Hearing Conservation Program for Noise Exposed Workers

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Nothing to Disclose

Noise and Workplace Safety

The Ear: anatomy
physiology of hearing
pathology of NIHL
Acoustic Trauma

Noise: definition
measurement

Designing a Hearing Conservation Program
Noise survey
Audiometry
Noise Reduction
Hearing Protective Devices
Signage
Awareness Enhancement Activities
Penalties and Incentives
Record keeping and Audit

Noise

Definition: sound of any kind which is either loud or disturbing

Non-Otologic Effects of Noise:

1. Headache
2. Elevated Blood Pressure
3. Fatigue
4. Irritability
5. Digestive Disorders
6. Decreased Immunity

Occupational Noise, Environmental Burden of Disease Series No.9,WHO Geneva 2004
Marisol Concha-Barrientos et.al.

Sound Measurement

Measurement:

decibel: the unit of sound pressure level

(20 times the log to the base 10 of the ratio of measured sound pressure to the reference sound pressure w/c is 20uPa)

pascal: the unit of sound pressure

0 dB = 0.00002 Pa = 20uPa
20dB = 0.0002 Pa = 200uPa
40dB = 0.002 Pa = 2000uPa
60dB = 0.02 Pa = 20,000uPa
80dB = 0.2 Pa = 200,000uPa
100dB = 2.0 Pa = 2,000,000uPa

Noise

With multiple sources of noise, dB is not simply added.

Difference (dB)	Add to higher (dB)
0	3
1	2.6
2	2.2
6	1
10	0.4
16	0.1

Definition of Noise Induced Hearing Loss

Transient Threshold Shift: hearing threshold that has become worse temporarily after exposure to loud noise

Permanent Threshold Shift: hearing threshold that does not return to pre-exposure levels

Presbycusis is progressive hearing loss mainly due to the ageing process; this may come early in life in some or late depending on individual susceptibility

Cochlea Pathology Due to Noise

NIHL is caused by a combination of 3 factors:

1. direct mechanical trauma to delicate cells and tissues by the vibration caused by loud noise. The cell membrane and stereocilia are literally torn apart during brief and intense noise (Acoustic Trauma)
2. At lower but sustained exposure levels, metabolic activity of cells is intense resulting in oxidative stress and cell death.
3. Vasoconstriction-induced reduction in cochlear blood flow.

Miller, J. et.al. Noise and Health 5(20);1-17,2003

Once exposure to damaging noise levels is discontinued, further significant progression of hearing loss stops.

Bohne, B.A. and Harding, G.W., Am J Otol, 2000 Jul;21(4)505-9

Effect of Noise on Hearing Depends on:

Sound intensity

Duration of exposure

Individual susceptibility to Noise
the reason for this is so far unknown

Theories: 1. Gene expression
2. Gender
3. Low HDL level
4. Nutrition
5. Underlying Systemic Disease

