SECTION 6:
NOISE AND HEARING CONSERVATION PROGRAM / REPORTS

Employee's exposure to excessively high sound pressure levels or high intensity noise can cause irreversible hearing loss. If noise levels cannot be reduced to within acceptable levels by technically and economically feasible controls, then employees must be protected by adequate personal protective equipment.

Hearing Conservation Program Elements:

I. Evaluation of Noise Exposure

Exposure measurements shall accurately reflect employee exposures. This is done with area sound level surveys and personal dosimetry. *Area noise monitoring* shall be used to determine noise levels in a given plant, specific area location, or while performing a particular job task. Sound level meters shall be set to the A scale, slow response for measurement of continuous noise. Impulse noise peaks shall be measured with a sound level meter with a peak hold capacity. Noise dosimeters used to evaluate *employee exposures* shall conform to the appropriate governing standard for personal dosimeters such as specified in ANSI:S1.25-1978. The microphone of the dosimeter shall be placed outside the employee's clothing on his shoulder. According to 29 CFR 1910.195, monitors shall use the following settings: 80 dBA threshold, 90 dBA criterion level and use a 5 dBA doubling rate. These instruments are to integrate all continuous, intermittent, and impulsive sound levels from 80 to 130 dBA. The personal dosimeters in Louisiana Division (i.e. Dupont MK2, Quest 14,15, or 27) meet these ANSI standards. To ensure accuracy all sound level meters and personal dosimeters are to be calibrated according to manufacturer's instructions before and after each use. *Additional monitoring* may be required in some areas. Monitoring shall be repeated in a timely manner, whenever a change occurs in production, process, equipment, or controls could result in new or additional exposures leading to greater than 50% daily dose, or may result in exposure exceeding 90 dBA.

II. H aring Protection

When excessive noise exposures cannot be reduced by feasible administrative or engineering controls, employees shall be provided with suitable hearing protectors to ensure proper fit and comfort. Hearing protectors must be worn if 1) an employee's noise exposure exceeds 85 dBA as an 8-hr. TWA or 2) an employee is working in an area with sound pressure levels are above 90 dBA or performing a task which generates greater than 90 dBA. All hearing protection shall be chosen which can attenuate *below 90 dBA* for the noise source and can ensure that the 8 hr. time weighted average will not exceed 85 dBA. The equation used for calculating the attenuation of a hearing protector is an OSHA Method which subtracts seven from the product Noise Reduction Rating (NRR). The corrected NRR of the hearing protector is then subtracted from the average sound level in dBA, to obtain the attenuated sound level in dBA. Note: an additional 5 dB is added to the corrected NRR when using dual

Hearing Conservation Program Elements:

II. Hearing Protection (continued)

hearing protection (both plugs and muffs). See Appendix B, page 14 of the Corporate Program Requirements for Hearing Conservation for examples. *Hearing Signs:* "CAUTION" signs shall be posted in work areas in which the sound pressure level may exceed 90 dBA, alerting the employee that hearing protection is required. Where sound pressure levels exceed 105 dBA, "DANGER" signs shall be posted to alert employees that a combination of plugs and muffs may be required.

III. Training and Education of Personnel

All employees whose noise exposure equals or exceeds an 85 dBA 8-hr. TWA or exceeds a 90 dBA Ceiling, must participate in an annual training program. The training shall consist of 1) the contents of the hearing conservation program, 2) results of area sound level surveys and personal dosimetry, 3) the effects of noise on hearing, 4) the type and purpose of hearing protectors; and instructions on selection, fitting, use, and care for them, and 5) the purpose of audiometric testing and an explanation of the test procedures and results. This training shall be documented, kept in the plant for the current year, and transferred to the Industrial Hygiene Department for the remainder of the 75 year retention period.

IV. Audiometric Testing Program

A baseline audiogram is given to all employees upon initial employment. As a minimum, all employees receive an annual audiogram when their noise exposure may exceed an 85 dBA 8-hr. TWA. The audiometric testing is performed in accordance with OSHA standard 29 CFR 1910.95 and the results are reviewed with the employees at the time of testing.

V. Control of Noise

The perferred method for noise reduction is feasible engineering controls. Any new equipment or process changes will be evaluated for the potential impact of noise in the area and when feasible will be engineered to keep noise levels below 85 dBA.

Attachment 1

Noise Levels for Common Jobs and Portable Equipment

The following levels were obtained under normal operating conditions and should be used as a guide. This list is not all inclusive. Sound levels for equipment not on this list may be extrapolated using this list as a guide if actual measurements are unavailable. However, if possible, actual readings should be obtained.

