glazing
16	2642	Envelopes
15	2643	Bags, except textile bags
30	2651	Folding paperboard boxes
8	2652	Set-up paperboard boxes
29	2653	Corrugated and solid fiber boxes
27	2711	Newspapers
3	2732	Book printing
57	2751	Commercial printing, ex lithographic
47	2752	Commercial printing, lighographic
7	2753	Engraving and plate printing
9	2822	Synthetic rubber
28	2834	Pharmaceutical preparations
11	2841	Soap and other detergents
5	2871	Fertilizers
42	2911	Petroleum refining
8	3011	Tires and inner tubes
42	3141	Shoes, except rubber
7	3211	Flat glass
11	3221	Glass containers
5	3255	Clay refractories
8	3281	Cut stone and stone products
51	3312	Blast furnaces and steel mills
4	3313	Electrometallurgical products
6	3315	Steel wire and related products
13	3316	Cold finishing of steel shapes
17	3317	Steel pipe and tubes

NUMBER OF QUESTIONNAIRES SENT	4 DIGIT SIC CODE	TYPE OF INDUSTRY
40	3321	Gray iron foundries
4	3322	Malleable iron foundries
30	3323	Steel foundries
3	3331	Primary copper
1	3332	Primary lead
5	3334	Primary aluminum
2	3339	Primary nonferrous metals
6	3341	Secondary nonferrous metals
12	3351	Copper rolling and drawing
7	3352	Aluminum rolling and drawing
10	3356	Nonferrous rolling and drawing
15	3357	Nonferrous wire drawing and insulating
21	3361	Aluminum castings
5	3362	Brass, bronze and copper castings
20	3369	Nonferrous castings
21	3391	Iron and steel forging
2	3392	Nonferrous forging
6	3399	Primary metal products
15	3411	Metal cans
5	3421	Cutlery
16	3423	Hand and edge tools
2	3425	Hand saws and saw blades
28	3429	Hardware
4	3431	Metal sanitary ware
10	3432	Plumbing fittings and brass goods
22	3433	Heating equipment, except electric
60	3441	Fabricated structural steel
26	3442	Metal doors, sash and trim
35	3443	Fabricated plate work (boiler shops)
31	3444	Sheet metal work
17	3449	Miscellaneous metal work
15	3451	Screw machine products
32	3452	Bolts, nuts, rivets and washers
67	3461	Metal stampings
16	3471	Plating and polishing
8	3479	Metal coating and allied services
34	3481	Misc. Fabricated wire products
4	3491	Metal barrels, drums and pails
9	3493	Steel springs
31	3494	Valves and pipe fittings
2	3496	Collapsible tubes
2	3497	Metal foil and leaf
10	3498	Fabricated pipe and fittings
21	3499	Fabricated metal products, nec
3	3511	Steam engines and turbines

NUMBER OF QUESTIONNAIRES SENT	4 DIGIT SIC CODE	TYPE OF INDUSTRY
6	3519	Internal combustion engines
16	3522	Farm machinery
23	3531	Construction machinery
10	3532	Mining machinery
32	3533	Oil field machinery
8	3534	Elevators and moving stairways
13	3535	Conveyors and conveying equipment
7	3536	Hoists, cranes and monorails
17	3537	Industrial trucks and tractors
22	3541	Machine tools, metal cutting type
23	3542	Machine tools, metal forming type
28	3544	Special dies, tools, jigs and fixtures
21	3551	Food products machinery
7	3552	Textile machinery
9	3553	Woodworking machinery
5	3554	Paper industries machinery
12	3555	Printing trades machinery
25	3559	Special industry machine
28	3561	Pumps and compressors
14	3562	Ball and roller bearings
20	3564	Blowers and fans
16	3612	Transformers
27	3621	Motors and generators
6	3623	Welding apparatus
1	3632	Household refrigerators and freezers
1	3633	Household laundry equipment
11	3634	Electric housewares and fans
2	3635	Household vacuum cleaners
3	3636	Sewing machines
25	3711	Motor vehicles
1	3712	Passenger car bodies
8	3713	Truck and bus bodies
59	3714	Motor vehicle parts and accessories
11	3715	Truck trailers
16	3721	Aircraft
15	3722	Aircraft engines and engine parts
3	3723	Aircraft propellers and parts
73	3729	Aircraft equipment
23	3731	Ship building and repairing
6	3732	Boat building and repairing
13	3742	Railroad and street cars
1	3751	Motorcycles, bicycles and parts
9	3791	Trailer coaches
1	3799	Transportation equipment
17	3841	Surgical and medical instruments
17	3842	Surgical appliances and supplies
5	3843	Dental equipment and supplies

APPENDIX B -- QUESTIONNAIRE AND RESPONSE

QUESTIONNAIRE RESULTS

Completed Section A: N = 2074 (all) companies

Completed Section B: N = 367 companies planning a hearing conservation program

Completed Section C: N = 502 companies have a hearing conservation program

NOTES:

The number of manufacturing companies responding in Sections B and C do not match the response to question number eight of Section A. The following reasons explain these discrepancies:

1. One company did not answer question eight, but responded in Section C.

2. One company answered (b) in question eight, but responded in Section C rather than B.

3. Seven companies answered (c) in question eight, and responded in Section B.

4. Two companies answered (c) in question eight, and responded in Section C.

5. Nine companies answered (c) in question eight, and responded in both Sections B and C.

Parentheses around some of the answers indicate that these choices were not listed in the actual questionnaire but were given frequently as "write-in" answers.

SURVEY OF HEARING CONSERVATION IN INDUSTRY

PUBLIC HEALTH SERVICE
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

SECTION A

Mfg.	Const.	Trans.	Mng.	All		
947,393†	11,857†	116,034†	57,562†	1,132,846†	1.	How many employees comprise your total workforce at the above location?
	See Table 3 (p. 8)					
					2.	Do you employ personnel who serve in the capacity of industrial hygienists?
4.2%	0.0%	0.0%	6.5%	3.3%		a. Yes, at this location
6.1%	0.0%	1.7%	18.7%	5.6%		b. Yes, at corporate headquarters
5.7%	0.5%	1.7%	2.2%	4.2%		c. Yes, on a consulting basis
1.7%	0.5%	1.0%	5.0%	1.6%		d. Yes, other (specify)
82.3%	99.0%	96.0%	67.7%	85.2%		e. No
1410*	284*	241*	139*	2074*		
					3.	Do you employ personnel who serve in the capacity of safety engineer?
35.0%	8.1%	16.6%	58.3%	30.8%		a. Yes, at this location
10.4%	5.0%	17.8%	15.8%	10.8%		b. Yes, at corporate headquarters
8.6%	3.9%	4.6%	3.6%	7.1%		c. Yes, on a consulting basis
46.0%	83.1%	61.1%	22.3%	51.2%		d. No
1410*	284*	241*	139*	2074*		
					4.	Do you employ a physician?
5.0%	0.0%	6.6%	7.2%	4.7%		a. Yes, full time on day shifts
11.2%	1.0%	3.3%	10.1%	8.8%		b. Yes, part-time
28.4%	3.5%	19.5%	43.9%	25.0%		c. Yes, on call
55.3%	96.1%	70.5%	38.8%	61.5%		d. No
1410*	284*	241*	139*	2074*		

† Totals for all companies responding
* Total number of companies responding to question

Mfg.	Const.	Trans.	Mng.	All	
					5. Do you employ a nurse?
31.1%	0.0%	7.1%	15.2%	23.0%	a. Yes, full time on day shifts
1.5%	0.0%	0.5%	1.4%	1.2%	b. Yes, part-time
3.2%	0.5%	4.6%	10.1%	3.4%	c. Yes, on call
64.3%	99.6%	88.1%	73.2%	72.5%	d. No
1410*	284*	241*	138*	2073*	
					6. Do you believe that noise problems exist in your job operations?
51.1%	22.2%	18.7%	66.2%	44.4%	a. Yes
48.9%	77.8%	81.3%	33.8%	55.6%	b. No
1410*	284*	241*	139*	2074*	
					7. Do you have a program concerned with reduction of noise levels?
33.3%	3.2%	10.8%	40.3%	27.0%	a. Yes
18.6%	3.5%	4.1%	31.7%	15.7%	b. No, but such a program is in the planning stage
48.1%	93.3%	85.1%	28.1%	57.2%	c. No, and no such program is being planned
1410*	284*	241*	139*	2074*	
					8. Do you have a program concerned with hearing conservation?
29.0%	2.1%	10.4%	35.3%	23.5%	a. Yes
20.1%	1.8%	3.3%	38.1%	16.9%	b. No, but such a program is in the planning stage
50.9%	96.1%	86.3%	26.6%	59.6%	c. No, and no such program is being planned
1409*	284*	241*	139*	2073*	

* Total number of companies responding to question

IF YOUR WORKPLACE HAS NO HEARING CONSERVATION PROGRAM AND NO PROGRAM IS BEING PLANNED AT THIS TIME, THE REMAINDER OF THIS QUESTIONNAIRE NEED NOT BE COMPLETED.

IF A HEARING CONSERVATION PROGRAM IS IN THE PROCESS OF BEING PLANNED, PLEASE COMPLETE SECTION B, BUT NOT SECTION C.

IF A HEARING CONSERVATION PROGRAM IS NOW IN EFFECT, PLEASE SKIP SECTION B AND COMPLETE SECTION C.

SECTION B

Mfg.	Const.	Trans.	Mng.	All	
					1. Who is developing and organizing your hearing conservation program?
6.4%	0.0%	16.7%	12.5%	7.4%	a. Industrial hygienist
41.1%	0.0%	35.3%	58.3%	43.0%	b. Safety engineer
6.4%	0.0%	16.7%	0.0%	5.6%	c. Physician
2.5%	0.0%	0.0%	0.0%	2.1%	d. Nurse
17.1%	0.0%	0.0%	2.1%	14.5%	e. Insurance underwriter
4.3%	33.3%	0.0%	0.0%	3.9%	f. Consultant
8.9%	66.7%	33.3%	20.8%	11.6%	(g.) Personnel manager
6.4%	0.0%	0.0%	0.0%	5.3%	(h.) Plant manager or superintendent
3.2%	0.0%	0.0%	2.1%	3.0%	(i.) Safety supervisor
2.1%	0.0%	0.0%	2.1%	2.1%	(j.) Industrial relations
1.4%	0.0%	0.0%	2.1%	1.5%	(k.) Other
280*	3*	6*	48*	347*	
					2. Who will supervise the program after it is established?
3.2%	0.0%	0.0%	6.3%	3.6%	a. Industrial hygienist
43.9%	0.0%	33.3%	64.6%	46.3%	b. Safety engineer
5.4%	0.0%	16.7%	2.1%	5.1%	c. Physician
4.7%	0.0%	0.0%	0.0%	3.9%	d. Nurse
5.4%	0.0%	0.0%	0.0%	4.5%	e. Insurance underwriter
3.6%	0.0%	0.0%	0.0%	3.0%	f. Consultant
8.6%	100.0%	50.0%	16.7%	11.3%	(g.) Personnel manager
12.2%	0.0%	0.0%	0.0%	10.1%	(h.) Plant manager or supt.
5.0%	0.0%	0.0%	6.3%	5.1%	(i.) Safety supervisor
4.3%	0.0%	0.0%	2.1%	3.9%	(j.) Industrial relations
3.6%	0.0%	0.0%	2.1%	3.3%	(k.) Other
278*	3*	6*	48*	335*	

* Total number of companies responding to question

Mfg.	Const.	Trans.	Mng.	All	
					3. Will the program include pre-employment audiometric hearing tests?
47.9%	0.0%	16.7%	64.6%	49.3%	a. Yes, for all employees
23.0%	0.0%	33.3%	18.8%	22.4%	b. Yes, for all employees in work areas which are noisy (i.e., above 90 dBA)
29.1%	100.0%	50.0%	16.7%	28.3%	c. No
282*	3*	6*	48*	339*	
					4. Will the noise levels in work areas be measured periodically during the year?
76.0%	33.3%	83.3%	86.5%	77.3%	a. Yes, using sound level meters with measurements in dBA
1.1%	0.0%	0.0%	0.0%	1.0%	b. Yes, using measurements in octave bands (or narrower frequency bands)
15.9%	0.0%	0.0%	9.6%	14.5%	c. Yes, using both dBA and octave band measurements
7.1%	66.7%	16.7%	3.8%	7.3%	d. No
283*	3*	6*	52*	344*	
					5. Will personal ear protectors be supplied to employees?
7.4%	66.7%	16.7%	0.0%	7.0%	a. Yes, to all employees
84.2%	0.0%	50.0%	80.4%	82.3%	b. Yes, only to employees in work areas which are noisy (i.e., above 90 dBA)
5.6%	0.0%	0.0%	13.7%	6.7%	c. Yes, only if employee requests them
2.8%	33.3%	33.3%	5.9%	4.1%	d. No
285*	3*	6*	51*	345*	
					6. Are you making any engineering changes (e.g., use of mufflers, enclosures or vibration isolators) and/or administrative changes (e.g., job schedule rotation) in attempting to reduce noise levels?
67.2%	50.0%	16.7%	67.3%	66.3%	a. Yes
9.4%	0.0%	50.0%	6.1%	9.6%	b. No, they are not needed
17.8%	0.0%	16.7%	16.3%	17.4%	c. No, the operations performed here make this impractical
5.6%	50.0%	16.7%	10.2%	6.7%	d. Other (specify)
287*	2*	6*	49*	344*	

* Total number of companies responding to question

SECTION C

Mfg.	Const.	Trans.	Mng.	All	
					1. Who developed this hearing conservation program?
19.5%	0.0%	0.0%	27.1%	19.2%	a. Industrial hygienist
39.7%	80.0%	50.0%	45.8%	41.2%	b. Safety engineer
4.6%	0.0%	10.0%	4.2%	4.7%	c. Physician
4.1%	0.0%	5.0%	0.0%	3.6%	d. Nurse
13.4%	20.0%	5.0%	2.1%	12.0%	e. Insurance underwriter
3.0%	0.0%	0.0%	2.1%	2.8%	f. Consultant
5.3%	0.0%	30.0%	18.8%	7.7%	(g.) Personnel manager
3.5%	0.0%	0.0%	0.0%	3.0%	(h,) Plant manager or supt.
2.8%	0.0%	0.0%	0.0%	2.4%	(i.) Safety supervisor
3.0%	0.0%	0.0%	0.0%	2.6%	(j.) Industrial relations
1.0%	0.0%	0.0%	0.0%	1.0%	(k.) Other
395*	5*	20*	48*	468*	
					2. Who is now primarily responsible for this hearing conservation program?
10.2%	0.0%	0.0%	14.6%	10.1%	a. Industrial hygienist
43.3%	80.0%	50.0%	56.3%	45.3%	b. Safety engineer
5.6%	0.0%	5.0%	4.2%	5.4%	c. Physician
5.9%	0.0%	5.0%	0.0%	5.2%	d. Nurse
3.1%	0.0%	5.0%	0.0%	2.8%	e. Insurance underwriter
1.0%	0.0%	5.0%	0.0%	1.1%	f. Consultant
6.6%	20.0%	30.0%	25.0%	9.7%	(g.) Personnel manager
8.1%	0.0%	0.0%	0.0%	6.9%	(h.) Plant manager or supt.
6.4%	0.0%	0.0%	0.0%	5.4%	(i.) Safety supervisor
6.5%	0.0%	0.0%	0.0%	5.4%	(j.) Industrial relations
3.6%	0.0%	0.0%	0.0%	3.0%	(k.) Other
393*	5*	20*	48*	466*	

See Table 6 (p. 14)

3. How many of your employees are located in areas where noise levels are 90 dBA or above?

* Total number of companies responding to question

THE FOLLOWING QUESTIONS MIGHT BEST BE ANSWERED BY THE PERSONNEL DIRECTLY INVOLVED WITH THE PARTICULAR PROCEDURES (HEARING TESTING, NOISE MEASURING AND DISPENSING PERSONAL EAR PROTECTION).