Treatment of Noise Induced Hearing Loss

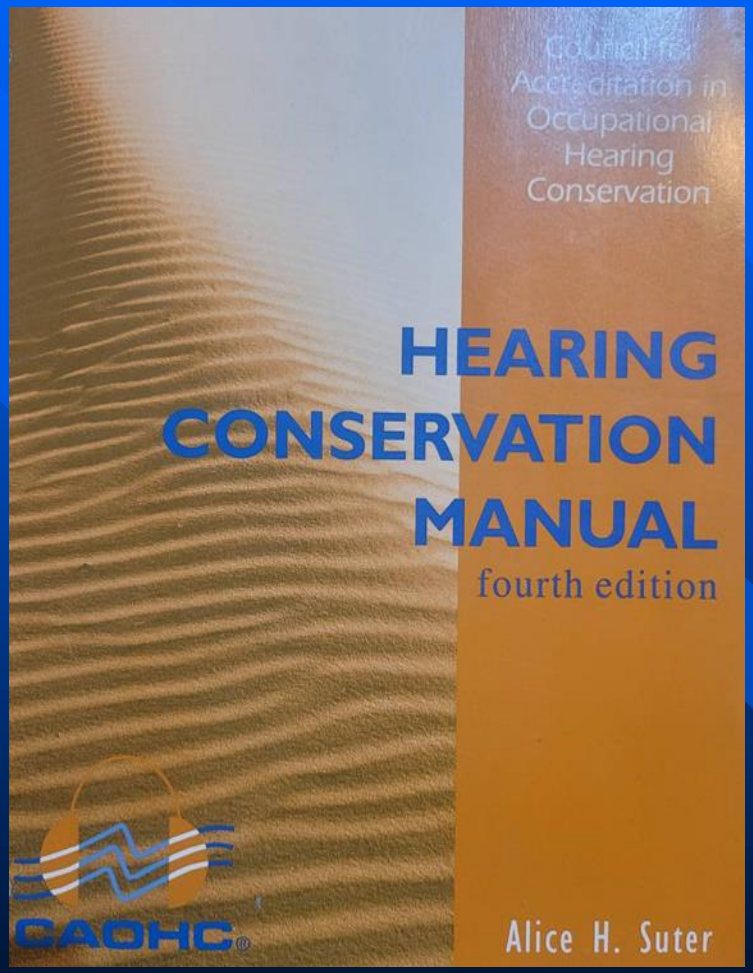
Noise Induced Hearing Loss is irreversible or PERMANENT!

Treatment modalities are largely experimental.

The ONLY way to address NIHL is through avoidance or PREVENTION.

Hearing Conservation Program: the objective is to prevent NIHL in the workplace

Designing a Hearing Conservation Program



The Noise Survey:

the objective is to identify high risk areas

Permissible Noise Exposure Levels

Occupational Safety and Health Standards
(as Amended 1989)

Duration/Day (hours)	Slow Response (dBA)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼	115

No exposure in excess of 115 dBA is allowed.
Impact noise shall not exceed 140 dBA peak spl.
Action Level for OSHA is 85dBA

Noise Measurement

The Sound Level Meter

dBA- uses the “A” scale which approximates the sensitivity of the human ear

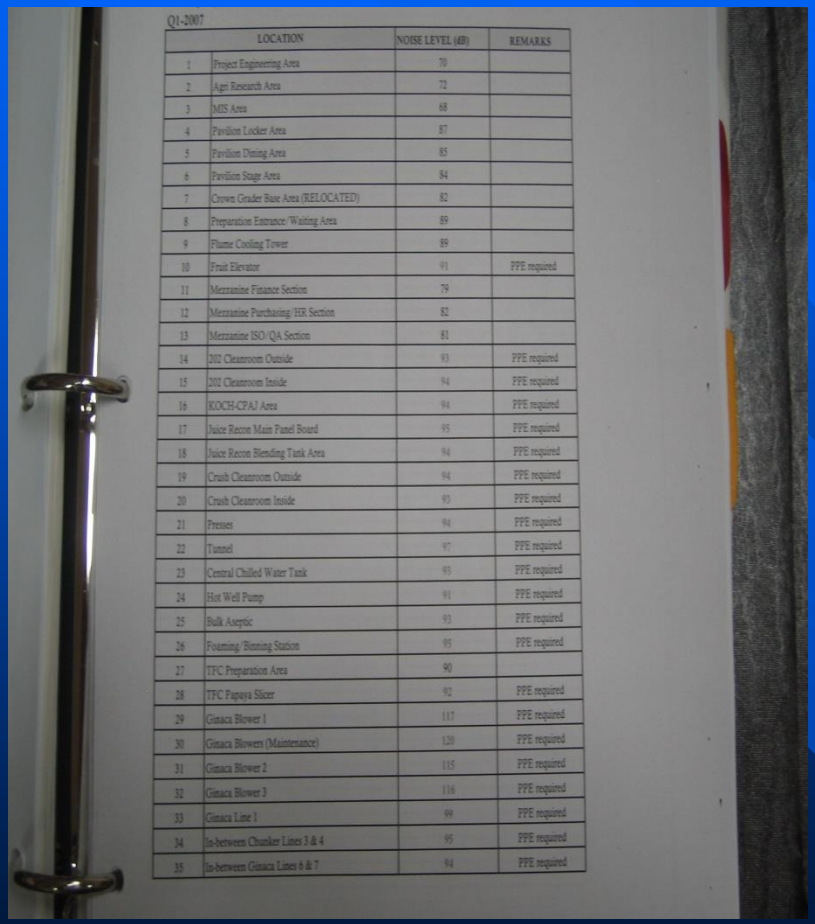
dBC- uses the “C” scale which is the way a machine would receive sound