Operation of multiple noise sources in the same area or operation of any noise source in a reverberant environment (such as within a confined space), will result in higher noise levels. In such cases, measurements must be taken to determine actual sound levels.

Activity/Equipment	Sound Level		Activity/Equipment	Sound Level	
	Idle	Max		Idle	Max
Aerial Lift		< 85	Fork Truck (4000 lb)	82	90 - 94
Air Compressor (185 psi)	80	90	Fork Truck (6000 lb)	82	100 - 104
Air Compressor (w/o muffler)		130	Fork Truck (8000 lb)	83	90 - 100
Air Hose (90 psi)		100 - 104	Grinder (bench)		90 - 95
Air Impact Wrench (1/2")		105 - 109	Grinder (pneumatic)		100 - 104
Back Hoe	83	95 to 99	Jack Hammer		> 115
Ball Mill		110	Needle Gunning		115
Blower (electric)		< 90	Pile Driving		125 - 127
Bull Dozer	84	100 - 104	Road Grader	80	< 90
Cherry Picker (8 or 15 ton)	85	100 - 104	Sandblasting		125 - 130
Chipping Hammer		120 - 124	Scaling Gun		105 - 109
Crane (hydraulic, 45 ton)	82	100 - 104	Welding Machine (200 amp)	85	> 90
Cut Off Saw		90 - 94	Welding Machine (400 amp)	85	95 - 99
Drill (electric, 3/8 ")		95 - 99			

Attachment 2

Hearing Protection Distance Requirements

Appropriate hearing protection shall be worn by both the operator and anyone within the distances specified below for sound levels within the specified ranges.

Sound Level Range	Protection Required at Specified Distances	
	Double	Single
125 - 130	0 - 50 ft	50 - 300 ft
120 - 124	0 - 30 ft	30 - 150 ft
115 - 119	0 - 15 ft	15 - 90 ft
110 - 114	0 - 10 ft	10 - 50 ft
105 - 109	0 - 5 ft	5 - 30 ft
100 - 104	—	0 - 15 ft
95 - 99	—	0 - 10 ft
90 - 94	—	0 - 5 ft

This section contains the following documents:

1. **The Plant/Department-Specific Written Hearing Conservation Program**
   Each plant/department is required to have a written hearing conservation program detailing the minimum requirements for an acceptable program within their area

2. **Current Noise Monitoring Reports for Specific Area**
   A copy of the most recent noise monitoring report should be kept in the manual. Historical data has been included in the annual Industrial Hygiene Report located in Section 2 of the manual.

3. **Industrial Hygiene Guide Documentation for Noise**
   This document explains the activities of the Corporate Task Force on Hearing Conservation and how DOW has implemented its Hearing Conservation Program.

4. **DOW Corporate Guidelines for a Hearing Conservation Program**

5. **Warning Sign Information**
   Color pictures of the signs and their corresponding MSMS code numbers are provided for ordering the necessary signs for your area.

6. **List of Hearing Protection**
   This provides a list of available approved hearing protection devices including MSMS code numbers. The manufacturer' NRR is included for each device.

7. **LAD Personal Noise Monitoring Record Form**

INDUSTRIAL HYGIENE GUIDE DOCUMENTATION

NOISE

ISSUED BY:

THE CORPORATE TASK FORCE ON HEARING CONSERVATION

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INTRODUCTION

In 1974, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Committee (3) adopted an 85 dBA criteria for an eight hour day, five day week, for long term exposures to occupational noise as an appropriate limit to ensure the protection of approximately 90 percent of exposed workers.

On March 8, 1983, the Occupational Safety and Health Administration (OSHA) published in the Federal Register a two year delay revision of the occupational noise exposure hearing conservation amendment (1) originally issued on Friday, January 16, 1981. (2) The standard specifies an action level of 85 decibels measured at slow response on the A-weighted network (dBA) as an 8-hour time-weighted average (TWA) at which point workers are placed in a hearing conservation program (HCP). Those in the HCP are given training and audiometric testing. Hearing protectors are made available and are mandatory under certain conditions. The standard sets a permissible exposure limit (PEL) of 90 dBA as an 8-hour TWA and establishes a ceiling value of 115 dBA. At the PEL, feasible engineering controls must be applied. The 5 dB exchange rate is employed and the criteria is expanded to include noise levels from 80 dBA to 130 dBA for continuous, intermittent and impact/impulse noise.

