MOSH Noise Adoption Team

Hearing Protection Devices – Training, Awareness and Selection

Instruction and Training Guide

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Noise Adoption Team HPDs – Training, Awareness and Selection Tool

Instruction and Training Guide

Dick Coutts, MOSH Noise Adoption Team Manager

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1. Purpose

The Noise Adoption Team Hearing Protection Devices – Training, Awareness and Selection Tool is a software training and communication tool for promoting hearing loss prevention and is based on the SIM 05 05 01-NIHL Prevention Programme – Track C Training and Awareness and HPD selection report dated June 2009. Previous SIMRAC projects dealing with occupational noise have included "GEN 011" (1997) and more recently, "Health 806" (Franz, 2005), which incorporated guidelines for best practice in the implementation and management of mine HCPs. Despite initiatives to reduce noise through engineering controls, personal protection, being the last resort in the hierarchy of controls, will however continue to be a very important means of limiting NIHL risks to mineworkers. Users are encouraged to read this manual while learning how to run the software.

2. Required and Recommended Items

2.1. Computer:

The Tool runs on computers with Windows 98 or higher. The computer must have standard Windows sound support. As long as the computer can run current mainstream applications (word processing, web browser, etc.) and can play music, it should be more than adequate. Laptop and notebook computers usually work fine, but may need supplemental external speakers. On Windows Vista systems, the NIHL Simulator must be run as administrator in order to register its components. The Simulator does not run on Apple Macintosh computers, but users can access selected hearing loss simulations on the NIOSH Mining Web site.

2.2. Speakers:

External speakers that can play at comfortable listening volumes are necessary to hear the different speech types, industrial sounds, and musical sounds generated by the simulator. For a classroom setting, you should have larger amplified speakers that can fill the room with sound.

2.3. Projector (optional):

When training a group, a projector or large display will help the trainees see the information on the Simulator screen. The Simulator can be used even if the trainees can't see the display because the instructor can explain the settings that result in the different sounds they are hearing.

2.4. Headphones (optional):

In conference halls and other settings with significant distracting background noise, headphones can be used to let trainees hear the Simulator while the background noise is blocked out. Full-size circumaural headphones that cover the ears completely are best at blocking background noise. An inexpensive headphone splitter/amplifier can be used to allow multiple trainees to listen through headphones at the same time.

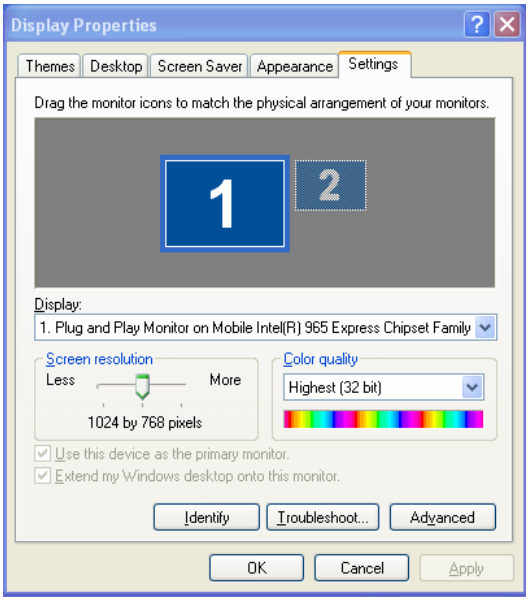
2.5. Microphone (optional):

A microphone can be used to record custom sounds (voices, machinery, etc.) with the Simulator to customize it for a specific workplace. A good-quality external microphone that can connect to the computer's microphone jack works best. The simple microphones built into notebook computers tend to have low quality and pick up unwanted noise from the computer itself.