OSHA requires the slow meter response

Technique

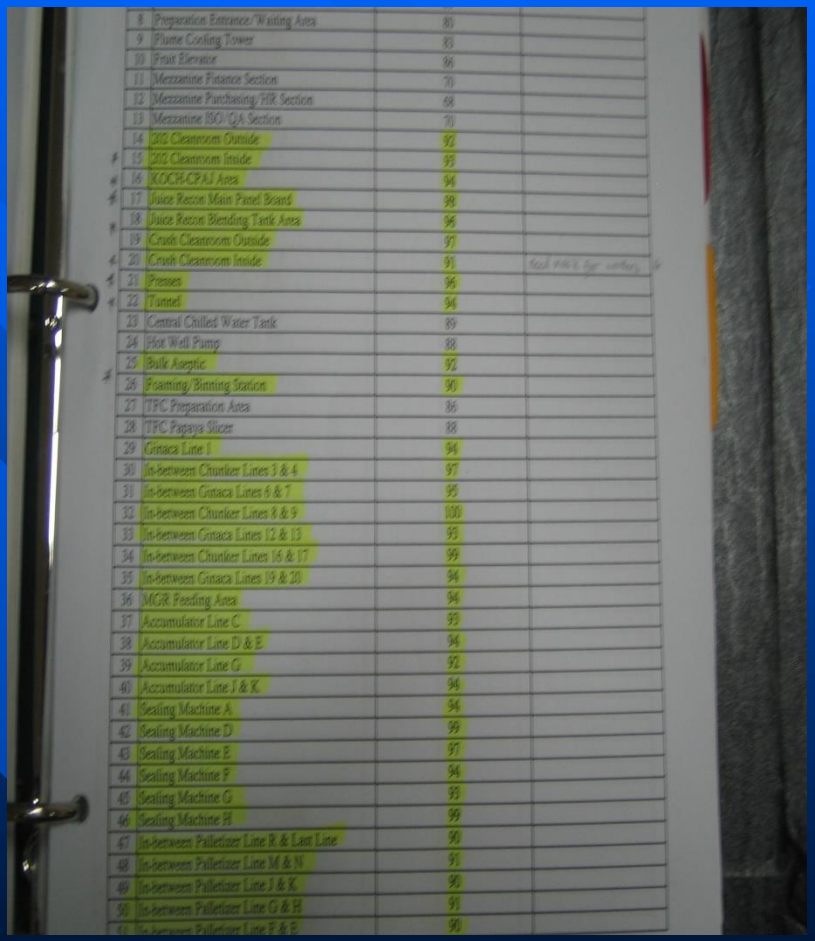
Calibration

Sound Level Monitoring Data



Q1-2007

	LOCATION	NOISE LEVEL (dB)	REMARKS
1	Project Engineering Area	70	
2	Agri Research Area	72	
3	MIS Area	68	
4	Pavilion Locker Area	87	
5	Pavilion Dining Area	85	
6	Pavilion Stage Area	84	
7	Crown Grader Base Area (RELOCATED)	82	
8	Preparation Entrance/Waiting Area	89	
9	Flume Cooling Tower	89	
10	Fruit Elevator	91	PPE required
11	Mezzanine Finance Section	79	
12	Mezzanine Purchasing/HR Section	82	
13	Mezzanine ISO/QA Section	81	
14	202 Cleanroom Outside	93	PPE required
15	202 Cleanroom Inside	94	PPE required
16	KOCH-CPAJ Area	94	PPE required
17	Juice Recon Main Panel Board	95	PPE required
18	Juice Recon Blending Tank Area	94	PPE required
19	Crush Cleanroom Outside	94	PPE required
20	Crush Cleanroom Inside	93	PPE required
21	Presses	94	PPE required
22	Tunnel	97	PPE required
23	Central Chilled Water Tank	93	PPE required
24	Hot Well Pump	91	PPE required
25	Bulk Aseptic	93	PPE required
26	Foaming/Binning Station	95	PPE required
27	TFC Preparation Area	90	
28	TFC Papaya Slicer	92	PPE required
29	Ginaca Blower 1	117	PPE required
30	Ginaca Blowers (Maintenance)	120	PPE required
31	Ginaca Blower 2	115	PPE required
32	Ginaca Blower 3	116	PPE required
33	Ginaca Line 1	89	PPE required
34	In-between Chunker Lines 3 & 4	95	PPE required
35	In-between Ginaca Lines 6 & 7	94	PPE required



8	Preparation Entrance/Waiting Area	89	
9	Flume Cooling Tower	89	
10	Fruit Elevator	86	
11	Mezzanine Finance Section	70	
12	Mezzanine Purchasing/HR Section	69	
13	Mezzanine ISO/QA Section	70	
14	202 Cleanroom Outside	92	
15	202 Cleanroom Inside	93	
16	KOCH-CPAJ Area	94	
17	Juice Recon Main Panel Board	98	
18	Juice Recon Blending Tank Area	96	
19	Crush Cleanroom Outside	97	
20	Crush Cleanroom Inside	93	
21	Presses	96	