Other countries in which Dow maintains operations have adopted similar regulations. The main differences in these standards are the level at which the PEL is set and the exchange rate (3 dBA vs 5 dBA) used when measuring exposures to noise.

On May 15, 1984, the Corporate Industrial Health Board adopted an Industrial Hygiene Guide (IHG) for Noise based on documentation by E. J. Schneider (4). The IHG was based on the OSHA criteria of 85 dBA (8-hour day) as an action level for the commencement of an HCP, and 90 dBA (8-hour day) for engineering controls. A 5 dB exchange rate was employed.

On July 14, 1987, a Corporate Task Force was appointed by the Corporate Chief Medical Officer and Corporate Director of Industrial Hygiene to "consider not only the number limits for noise exposure but the various program elements that are so important in achieving effective conservation of hearing." This report summarizes the findings and recommendations of the Task Force.

THRESHOLD OF HEARING

When young people with good hearing are tested under ideal conditions. the threshold for pure tones is labeled the minimum audible field. The minimum audible field varies as a function of the frequency of the tone. The ear is much less sensitive in the lower frequencies, requiring a higher level of sound pressure to appear as loud as the sound at a mid frequency. The ear is also somewhat less sensitive to higher frequencies.

For approximately 10 years, two sets of reference zero levels for pure tone audiometers were in widespread use. The American Standards Association (ASA) levels were based on determinations of the threshold of hearing in "normal" ears made in the United States Health Survey (5) in 1935-36.

THRESHOLD OF HEARING (CONT'D)

The British Standard (5) was developed from studies carried out in England in the early 1950s, using more modern equipment, better acoustic conditions and improved psychoacoustic techniques. The British values were approximately 10 dB lower on the average than the corresponding 1951 American standard values.

To meet the desires of leading otologists and audiologists, the International Organization for Standardization (6) (ISO) began in 1955 to review all published data on the thresholds of normal hearing. Fifteen studies, half of them in the United States, were reviewed and all differed from the 1951 American standard. The data from the 15 studies were combined to form an international standard reference zero for calibration of pure tone audiometers. The adoption of an international standard was endorsed by the American Academy of Ophthalmology and Otolaryngology (AAOO) in 1960. The American standard (7) was later changed in 1969.

NOISE QUANTIFICATION CRITERIA (4)

Early efforts (before 1950) at determining the maximum safe level exposure to noise relied heavily on overall levels of sound pressure and no other factors.

By 1950 it was apparent that proposed limits must consider, in addition to intensity, other physical characteristics of noise exposure. Concern shifted from measurements of noise based on overall sound pressure to measurements which were more indicative of the response of the hearing mechanism. Several damage risk criteria emphasized setting limits by frequency bands, since data on minimum audible field sensitivity and measurements of equal loudness indicated that the ear was not equally sensitive at all frequencies.

The second major impetus for measurements of noise based on octave band analysis came from research which indicated that the amount of threshold shift observed was closely related to the frequency spectrum of the noise exposure.

In 1960 an intersociety committee sponsored by the Industrial Medical Association, proposed a new approach of using A-weighted sound level measurement. The use of the A-weighting was considered a means of rating noises in a manner reasonably similar to the human ear.

In a study of 580 industrial noises, Botsford showed that the A-weighted sound level indicated the hazard to hearing as accurately as did limits expressed as octave band sound pressure levels in 80% of the cases. Other studies by Passchier-Vermeer and Robinson supported the use of dBA as accurate as octave band analysis.

As a result of its simplicity and accuracy in rating hazard to hearing, the A-weighted sound level was adopted as the measure for assessing noise exposure by the ACGIH in 1960 and by the U. S. Department of Labor and by the British Occupational Hygiene Society in 1971.

HEARING IMPAIRMENT

The capacity to learn and understand speech is considered the most critical function of human hearing. Definitions of impairment of hearing are directly related to an individual's ability to understand speech in everyday social conditions.

There is very little debate about the usefulness of pure tones to assess hearing impairment, but there is disagreement about which audiometric frequencies should be used in the assessment as well as the hearing level at which material impairment begins.

In 1959 the AAOO defined the ability to understand speech in terms of a simple average of hearing levels at the three frequencies 500, 1000, and 2000 Hz. The point at which impairment begins (low fence) was set at an average of 25 decibels above audiometric zero. This was referred to as the hearing loss index.