MEASURING NOISE LEVELS

Mfg.	Const.	Trans.	Mng.	All	
					4. Are the noise levels in your workplace measured (in dB - decibels) periodically?
57.1%	60.0%	31.8%	72.9%	57.5%	a. Yes, using sound level meters with measurements in dBA
1.0%	20.0%	0.0%	2.1%	1.2%	b. Yes, using measurements in octave bands (or narrower frequency bands)
32.0%	0.0%	18.2%	20.8%	29.9%	c. Yes, using both dBA and octave band measurements
10.0%	20.0%	50.0%	4.2%	11.3%	d. No
410*	5*	22*	48*	485*	
					5. If the answer to the previous question is "yes," how often are these measurements taken?
6.6%	25.0%	0.0%	6.5%	6.6%	a. Monthly
27.3%	0.0%	27.3%	39.1%	28.3%	b. Semi-annually
34.2%	75.0%	18.2%	28.3%	33.7%	c. Annually
31.7%	0.0%	54.5%	26.1%	31.4%	d. Other (specify)
366*	4*	11*	46*	427*	
					6. Who takes the measurements?
20.3%	0.0%	9.1%	19.6%	19.7%	a. Industrial hygienist
41.6%	100.0%	36.4%	50.0%	46.9%	b. Safety engineer
38.1%	0.0%	54.5%	30.4%	37.4%	c. Other (specify)
375*	4*	11*	46*	436*	
					7. In designing an industrial process or purchasing new equipment, do you consider noise levels that may be generated?
73.3%	20.0%	85.7%	66.7%	72.7%	a. Yes
6.1%	20.0%	4.8%	14.6%	7.0%	b. No, because the equipment produced by different manufacturers was very similar in producing noise
2.2%	20.0%	0.0%	2.1%	2.3%	c. No, it was not considered
18.1%	40.0%	9.5%	14.6%	17.6%	d. No, but the policy will be followed in the future
0.5%	0.0%	0.0%	2.1%	0.5%	e. Other specify
409*	5*	21*	48*	483*	

* Total number of companies responding to question

Mfg.	Const.	Trans.	Mng.	All	
					8. Have you made any engineering changes (e.g., use of mufflers, enclosures, or vibration isolators) and/or administrative changes (e.g., job schedule rotation) in attempting to reduce noise levels?
66.3%	80.0%	70.0%	64.6%	66.4%	a. Yes
12.7%	0.0%	25.0%	16.7%	13.5%	b. No, the operations performed here make this impractical
18.6%	20.0%	0.0%	14.6%	17.4%	c. No, but plans for the future will consider this point
2.4%	0.0%	5.0%	4.2%	2.7%	d. Other (specify)
409*	5*	20*	48*	482*	

PERSONAL EAR PROTECTION

					9. Are personal ear protectors supplied to your employees?
12.6%	0.0%	14.3%	6.3%	11.9%	a. Yes, if the employee requests
29.1%	40.0%	33.3%	37.5%	30.2%	b. Yes, all employees working in noisy areas (90 dBA or above) are given ear protectors
53.5%	60.0%	38.1%	43.8%	52.0%	c. Yes, all employees working in noisy areas (90 dBA or above are required to wear ear protectors
4.8%	0.0%	14.3%	12.5%	6.0%	d. No
413*	5*	21*	48*	487*	
					10. If the answer to the previous question was "yes," what types of ear protectors are made available to your employees?
11.5%	60.0%	17.6%	18.2%	12.9%	a. Muffs
22.4%	20.0%	0.0%	13.6%	20.7%	b. Plugs
65.4%	20.0%	82.4%	68.2%	65.8%	c. Muffs and plugs
1.0%	0.0%	0.0%	0.0%	0.5%	d. Other (specify)
393*	5*	17*	44*	459*	

* Total number of companies responding to question

Mfg.	Const.	Trans.	Mng.	All	
					11. Who dispenses the ear protectors to the employees?
1.0%	0.0%	0.0%	0.0%	1.0%	a. Industrial hygienist
21.5%	40.0%	5.9%	31.8%	22.1%	b. Safety engineer
5.6%	0.0%	5.9%	4.5%	5.5%	c. Physician
33.8%	0.0%	5.9%	9.1%	30.0%	d. Nurse
7.2%	0.0%	5.9%	0.0%	6.3%	(e.) "Tool crib" personnel
31.0%	60.0%	76.5%	54.5%	35.2%	(f.) Other
391*	5*	17*	44*	457*	

HEARING TESTING

					12. Are pre-employment audiometric tests performed?
56.3%	0.0%	59.1%	68.8%	57.1%	a. Yes, for all employees
11.7%	0.0%	27.3%	6.3%	11.7%	b. Yes, for employees in noisy work areas (90 dBA or above)
2.2%	0.0%	0.0%	2.1%	2.1%	c. Yes, for employees with histories of hearing trouble
29.9%	100.0%	13.6%	22.9%	29.2%	d. No
412*	5*	22*	48*	87*	

See Table 9 (p. 17)

13. If the answer to the previous question was "yes," how many years has this practice been followed?

14. Do you give periodic hearing tests to your employees at least once in two years?

21.6%	0.0%	25.0%	20.5%	21.4%	a. Yes, to all
35.9%	0.0%	35.0%	10.3%	32.6%	b. Yes, to those working in noisy areas (90 dBA or above)
8.3%	0.0%	20.0%	15.4%	9.6%	c. Yes, if employee requests it
1.3%	0.0%	5.0%	0.0%	1.4%	d. Yes, for employees with history of hearing trouble
32.9%	100.0%	15.0%	53.9%	35.1%	e. No
301*	5*	20*	39*	365*	

See Table 10 (p. 17)

15. If the answer to the previous question was "yes," how many years has this practice been followed?

* Total number of companies responding to question

Mfg.	Const.†	Trans.	Mng.	All		
					16.	Are bone conduction tests also performed?
1.0%		0.0%	2.6%	1.1%		a. Yes, for all
11.4%		5.0%	12.8%	11.1%		b. Yes, for some
87.6%		95.0%	84.6%	87.7%		c. No
299*		20*	39*	358*		
	See Table 11 (p. 18)				17.	If the answer to the previous question was "yes," how many years has this practice been followed?
					18.	Where is the hearing test performed?
57.4%		47.4%	39.5%	55.0%		a. In a company owned testing facility
2.6%		0.0%	0.0%	2.2%		b. In a central facility, jointly supported by neighboring plants or companies
21.1%		21.1%	21.1%	21.1%		c. In a private hearing clinic
18.8%		31.6%	39.5%	21.7%		d. Other (specify)
303*		19*	38*	360*		
					19.	When during the workday might the employee who works in a noisy area (90 dBA or above) have his hearing tested?
47.5%		66.7%	36.1%	47.1%		a. At any time during the workday
46.3%		13.3%	22.2%	41.9%		b. At the beginning of the shift
1.6%		6.7%	13.9%	3.2%		c. At the end of his shift
4.7%		13.3%	27.8%	7.8%		d. Other (specify)
257*		15*	36*	308*		

IF THE HEARING TESTING PROGRAM IS PERFORMED AT A COMPANY OWNED FACILITY OR AT A FACILITY JOINTLY SUPPORTED BY YOUR COMPANY AND NEIGHBORING COMPANIES, PLEASE ANSWER THE FOLLOWING QUESTIONS

					20.	What brand(s) and model(s) audiometer is/are used?**
20.8%		20.0%	6.3%	19.6%		(a.) Automatic
78.0%		60.0%	93.8%	78.4%		(b.) Manual
1.2%		20.0%	0.0%	2.1%		(c.) Both
168*		10*	16*	194*		

* Total number of companies responding to question

** The actual questionnaire provided only a blank to fill in the answer to this question

† Performed no audiometric tests; see questions 12 and 14

Mfg.	Const.†	Trans.	Mng.	All		
					21.	When was the audiometer last calibrated?
60.1%		30.0%	31.3%	56.2%		a. One to six months ago
29.8%		70.0%	25.0%	31.4%		b. Seven to twelve months ago
10.1%		0.0%	43.8%	12.4%		c. Other (specify)
168*		10*	16*	194*		
					22.	Who last calibrated the audiometer?
4.1%		0.0%	0.0%	3.6%		a. Industrial hygienist
16.6%		20.0%	18.8%	16.9%		b. Consultant
71.6%		80.0%	43.8%	69.7%		c. Manufacturer of audiometer
7.7%		0.0%	37.5%	9.7%		d. Other (specify)
169*		10*	11*	195*		
					23.	Who performs the hearing testing?
6.4%		0.0%	12.5%	6.6%		a. Physician
8.1%		20.0%	0.0%	8.1%		b. Audiologist
76.7%		50.0%	62.5%	74.2%		c. Nurse
8.7%		30.0%	25.0%	11.1%		d. Other (specify)
172*		10*	16*	198*		
					24.	When did this hearing tester last attend a course or training program concerned with audiometric testing techniques?
52.1%		40.0%	18.8%	48.7%		a. One year ago
10.7%		10.0%	31.3%	12.3%		b. Two years ago
10.7%		10.0%	6.3%	10.3%		c. Three years ago
26.6%		40.0%	43.8%	28.7%		d. Other (specify)
169*		10*	16*	195*		
					25.	What type of test environment is used for hearing testing?
9.3%		10.0%	37.5%	11.6%		a. In office or similar quiet test area
13.4%		10.0%	6.3%	12.6%		b. In sound treated room, non-prefabricated
75.6%		80.0%	56.3%	74.2%		c. In prefabricated sound treated booth
1.7%		0.0%	0.0%	1.5%		d. Other (specify)
172*		10*	16*	198*		

* Total number of companies responding to question
† Performed no audiometric tests; see questions 12 and 14

APPENDIX C -- NOISE MEASUREMENT SHEETS

NOISE SURVEY

Date:

Department _____ _____

Sound Level Meter
Model -
Calibrater Type
Calibration: Check at 93.6 dba
Before_____ After _____

Operator: _____
(Signature)

DIAGRAM:
(Show measuring location with an X.)

MAXIMUM LEVELS AS MEASURED ON THE "A_S" SCALE OF THE SOUND LEVEL METER. IF THE READING IS BETWEEN LEVELS SPECIFIED, USE THE HIGHER LEVEL.

Location (Bldg. & Floor)	Time	Meter db Scale A	B	C	Remarks (Distance from Source-Employee-Exposure Time)

dB(A) MAX LEVEL	PERMISSIBLE HOURS PER DAY
OVER 115	NONE
115	¼
110	½
105	1
102	1½
100	2
97	3
95	4
92	6
90	8

NOTES: .....

.....

.....

.....

.....

RECOMMENDATIONS: .....

.....

PACKING ROOM

NOISE MEASUREMENTS[1]

Plant: _____ Measurements by: _____

Date	Line No.	Size Being Packed	Were Readings Taken When 1 Or More Lines Were Running	dBA[2]				
				Carton Feed Operator Position[3]	Reject Hopper, Standing Next to it[4]	Case Packer or Case Loading Operator Operator	Case Packer Vacuum Pumps, Standing Next to them [3]	Other & Comments

1. All measurements to be taken on the A scale, slow response at ear level.

2. Fluctuations of less than 6 dBA should be read as the "eyeball" average of the needle fluctuation. Fluctuations greater than 6 dBA should be recorded as a range, e.g., 88-95 dBA.

3. Operating position means best estimate of where operator spends most of his time.

4. Next to means standing adjacent to a described equipment.

SOUND SURVEY RECORD

PLANT	DEPARTMENT	SECTION	DATE	PAGE NO.
SURVEY MADE BY	ENVIRONMENT (Type of Building, Kind of Wall Surfaces, Ceilings, Etc.)			

DESCRIPTION OF SECONDARY NOISES (Background)

BATTERY VOLTAGE

METER USED : TYPE SERIAL NO.	MANUFACTURER	MICROPHONE TYPE SERIAL NO.
CALIBRATED WITH : TYPE SERIAL NO.	MANUFACTURER	DATE OF LAST CALIBRATION BY WHOM

ITEM NO.	TYPE OF MACHINE	MACHINE NO. OR OTHER IDENTIFICATION	*COLUMN AND/OR LOCATION OF MEASUREMENT (Working Position, Feet From Noise Source, Etc.)	SOUND LEVEL (Decibels) **DEGREE OF INCIDENCE					
				A^{0}	A^{90}	B^{0}	B^{90}	C^{0}	C^{90}

NOTE: Fast or Slow Meter Response Should be Indicated as F or S. Use Fast Response on C Scale for Impact and Slow Response on A Scale for Continuous Noise.

* An Additional Descriptive Diagram for Identification of Measurement Point may be needed. Attach it to This Sheet.

** Incidence = direction noise enters ears.

OCTAVE BAND ANALYSIS

SOUND LEVEL METER USED	TYPE SERIAL NO.	DATE
MANUFACTURER	MICROPHONE TYPE SERIAL NO.	DATE OF LAST CALIBRATION
OCTAVE BAND : MANUFACTURER ANALYZER USED	TYPE SERIAL NO.	

ITEM NO.	**** C OR I	NUMBER PERSONS EXPOSED	(T) TOTAL EXPOSURE TIME/DAY (HOURS)	(P) PERMISSIBLE HOURS/DAY**	(T)/(P)	BACKGROUND NOISE "A" SCALE	BACKGROUND NOISE "C" SCALE	OVERALL NOISE LEVEL "C" SCALE	***FREQUENCY RANGES (cps) 20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-10KC	OVERALL NOISE LEVEL "C" SCALE

C-4

***Use Center Frequencies When New Equipment is Calibrated for Use of Such Frequencies (63, 125, 250, 500, 1000, 2000, 4000, 8000)

****C = Continuous Noise. I = Impact Noise.
Background Noise Should be Measured on "Slow" Meter Response.

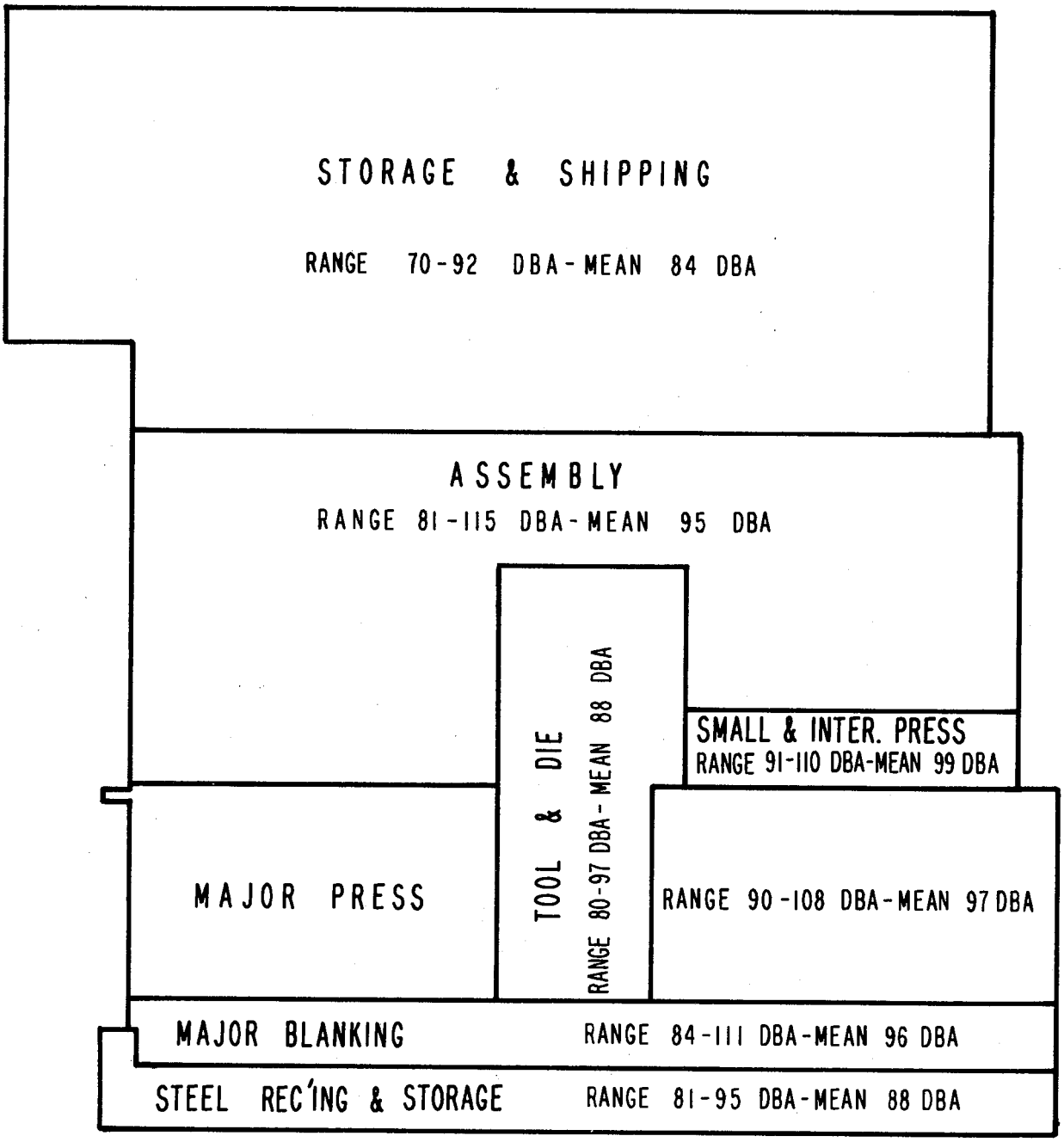
OCTAVE BAND ANALYSIS

SOUND LEVEL METER USED	TYPE SERIAL NO.	DATE
MANUFACTURER	MICROPHONE TYPE SERIAL NO.	DATE OF LAST CALIBRATION
OCTAVE BAND : MANUFACTURER ANALYZER USED	TYPE SERIAL NO.	

ITEM NO.	****C OR I	NUMBER PERSONS EXPOSED	(T) TOTAL EXPOSURE TIME/DAY (HOURS)	(P) PERMISSIBLE HOURS/DAY**	(T)/(P)	BACKGROUND NOISE		OVERALL NOISE LEVEL "C" SCALE	***FREQUENCY RANGES (cps)								OVERALL NOISE LEVEL "C" SCALE
						"A" SCALE	"C" SCALE		20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-10KC	

***Use Center Frequencies When New Equipment is Calibrated for Use of Such Frequencies (63, 125, 250, 500, 1000, 2000, 4000, 8000)
****C = Continuous Noise. I = Impact Noise.
Background Noise Should be Measured on "Slow" Meter Response.