22	Tunnel	94	
23	Central Chilled Water Tank	89	
24	Hot Well Pump	88	
25	Bulk Aseptic	92	
26	Foaming/Binning Station	90	
27	TFC Preparation Area	86	
28	TFC Papaya Slicer	88	
29	Ginaca Line 1	94	
30	In-between Chunker Lines 3 & 4	97	
31	In-between Ginaca Lines 6 & 7	95	
32	In-between Chunker Lines 8 & 9	100	
33	In-between Ginaca Lines 12 & 13	95	
34	In-between Chunker Lines 16 & 17	99	
35	In-between Ginaca Lines 19 & 20	94	
36	MGR Feeding Area	94	
37	Accumulator Line C	93	
38	Accumulator Line D & E	94	
39	Accumulator Line G	92	
40	Accumulator Line J & K	94	
41	Sealing Machine A	94	
42	Sealing Machine D	99	
43	Sealing Machine E	97	
44	Sealing Machine F	94	
45	Sealing Machine G	93	
46	Sealing Machine H	99	
47	In-between Palletizer Line R & Last Line	90	
48	In-between Palletizer Line M & N	91	
49	In-between Palletizer Line J & K	90	
50	In-between Palletizer Line G & H	91	
51	In-between Palletizer Line F & E	90	

Designing a Hearing Conservation Program

Noise Reduction:

- Engineering Controls
  - the choice of equipment
  - maintenance
  - replacement

Sound dissemination

soundproofing

soundproofing

Designing a Hearing Conservation Program

Noise exposure reduction:

Administrative Controls:

periodically rotating staff from high risk areas to low risk whenever possible provides recovery periods for transient threshold shift to return to normal threshold

Designing a Hearing Conservation Program (OSHA compliance)

Audiometry:

Usually on-site using a mobile unit but may be done in the clinic

OSHA Maximum allowable SPL inside test areas:

500Hz	1000Hz	2000Hz	4000Hz	8000Hz
40dB	40dB	47dB	57dB	62dB

Screening Method is used using the above frequencies including 3000Hz and 6000Hz

Regular calibration of the Audiometer is important for accuracy.

Audiometrician's technique should be standardized thru a training seminar.