Subsequent data showed that the hearing level at 3000 Hz is related to the understanding of speech, particularly in the presence of noise. In its criteria document (8) NIOSH recommended that the definition of impairment be expanded to include the ability to understand speech in noisy or difficult listening conditions. NIOSH used an average loss at 1000, 2000, and 3000 Hz, still using a 25 dB fence.

In 1979 the American Medical Association (AMA) changed its formula for hearing handicap to include 3000 Hz. It now uses a low fence of 25 dB for hearing levels averaged at the frequencies 500, 1000, 2000, and 3000 Hz. The primary use of the AMA formula is for "medico-legal" compensation purposes.

OSHA, in the 1981 hearing conservation amendment document (1), also defines impairment of hearing as an average hearing level with respect to audiometric zero that exceeds 25 dB for the frequencies 1000, 2000, and 3000 Hz. The agency believes the 3000 Hz should be included in the definition of impairment but 500 Hz should be excluded since it is considered not as important for understanding speech and is thought to be the last and least affected by noise.

Measurement procedures have been developed to determine hearing loss in its early stages, before material hearing impairment begins. The 1983 Hearing Conservation Amendment (2) specifies for this purpose the use of a Standard Threshold Shift (STS). An STS is defined as an average hearing loss of 10 dBA or more at 2000, 3000, and 4000 Hz when compared to a baseline audiogram and corrected for aging.

QUANTIFYING NOISE INDUCED HEARING LOSS

The two concepts used for describing dose response relationships for noise-induced hearing loss are"percentage risk" and "noise-induced permanent threshold shift." (1)

The "percentage risk" concept is a limited description of noise-induced hearing loss which predicts the percentage of a population that will develop hearing impairment as a result of a given level and duration of noise.

The second concept, "noise-induced permanent threshold shift", is used to predict the amount of hearing loss in decibels that will occur as a result of given levels and durations of noise after allowing for aging.

QUANTIFYING THE EFFECTS OF NOISE

W. L. Baughn (9) found that a work population when exposed to broad band steady state noise at 80 dBA for a working lifetime experienced hearing loss (as measured by percentage risk) which was essentially identical in magnitude to a group which was not exposed to work related noise. At SPLs above 80 dBA, the percent risk increases resulting in essentially the entire population becoming impaired at 100 dBA and above. See Figure 1.

Data compiled by ISO, EPA and NIOSH (which included the Baughn study) (1) indicated that the risk of material hearing impairment after a working lifetime at 80 dBA ranged from 0 to 5 percent. The risk of material impairment at 85 dBA and 90 dBA ranged from 10-15 percent and 21-29 percent, respectively.

Mills et al (10) exposed human subjects to steady state wide band noise at various sound pressure levels for 8 to 24 hours. Temporary threshold shift (TTS) increased for about 8 hours and then reached a plateau or asymptote. TTS at asymptote (ATS) increased about 1.7 dB/dB increase in sound pressure level above about 78 dBA (see figure 2). They concluded that "There is a remarkable coincidence between the relationship which describes ATS and noise level and the relationship which describes noise-induced permanent threshold shift (in industrial workers) and noise level."

The Mills data predicts an average noise-induced hearing loss (at 4000 Hz) of 12 dB and 20dB after ten years work exposure at 85 dBA and 90 dBA, respectively. At 95 dBA exposure the loss approaches 30 dBA.

QUANTIFYING THE EFFECTS OF NOISE (CONT'D)

Other studies support the same conclusions:

1. The sound pressure level at which chronic exposure to noise will not damage the human ear is at or below 80 dBA.
2. Hearing loss increases linearly as a function of sound pressure level (8-hour day) over a range from approximately 85 dBA to 110 dBA (10, 11, 12).
3. Sound pressure levels at or above 110 dBA (8-hour day) may exceed the "elastic limit" of the normal hearing mechanisms (TTS = 50 dB) and result in acoustical trauma (hearing loss due to mechanical damage to the hearing mechanisms).
4. Sound pressure levels above 110 dBA may result in acoustical trauma in a much shorter time period (e.g. after less than 15 minutes at 130 dBA).

IMPULSE/IMPACT NOISE (12)

Impulse/impact noise is a generic term which includes all forms of high-intensity short-duration sounds. Durations may vary from tens of milliseconds for small arms fire to several hundred milliseconds for a reverberant industrial impact. Intensities may vary from less than 100 dB to in access of 185 dB peak sound pressure level (SPL).

The waveforms can be very different. Impact noise is reverberant and its physical behavior generally conforms to the laws of acoustics. Impulses are shock waves which are governed by physical principles that are different from the laws of acoustics. The damage to the ear from impulse/impact noise may vary with rise time, peak level, duration, spectrum, repetition rate and number of impulse/impacts.