FOREMAN	BLDG.	UNIT	COL.	OPERATION	PRIMARY NOISE SOURCES	BACK GROUND DURATION HOURS	PEAK EXPOSURE LEVELS AND DURATION #1	#2	#3	#4	$\frac{Cn}{Tn}$



AVERAGE STAMPING PLANT NOISE EXPOSURE

APPENDIX D -- NOISE SPECIFICATION SHEETS

EQUIPMENT NOISE SPECIFICATION

1. GENERAL

1.1 This Specification is a means of establishing the limiting value of noise (unwanted sound) generated by equipment to be installed in an industrial plant. It also provides a uniform method of conducting and recording noise tests to be made on such machinery.

1.2 Application of Specification. This Specification describes limits and methods of measuring sound emission in the purchase of equipment. Tests are to be made by the vendor and witnessed by purchaser unless otherwise specified. Confirming or additional measurements by purchaser shall be permissible.

1.3 American Standards Association. Noise measurement sections 2 and 3 of this Specification are based on ASA Z24.7-1950.

2. INSTRUMENTS

2.1 A Sound Level Meter as specified in ASA S1.4-1961 when used alone measures over-all noise levels only.

2.2 An Octave Band Analyzer, as specified in ASA Z24.10-1953, is the preferred instrument for measuring broad band noise by this Specification, used in conjunction with a sound level meter.

2.3 A Narrow Band Analyzer in conjunction with a Sound Level Meter is used to identify Narrow Band or Pure Tone sounds.

2.4 Instruments shall be calibrated as recommended by the instrument manufacturer. Over-all calibrations of the instruments, including the microphone and internal calibration of the meters, shall be made before and after the test of each piece of equipment.

3. NOISE TESTS

3.1 Ordinarily, the test will be made at the factory or in a test room provided by the vendor at his expense. The test room should preferably provide conditions free of extraneous sounds and minimize the conveyance and reverberation of sounds emitted by the equipment under test which tend to increase the sound level in the test environment.

3.2 Ambient sound levels within the test room should be 8 dB or more below the sound level that prevails when the tested equipment is in operation.

3.3 Unless otherwise specified, equipment tested should be at full load.

3.4 The placement of the microphone during the test should be such as to protect it from air currents, vibration, electric or magnetic fields, and other disturbing influences that might affect the readings obtained. Positioning of the microphones at ear level and a horizontal distance of 3 feet from the nearest major surface is usually satisfactory. The entire area surrounding the equipment should be explored to insure that the maximum noise levels are measured.

3.5 Measurements shall be made at a minimum of 6 points approximately 60 degrees apart in the plane specified in paragraph 3.4, starting with the line of maximum noise level. Additional readings will be specified when a directivity pattern is to be established. When multiple similar units are to be purchased, tests on more than one might be requested.

4. RECORDS

4.1 Records of tests for each piece of equipment shall include the information and readings called for in this specification.

4.2 Test results are to be reported to the purchaser for analysis and acceptance before equipment is shipped unless otherwise specified.

5. SOUND LEVEL SPECIFICATIONS

5.1 The location and orientation of the microphone for measurements of total (ambient plus machinery) and ambient noise levels shall be identical. If either the machine or ambient noise levels fluctuate appreciably, maximum levels shall be recorded. If the difference between total and ambient readings is less than 3 dB the ambient elvel is unsatisfactory for measuring the noise produced by the machine. If the difference is 10 dB or more the higher readings are essentially the noise levels generated by the machine. For differences of 3 to 10 dB, the machinery noise levels shall be determined by applying the correction values indicated below.

5.2 Unless otherwise specified, octave band analysis will be used to measure equipment sound levels. Maximum levels suitable for the application intended shall be specified by purchaser for each purchase. Sound level specifications for equipment to be installed in various environments are to be supplied by purchaser.

Correction Values Allowed for High Ambient Sound Levels

Difference between Total and Ambient Noise Levels, dB	Correction to be Subtracted from Total Sound Level, dB
3	3
4-5	2
6-9	1
10	0

NOISE CONTROL

1. SCOPE:

This standard defines the acceptable limits for noise generated by machinery and equipment supplied to the Company. The basis of the numbers cited relate to Federal Safety and Health regulations to protect the hearing of employes.

2. APPLICATION:

This standard is applicable to all machines, power tools, and equipment. It shall be used for the purpose of protecting employe hearing by limiting noise exposure from all sources to comply with the Occupational Safety and Health Act of 1970.

3. REQUIREMENTS:

3.1 All steady state or cyclical noise levels produced by machinery or equipment at the operator's position, and at all other points three feet from the equipment, shall not exceed 84 decibels when measured by a sound level meter meeting ANSI 1.4-1961, "Specification for General Purpose Sound Level Meters;" set to "A" weighting and slow response.

3.2 Impulse noise levels, as measured at the positions stipulated for steady state or cyclical noise levels, shall not exceed 115 dBC when read with a sound level meter conforming to ANSI 1.4-1961 set to fast response; nor shall they exceed 130 dBC as measured with an approved impact instrument.

Exceptions to requirements 3.1 and 3.2 are special equipment as outlined in Section 5 of this standard.

3.3 Noise measurements shall be the responsibility of the supplier. Actual noise levels shall be submitted to the requisitioning activity prior to shipment of any unit covered in this standard. Certification of the measurements shall be available upon request. An octave band analysis, when required, shall be made with a filter set conforming to ANSI S1.11-1966.

3.4 The quotation shall include any added costs required to meet this noise standard, stated as an alternate and separate item to the cost of the supplier's standard product. Such additions shall be identified in the quotation in sufficient detail to permit a complete evaluation by the purchaser.

4. MEASUREMENT TECHNIQUES:

4.1 The noise measurements, instrumentation, and reporting of data shall be in accordance with the National Machine Tool Builders' Association's document "NMTBA Noise Measurement Techniques," issued June 1970 or latest edition.

4.2 Noise levels shall be measured during the simultaneous operation of all components and applicable accessories when running under all anticipated operating conditions.

4.2.1 Unloaded

Measurement shall be made at all probable unloaded modes such as idle or maximum traverse.

4.2.2 Loaded

The various rated load modes of operation shall also be measured as per Section 3, unless otherwise specified. The supplier shall state whether the load conditions were actual or simulated; and if simulated, shall state the means of simulation. The supplier shall be provided a reasonable quantity of parts or materials by the purchaser, if these are peculiar to the purchaser.

Exceptions to Section 4 are special equipment as outlined in Section 5.

5. SPECIAL MEASUREMENT TECHNIQUES:

5.1 Compressors

Compressors shall not exceed 84dBA sound pressure level, when measured at the loudest location on the envelope as defined in section 7.4.1 of the CAGI-PNEUROP Test Code for the Measurement of Sound from Pneumatic Equipment. All measurements and reporting of data shall be in accordance with the CAGI-PNEUROP Test Code, latest edition.

5.2 Pneumatic Tools

Air motors, hand grinders, screwdrivers, nutsetters, impact wrenches, etc., shall not exceed 85dBA, sound pressure level, at any of the microphone positions specified in section 5.6.1 of the CAGI-PNEUROP Test Code. All measurements shall be taken with the tool operating at an air pressure of 85 p.s.i., in a free running, no load condition. Data shall be reported in accordance with the CAGI-PNEUROP Test Code, latest edition.

5.3 Fans (Nonducted)

Exhaust and supply nonducted air moving devices shall not exceed 30 sones at 5 feet from the acoustic center of the fan when converted in accordance with AMCA Standard 301 from sound power levels obtained in accordance with AMCA Standard 300.

5.4 Fans (Ducted)

5.4.1 Exhaust and supply ducted air moving devices shall not exceed 90dBA sound power* level, (ref. 10^{-12} watts) total of inlet and outlet power. Measurements and reporting of data shall be in accordance with AMCA Standards 300 & 301.

5.4.2 The sound power* level (ref. 10^{-12} watts) at each system terminal shall not exceed 85dBA. Prefabricated duct silencers or acoustical plenums may be used to meet this requirement. The ASHRAE procedure (ref. ASHRAE Guide and Data Book, 1965, 1966, chapter 14) shall be used for estimating the sound power level at each terminal. All calculations shall be submitted to the requisitioning activity prior to the installation of the system.

5.4.3 In all cases, the quietest fan shall be considered in order to limit the noise as much as possible at the source.

5.5 Electric Motors

5.5.1 The sound power* level (ref. 10^{-12} watts) of electric motors, 1800 rpm and less, shall not exceed 85dBA on frames 405 and smaller, and 88dBA on frames 444 and 445.

5.5.2 The sound levels specified shall be measured in accordance with IEEE Publication No. 85, latest edition, and ANSI Standard S1.2-1962.

6. VARIATION FROM REQUIREMENTS:

6.1 All quotations shall clearly state any exceptions regarding the ability of the prospective supplier in complying with this standard.

6.2 If the supplier cannot meet the noise level requirements of this standard, it shall be his responsibility to investigate known resources outside the Company before requesting assistance from the purchaser. When he can demonstrate that he has fully explored engineering solutions with unsuccessful results, he shall provide the purchaser with a complete octave band analysis, together with identification of probable noise sources. The data shall include readings at each test point for each load condition along with noise level duration per work cycle in sufficient detail to permit calculations of equivalent daily exposures. If it is mutually concluded that no engineering solutions are feasible, the supplier shall furnish corrective schemes, such as enclosures, that the purchaser may elect to use after installation. The cost of such corrective measures shall be the responsibility of the supplier unless the item was identified in the accepted quotation and purchase order as an exception.

6.3 The supplier must obtain written permission from the purchaser to ship any unit covered in this standard that will operate above the specified noise limitations.

*Note: To obtain dBA sound power level, adjust each octave band power level, according to the weighting of the "A" network and combine the resultant values.

1. General

1.1 These specifications control the permissible noise level of industrial equipment and are in accordance with the latest editions of the following:

Dept. of Labor, Bureau of Labor Standards; Part 50-204
Safety and Health Standard for Federal Supply Contracts

Standards for Calibration of Sound Meters
(ASA S.1.4-1961 and IEC S.R.123)

1.2 The purpose of noise control is two-fold:

to prevent the hazard of permanent hearing damage, and
to improve employee comfort and work efficiency

1.3 The absolute unit of sound pressure is BAR=DNY/SQ.CM. Experiments have shown that the human ear responds logarithmically to a stimulus loudness, therefore the sound pressure level of noise measurement is established as follows:

$SPL = 20 \text{ Log } P/P_O \text{ (Decibel)} = 20 \log P + 74$ where SPL = dB
P = μ Bar
Po = .0002 ·· Bar
as ref. pressure

2. Permissible Noise

2.1 Noises with high frequencies are more damaging to the human ear than the same sound pressure level at low frequencies, thus necessitating a specification and control of sound pressure levels in relation to octave bands. The influence of sound power and intensity is evaluated by determining the noise levels at 3' and 15' radii from the source of the noise.

2.2 Permitted noise levels for 40-hour weekly exposure

Frequency Band Cycles per Sec. C.P.S.	Noise Level (dB) Max. created by the Equipment		
	3' from Equip.	15' from Equipment	
	for all Equip.	Assy. Floor Equip.	Press Shop Eq.
20 - 75	105	90	95
75 - 150	100	90	95
150 - 300	95	90	95
300 - 600	90	85	90
600 - 1200	85	82	85
1200 - 2400	85	82	85
2400 - 4800	85	82	85
4800 - 9600	85	82	85

2:3 For new equipment, the following noise levels, excluding background noises, are permissible. The noise is measured in a flat frequency level (dBA, see Dept. of Labor Standard Par. 50-204.10):

Tool or Equipment	Idle Noise (dBA) Max. 3' from Equipment	Full Load Noise (dBA) Max. 3' from Equipment
Air Hand Tools	82	85
Chipping Tools	84	85
Conveyors	80	83
Drilling Machine	80	82
Grinders	80	84
Hydraulic Unit	85	85
Kellering Machine	82	85
Milling Machine	82	85
Presses	84	85
Sawing Machine	82	85
Shears	84	85
Shot Blasting	83	85
Tumbling	80	85

3. Control of Noise Level

3.1 All purchased equipment shall be tested by vendor with respect to noise level and approved prior to shipment to The Budd Company.

3.2 All pneumatic components with pressure relief exhausts shall be equipped with noise silencer.

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 1						
Vertical turret lathe	90-100	20-25	30 min.		Recommended	
Grinding operation	80-90				Recommended	
Test cell	130, inside 75-80, outside		2 times		Required	
COMPANY # 2						
Power press (500 lb)	95-100		7 hr.		Recommended	
Automatic screen	92-93		7 hr.			
COMPANY # 3						
Punch press	92-95, idle 110, manual 98-102, auto	1	5-7 hr.			
Plastic grinder	92-98					
Screw machines	96					
Header	96→104→110					
Calsh wire draw	92-97					
Braiding cloth cover	91-93					
Extenders	86-111					Insulators on wire

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 4						
Braiding machine	95-99	120	7 hr.		Recommended	
COMPANY # 5						
Metal turning		4-5				
COMPANY # 6						
Arc welding	105	6	4 hr. (10-15 min. periods)			
Sand blasting	95		3-4 hr.			
Test cell	80 115-120, eng. idle		6 min.			
COMPANY # 7						
Sifting & conveyors	92	2	6 hr.		Recommended	
Sealing process	97	1	6 hr.		Recommended	
Copper carton stuffer	106	none				
Bottle filling	97				Recommended	
Tablet counter	90-95	1	6 hr.		Recommended	
Bottle washer	92-95	2	7-1/2 hr.		Recommended	
Labeler machine	92	1	6 hr.		Recommended	

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 7 (cont'd)						
Mill (pulverizing)	92-95	1	6 hr.		Recommended	
Slugging	90-97	1	1 hr.		Recommended	
COMPANY # 8						
Compressors	100	2	1 hr.		Required	
Tablet coating	100	12				Fiberglass & canvas outside, paint inside reduced levels to 85 dBA
Computer room	95	6-8				False ceiling, sound absorbing panels on machine-reduced levels to 84 dBA
COMPANY # 9						
Compressor heaters	103-105					Acoustical ductwork on intake & exhaust, acoustical plumbing enclosures
Steam exhausts	130-132	24	2 min. (not daily)			Installation of mufflers reduced levels to 92-94 dBA
Packing & grease	92-97	7		no	Required	

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 10						
Riveting		6-7				
COMPANY # 11		850				
Palatizers	93-95			no	Required	Cost $500,000
Line pack	92-101			no		
Depressors	99-100			no		
Lithograph	87-100			no		
Body makers	103-105			no		
Line	89-97			no		
Strip presses	102-103			no		
COMPANY # 12						
Canning oil	96	29	4 hr.	yes		Replaced metal with webbing, coated divider with foam rubber, cut back air lift, replaced header, routed air stream
Furnace	98-100					Silencers on vent stack and air flow reduced levels to 86-88 dBA

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 13						
Riveting	>90 95-100	24	8 hr.		Required	
Magnetic hammer	140 dB peak	<50	20 imp./4 hr., 2 day/mo.		Required	
High pressure release	125	15-16	5-10 sec., 1-2 day/mo.		Required	
COMPANY # 14						
Electric furnace	90-108	115	5-1/2 hr.	no	Recommended	Sound proofing control rooms -- lead 1/2" thick
Nail mill	90-106	65				Enclosures of plywood, lead, & foam; installed hydraulic lift -- $3,000
Ball complex	90-110	39				Protective coating on trays from trough conveyor belt
Rope mill	104-105	90				Air flow changes
COMPANY # 15						
Hydraulic pump	100, operating 92, background	4		no	Recommended	

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 15 (cont'd)						
Riveting	130			yes	Recommended	Sheet lead mufflers
Engine testing	120, front 130, back	300	6 hr.	no	Required	Installation of mufflers reduced levels to 90 dBA
Drop hammer	140 dB peak	10		no	Required	
COMPANY # 16						
Flight line	90-92	24	<1 hr.	no	Required	
Engine testing	90 120 dB, sometimes	8	1 hr.	no	Required	Insulated test shack
Final assembly	>90		1 hr./wk.			
Acoustic arena		6		no		Sound absorbing material
COMPANY # 17						
Air foil mills	102-103	3	>90 - 50%			
Flightlines	115-120	4	1-1/2 hr./ 2-3 days		Required	
Sand blasting	92-95	10-15			Required	Shock pads, sound-treated rooms, rubber mounts, acoustic curtains

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 18						
Furnaces	98-104	4	1	no	Required	Muffler mutes
Process control valves	130 dB peak					
Gas & steam turbines		5				Hoods - fire hazard
COMPANY # 19						
Pneumatic tools					Required	
Pump house	>90	40				Fiberglass castors, ceiling baffles
COMPANY # 20						
Metal working plant	>90				Required	
Air flow noise						Enclosures - fire hazard - cost $35,000
Punch presses	>90	15%	7-1/2 hr.		Required	
COMPANY # 21						
Riveting	90-114	175		no	Recommended	
Punching/shearing	88-99	7	1 day/ several wks.			
Blanking/punching	90-103	94	1 day/ several wks.			
Flighting machine	100	7	1-2 days/mo.			