Pre-employment Audiometry: serves as the baseline and should be done after at least 14 hours away from workplace noise and within six months from date of report for work

Annual Audiometry: should be done towards the end of the work shift to identify possible TTS

Re-test Audiometry: if a threshold shift is noted the employee is re-tested within 1 month and after 14 hours rest

If results do not improve a report is made

Exit Audiograms are optional for the company

Annual Audiometry

2000Hz, 3000Hz, 4000Hz: used to compute for standard (significant) threshold shift

Rationale:

1. the low and high frequencies are affected by ambient noise
2. Speech range is covered (300-3000Hz)
3. Area of cochlea corresponding to 4000Hz is most sensitive to excessive noise (dip or notch)

6000Hz required by OSHA but not included in computation

8000Hz is optional

10dB Threshold shift is reportable if the threshold exceeds 25 dB and this would change the baseline

Age-Correction to account for Presbycusis

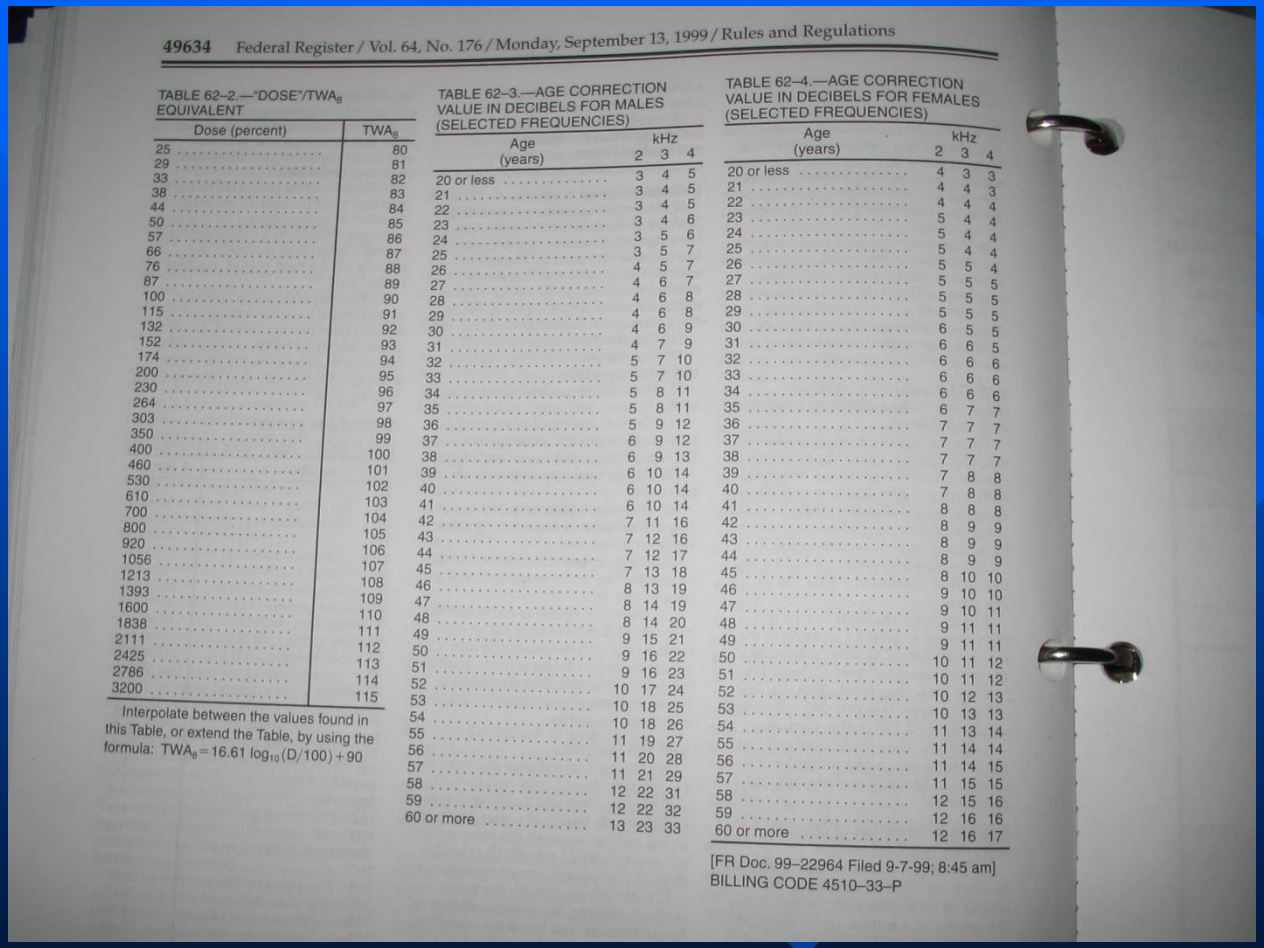


TABLE 62–2.—"DOSE"/TWA_8 EQUIVALENT

Dose (percent)	TWA_8
25	80
29	81
33	82
38	83
44	84
50	85
57	86
66	87
76	88
87	89
100	90
115	91
132	92
152	93
174	94
200	95
230	96
264	97
303	98
350	99
400	100
460	101
530	102
610	103
700	104
800	105
920	106