In general, studies have shown that impulse/impact noise can affect the auditory system differently than lower levels of continuous noise. Effects that are probably attributable to excessive displacements of the cochlear partition of the ear leading to direct mechanical damage are seen. These effects can also result from high levels of continuous noise, but in practice it is unusual to have protracted exposures to continuous noise above 110-120 dB.

The slope of a plot of dB ATS/dB increase in impulse peak SPL inflects dramatically at about 110 dB. This change in slope may signal a change from a primary metabolic mode of damage (a disturbance of the bio-chemical balance) to a primary mechanical mode and may be related to the "elastic limit" of the hearing mechanisms.

EXCHANGE RATE

The logarithmic nature of sound measurement results in a ten-fold increase in SPL with a 10 dB increase in amplitude or a doubling for approximately every 3 dB increase in amplitude. Because of other factors which influence the damage to the hearing mechanism, the 3 dB doubling (exchange rate) was thought to be overly conservative. This resulted in the adoption by OSHA of a 5 dB exchange rate in the 1983 Hearing Conservation Amendment (1). The decision was, and remains, very controversial.

Most workers who are exposed to noise are exposed to variable or intermittent noise. When this is the case the weighting that is given to various sound pressure levels can greatly affect the calculated exposure level.

Figure 3 is a tabulation of potential noise exposure data (in most cases the subjects wore hearing protectors during the periods of high sound pressure) for a group of carpenters and painters in Texas Operations. The data was obtained employing a Quest Electronics Micro-15 Noise Dosimeter. The Micro-15 calculates the percent dose and other parameters using both a 3 dB and 5 dB exchange rate.
The data is arranged in order of increasing noise exposures with Sample #1 being the lowest exposure and Sample #22 the highest exposure.

The exposures were typical of those normally expected for craftsmen; periods of relative quiet ($\leq$ 80 dBA) interspersed with periods of very loud noise from saws ($\geq$ 112 dBA), grinders ($\geq$ 110 dBA), pneumatic nail drivers ($\geq$ 120 dBA), sand blasters ($\geq$ 115 dBA), etc.

A comparison of percent dose versus exchange rate from Figure 3 demonstrates that the exchange rate will markedly influence the level at which the standard is enforced. While there is little difference due to exchange rate at low dose levels, as the dose increased the spread increased. Samples 9 through 14 which are below the action level included in an HCP of 50% of the OSHA allowable dose when the 5 dB exchange rate is employed show a noise dose ranging from 50% to nearly 300% when a 3 dB exchange rate is employed. Also, sample 18 is the first above 100% dose using 5 dB exchange rate which is equivalent to more than 5000% dose using the 3 dB exchange rate.

A 3 dB exchange rate gives a much more conservative estimate of the population at risk (action level) and a permissible exposure level for variable noise far below that being enforced currently.

CONCLUSIONS

A careful study of the data presented herein leads to the following conclusions:

1. The action level in the OSHA Standard for commencement of an HCP (85 dBA as an 8-hour TWA) does not identify all individuals at risk of material hearing impairment.

   Many individuals may be exposed at less than 85 dBA as an 8-hour TWA but above the no affect level (about 78 dBA as an 8-hour TWA) and due to their exposure suffer hearing impairment. There is no mechanism under the current OSHA standard to identify and protect this group.

2. The PEL (90 dBA as an 8-hour TWA) specified in the OSHA Standard does not protect the exposed population from hearing impairment.

   Data compiled by ISO, EPA and NIOSH (1) show that up to 29% of those exposed at 90 dBA for a working lifetime will become socially impaired ($\geq$ 25 dB average loss at 500, 1000, and 2000 Hz). One could reasonably extrapolate from this data that the loss in those frequencies first and most affected by noise (3000, 4000 and 6000 Hz) would be much greater. Although this may not materially impair an individual's ability to understand speech, the enjoyment of music and other "quality of life" factors may be significantly affected.

3. The 5 dB exchange rate employed in the OSHA Standard under-estimates the actual dose for highly variable noise exposures.

   The 3 dB rule assumes that noise induced hearing loss (NIHL) is associated with the total amount of energy that enters the ear regardless of patterning. The 5 dB rule is assumed to account for temporal effects of noise exposure on the job.