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 22						
Heaters						Installed mufflers
Electric motors	98					Installed mufflers which reduced levels to 78 dBA
Canning	101	24		no		Covered gear brakes with asphalt
COMPANY # 23						
Cleaning mills	108-112	110	7 hr.	no		Coated with foam (not successful), mufflers
Tapping	100-103	80-85	7 hr.	no		
COMPANY # 24						
Kiln Hoise Quarry Mill	93	26	4 hr.		Required	
COMPANY # 25						
Fans Heavy equipment Kilns		25		no	Required	Enclosures

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 26						
Tent tunnel			2 hr.		Required	
Rocket launching		8			Required	
COMPANY # 27						
Nygren printing press	92-98	12		no	Required	
Horizontal braider	93-105	10		no	Required	Sound reducing enclosures reduced levels to 93-105 dBA
Snow track test area	78-93			no	Required	Enclosures reduced levels to 78-93 dBA
Vacuum scrap removal system	95-99	13		no	Required	Enclosures reduced levels to 95-99 dBA
Machine shop grinder				no	Required	Enclosures reduced levels to 15 dB red
White side wall buffer	100			no	Required	Enclosures (cost $5,000) reduced levels to 100 dBA
Scrap chopper		8		no	Required	Enclosures (cost $14,000) reduced levels to 94 dBA
COMPANY # 28						
Control valves	101					Insulation
Compressors	101					Mufflers

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE.	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 29						
Engine testing						Acoustical baffles
COMPANY # 30						
Machining operation	115 80-84	18				Insulated with rubber tubing
COMPANY # 31						
Glass forming		13	7 hr.		Required	Change from air cooling to liquid cooling, enclose blower
Bandsaw	98-100	3-4	7 hr.		Required	Enclosed blowers
Container inflation	104-107				Required	Liquid coating
COMPANY # 32						
Locomotives	100	2	4 hr.			Mufflers and enclosures (lead shielding)
COMPANY # 33						
Gear noise					Recommended	Enclosures, plastic components
Presses and rimrolls	92-106	40	8 hr.		Recommended	

JOB-OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 33 (cont'd)						
Bandlines	94-102	24	7 hr.		Recommended	Screens (acoustic) reduced by 2 or 3 dB at a cost of $150; hoods, curtains and styrofoam reduced levels to 85 dBA at a cost of $200
Heavy equipment	95-100		4 hr.			
COMPANY # 34						
Electric furnace						Acoustical enclosures attenuated level by 45 dBA - cost was $30,000
Blast furnace	100	25	2 hr.			
Metal forming operation	100		4 hr.			
COMPANY # 35						
Can-making	95					Plastic lines and rails
Filling operation	100	130	8 hr.		Required	
Punch press	96-97	42	8 hr.		Required	
COMPANY # 36						
Grinder	94					Use of exhaust muffler reduced levels to 83 dBA

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 36 (cont'd)						
Saw	126					Added tile to blade guard which reduced levels to 106 dBA
COMPANY # 37						
30 ton pump	104					Changed valves reduced levels to 92 dBA
50 ton motor	104					Large motor replaced by small motors reduced level to 92 dBA
COMPANY # 38						
Grinders	88-96					
COMPANY # 39						
Riveting	105-120					
Drop hammer	130 dB peak					
COMPANY # 40						
Riveting	860110					
Air motor drill	110-115					Silicone rubber

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 41						
Can packing	95					
Can feeding	93					
Oil packing	96					
COMPANY # 42						
Electric furnace	98-102					
Pneumatic painters	90-96					
Chipping	94-109					
COMPANY # 43						
Hi-speed air blower	104					
Rubber trimming	94					
Rubber mills	86-95					
Jack hammer (on concrete)	120					
COMPANY # 44						
Air-operated equipment	>90	35	5 hr.	no		Modification of air jets with mufflers and suppressors
Channel straightening	92					Soundproof enclosure
Bar casting area	95					

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 45						
Riveting	95-105 (quasi-steady)	1500-2000	3 hr.		Required	Experimenting with electro-magnetic riveting reduced levels 2 to 3 dB
Metalizing procedure	105-120	400-500	2 hr.		Required	Enclosures, isolation
COMPANY # 46						
Test cells	115-120			yes	Required	
Burr room	96				Required	
COMPANY # 47						
Cutting (with saw)	105-113	50	4 hr.		Required	
Heavy equipment	104	10	4 hr.		Recommended	
Power shovel	95-101	3	5 hr.		Recommended	
Yarding and loading	95	38			Recommended	Modified exhaust systems, acoustic lining in cabs
Log sorting	93	8	3 hr.			Mufflers, modified exhaust systems
Chippers	95	8	7-1/2 hr.		Required	Tightened bearings, changed lubricants and saw scarves
Pony off-bearer	95-103		7-1/2 hr.			
Trimmer	98-101	2	5 hr.			
Planing mill	85-105	10	6-1/2 hr.			

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
COMPANY # 48						
Tissue mill (finishing)	82-96	198	7-1/4 hr.		Required	
Napkin manuf.	103	35	7-1/2 hr.		Required	Changed embossing materials at a cost of $18,000 - reduced level to 96.5 dBA
Roll & folded towels	96	40	7-1/2 hr.		Required	Used sandwich type foam & lead barriers, enclosed gears on machinery - reduced level to 92 dBA at a cost of $8,000
Bale weighing	92	4	2 hr.	yes		
Paper mill	94-103	80				
COMPANY # 49						
Paper machines	84-104	16	4 hr.		Required	Use of newer design parts - cost $9,000
COMPANY # 50						
Pot liners	102	4	2 hr.		Required	
Strander	91-98	3	5 hr.		Required	3" insulating material
Stone saw	101-102	1			Required	Fed through lead loaded vinyl enclosures - reduced levels to 45 dBA
Fans & extrusion presses	91-97	45			Required	

JOB OPERATION	dBA LEVELS	NUMBER OF EMPLOYEES	DAILY EXPOSURE	ADMIN. CONTROLS	USE OF EAR PROTECTORS	ENGINEERING CONTROL
Company # 50 (Cont'd)						
Rodding	82-96	15			Required	Rubberized matting, mufflers at point of air exchange, acoustic cabinet around station, sprayed sound-deadening material
Saws	95	3			Required	Checked blades, replaced worn teeth
COMPANY # 51						
Tube bender	95	2	8 hr.		Required	
Punch press - blanking	99	1	8 hr.		Required	Shaped die, bi-directional shear angles - cost $3.00
Press	92-94	1				Replaced worn parts in gears - reduced to under 90 dBA at a cost of $2,500
Air detection noise	92	1	1-1/2 hr.			Equipped with mufflers at a cost of $5 to $8
Shear Dept.	95	1	5 hr.			Mufflers & repair of air leaks
Fin press	92-99	1	8 hr.		Required	Enclosing bottom with plywood and acoustic lining
Force Flo expanding table	98	1				Muffler

APPENDIX F -- EMPLOYEE EAR PROTECTOR RATING SHEET

TO:

FROM: Safety Department

SUBJECT: (Molded) Ear Protectors

You have been fitted with personally molded ear protection known as (____). Will you please answer the following questions and return questionnaire to the Safety Department. Please check appropriate box. /__/

I. Have you been wearing them?

a. Daily /__/ b. Part Time /__/ c. Not at All /__/

II. Have you worn other types of hearing protection?

a. Yes /__/ b. No /__/

III. What type?

a. Muffs /__/ b. Plugs /__/ c. Swedish wool /__/

d. Other (Write in)_____

IV. If you wore other type, did you wear them: a. Daily /__/ b. Part Time /__/

V. How do you compare (the molded plug) with other types?

a. Equal /__/ b. Better /__/ c. Not as Good /__/

VI. Are (the molded plugs) comfortable?

a. Yes /__/ b. No /__/

VII. Are (the molded plugs) easy to insert and remove?

a. Yes /__/ b. No /__/

VIII. According to their effectiveness, what type would you prefer? Give number according to preference - 1, 2, 3, etc.

a. Plugs /__/ b. Muffs /__/ c. Swedish Wool /__/

d. (the molded plug) /__/ e. Other (Write in type) _____

IX. Additional Remarks _____

_____

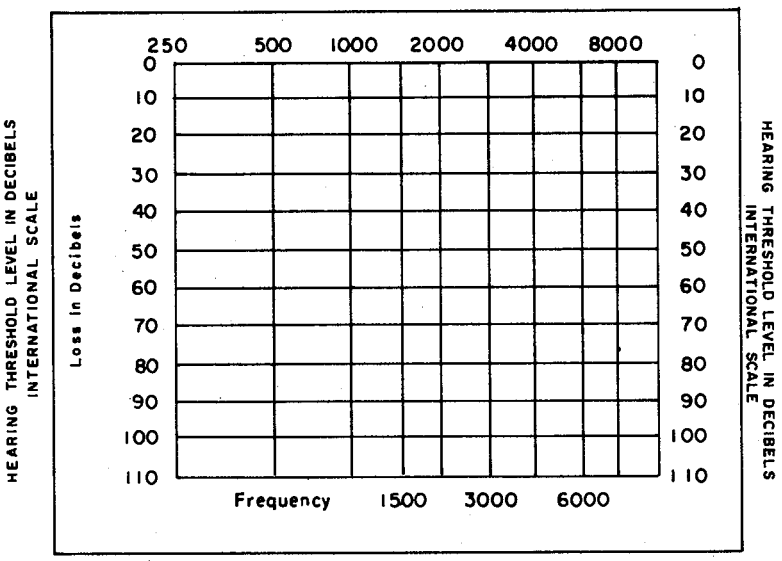
_____

This audiogram is plotted on the basis of 1969 reference thresholds.

(Check Frequency Column Used)

Freq.	Decibel Loss		Freq.
	Right	Left	
250			250
500			500
1000			1000
1500			1500
2000			2000
3000			3000
4000			4000
6000			6000
8000			8000

AUDIOGRAM
INTERNATIONAL SCALE



Right	Left
Red	Blue
O	X

Prospective Employee ( ) Rehire ( ) Recheck ( )

Name Social Security No.

Date of Birth Sex Occupation

Military Service Length of Servie Assignment

History of exposure to noise

How often do you use firearms ?

Ever had: Head noises ? Deafness in Family ? Running ear ?

Ever treated by a Doctor for ear trouble ?

Doctor's name : Address

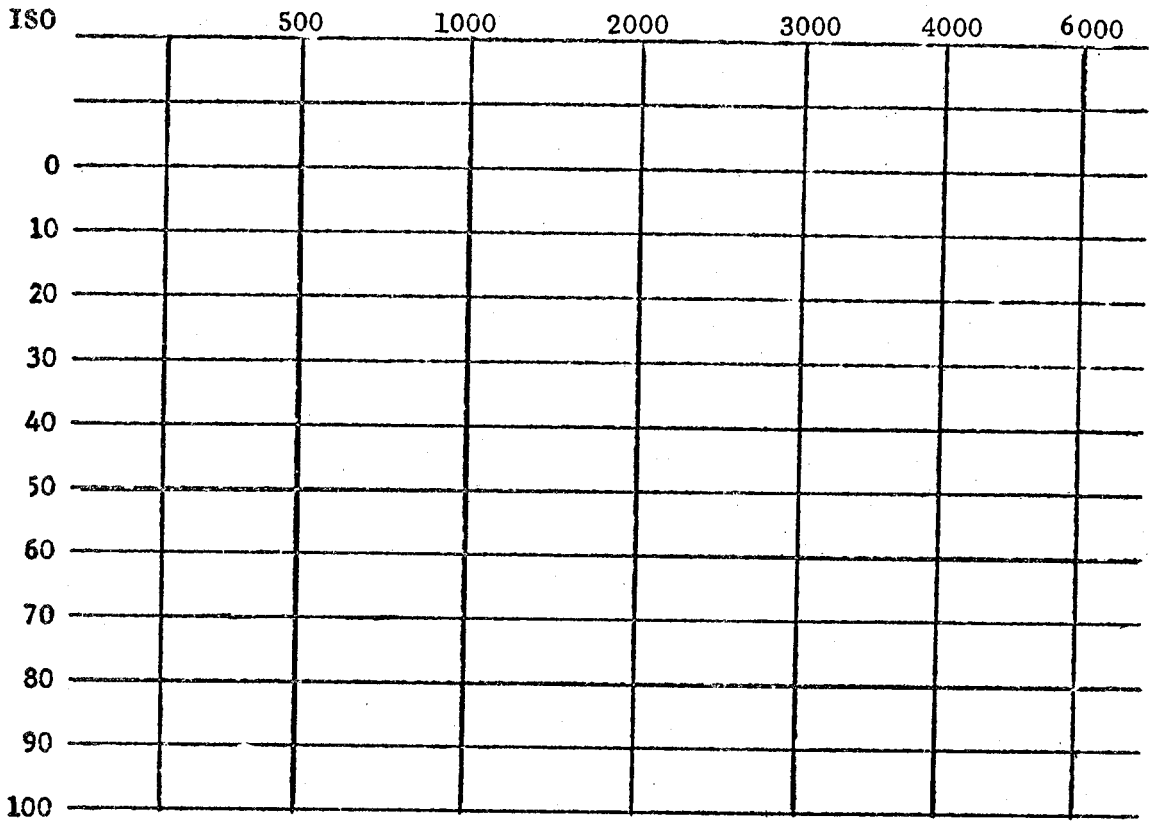
Technician Location Make of Audiometer Date Time Day of week

Remarks

PURE TONE AUDIOGRAM
Practice Form

Name: _____ Tested by: _____

Date: _____ Audiometer used: _____ Validity of test: ____



Key: Air Conduction
Right Ear -- Red O; △ w/masking at _____dB
Left Ear -- Blue X; □ w/masking at _____dB

Bone Conduction
Right Ear > w/masking at _____dB
Left Ear < w/masking at _____dB

↓ If no response at maximum intensity.

Remarks: _____

_____

Recommendations: _____

_____

_____

AUDIOGRAM RECORD

NAME _____ PRE EMP _____
SEX _____ BIRTHDATE _____ BI-ANNUAL _____
OTHER _____

TIME SINCE MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4-7 hrs. 1 Day
21-50 min. 2-3 hrs. 8-16 hrs. 2-3 Days

DURATION OF MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4 7 hrs. 1 Day
21-50 min. 2-3 hrs. 7+ hours

AGE	DATE	DAY OF WEEK	TIME OF DAY	WAS EAR PROTECTION WORN ABOVE YES NO

RIGHT EAR							LEFT EAR						
250	500	1000	2000	3000	4000	6000	250	500	1000	2000	3000	4000	6000

AUDIOMETER BELTONE MODEL 10D
SERIAL NO. 22180
ASCENDING TECHNIQUE NO BONE CONDUCTION DONE
COMMENTS:

LAST CALIBRATED ISO: _____
TESTED BY: _____
DATE: _____

BI-ANNUAL OTHER

TIME SINCE MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4-7 hrs. 1 Day
21-50 min. 2-3 hrs. 8-16 hrs. 2-3 Days

DURATION OF MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4-7 hrs. 1 Day
21-50 min. 2-3 hrs. 7+ hours

AGE	DATE	DAY OF WEEK	TIME OF DAY	WAS EAR PROTECTION WORN ABOVE YES NO

RIGHT EAR							LEFT EAR						
250	500	1000	2000	3000	4000	6000	250	500	1000	2000	3000	4000	6000

AUDIOMETER BELTONE MODEL 10D
SERIAL NO. 22180
ASCENDING TECHNIQUE NO BONE CONDUCTION DONE
COMMENTS:

LAST CALIBRATED ISO: _____
TESTED BY: _____
DATE: _____

BI-ANNUAL OTHER

TIME SINCE MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4-7 hrs. 1 Day
21-50 min. 2-3 hrs. 8-16 hrs. 2-3 Days

DURATION OF MOST RECENT NOISE EXPOSURE
0-20 min. 1 hr. 4-7 hrs. 1 Day
21-50 min. 2-3 hrs. 7+ hours

AGE	DATE	DAY OF WEEK	TIME OF DAY	WAS EAR PROTECTION WORN ABOVE YES NO

RIGHT EAR							LEFT EAR						
250	500	1000	2000	3000	4000	6000	250	500	1000	2000	3000	4000	6000

AUDIOMETER BELTONE MODEL 10D
SERIAL NO. 22180
ASCENDING TECHNIQUE NO BONE CONDUCTION DONE
COMMENTS:

LAST CALIBRATED ISO: _____
TESTED BY: _____
DATE: _____

PREVIOUS NOISE EXPOSURE AND MEDICAL HISTORY

LAST THREE JOBS	TYPE OF WORK	NOISE EXPOSURE	PROTECTION WORN	DURATION

FREQUENT USE OF FIREARMS_____ DO YOU RIDE A MOTORCYCLE____ WEAR A HELMET____
MILITARY SERVICE: BRANCH_____ NOISE EXPOSURE_____ RECHECK AUDIOS
DURATION_____ PROTECTION WORN_____ DONE: YES____ NO_____

HEARING LOSS IN FAMILY:_____ HISTORY OF HEAD INJURY_____ MALFORMATION OF EARS____
HISTORY OF PERFORATED EAR DRUM: RIGHT_____ LEFT_____
DRAINAGE OR CHRONIC INFECTION: RIGHT_____ LEFT_____
TINNITUS FOLLOWING NOISE EXPOSURE: _____
COMMENTS:_____