1056	107
1213	108
1393	109
1600	110
1838	111
2111	112
2425	113
2786	114
3200	115

Interpolate between the values found in this Table, or extend the Table, by using the formula: $TWA_8 = 16.61 \log_{10}(D/100) + 90$

TABLE 62–3.—AGE CORRECTION VALUE IN DECIBELS FOR MALES (SELECTED FREQUENCIES)

Age (years)	kHz 2	3	4
20 or less	3	4	5
21	3	4	5
22	3	4	5
23	3	4	6
24	3	5	6
25	3	5	7
26	4	5	7
27	4	6	7
28	4	6	8
29	4	6	8
30	4	6	9
31	4	7	9
32	5	7	10
33	5	7	10
34	5	8	11
35	5	8	11
36	5	9	12
37	6	9	12
38	6	9	13
39	6	10	14
40	6	10	14
41	6	10	14
42	7	11	16
43	7	12	16
44	7	12	17
45	7	13	18
46	8	13	19
47	8	14	19
48	8	14	20
49	9	15	21
50	9	16	22
51	9	16	23
52	10	17	24
53	10	18	25
54	10	18	26
55	11	19	27
56	11	20	28
57	11	21	29
58	12	22	31
59	12	22	32
60 or more	13	23	33

TABLE 62–4.—AGE CORRECTION VALUE IN DECIBELS FOR FEMALES (SELECTED FREQUENCIES)

Age (years)	kHz 2	3	4
20 or less	4	3	3
21	4	4	3
22	4	4	4
23	5	4	4
24	5	4	4
25	5	4	4
26	5	5	4
27	5	5	5
28	5	5	5
29	5	5	5
30	6	5	5
31	6	6	5
32	6	6	6
33	6	6	6
34	6	6	6
35	6	7	7
36	7	7	7
37	7	7	7
38	7	7	7
39	7	8	8
40	7	8	8
41	8	8	8
42	8	9	9
43	8	9	9
44	8	9	9
45	8	10	10
46	9	10	10
47	9	10	11
48	9	11	11
49	9	11	11
50	10	11	12
51	10	11	12
52	10	12	13
53	10	13	13
54	11	13	14
55	11	14	14
56	11	14	15
57	11	15	15
58	12	15	16
59	12	16	16
60 or more	12	16	17