   Cluff (13) reviewed the development of the 3 dB and 5 dB rules. He concluded that "It (the 3 dB rule) has been shown to allow a reasonably accurate prediction of group-average NIHL in humans. In contrast, the 5 dB rule appears to lack credibility."

RATIONALE FOR 90 dBA CEILING

If one assumes that the above conclusions (which are supported by a preponderance of the data) are in fact correct, then the problem becomes to promulgate an IHG which:

1. Will provide a reasonable measure of protection for those who are exposed to work-related noise.
2. Can be applied universally throughout all countries in which Dow has operations without conflicting with the requirements of various local laws and regulations.
3. Is enforceable.

The first logical thought would be to lower the current Dow IHG and action level for commencement of HCP while retaining the 8-hour TWA aspect. To be fully protective the IHG would have to be set at or below 80 dBA (8-hour day) with the action level at approximately 75 dBA (8-hour day) and a 3 dB doubling rate.

The IHG and action level would be lower than for any country in which Dow has operations and Brazil and the USA employ a 5 dB doubling rate. Problems involved in simultaneously enforcing a Dow IHG and a conflicting local standard could be complex.

Additionally it is extremely difficult to enforce an 8-hour TWA standard. Exposures vary widely according to the tasks being performed on a particular work shift and it is impossible, short of wearing a noise dosimeter, for the individual to know when he is approaching or has exceeded the allowable daily dose.

A far better solution is to set a ceiling above which workers cannot be exposed without the use of personal hearing protectors. To be fully protective the Task Force recommends a 90 dBA ceiling based on the data in Figure 4.

Figure 4 is from the same data set as Figure 3 and shows the effect of wearing hearing protectors above 90 dBA. The Quest Electronics Micro-15 is capable of determining a Low Threshold Limit Dose (LTLD) and a High Threshold Limit Dose (HTLD). The LTLD is the accumulated noise dose (5 db exchange rate) expressed as the percent of allowable dose for all noise above a predetermined low threshold (in this case 80 dBA which closely corresponds to the no-effect level). The HTLD is the accumulated noise dose (5 dB exchange rate) for all noise above a high threshold (in this case 90 dBA).

When the HTLD is subtracted from the LTLD the resulting percent dose is that accumulated between the low threshold, 80 dBA, and the high threshold, 90 dBA. The data shows that for the variable noise exposures of the test group almost all the percent dose is received above 90 dBA. Regardless of the total percent dose (LTLD) the dose received below 90 dBA (LTLD-HTLD) ranges from 6% to 13% for all but one sample. This corresponds to an 8-hour TWA exposure of 70-75 dBA. Assuming that sound pressure levels above 90 dBA are attenuated to a safe level by personal hearing protectors, a ceiling at 90 dBA would almost surely be protective regardless of action level, PEL, or exchange rate employed. Conversely, a 90 dBA ceiling can be enforced in addition to any other local requirements (i.e. 85 dBA as an 8-hour TWA action level, 90 dBA 8-hour TWA requirements for engineering controls, 3 dB or 5 dB exchange rate, etc.) without interference.

A 90 dBA ceiling, therefore, meets the criteria of enforceability and universality. The criteria of protection appears to be satisfied in most cases for those exposed to variable or intermittent noise. Groups of workers who are not exposed to SPL's above 90 dBA but who have 8-hour TWA exposures above 75 dBA should be evaluated on a case by case basis taking into account any evidence of NIHL in the group.