BI-ANNUAL OTHER CURRENT NOISE EXPOSURE

JOB TITLE DEPARTMENT TIME ON JOB? YEARS_____ EMPLOYEE'S ESTIMATE OF OWN
MONTHS_____ HEARING:
GOOD____ FAIR____ POOR____

TYPE OF NOISE EXPOSURE

STEADY NOISE	IMPULSE NOISE	PERCENT OF JOB TIME EXP.	PROTECTION WORN
CONTINUOUS EXPOSURE_____	CONTINUOUS_____	0 10 20 30 40 50 60	YES_____
INTERMITTENT EXPOSURE_____	INTERMITTENT____	70 80 90 100	HOW LONG_____
			NO_____

BI-ANNUAL OTHER CURRENT NOISE EXPOSURE

JOB TITLE DEPARTMENT TIME ON JOB? YEARS_____ EMPLOYEE'S ESTIMATE OF OWN
MONTHS____ HEARING:
GOOD_____ FAIR_____ POOR_____

TYPE OF NOISE EXPOSURE

STEADY NOISE	IMPULSE NOISE	PERCENT OF JOB TIME EXP.	PROTECTION WORN
CONTINUOUS EXPOSURE____	CONTINUOUS EXPOSURE____	0 10 20 30 40 50 60	YES_____
INTERMITTENT EXPOSURE____	INTERMITTENT EXPOSURE____	70 80 90 100	HOW LONG_____
			NO_____

AUDIOGRAM

NAME _____ DATE _____

AGE _____ SEX _____ REF. _____

ADDRESS _____ OCCUPATION _____

YEARS DEAF _____ DEAFNESS VARIABLE _____

CAUSE OF DEAFNESS _____

HEARS IN CHURCH AND THEATER _____ HEARS IN SINGLE CONVERSATION _____ HEARS IN GROUP CONVERSATION _____

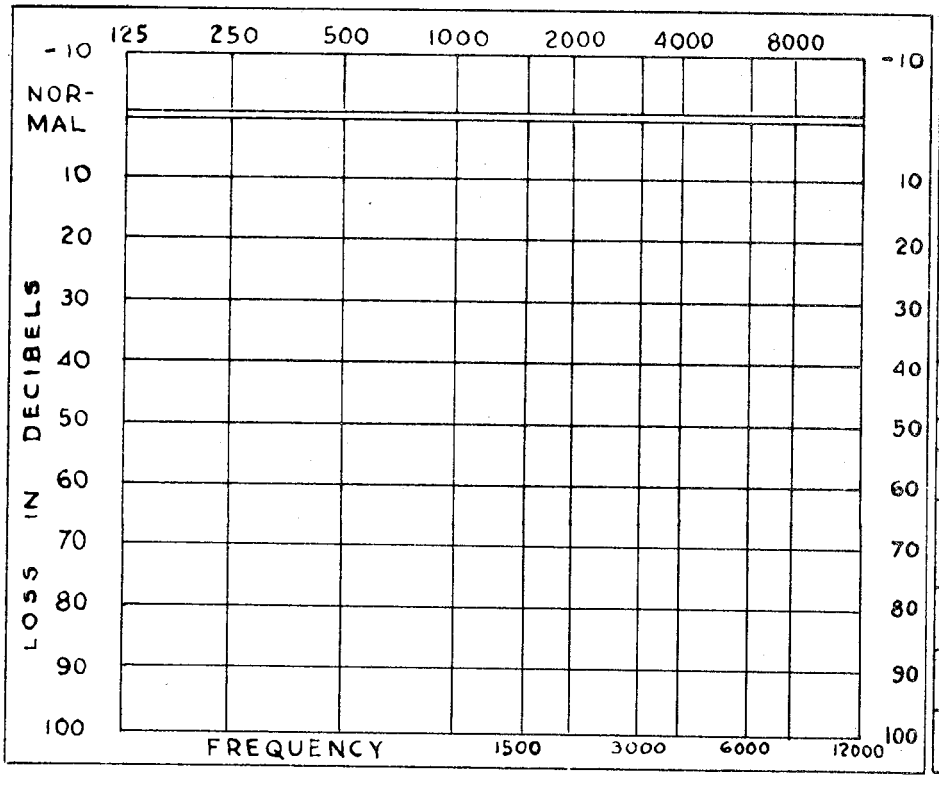
NOW USING H. A. _____ SINCE _____ MAKE _____ RESULTS _____

FENESTRATION _____ DATE _____ BY _____

TINNITUS ☐ SUPPURATIVE EAR ☐ DRUM ☐ OTOSCLEROSIS ☐ CONDUCTIVE ☐ NERVE ☐ MIXED ☐

REMARKS: _____

NAME AND TITLE OF TECHNICIAN _____ AUDOIMETER MAKE _____



	LEFT EAR	RIGHT EAR
	BLUE	RED
AIR	X	○
AIR WITH MASKING	□	△
BONE COND. WITH MASKING	◁	▷
D B INTENSITY OF MASKING		

A. M. A % HEARING LOSS		
L. ___	R. ___	COMB. ___

	LEFT EAR	RIGHT EAR
S. R. T.		
M. C. L.		
T. D.		

DEFICIENCY IN ACUITY AS ESTIMATED FROM ABOVE GRAPH

LEFT EAR _____ DECIBELS RIGHT EAR _____ DECIBELS

AUDIOGRAM RECORD _____ Plant / Division

Name _____ Clock No. _____ Date of Birth _____ Date Hired _____

	RIGHT EAR YES	RIGHT EAR NO	LEFT EAR YES	LEFT EAR NO
Does drum look normal ?				
Is a perforation present ?				

Comments

	RIGHT EAR							LEFT EAR												
Date	500	1000	2000	3000	4000	6000	8000	500	1000	2000	3000	4000	6000	8000	Audiometer	Standard	Time interval since exposure to noisy operation	Ear Protection Used	Time at job	Job and Comments	Technical

Note under comments any change of job or anything that has has happened since last exam that may affect the hearing.

MEDICAL DEPARTMENT

PRE PLACEMENT EXAMINATION

Date_____

NAME	NO.	AGE	DATE OF BIRTH	SEX ☐ M ☐ F	TELEPHONE	IN CASE OF EMERGENCY, NOTIFY:

ADDRESS	FAMILY M.D.	MARITAL STATUS ☐ ☐ ☐ ☐ ☐ M S W D SEP.	DEPARTMENT

FAMILY HISTORY

	NO.	AGE(S)	LIVING & WELL	AGE AND CAUSE OF DEATH
MOTHER				
FATHER				
BROTHERS				
SISTERS				
SPOUSE				
CHILDREN				

HAS ANYONE ON EITHER SIDE OF FAMILY HAD:

	Yes	No		Yes	No		Yes	No
Allergy	☐	☐	Heart Disease	☐	☐	Obesity (over wt)	☐	☐
Anemia or Blood Dis.	☐	☐	High Blood Pres.	☐	☐	Rheumatic Fever	☐	☐
Arthritis	☐	☐	Stroke	☐	☐	Tuberculosis	☐	☐
Cancer	☐	☐	Kidney Disease	☐	☐	Typhoid Fever	☐	☐
Diabetes	☐	☐	Epilepsy	☐	☐	Other Disease	☐	☐
			Migraine Headache	☐	☐			

COMMENTS:

OCCUPATIONAL AND EDUCATIONAL HISTORY

(FULL AND CHRONOLOGICAL ORDER)

SOCIAL HISTORY

DO YOU:

SMOKE_____ HOW MUCH_____ HOW LONG_____

USE ALCOHOL_____ HOW MUCH_____

USE MEDICINE_____ WHAT KIND_____

SLEEP WELL_____ HOW MANY HOURS_____

HOBBIES_____

LAST VACATION_____

PAST HISTORY

HAVE YOU EVER:	YES	NO
BEEN HOSPITALIZED	☐	☐
TREATED FOR ALCOHOLISM	☐	☐
TREATED FOR DRUG ADDICTION	☐	☐
BEEN ADVISED TO HAVE AN OPERATION	☐	☐
REQUIRED PSYCHIATRIC CARE	☐	☐
DRUG SENSITIVITY	☐	☐
BEEN REFUSED OR RATED UP FOR LIFE INSURANCE	☐	☐
RECEIVED DISABILITY PAYMENT OR COMPENSATION	☐	☐
RECEIVED A MEDICAL DISCHARGE FROM ARMED FORCES	☐	☐
HAD INOCULATIONS	☐	☐

HAVE YOU EVER HAD:

	YES	NO		YES	NO
TUBERCULOSIS	☐	☐	THYROID DISEASE	☐	☐
PLEURISY	☐	☐	DIABETES	☐	☐
PNEUMONIA	☐	☐	CANCER	☐	☐
TYPHOID FEVER	☐	☐	TUMOR	☐	☐
DIPHTHERIA	☐	☐	EPILEPSY	☐	☐
MEASLES	☐	☐	ALLERGY	☐	☐
CHICKEN POX	☐	☐	NERVOUS DISORDER	☐	☐
RHEUMATIC FEVER	☐	☐	ANEMIA OR BLOOD DIS.	☐	☐
MALARIA	☐	☐	VENEREAL DISEASE	☐	☐
POLIO	☐	☐	OTHER	☐	☐

COMMENTS:

CONTINUED ON NEXT PAGE

REVIEW OF SYSTEMS

DO YOU HAVE, OR HAVE YOU EVER HAD:

	Yes	No		Yes	No		Yes	No
FREQUENT HEADACHES	☐	☐	SWELLING OF ANKLES	☐	☐	ANY BLADDER TROUBLE	☐	☐
DIZZY SPELLS	☐	☐	HEART MURMUR	☐	☐	BLOOD IN URINE	☐	☐
FAINTING SPELLS	☐	☐	ANY HEART DISEASE	☐	☐	ALBUMIN (PROTEIN) IN URINE	☐	☐
CONVULSIONS	☐	☐	HIGH BLOOD PRESSURE	☐	☐	SUGAR IN URINE	☐	☐
DIFFICULTY WITH VISION	☐	☐	INCREASE OF WEIGHT	☐	☐	AWAKEN AT NIGHT TO URINATE	☐	☐
EYE GLASSES	☐	☐	DECREASE OF WEIGHT	☐	☐	EXCESSIVE THIRST	☐	☐
DIFFICULTY WITH EARS OR HEARING	☐	☐	TROUBLE SWALLOWING	☐	☐	EXCESSIVE URINATION	☐	☐
FREQUENT COLDS	☐	☐	FREQUENT HEARTBURN	☐	☐	DIFFICULTY OR PAIN ON URINATION	☐	☐
SINUSITIS	☐	☐	POOR APPETITE	☐	☐	UNCONTROLLABLE URINATION	☐	☐
EARACHES	☐	☐	FREQUENT INDIGESTION	☐	☐	RHEUMATISM	☐	☐
SORE THROAT	☐	☐	ABDOMINAL PAIN	☐	☐	ARTHRITIS	☐	☐
HOARSENESS	☐	☐	DIARRHEA	☐	☐	BURSITIS	☐	☐
TEETH TROUBLE	☐	☐	CONSTIPATION	☐	☐	SCIATICA	☐	☐
WEAR DENTURES	☐	☐	CHANGE OF BOWEL HABIT	☐	☐	CONSTANT OR RECURRENT BACK PAIN	☐	☐
SHORTNESS OF BREATH ON MILD EXERTION	☐	☐	BLACK TARRY STOOL	☐	☐	SWOLLEN PAINFUL JOINTS	☐	☐
PERSISTENT COUGH	☐	☐	BLOODY BOWEL MOVEMENT	☐	☐	VARICOSE VEINS	☐	☐
SPITTING BLOOD	☐	☐	ULCERS	☐	☐	LEG CRAMPS WITH EXERCISE	☐	☐
PAIN, PRESSURE OR TIGHTNESS OF CHEST	☐	☐	GALLSTONES	☐	☐	FLAT FEET	☐	☐
UNCOMFORTABLE BEATING OF HEART	☐	☐	JAUNDICE	☐	☐	DIFFICULTY IN WALKING OR STANDING	☐	☐
PALPITATIONS	☐	☐	ANY LIVER DISEASE	☐	☐	PINS AND NEEDLES OF FEET OR HANDS	☐	☐
DIFFICULTY LYING FLAT BECAUSE OF SHORTNESS OF BREATH	☐	☐	HERNIA OR RUPTURE	☐	☐	SKIN DISEASE OR RASH	☐	☐
			HEMORRHOIDS (PILES)	☐	☐	TREATMENT FOR NERVOUS CONDITION	☐	☐
FRACTURE OR DISLOCATION	☐	☐	ANY KIDNEY DISEASE	☐	☐	OFTEN FEEL DEPRESSED & UNHAPPY	☐	☐
DISEASE OF BONES OR JOINTS	☐	☐						

COMMENTS:

FOLLOWING QUESTIONS FOR WOMEN ONLY

AGE WHEN PERIOD STARTED _____ HOW OFTEN NOW _____ LASTS HOW LONG _____

REGULARITY _____ ANY CRAMPS _____ DATE OF LAST PERIOD _____

EVER BEEN PREGNANT _____ FULL TERM DELIVERIES _____ MISCARRIAGES _____

I hereby declare that the above statements are true to the best of my knowledge. I understand that deliberate false answers to the above questions may be basis for dismissal from employment.

Dated this ____ day of _____ 19__. _____ SIGNATURE _____ WITNESS

LABORATORY DATA

SUMMARY OF X-RAY FINDINGS

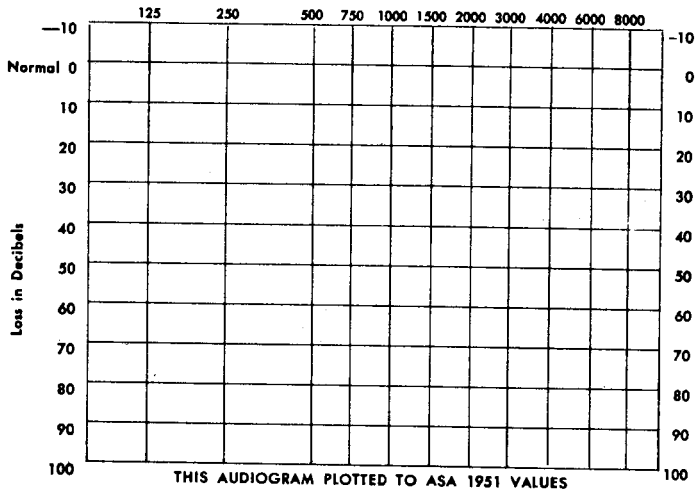
ELECTROCARDIOGRAM

CHEST

OTHER

FINAL SUMMARY, COMMENTS AND RECOMMENDATIONS
(LIST ALL SIGNIFICANT MEDICAL FINDINGS)

AUDIOGRAM



WORK RESTRICTIONS

I have discussed the examination results and the listed recommendations with the employee.

DATE: ..... M.D.