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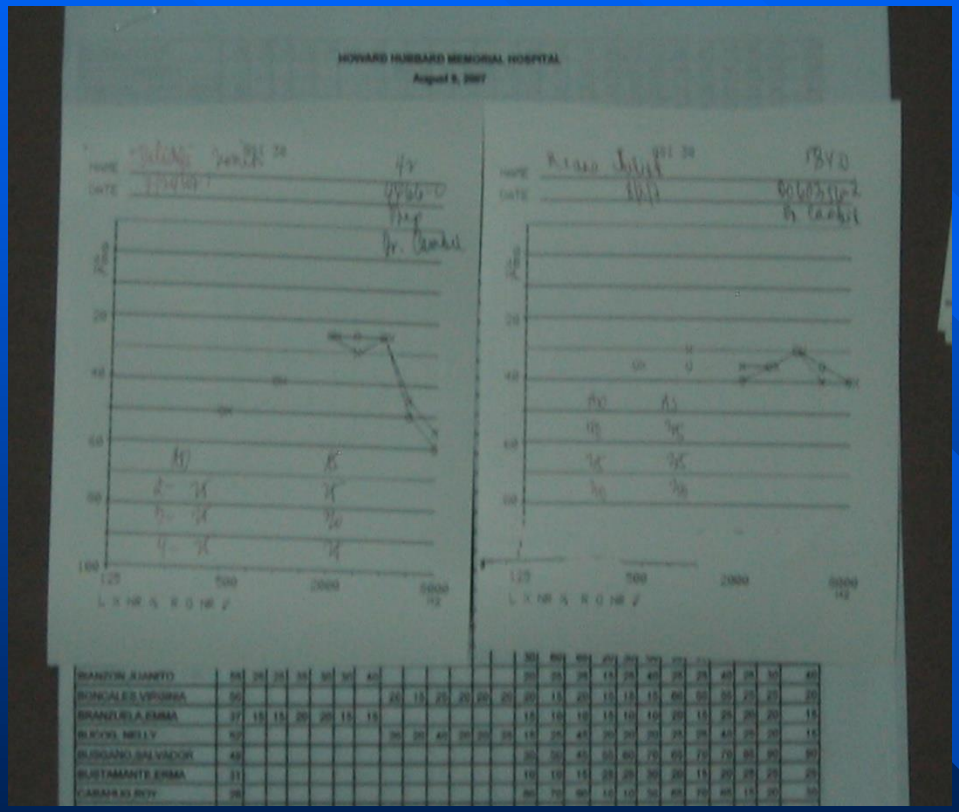
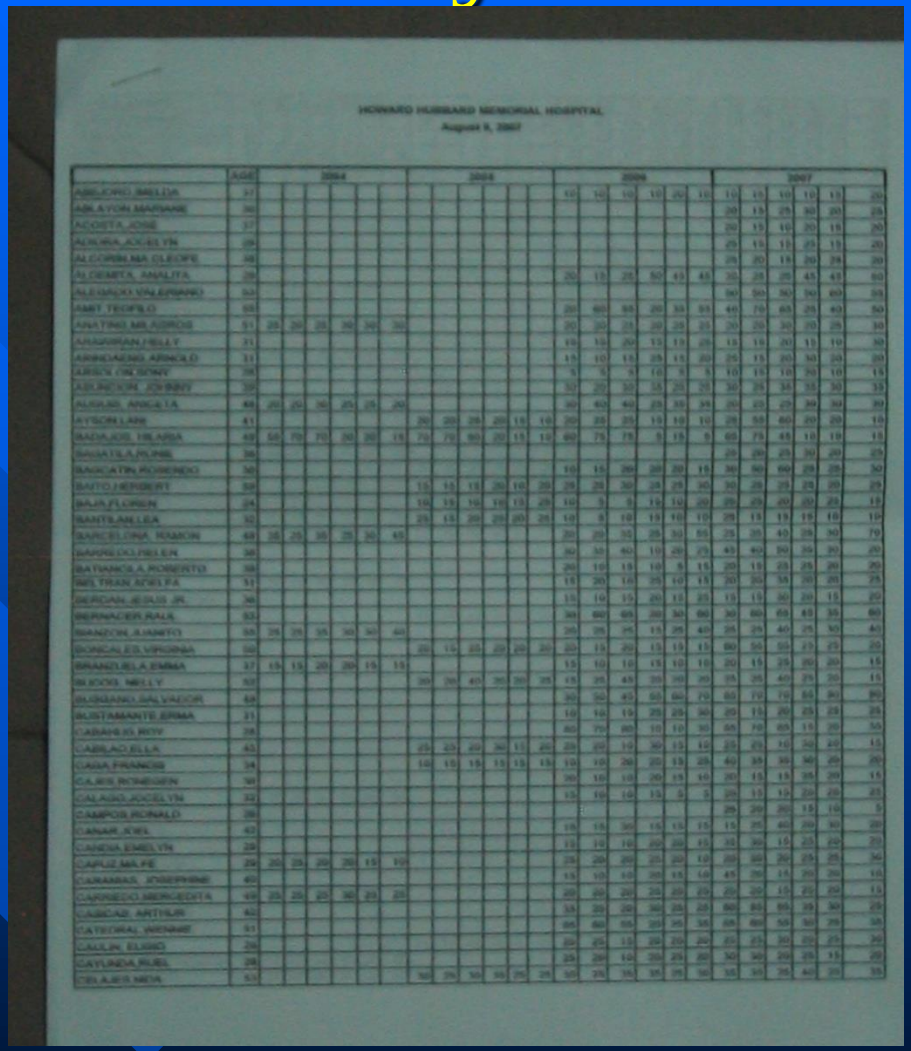
Screening Audiometry