FIGURE 1

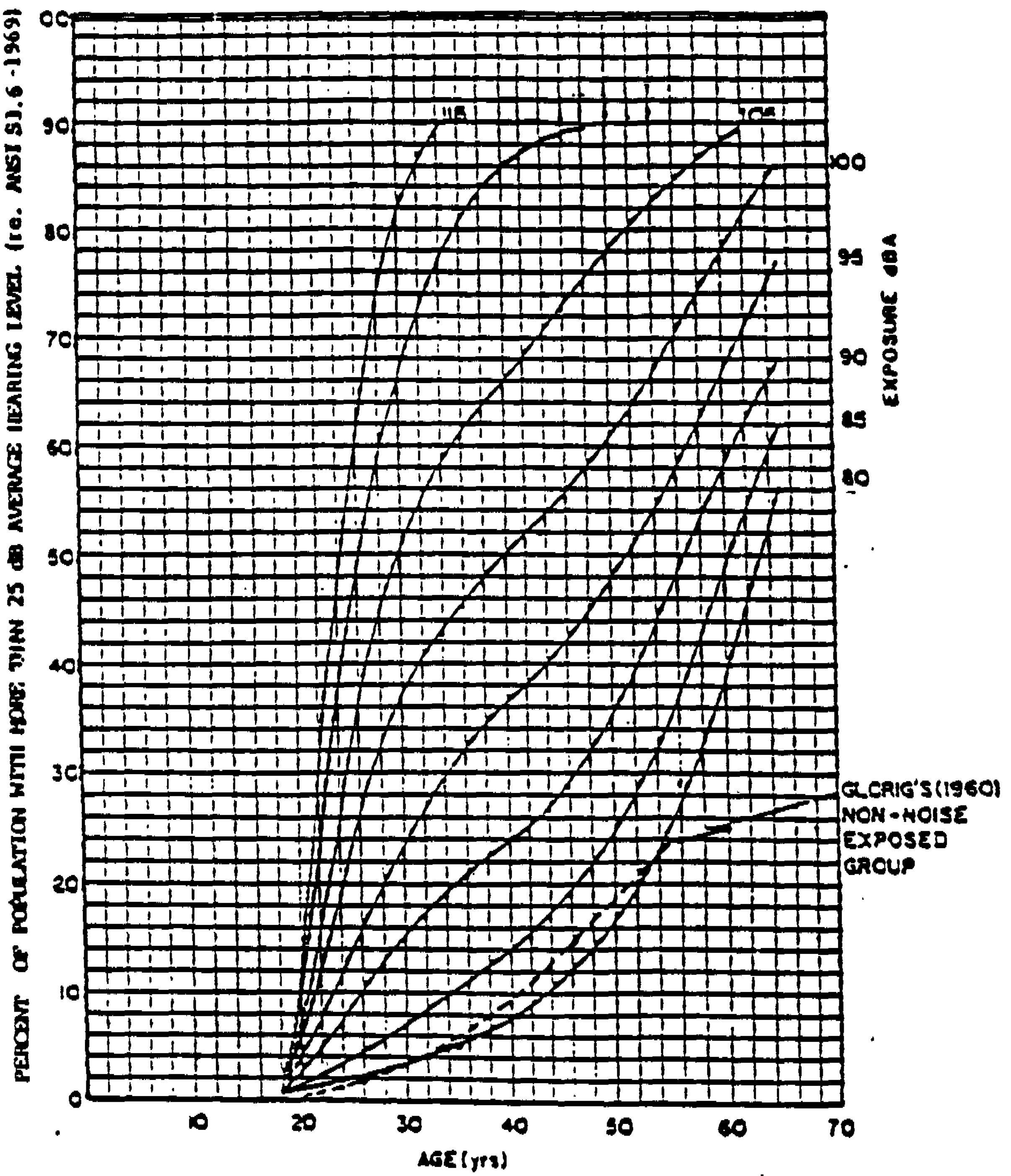

Figure 1. Percent of the population with more than 25 dB average hearing level for the frequencies 500, 1000, and 2000 Hz as a function of noise exposure level.