Medical Department

INITIAL HEARING CONSERVATION EVALUATION

1 - LAST NAME	FIRST	MIDDLE	2 - PLANT	3 - REASON FOR EXAMINATION:	4 - SEX	AGE
					MALE ☐ FEMALE ☐	

5 - DEPT.	6 - JOB TITLE

NOISE EXPOSURE HISTORY

7 - MILITARY EXPERIENCE YES ☐ NO ☐ GUN FIRE: BASIC TRAINING ☐ COMBAT - LIGHT ☐ HEAVY ☐ LENGTH OF EXPOSURE

8 - PREVIOUS EMPLOYMENT:

NAME OF COMPANY	LAST DATE	JOB TITLE	YEARS EXPOSED	TYPE: IMPACT YES	TYPE: IMPACT NO	TYPE: STEADY YES	TYPE: STEADY NO	INTENSITY: LIGHT	INTENSITY: MOD.	INTENSITY: SEVERE	EAR PROTECTION: YES	EAR PROTECTION: NO	TYPE: C	TYPE: F	TYPE: M	TYPE: H

9 - CYANAMID EMPLOYMENT

DEPARTMENT	LAST DATE	JOB TITLE	TIME IN JOB	NOISE CODE	IMPACT NOISE: CONTINUOUS	IMPACT NOISE: INTERMITTENT	STEADY NOISE: CONTINUOUS	STEADY NOISE: INTERMITTENT

10 - MEDICAL HISTORY

	YES	NO		YES	NO
EAR PAIN	☐	☐	NASAL ALLERGY	☐	☐
DRAINAGE	☐	☐	SURGERY TO EAR OR MASTOID	☐	☐
RINGING IN EARS	☐	☐	HEAD OR EAR INJURY	☐	☐
DIZZINESS	☐	☐	HEARING LOSS IN FAMILY	☐	☐

REMARKS:

11 - PHYSICAL EXAMINATION

	DRAINAGE	CANAL	DRUM
EARS: RIGHT			
EARS: LEFT			

MASTOID SCAR: RIGHT ☐ LEFT ☐

NOSE AND SINUSES

REMARKS:

12 - REFERENCE AUDIOGRAM (See Instructions)

HAD PRIOR AUDIOMETRIC TEST: YES	NO	DATE	TIME SINCE LAST NOISE EXPOSURE	RIGHT EAR 250	500	1000	2000	3000	4000	6000	LEFT EAR 250	500	1000	2000	3000	4000	6000	13 - TESTED BY: DATE

14 - COMMENTS:

MONITORING AUDIOMETRY

LAST NAME | FIRST | MIDDLE | AGE

Medical Department

1 - DEPARTMENT	LAST DATE	JOB TITLE	TIME IN JOB	NOISE CODE	IMPACT NOISE		STEADY NOISE	
					CONTINUOUS	INTERMITTENT	CONTINUOUS	INTERMITTENT

2 - INTERIM HISTORY

	YES	NO		YES	NO
EAR PAIN	☐	☐	DIZZINESS	☐	☐
DRAINAGE	☐	☐	E.N.T. SURGERY	☐	☐
RINGING IN EARS	☐	☐	CHANGE IN HEARING	☐	☐

EARS:	DRAINAGE	CANAL	DRUM
RIGHT			
LEFT			

NOSE & SINUSES:

AUDIOGRAM

3 - TIME SINCE LAST NOISE EXPOSURE

RIGHT EAR 250	500	1000	2000	3000	4000	6000	LEFT EAR 250	500	1000	2000	3000	4000	6000

TESTED BY:
DATE:

4 - COMMENTS AND RECOMMENDATIONS

1 - DEPARTMENT	LAST DATE	JOB TITLE	TIME IN JOB	NOISE CODE	IMPACT NOISE		STEADY NOISE	
					CONTINUOUS	INTERMITTENT	CONTINUOUS	INTERMITTENT

2 - INTERIM HISTORY

	YES	NO		YES	NO
EAR PAIN	☐	☐	DIZZINESS	☐	☐
DRAINAGE	☐	☐	E.N.T. SURGERY	☐	☐
RINGING IN EARS	☐	☐	CHANGE IN HEARING	☐	☐

EARS:	DRAINAGE	CANAL	DRUM
RIGHT			
LEFT			

NOSE & SINUSES:

AUDIOGRAM

3 - TIME SINCE LAST NOISE EXPOSURE

RIGHT EAR 250	500	1000	2000	3000	4000	6000	LEFT EAR 250	500	1000	2000	3000	4000	6000

TESTED BY:
DATE:

4 - COMMENTS AND RECOMMENDATIONS

1 - DEPARTMENT	LAST DATE	JOB TITLE	TIME IN JOB	NOISE CODE	IMPACT NOISE		STEADY NOISE	
					CONTINUOUS	INTERMITTENT	CONTINUOUS	INTERMITTENT

2 - INTERIM HISTORY

	YES	NO		YES	NO
EAR PAIN	☐	☐	DIZZINESS	☐	☐
DRAINAGE	☐	☐	E.N.T. SURGERY	☐	☐
RINGING IN EARS	☐	☐	CHANGE IN HEARING	☐	☐

EARS:	DRAINAGE	CANAL	DRUM
RIGHT			
LEFT			

NOSE & SINUSES:

AUDIOGRAM

3 - TIME SINCE LAST NOISE EXPOSURE

RIGHT EAR 250	500	1000	2000	3000	4000	6000	LEFT EAR 250	500	1000	2000	3000	4000	6000

TESTED BY:
DATE:

4 - COMMENTS AND RECOMMENDATIONS

AUDIOGRAM WORKSHEET

Date_____

NAME_____

JOB CLASSIFICATION_____

Hearing Threshold Level Left	Frequencies	Hearing Threshold Level Right
	250	
SPEECH LEVEL	500	AAOO LOSS
	1000	
	2000	
TOTAL 3	3000	
	4000	
	6000	
	8000	
TOTAL 8		

Average deficiency in hearing acuity (American Academy of Ophthalmology and Otolaryngology formula for compensation purposes).

LEFT RIGHT

BINAURAL

AUDIOGRAM

DATE _____ HAVE YOU HAD A PREVIOUS HEARING TEST? _____ WHEN? _____

NAME _____ SEX _____ AGE _____ BY WHOM? _____

SAL. OR C.C. _____ DEPT. _____ PLANT _____ RESULTS? _____

ANY TREATMENT?

JOB CLASSIFICATION _____

DATE MO. / DAY / YR.	TESTER	RIGHT EAR						LEFT EAR						AUDIOMETER TYPE & CALIBRATION	DURATION OF EXPOSURE TO NOISE IN THE PAST (YEARS)	TYPE OF NOISE EXPOSURE A-B-C-D (A) GUNFIRE (B) JET PLANE (C) LOUD MUSIC (D) PLANT INDUSTRY (E) EXPLOSIVES	TIME INTERVAL SINCE EXPOSURE TO NOISE	COMMENTS
		500	1000	2000	4000	6000	8000	500	1000	2000	4000	6000	8000					

HISTORY

	YES	NO			
HAVE YOUR EARS EVER RUN? RIGHT EAR			WHEN?	TREATED BY WHOM?	
(FROM INFECTION OR INJURY) LEFT EAR			WHEN?	TREATED BY WHOM?	
HAVE YOU HAD ANY OPERATIONS ON EARS?			WHEN?	BY WHOM? RESULTS—	
HAVE YOU EVER HAD DIZZINESS?			WHEN?	TREATED FOR IT?	
HAVE YOU EVER HAD NOISES IN YOUR EARS?			WHEN?	TREATED FOR IT?	
HAVE YOU BEEN IN THE MILITARY SERVICE?			WHEN?	EXPOSED TO ANY SORT OF GUNFIRE?	
HAVE YOU EVER HAD A SEVERE HEAD INJURY?			WHEN?	TYPE	
HAVE YOU EVER HAD HEARING TROUBLE?			WHEN?	RECEIVED ANY TREATMENT?	
DO YOU NOW HAVE ANY TROUBLE HEARING?			IF YES, DESCRIBE DIFFICULTY.		
HAVE YOU EVER WORKED IN A NOISY INDUSTRY?			WHEN?	FOR WHOM?	HOW LONG?
HAVE YOU DONE ANY DEEP SEA DIVING?			WHEN?	ANY INJURIES?	
DO YOU VISIT NOISY DANCING HALLS (BEATLES OR COMBO MUSIC) ETC.?			HOW OFTEN?	HOW MANY HOURS PER WEEK?	

EXAMINATION

	RIGHT EAR		LEFT EAR	
	YES	NO	YES	NO
IS THE EAR DRUM VISIBLE?				
IS THE EAR DRUM INTACT?				
IS THE CONE OF LIGHT VISIBLE?				
IS THE MALLEUS NORMAL?				
IS THE EXTERNAL CANAL NORMAL?				
DOES THE EAR APPEAR NORMAL?				

COMMENTS

E-14

B/P= /	VISION	GLASSES:	DATE:
F A R	UNCORRECTED: RE=_____ :: LE=_____ CORRECTED: RE=_____ :: LE=_____ COLOR:_____ :: DEPTH:_____		VER.PHORIA LAT. PHORIA
N E A R	UNCORRECTED: RE=_____ :: LE=_____ CORRECTED: RE=_____ :: LE=_____		VER.PHORIA LAT. PHORIA

SPLER= AUDIOGRAM Standard:

DATE: TIME SINCE LAST EXP= DURATION OF LAST EXP=

	500	1000	2000	3000	4000	6000	%
L							
R							

Bilateral = %

B/P= /	VISION	GLASSES:	DATE:
F A R	UNCORRECTED: RE=_____ :: LE=_____ CORRECTED: RE=_____ :: LE=_____ COLOR:_____ :: DEPTH:_____		VER.PHORIA LAT. PHORIA
N E A R	UNCORRECTED: RE=_____ :: LE=_____ CORRECTED: RE=_____ :: LE=_____		VER.PHORIA LAT. PHORIA

SPLER AUDIOGRAM Standard:

DATE TIME SINCE LAST EXP= DURATION OF LAST EXPOSURE=

	500	1000	2000	3000	4000	6000	%
L							
R							

Bilateral= %

NAME:_____ ::EMP #:_____

STATION::_____/ TITLE::_____

DATE OF BIRTH:_____

TYPE OF CLASSES WORN:_____/ LAST CHECKED_____

TIME ON JOB AS OF:_____ YRS=_____ MOS=_____

AVERAGE NOISE EXPOSURE TIME:_____.

SELF ESTIMATE OF HEARING: __GOOD/ FAIR:___/ POOR___

HISTORY: OTOSCOPIC EXAMINATION: FINDINGS & RECOMMENDATIONS ON REVERSE.

(over)

B/P= /	VISION	GLASSES:	DATE:
F A R	UNCORRECTED: RE=____:: LE=____		VER. PHORIA
	CORRECTED: RE=____:: LE=____		LAT. PHORIA
	COLOR:____::DEPTH____		
N E A R	UNCORRECTED: RE=____:: LE=____		VER.PHORIA
	CORRECTED:: RE=____:: LE=____		LAT. PHORIA

SPLER= AUDIOGRAM Standard:

DATE TIME SINCE LAST EXP= DURATION OF LAST EXPOSURE=

	500	1000	2000	3000	4000	6000	%
L							
R							

Bilateral= %

HISTORY: OTOSCOPIC EXAMINATION: FINDINGS: REMARKS: RECOMMENDATIONS: ETC

APPENDIX H -- PROCEDURE FOR OBTAINING AUDIOMETRIC AND ENVIRONMENTAL NOISE DATA

A. Preliminary:

1. Remove earphone cushion and record model number (this will generally be TDH-39 but always make sure).

2. Replace earphone cushion.

3. Set up equipment and allow a warm-up period. Make sure that all connections are secure.

B. Calibration of Sound Level Meter: (use of 4144 microphone)

1. Set weighting selector of the sound level meter to SLOW.

2. Set the meter dial to 120.

3. Perform a battery check on the B & K 4220 pistonphone by turning the switch to the "check" position. Listen for a change in frequency which indicates proper battery function.

4. Mount the B & K 4144 microphone on the artificial ear.

5. Carefully place the pistonphone on this microphone and turn pistonphone switch to "on." Read output on the VU meter of the SLM and, using the calibration set screw, adjust the meter until it reads 124 dB (the intensity output of the pistonphone). Remove the pistonphone, mount 6 cc coupler on the artificial ear. This completes the calibration procedure for measuring sound pressure level outputs.

C. Sound Pressure Level Measurements:

1. Carefully place the earphone on the artificial ear, center and level it.

2. Place the 420 gm weight on the earphone.

3. Set the weighting selector of the sound level meter to EXTERNAL FILTER.

4. Set the intensity dial of the audiometer to:*

   70 dB (re ANSI S3.6-1969)
   60 dB (re ASA 1951)

*In cases where a self recording audiometer is used, make sure the pen falls on the 70 dB line of the data card by substituting a specially made switch for the subject response button.

5. Set the presentation mode of the audiometer to "continuously on" or its equivalent.

6. Record sound pressure levels at the above intensity settings at all frequencies for both ears.

7. Record frequency readings from the frequency counter simultaneously.

D. Check on Interstep Spacing:

1. Set the frequency dial of the audiometer at the selected frequency.

2. Starting at an intensity dial setting of 100 dB on the audiometer, record sound pressure levels at 5 dB increments until reaching a level where the needle on the SLM* fluctuates. This usually occurs at around 30-25 dB HL. At this point, ambient noise levels in the room are affecting the readings registering on the sound level meter. This completes this procedure.

E. Calibration of Sound Level Meter: (for use of 4145 microphone)

1. Remove all equipment not necessary for obtaining ambient noise levels in the testing area.

2. Place the B & K 4145 microphone on the sound level meter.

3. Follow calibration procedures listed in Section B.

4. Make sure maximum noise conditions are present (fans, air conditioners, typing, etc.).

5. Hold SLM in a position so that the microphone is approximating the subject's ear.

6. Measure and record octave band levels from 125-8000 Hz.

F. Instrumentation** Used in the Evaluation of Hearing Test Equipment and Environments:

1. Bruel & Kjaer 2203 Sound Level Meter

2. Bruel & Kjaer 1613 Octave Band Filter

*Sound Level Meter

**Mention of the names of commercial concerns or products does not constitute endorsement by the U. S. Public Health Service.

3. Bruel & Kjaer 4152 Artificial Ear with 6cc coupler

4. Bruel & Kjaer 4144 Microphone (for measuring audiometer output)

5. Bruel & Kjaer 4145 Microphone (for making test area measurement)

6. Bruel & Kjaer 4220 Pistonphone

7. Monsanto 150A frequency counter

APPENDIX I. PART 1.

SURVEY	INDICATED TONE FREQUENCY IN HERTZ										
NUMBER	125	250	500	750	1000	1500	2000	3000	4000	6000	8000
1	***	245	491	***	1005	****	2001	2988	4001	5990	7974
2	***	***	504	***	989	****	2001	3012	3992	6013	****
3	***	***	502	***	1010	****	2070	3127	4157	6271	****
4	124	249	500	***	1001	****	1981	2990	3991	5975	7922
5	113	233	466	***	951	****	1770	****	3858	****	7200
6	123	245	499	755	1005	1489	1986	3002	4008	6011	7987
7	120	230	477	***	938	1387	1899	2876	3811	5521	7326
8	125	252	501	755	1044	1512	2014	3030	4012	6027	8103
9	124	247	492	730	977	1437	1957	2932	3850	5844	7704
10	124	245	520	765	999	1524	2025	3020	4052	6092	8138
11	***	252	507	***	1009	****	2010	3025	4002	6019	8024
12	***	254	498	***	1021	****	2011	3008	4001	6040	8000
13	123	243	498	***	1003	1503	1992	3048	4090	6074	8110
14	123	258	498	736	1008	1506	2014	3075	4110	6153	8187
15	125	251	502	765	1005	1510	2030	2995	4032	5973	7879
16	122	243	506	766	****	1507	2005	3009	4097	5939	7970
17	125	320	680	760	1007	1482	1977	2986	3965	5989	9198
18	124	251	502	759	1008	1501	1993	3014	4022	5947	7919
19	121	238	475	***	989	1480	1960	2999	3875	5932	7885
20	126	248	510	742	1013	1512	2008	3010	4022	6045	8125
21	***	252	509	***	984	****	2017	3032	4016	6041	7980
22	122	244	486	739	983	1491	1984	3014	4004	5966	7934
23	123	251	500	747	1023	1490	2047	3049	4015	5942	7901
24	124	250	501	755	1003	1507	1998	3012	4021	6033	8026
25	124	249	502	755	1004	1511	2001	3006	4016	5976	7964
26	126	254	510	723	986	1445	1914	2871	3700	5631	7386
27	124	247	494	736	995	1474	1964	2951	3936	5975	7991
28	***	246	508	***	980	****	2019	3011	4022	6017	7988
29	123	244	495	***	993	1478	1969	2999	3981	5921	7827
30	122	244	500	761	1017	1511	2019	3078	4013	6060	8137
31	122	247	492	***	1021	1475	2026	3024	4033	6040	8105
32	125	240	508	742	997	1479	1993	2965	3967	5977	7794
33	***	258	502	***	1012	****	2014	3010	4042	6016	8007
34	***	248	486	***	993	****	1980	2972	4024	6059	8176
35	120	238	487	***	969	1445	1951	2867	3743	5771	7640
36	126	255	504	760	1014	1501	2000	3048	4025	6049	8027
37	120	241	502	759	1007	1514	2011	3035	4017	6018	****
38	125	255	508	748	1019	1489	2018	3006	3956	5985	7799
39	129	259	516	754	1015	1501	2055	3057	3987	6063	7827
40	126	248	512	***	1013	1522	2022	3064	4049	6032	7923
41	124	240	477	746	974	1474	1926	2882	3906	6038	8132
42	127	252	507	759	1015	1501	2054	3056	4040	6074	8007
43	125	257	513	755	997	1507	2017	3005	3889	5956	7663
44	124	248	496	759	988	1511	1985	2986	4036	5881	8069
45	121	243	500	757	1005	1509	2004	3021	4009	5982	8025
46	***	***	493	***	998	****	1994	2984	3972	5975	****
47	***	***	498	***	984	****	1976	2993	3977	5990	****
48	***	***	496	***	988	****	1997	3000	3970	5967	****
49	***	***	500	***	984	****	1985	2985	3958	5945	****
50	***	***	494	***	1002	****	2003	2995	3993	6021	****
51	***	***	502	***	1008	****	2013	3001	3987	5995	****
52	***	***	493	***	985	****	2003	3043	4053	6129	****
53	***	***	505	***	997	****	1995	2992	4003	6071	****
54	***	***	491	***	991	****	1988	2976	3979	6013	****
55	***	***	510	***	1008	****	2043	3072	4069	6127	****
56	***	***	496	***	988	****	2007	3044	4059	6135	****
57	***	***	511	***	1009	****	2043	3082	4091	6141	****
58	***	***	503	***	1009	****	2053	3117	4157	6293	****
59	125	244	482	741	1027	1458	1944	2923	3830	5997	7920
60	***	247	490	757	1027	1508	2018	3020	3910	5757	7722
61	126	254	500	759	1008	1513	2007	3024	4012	6027	7925
62	124	250	501	755	1004	1509	2000	3009	3983	5978	7944
63	125	250	499	759	1010	1481	1974	3005	4030	6055	8104
64	127	258	514	744	991	1483	1999	2972	3973	5891	7794
65	122	237	498	807	1020	1497	1991	2999	4024	6037	8014
66	126	250	500	761	1011	1486	1980	2964	3924	5875	7838
67	***	***	495	***	1005	****	2011	3022	4000	6002	****
68	127	254	499	756	1010	1505	2012	3012	4023	6010	7977
71	***	255	514	***	1012	****	2030	3075	3917	5975	8182
72	***	250	507	***	1033	****	1986	2939	3971	5547	7613
73	***	248	509	***	1022	****	2010	3011	4007	6014	7975
74	***	253	507	***	1001	****	2013	3017	4016	6033	7996
75	***	253	510	***	1004	****	2020	3011	4021	6022	8002
76	122	240	496	***	1007	****	1995	2981	4019	5836	7961
77	***	257	514	***	1009	****	2015	3016	4002	6042	7988