Hearing Protective Devices

Noise Reduction Rating
maximum: 30dB

1.Earmuff
25-30 NRR

2.Ear Mold
17 –25 NRR

3. Ear Plug
17 – 25 NRR

4. Semi-aural Device
17 – 25 NRR

Combination: can only add approx. 5 dB NRR

NIOSH adjustment or derating:
earmuff- subtract 25% from NRR
earplug -subtract 50% from NRR

Hearing Protective Devices

The Occlusion Effect:

Occluding and sealing the ear with an earplug or earmuff increases the efficiency of bone conduction below 2000Hz.

This causes the wearer to experience a change in their perceived voice quality and other body-generated sound (chewing, biting, walking, etc.).

Of all the fitting tips devised, listening for the occlusion effect is the most widely applicable, being suited for use with nearly all types of HPD.

Hearing Protective Devices

Should be used at all times in areas with sound levels above 90 dB

Should be available upon request for sound levels between 85-90 dB (action level of OSHA)

Should be worn properly with good fit

Main cause of non-use is discomfort and inability to communicate

Studies have shown that even occasional removal of the device will result in threshold shift

Awareness Enhancement Activities

Objective: to promote the use of hearing protective devices

Identify the target population

Simple, easy to understand

Emphasize the advantage of using the HPD properly and consistently

Encourage interaction to thresh out actual problems regarding the use of HPD

Penalties and Incentives

Objective: to promote the use of Hearing Protective Devices

The staff should be made to understand the reason behind these measures.

Penalties should be reasonable.

Incentives should be encouraging.

Signage

Objective: to promote the use of hearing protective devices in designated areas

Should:

- be attractive
- have a clear message
- be well placed
- be adequate in number

Signage


CAUTION
WEAR
EAR PROTECTION
IN THIS AREA


CAUTION
HEARING
PROTECTION
REQUIRED


CAUTION
WEAR
EAR PROTECTION
IN THIS AREA

Designing a Hearing Conservation Program

Record Keeping:

Systematic and confidential

Records are kept for a minimum of 5 years from date of separation/retirement

Audit:

To assure quality and effectiveness of the program

Characteristics of a Successful HCP

- Support of management
- Enforcement
- Education
- Motivation
- Comfortable and Effective Hearing Protective Devices

Zohar, D. J. Safety Res. (1980)Vol.2, No. 2, 78-85

Recommendations

1. Review existing government regulations that deal with workplace noise and the prevention of NIHL in the workplace
2. Standardize the design and implementation of Hearing Conservation Programs in the workplace
3. Push for Legislation if necessary on the Implementation of Hearing Conservation Programs in high noise risk workplaces
4. Employ workplace education to increase awareness on the effects of noise on hearing both for employees as well as employers

In Conclusion: A Hearing Conservation Program is a wise investment.

A good Hearing Conservation Program is advantageous to the health, safety and productivity of the worker.

A good program also protects the employer from unscrupulous and spurious claims by employees.

It also promotes harmony and goodwill between employer and employee.

Thank You

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