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CONFIDENTIAL

FIGURE 2

TEMPORARY THRESHOLD SHIFT
VS
SOUND PRESSURE LEVEL

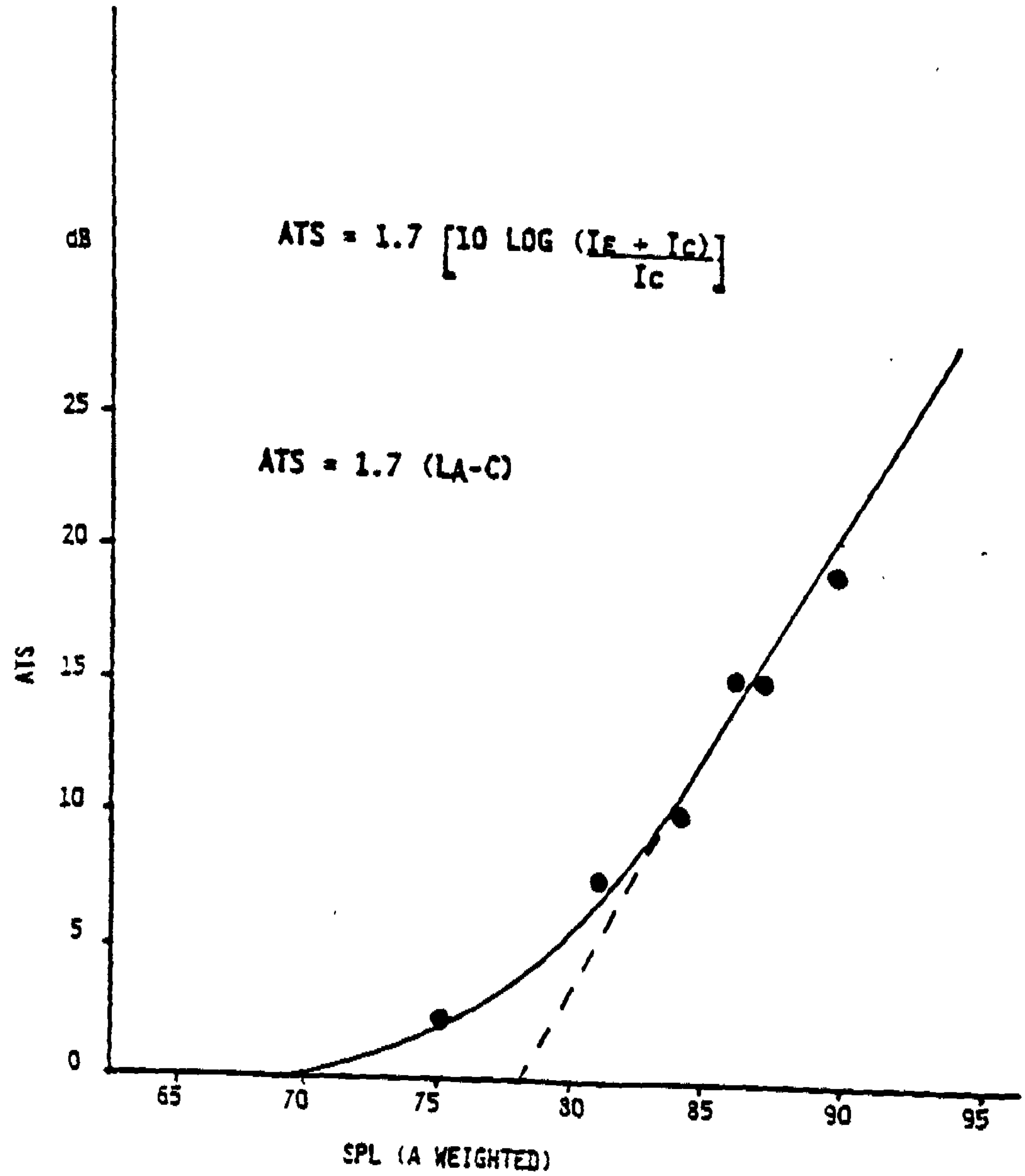

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FIGURE 3

PERCENT DOSE AND 8-HR TWA (dBA) VS EXCHANGE RATE FOR PLANT B CARPENTERS AND PAINTERS

Sample #	5 dB Exchange Rate Percent Dose	3 dB Exchange Rate Percent Dose
1	7.2	8.2
2	8.0	8.7
3	10.4	16.6
4	13.9	29.2
5	19.4	38.8
6	21.2	36.3
7	22.0	37.6
8	22.5	27.9
9	23.7	52.9
10	26.9	47.2
11	34.2	85.9
12	37.0	76.0
13	39.5	69.7
14	39.7	287.0
15	59.6	213.2
16	66.0	366.5
17	88.3	358.5
18	111.6	5673.0
19	179.4	1405.9
20	223.6	2214.0
21	509.7	7663.0
22	823.7	17814.0

FIGURE 4

PLANT B CARPENTERS AND PAINTERS

NOISE EXPOSURE PERCENT DOSE EMPLOYING

A LOW THRESHOLD LIMIT (80 dBA) AND A HIGH THRESHOLD LIMIT (90 dBA)

	% Dose (5 dB Exchange Rate)		
Sample #	LTLD	HTLD	LTLD-HTLD
1	7.2	1.0	6.2
2	8.0	2.3	5.7
3	10.4	3.1	7.3
4	13.9	6.7	7.2
5	19.4	12.2	7.2
6	21.2	13.5	7.7
7	22.0	11.2	10.8
8	22.5	8.2	14.3
9	23.7	16.6	7.1
10	26.9	14.8	12.1
11	34.2	23.9	10.3
12	37.0	24.8	12.2
13	39.5	25.8	13.7
14	39.7	28.7	11.0
15	59.6	46.5	13.1
16	66.0	54.8	11.2
17	88.3	75.7	12.6
18	111.6	89.7	21.9
19	179.4	171.7	7.7
20	223.6	214.1	9.5
21	509.7	499.0	10.7
22	823.7	810.3	13.4