APPENDIX I. PART 2. COUPLER SOUND PRESSURE LEVEL MEASUREMENTS RE. ANSI S3.6: '70 DB' DIAL SETTING (SEE NOTE AT END OF APPENDIX PART B)

SUR- VEY	AUD. TYPE	CAL. STD.	EAR- PHONE	FREQUENCY SETTING IN HERTZ 125	250	500	1000	1500	2000	3000	4000	6000	8000
1	MANUAL	ANSI -1969	LEFT	*****	97.0	82.0	78.5	****	80.0	80.5	81.0	85.5	82.0
			RIGHT	*****	97.5	82.5	79.0	****	80.5	80.5	80.5	86.0	82.5
2	AUTO.	ASA -1951	LEFT	*****	*****	80.5	76.0	****	80.5	76.5	79.0	81.0	****
			RIGHT	*****	*****	80.5	77.5	****	80.0	78.0	80.0	82.0	****
3	AUTO.	ASA -1951	LEFT	*****	*****	82.5	80.0	****	83.0	81.0	82.5	84.5	****
			RIGHT	*****	*****	82.0	79.5	****	82.5	81.0	80.0	84.5	****
4	AUTO.	ANSI -1969	LEFT	115.0	95.0	81.5	78.5	****	79.5	81.0	80.0	87.0	85.0
			RIGHT	114.0	93.5	80.0	77.5	****	79.0	80.0	79.0	88.0	84.0
5	MANUAL	ASA -1951	LEFT	116.5	98.0	82.0	78.5	****	81.0	****	86.5	****	87.0
			RIGHT	117.5	99.0	83.5	80.0	****	80.0	****	88.5	****	89.0
6	AUTO.	ASA -1951	LEFT	105.9	94.9	82.2	75.9	75.6	79.1	76.0	77.5	81.0	88.3
			RIGHT	105.9	95.2	81.0	77.3	77.8	80.9	75.3	77.4	78.5	85.0
7	MANUAL	ANSI -1969	LEFT	109.0	98.4	82.6	82.3	75.2	81.5	84.9	79.5	87.9	82.5
			RIGHT	107.8	97.2	81.4	81.6	74.3	79.7	82.4	78.7	86.8	82.1
8	MANUAL	ASA -1951	LEFT	*****	88.4	75.3	75.3	73.9	78.7	78.5	79.4	78.1	75.7
			RIGHT	*****	87.5	75.0	75.7	73.5	77.1	76.9	78.3	77.2	74.7
9	MANUAL	ASA -1951	LEFT	114.0	96.0	82.0	77.0	76.5	78.5	76.5	80.5	78.0	79.0
			RIGHT	116.0	96.0	83.0	80.5	82.0	84.0	82.5	74.0	83.0	85.5
10	MANUAL	ASA -1951	LEFT	113.0	90.5	76.0	74.5	78.0	76.0	76.0	77.5	82.0	85.5
			RIGHT	112.5	92.0	78.5	76.5	79.0	82.5	74.0	75.5	82.5	85.5
11	MANUAL	ASA -1951	LEFT	*****	96.0	82.0	79.0	****	80.0	78.0	81.5	77.5	87.5
			RIGHT	*****	96.0	82.0	78.5	****	80.0	78.0	81.5	74.5	84.0
12	MANUAL	ANSI -1969	LEFT	*****	96.5	82.5	78.0	****	82.0	82.0	82.0	85.0	84.0
			RIGHT	*****	96.0	82.5	78.0	****	81.5	81.0	82.0	82.5	83.0
13	MANUAL	ANSI -1969	LEFT	115.0	98.0	83.0	78.5	80.0	80.5	82.5	83.5	86.5	86.0
			RIGHT	114.0	97.5	82.0	78.5	79.0	79.5	82.0	83.5	85.0	85.0
14	MANUAL	ASA -1951	LEFT	*****	60.5	58.0	71.5	74.0	72.5	63.5	75.5	66.5	75.0
			RIGHT	76.5	67.5	66.0	81.0	80.0	79.0	71.5	86.0	78.5	87.0
15	MANUAL	ANSI -1969	LEFT	115.5	93.5	80.0	76.0	76.5	78.0	74.5	78.5	79.0	85.0
			RIGHT	111.5	93.5	80.0	75.5	76.0	78.0	75.0	78.5	79.5	85.0
16	MANUAL	ASA -1951	LEFT	116.0	94.5	86.5	****	83.5	84.5	83.0	85.5	82.5	92.5
			RIGHT	114.5	83.0	84.0	****	83.5	85.0	84.5	85.5	87.0	95.0
17	MANUAL	ANSI -1969	LEFT	82.5	72.0	70.5	83.5	81.5	78.0	74.0	81.5	78.0	61.0
			RIGHT	78.5	71.0	69.0	81.5	83.5	80.5	74.5	79.5	78.0	58.5
18	MANUAL	ANSI -1969	LEFT	107.0	93.0	81.5	77.5	75.0	76.5	77.0	84.5	87.0	82.5
			RIGHT	103.5	90.5	82.0	79.0	76.5	77.5	77.5	85.0	85.5	82.5
19	MANUAL	ASA -1951	LEFT	105.5	88.5	76.0	74.5	74.0	75.5	75.5	78.5	79.0	81.0
			RIGHT	105.5	88.5	76.5	75.0	74.5	75.5	74.5	79.0	77.5	80.0
20	MANUAL	ANSI -1969	LEFT	117.0	97.0	82.5	77.5	76.5	79.0	81.0	82.0	83.0	84.0
			RIGHT	115.5	96.0	81.0	76.5	75.0	78.0	80.0	81.0	82.0	83.5
21	MANUAL	ASA -1951	LEFT	*****	95.0	81.0	77.5	****	80.0	79.0	81.5	79.5	86.0
			RIGHT	*****	95.0	81.0	77.0	****	79.0	79.5	81.5	79.0	85.5
22	MANUAL	ASA -1951	LEFT	115.0	93.5	77.5	77.0	77.0	78.5	79.0	83.5	80.5	82.5
			RIGHT	113.0	94.0	78.0	77.5	77.0	78.0	79.0	82.5	79.5	82.0
23	MANUAL	ASA -1951	LEFT	117.0	97.5	83.5	79.5	79.5	81.5	80.5	81.5	81.5	88.0
			RIGHT	116.5	98.0	83.5	80.0	81.0	82.5	80.5	81.5	82.5	89.0
24	MANUAL	ANSI -1969	LEFT	114.5	96.0	81.0	78.5	78.0	80.5	78.0	79.5	80.0	85.0
			RIGHT	114.0	95.5	80.5	78.5	78.0	80.5	78.0	79.5	79.5	84.5
25	MANUAL	ANSI -1969	LEFT	113.0	83.5	80.0	78.5	76.5	80.0	76.0	79.0	82.0	87.5
			RIGHT	111.0	92.0	79.0	77.5	76.5	80.0	76.5	77.5	80.0	86.5

APPENDIX I. PART 2. COUPLER SOUND PRESSURE LEVEL MEASUREMENTS RE. ANSI S3.6: '70 DB' DIAL SETTING (SEE NOTE AT END OF APPENDIX PART B)

SUR- VEY	AUD. TYPE	CAL. STD.	EAR- PHONE	FREQUENCY SETTING IN HERTZ 125	250	500	1000	1500	2000	3000	4000	6000	8000
26	MANUAL	ANSI	LEFT	111.8	100.4	87.6	79.3	74.5	76.6	76.2	77.6	69.5	91.8
		-1969	RIGHT	112.0	100.5	87.3	77.4	74.0	78.1	76.9	77.5	72.7	92.0
27	MANUAL	ANSI	LEFT	116.6	95.4	81.7	77.6	76.0	79.0	80.2	80.1	84.7	82.5
		-1969	RIGHT	116.7	95.9	81.7	77.5	76.3	79.2	80.3	80.0	84.9	82.5
28	MANUAL	ANSI	LEFT	*****	93.0	79.3	74.8	****	79.3	81.0	77.3	79.7	82.2
		-1969	RIGHT	*****	92.2	78.6	74.8	****	76.4	80.4	77.4	80.5	81.3
29	MANUAL	ASA	LEFT	110.2	93.2	81.3	79.8	79.8	77.9	75.3	80.2	71.7	84.7
		-1951	RIGHT	98.0	90.5	83.0	76.3	76.0	77.3	76.7	80.0	78.8	85.9
30	MANUAL	ASA	LEFT	115.5	95.0	81.5	77.0	78.0	81.5	77.5	81.0	80.0	84.5
		-1951	RIGHT	113.0	94.0	81.0	76.0	76.5	82.5	76.5	81.0	81.0	81.0
31	AUTO.	ANSI	LEFT	116.5	97.0	82.5	80.5	79.5	83.0	83.0	81.5	89.5	88.5
		-1969	RIGHT	115.0	97.0	82.5	80.0	76.5	83.5	82.0	81.5	88.0	83.5
32	MANUAL	ANSI	LEFT	90.0	84.0	85.5	80.0	78.5	80.5	81.0	82.0	88.0	83.0
		-1969	RIGHT	87.0	80.0	77.0	86.0	82.0	82.0	82.0	83.0	85.0	80.0
33	MANUAL	ANSI	LEFT	*****	96.8	83.6	79.5	****	82.6	78.8	82.5	81.0	85.2
		-1969	RIGHT	*****	96.8	82.9	80.1	****	81.7	78.4	82.8	83.0	85.6
34	MANUAL	ASA	LEFT	*****	94.7	80.4	77.4	****	79.2	77.1	82.2	75.8	85.7
		-1951	RIGHT	*****	95.5	79.7	77.7	****	79.9	78.6	81.8	78.9	86.7
35	MANUAL	ASA	LEFT	112.5	94.7	79.8	77.0	76.8	78.2	75.5	79.8	81.3	85.9
		-1951	RIGHT	113.2	95.1	80.4	77.3	77.3	79.0	76.9	80.8	81.9	85.9
36	MANUAL	ANSI	LEFT	*****	92.0	79.4	75.4	74.6	79.1	78.4	80.0	84.2	80.0
		-1969	RIGHT	90.0	92.5	83.8	77.9	76.3	79.0	79.9	80.9	84.0	82.0
37	MANUAL	ANSI	LEFT	102.0	92.5	80.0	76.0	77.0	79.0	75.0	78.0	80.5	86.0
		-1969	RIGHT	102.5	93.5	81.0	77.0	78.0	79.5	75.0	78.0	81.0	89.5
38	MANUAL	ANSI	LEFT	114.5	93.0	80.5	77.5	76.5	78.8	78.2	81.5	84.0	82.0
		-1969	RIGHT	116.0	94.0	80.5	77.0	77.5	78.0	79.5	80.0	84.5	83.0
39	AUTO.	ANSI	LEFT	113.5	93.0	79.5	76.5	74.0	77.5	78.5	76.5	87.5	82.0
		-1969	RIGHT	114.0	92.5	78.5	78.5	73.0	78.5	78.0	79.0	84.0	82.0
40	MANUAL	ANSI	LEFT	113.5	93.5	82.5	77.5	78.5	78.0	81.5	79.0	84.5	85.0
		-1969	RIGHT	113.0	93.0	82.0	77.5	78.0	78.5	81.0	78.5	85.0	84.5
41	MANUAL	ANSI	LEFT	116.5	96.5	83.0	77.0	77.5	79.5	80.0	80.5	84.5	80.5
		-1969	RIGHT	116.5	97.5	82.0	78.5	77.5	80.5	81.5	80.5	86.0	82.0
42	MANUAL	ANSI	LEFT	115.0	95.0	81.0	76.5	79.0	79.0	80.0	82.0	86.5	86.5
		-1969	RIGHT	114.5	95.0	81.0	76.5	78.5	79.0	81.0	81.0	89.5	86.5
43	MANUAL	ASA	LEFT	109.5	92.0	77.0	72.0	74.0	75.5	74.5	75.0	80.0	77.4
		-1951	RIGHT	107.5	89.0	76.5	71.5	72.0	73.5	72.5	74.5	77.5	79.0
44	MANUAL	ASA	LEFT	114.0	96.5	83.5	77.0	76.5	78.0	78.5	77.5	80.5	84.0
		-1951	RIGHT	115.0	96.0	83.0	75.5	75.0	78.5	76.0	79.5	79.0	86.0
45	MANUAL	ASA	LEFT	107.0	94.5	80.5	78.5	79.0	80.0	79.0	82.0	78.5	84.5
		-1951	RIGHT	106.0	91.5	82.0	78.5	79.0	81.5	74.0	82.5	82.0	83.0
46	AUTO.	ANSI	LEFT	*****	*****	82.5	80.5	****	80.0	78.0	78.5	77.0	****
		-1969	RIGHT	*****	*****	76.5	74.5	****	76.5	76.0	75.0	69.0	****
47	AUTO.	ANSI	LEFT	*****	*****	77.0	85.0	****	83.5	80.0	80.0	85.5	****
		-1969	RIGHT	*****	*****	75.0	87.0	****	85.0	80.0	80.5	83.5	****
48	AUTO.	ASA	LEFT	*****	*****	79.5	75.5	****	77.5	76.5	79.0	75.5	****
		-1951	RIGHT	*****	*****	74.5	82.0	****	79.5	78.0	79.0	71.5	****
49	AUTO.	ASA	LEFT	*****	*****	78.5	74.5	****	77.5	80.0	77.5	75.5	****
		-1951	RIGHT	*****	*****	78.0	74.5	****	77.5	79.0	77.0	77.5	****
50	AUTO.	ANSI	LEFT	*****	*****	81.5	77.5	****	80.0	80.5	80.0	84.5	****
		-1969	RIGHT	*****	*****	82.5	81.0	****	80.5	80.0	80.0	85.5	****

APPENDIX I. PART 2. COUPLER SOUND PRESSURE LEVEL MEASUREMENTS RE. ANSI S3.6: '70 DB' DIAL SETTING (SEE NOTE AT END OF APPENDIX PART B)

SUR-VEY	AUD. TYPE	CAL. STD.	EAR-PHONE	FREQUENCY SETTING IN HERTZ 125	250	500	1000	1500	2000	3000	4000	6000	8000
51	MANUAL	ANSI -1969	LEFT	*****	*****	82.0	81.5	****	79.0	80.5	80.5	86.0	****
			RIGHT	*****	*****	81.5	77.0	****	79.5	81.0	81.0	84.5	****
53	AUTO.	ANSI -1969	LEFT	*****	*****	78.2	75.3	****	78.2	75.7	76.2	79.4	****
			RIGHT	*****	*****	78.8	74.9	****	78.2	75.5	76.1	79.7	****
54	AUTO.	ASA -1951	LEFT	*****	*****	79.6	75.4	****	77.3	76.9	78.0	78.1	****
			RIGHT	*****	*****	80.4	76.9	****	77.5	77.4	78.7	76.4	****
55	AUTO.	ASA -1951	LEFT	*****	*****	80.0	77.0	****	79.0	77.5	78.5	80.5	****
			RIGHT	*****	*****	80.0	77.0	****	80.0	78.5	77.5	81.0	****
56	AUTO.	ANSI -1969	LEFT	*****	*****	81.0	77.0	****	80.5	83.0	79.5	86.5	****
			RIGHT	*****	*****	82.0	77.0	****	77.5	79.0	80.5	82.5	****
57	AUTO.	ASA -1951	LEFT	*****	*****	76.5	76.0	****	80.0	79.5	81.5	83.5	****
			RIGHT	*****	*****	77.0	77.5	****	80.0	78.5	81.0	82.5	****
58	AUTO.	ANSI -1969	LEFT	*****	*****	82.0	77.5	****	79.5	81.0	80.5	86.5	****
			RIGHT	*****	*****	82.0	78.0	****	79.5	81.0	81.5	85.0	****
59	MANUAL	ASA -1951	LEFT	111.0	93.5	78.0	75.5	76.0	77.0	74.5	77.5	80.0	82.5
			RIGHT	114.0	96.0	78.0	73.5	75.5	76.5	72.5	76.0	78.0	81.0
60	MANUAL	ASA -1951	LEFT	*****	65.0	64.0	78.0	84.5	81.5	77.5	79.0	70.5	82.5
			RIGHT	82.0	66.0	66.0	79.0	84.5	80.5	74.0	81.5	74.5	83.5
61	MANUAL	ASA -1951	LEFT	82.5	81.0	69.0	81.0	80.7	80.5	78.0	79.5	81.0	82.0
			RIGHT	78.5	75.0	62.5	78.0	82.0	76.0	77.5	81.0	80.5	75.5
62	MANUAL	ANSI -1969	LEFT	116.0	95.0	90.0	77.5	76.0	79.0	81.0	80.0	88.0	81.0
			RIGHT	116.0	95.0	82.5	77.5	76.0	79.0	81.0	80.0	87.0	80.5
63	MANUAL	ANSI -1969	LEFT	114.5	95.0	82.0	77.2	76.0	78.5	80.5	81.5	85.0	81.0
			RIGHT	114.5	96.0	82.5	76.5	75.5	78.5	79.0	81.5	86.0	84.0
64	MANUAL	ANSI -1969	LEFT	115.0	97.0	82.0	77.0	76.5	80.0	80.5	80.0	87.5	82.5
			RIGHT	114.0	94.0	80.5	76.0	76.5	78.0	79.0	79.0	86.5	82.0
65	MANUAL	ANSI -1969	LEFT	114.5	95.5	80.0	76.5	77.5	79.0	76.5	79.5	80.0	84.0
			RIGHT	113.5	97.0	81.0	77.5	78.5	79.5	76.5	79.5	80.0	85.0
66	MANUAL	ANSI -1969	LEFT	114.0	95.0	81.0	77.5	79.0	78.0	79.5	80.5	81.5	87.0
			RIGHT	109.0	95.0	81.5	78.0	79.0	80.0	79.5	82.0	80.0	87.0
67	MANUAL	ANSI -1969	LEFT	*****	*****	81.0	77.0	****	80.0	80.0	81.5	85.5	****
			RIGHT	*****	*****	81.0	77.0	****	80.0	80.0	80.5	85.5	****
68	MANUAL	ANSI -1969	LEFT	115.5	96.0	81.5	77.5	76.5	80.0	81.0	82.0	86.0	84.0
			RIGHT	115.5	96.5	82.0	78.5	77.0	79.5	81.0	82.0	85.5	83.5
71	MANUAL	ANSI -1969	LEFT	*****	93.0	80.5	78.0	****	80.0	79.0	80.5	78.5	88.0
			RIGHT	*****	92.0	77.0	75.5	****	74.5	76.0	77.5	76.0	84.5
72	MANUAL	ANSI -1969	LEFT	*****	94.5	78.5	76.5	****	79.5	77.0	78.5	78.5	89.0
			RIGHT	*****	90.0	75.0	72.0	****	75.5	74.0	74.5	74.0	83.5
73	AUTO.	ANSI -1969	LEFT	*****	96.5	83.3	77.5	****	78.5	77.5	81.0	82.0	81.5
			RIGHT	*****	94.5	80.1	77.0	****	82.5	78.5	80.3	82.0	81.5
74	AUTO.	ANSI -1969	LEFT	*****	96.5	83.3	78.5	****	81.0	81.5	81.5	84.5	85.5
			RIGHT	*****	96.0	83.0	77.8	****	81.0	82.0	81.0	85.0	85.5
75	AUTO.	ANSI -1969	LEFT	*****	98.0	83.0	79.0	****	81.0	81.0	83.0	86.5	84.5
			RIGHT	*****	98.0	82.5	77.8	****	81.5	82.5	82.5	86.0	84.0
76	AUTO.	ANSI -1969	LEFT	112.5	94.5	81.0	77.0	****	79.5	80.0	80.0	84.0	83.5
			RIGHT	112.5	95.5	81.5	76.5	****	78.0	80.5	79.6	84.5	83.0
77	AUTO.	ANSI -1969	LEFT	*****	91.0	88.5	81.0	****	81.5	81.8	81.3	84.5	84.0
			RIGHT	*****	97.8	82.0	78.0	****	81.0	80.8	81.0	88.8	85.5

NOTE MEASUREMENTS SHOWN IN PART B OF THIS APPENDIX WHICH WERE OBTAINED FROM AUDIOMETERS CALIBRATED RE. ASA Z24.5-1951 WERE USUALLY TAKEN AT A DIAL SETTING OF 60 DB. EACH SUCH MEASUREMENT WAS INCREASED +10 DB AND THEN ALL MEASUREMENTS OBTAINED FROM AUDIOMETERS CALIBRATED RE. ASA Z24.5 WERE ADJUSTED BY THE "ANSI VS ASA-1951" DB DIFFERENCES IN REFERENCE THRESHOLD LEVEL SHOWN IN APPENDIX E OF ANSI S3.6-1969: " SPECIFICATION FOR AUDIOMETERS."

APPENDIX I. PART 3. COUPLER SOUND PRESSURE LEVEL MEASUREMENTS RE. ANSI S3.6
(SEE NOTE AT END OF APPENDIX PART B)

SUR-VEY	FREQ. (HZ)	EAR-PHONE	DIAL SETTING IN DB 100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25
1	1000	RIGHT	109.0	103.8	99.0	93.5	88.8	83.5	79.0	73.5	68.5	63.0	58.5	53.0	48.0	43.0	38.0	32.5
5	1000	LEFT	*****	*****	*****	*****	****	83.0	78.5	74.0	68.5	63.5	58.5	52.0	46.5	42.0	36.5	31.5
7	2000	LEFT	113.2	107.2	101.7	96.6	91.5	86.7	81.5	76.3	71.2	69.9	64.9	59.9	50.5	45.0	45.0	34.0
8	1000	LEFT	104.8	100.5	95.4	90.7	85.5	81.0	75.8	71.5	65.0	60.5	55.5	51.4	46.7	41.8	37.0	32.0
9	1500	LEFT	106.0	101.5	96.5	92.5	86.5	82.5	76.5	72.5	66.5	62.5	57.0	52.5	47.0	43.0	37.0	33.0
10	1000	LEFT	108.5	104.0	97.0	91.5	84.0	79.0	74.5	69.5	64.0	60.0	55.0	51.5	45.0	41.5	34.5	31.0
11	1000	LEFT	108.5	104.0	99.0	94.0	89.0	84.0	79.0	73.5	69.0	63.5	59.0	54.0	50.5	44.0	40.5	34.0
12	1000	LEFT	108.5	103.0	98.0	93.0	88.0	83.0	78.0	72.5	68.0	62.5	57.5	52.5	47.5	42.5	37.5	32.5
13	1000	LEFT	108.0	103.0	98.0	93.5	88.5	84.0	78.5	73.5	68.0	63.5	58.5	54.0	49.5	44.5	40.5	36.0
14	1000	RIGHT	110.5	105.5	100.0	95.5	90.0	85.5	81.0	76.0	71.0	65.5	60.5	55.5	51.0	47.0	42.0	37.0
15	1000	LEFT	106.0	101.0	96.0	91.0	86.0	81.0	76.0	71.0	66.0	61.5	56.0	51.5	46.5	42.0	36.5	32.0
16	2000	LEFT	111.0	109.5	106.0	101.5	96.5	91.5	86.0	79.5	76.0	71.5	66.0	60.5	55.5	49.5	43.0	39.0
17	1000	LEFT	112.5	107.5	102.5	98.0	93.0	88.5	83.5	78.5	73.5	69.0	64.0	59.5	53.5	49.0	44.0	41.0
18	1000	LEFT	108.5	103.5	98.5	93.0	87.5	82.5	77.5	72.5	67.5	63.0	57.5	53.0	48.0	43.5	38.0	33.5
19	1000	LEFT	108.5	101.5	95.0	89.0	84.5	79.5	74.5	70.0	64.5	59.0	54.0	49.0	43.5	37.5	31.5	25.5
20	1000	LEFT	107.5	102.5	97.0	92.5	87.0	82.5	77.0	72.5	67.5	63.0	57.5	53.0	47.5	43.0	37.5	33.0
21	1000	RIGHT	107.5	102.5	97.5	92.5	87.5	82.0	77.5	72.0	67.0	62.0	57.0	51.5	47.0	41.5	36.5	31.0
22	1000	LEFT	106.5	101.0	95.5	91.0	85.0	80.5	76.5	72.5	67.0	62.0	56.0	52.0	44.0	41.5	36.0	31.5
23	2000	LEFT	113.5	108.5	103.0	99.0	93.0	88.5	82.0	78.0	71.5	66.5	61.0	56.5	50.5	45.5	40.0	****
24	1000	LEFT	109.0	103.0	98.5	93.5	88.5	83.0	79.0	74.0	69.5	64.5	58.0	53.5	48.5	44.5	40.0	35.5
25	1000	LEFT	108.5	103.0	98.0	93.5	88.0	83.0	78.0	73.0	68.0	64.0	60.0	54.5	50.5	45.0	40.5	35.5
26	500	RIGHT	116.7	112.0	107.0	102.7	97.3	92.7	87.2	82.9	77.4	72.4	67.3	62.4	57.2	52.8	47.2	42.6
27	1000	LEFT	107.7	102.6	98.2	92.8	88.3	82.5	77.8	72.7	67.6	62.0	57.5	52.1	48.2	42.5	36.6	32.7
28	1000	LEFT	104.4	99.4	94.4	89.3	84.3	78.8	74.0	68.7	63.7	58.4	53.5	48.2	43.2	38.0	33.0	28.0
29	1500	RIGHT	106.3	101.0	96.2	91.2	86.2	81.2	76.4	71.5	66.0	61.0	56.0	51.5	45.9	40.2	34.2	28.5
30	3000	LEFT	104.0	102.5	98.0	92.0	87.5	82.5	77.5	72.0	67.5	63.5	59.5	54.5	50.0	43.5	39.0	34.0
32	1000	LEFT	114.5	110.0	105.0	100.0	94.5	90.0	84.5	80.0	74.5	71.0	68.0	67.0	67.0	****	****	****
33	1000	RIGHT	110.0	105.0	100.0	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0	45.0	40.5	35.6
34	1000	RIGHT	*****	*****	*****	*****	88.2	83.0	77.8	72.6	67.8	62.8	57.9	52.8	48.2	43.2	38.2	33.3
35	1000	RIGHT	106.9	101.6	96.8	93.4	87.5	82.4	77.5	72.1	67.3	62.0	57.5	56.5	47.0	46.3	41.2	32.0
36	1500	RIGHT	*****	*****	*****	*****	****	****	76.3	71.8	66.8	62.0	57.4	52.4	47.8	42.7	37.5	33.0
37	1500	LEFT	*****	*****	*****	*****	****	****	77.0	73.0	68.0	63.5	57.0	51.0	46.0	41.0	36.0	31.0
38	1000	RIGHT	*****	*****	*****	*****	****	****	77.0	72.0	67.0	62.5	57.0	52.5	47.0	42.5	36.5	31.5
40	1000	LEFT	*****	*****	*****	*****	****	****	77.5	72.5	67.5	62.0	56.5	51.5	46.5	41.0	36.0	31.0
41	1000	RIGHT	*****	*****	*****	*****	****	****	78.5	74.0	68.5	64.0	58.5	54.0	48.5	44.0	39.0	34.5
42	1000	LEFT	*****	*****	*****	*****	****	****	76.5	71.5	66.5	61.5	56.5	51.5	46.5	41.5	36.5	31.5
43	1000	LEFT	*****	*****	*****	*****	****	****	72.0	67.5	62.0	57.5	51.0	47.0	41.0	36.5	30.5	26.5
44	1000	RIGHT	*****	*****	*****	*****	****	****	75.5	71.0	65.5	61.0	55.5	51.0	45.0	40.5	35.0	30.5
45	1000	LEFT	*****	103.5	99.0	93.5	89.0	83.5	78.0	74.0	69.0	63.5	59.0	54.0	49.0	44.0	39.0	34.0
51	3000	LEFT	*****	*****	102.5	*****	91.5	****	80.5	****	72.0	****	60.5	****	50.5	****	40.0	****
59	1000	RIGHT	105.0	100.5	95.5	91.0	85.5	81.0	75.5	71.0	65.5	61.0	56.0	51.5	45.5	41.0	35.5	31.0
60	1000	RIGHT	108.0	101.0	95.5	90.0	89.5	84.0	79.4	74.5	69.5	64.0	59.0	54.0	50.0	45.0	40.0	36.0
61	1000	RIGHT	*****	103.5	98.0	93.5	89.0	83.5	79.0	73.5	68.5	64.0	58.7	53.5	49.0	43.5	39.0	34.0
62	1000	LEFT	105.0	101.5	96.5	91.5	86.5	82.5	77.5	70.5	67.0	62.0	58.0	52.5	48.0	42.5	38.0	34.0
63	1000	RIGHT	104.0	101.5	96.0	92.0	86.0	81.0	76.5	72.0	67.5	62.5	57.5	53.0	47.0	42.0	38.5	34.5
64	1000	RIGHT	107.0	102.5	97.0	92.0	86.0	82.0	76.0	72.0	66.5	62.0	56.5	52.0	46.5	42.5	36.5	32.0
65	1000	LEFT	104.5	99.0	95.0	80.0	85.5	81.0	76.5	71.5	65.5	61.0	55.5	51.0	46.0	42.0	36.0	33.0
66	1000	LEFT	107.0	101.5	96.5	92.0	86.5	82.0	77.5	73.0	68.0	63.5	58.5	54.0	50.0	44.0	39.0	34.0
67	2000	LEFT	*****	*****	101.0	*****	90.0	****	80.0	****	70.0	****	60.5	****	51.0	****	41.0	****
68	1000	LEFT	107.5	103.0	97.5	92.5	87.5	82.5	77.5	72.5	67.5	63.0	57.5	53.0	48.0	43.0	38.0	33.0
71	1000	LEFT	109.0	104.0	99.0	94.0	89.0	84.5	79.0	74.0	69.0	64.0	59.0	54.0	49.0	44.0	39.0	35.0
72	1000	RIGHT	102.0	97.5	92.5	87.5	82.5	77.5	72.0	67.0	62.0	57.0	52.0	47.0	42.0	37.0	32.0	27.0

APPENDIX I. PART 4. AMBIENT NOISE LEVEL MEASUREMENTS

SURVEY NUMBER	FREQUENCY SETTING IN HERTZ								
	31	63	125	250	500	1000	2000	4000	8000
1	**	**	44	29	17	13	14	13	11
2	**	**	43	29	22	12	16	16	18
3	**	**	44	29	21	16	13	14	14
4	**	**	**	**	20	15	19	17	16
5	**	**	43	43	37	33	24	20	18
6	56	52	40	31	30	17	28	19	29
7	53	55	47	29	23	16	16	13	13
8	**	**	33	21	18	14	15	15	16
9	**	**	35	25	19	17	16	16	16
10	**	**	34	26	24	24	22	24	24
11	**	**	42	28	24	16	14	12	12
12	**	**	36	26	20	14	12	12	12
14	**	**	49	34	20	19	16	15	20
15	**	**	38	30	22	18	15	14	14
16	**	**	34	19	16	16	16	14	14
17	**	**	42	33	16	12	12	14	14
19	**	**	44	44	28	16	14	11	10
20	**	**	42	32	21	16	12	14	14
22	**	**	**	**	10	10	10	10	10
23	**	**	**	**	21	18	16	16	19
24	**	**	**	37	28	15	18	15	17
25	**	**	**	**	31	22	20	23	15
26	**	**	**	**	48	41	34	20	20
27	**	**	**	**	17	15	20	18	18
28	**	**	**	**	20	25	22	18	20
29	**	**	**	**	20	21	21	22	8
30	**	**	**	**	32	16	22	20	20
32	**	**	41	36	38	32	24	18	16
33	68	60	57	46	45	35	33	26	24
34	60	51	50	43	42	37	29	25	26
35	60	53	32	18	**	**	20	15	**
36	58	47	40	30	24	18	21	19	22
37	64	54	36	28	19	26	17	17	19
38	66	56	51	32	41	30	28	28	33
39	78	62	56	50	40	28	23	18	18
40	68	50	50	28	20	22	22	25	20
43	66	64	53	36	22	26	22	22	22
44	60	46	48	31	24	21	26	26	25
45	56	43	34	26	18	16	16	14	14
46	**	**	**	**	26	26	15	15	**
47	**	**	**	**	15	17	12	14	17
48	**	**	**	**	26	11	19	11	13
49	**	**	**	**	10	10	10	10	11
50	**	**	**	**	26	28	24	22	20
51	**	**	35	15	12	12	12	12	11
52	**	49	41	35	22	18	17	18	18
53	63	60	43	39	25	20	20	21	22
54	59	61	49	47	40	35	30	26	26
55	68	52	44	32	22	22	22	24	20
56	49	41	30	22	16	17	13	13	13
57	58	49	58	44	34	27	20	20	40
58	47	42	37	23	18	19	16	17	12
59	**	**	37	24	15	15	12	14	12
60	**	**	**	32	24	20	18	18	19
61	**	**	49	36	26	19	18	22	20
62	**	**	41	36	24	18	16	15	14
63	**	**	38	26	18	17	14	18	16
64	**	**	62	46	34	37	36	24	21
65	**	**	34	39	25	14	13	18	15
66	**	**	34	28	22	14	14	16	17
67	**	**	40	28	18	14	14	13	15
68	**	**	33	25	32	20	20	18	12
69	**	**	**	**	19	18	20	16	23
70	**	**	55	45	42	34	29	21	19
71	**	**	50	40	32	28	24	17	14
72	**	**	39	26	20	13	12	12	10

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