3. Settings:

3.1. Display:

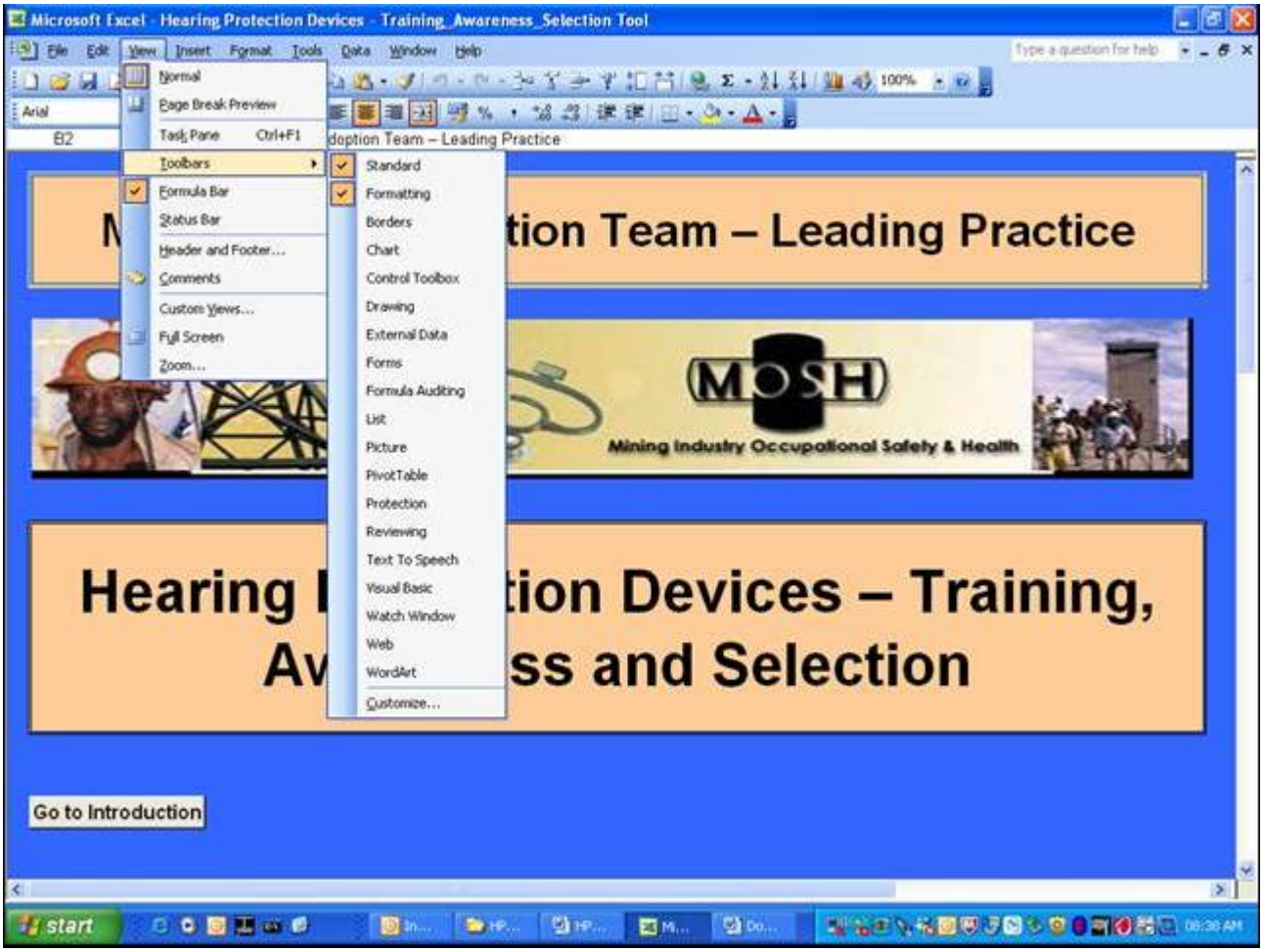
The tool is best viewed on a screen resolution setting of 1024 x 768 pixels.



3.2. Toolbar Settings:

The tool is a fit screen design and the user is required to ensure that all tools are de-selected;

Normal view display: note the Formula Bar display is “on”, under Toolbars, Standard and Formatting is “on”,



Un-select the above mentioned to close all the tools as per Figure below;

3.3. Security Level:

The Tool is an Excel® software based version of SIM 05 05 01-NIHL Prevention Programme – Track C Training and Awareness and HPD selection report and contains macros and hyperlinks (action or a set of actions) used to automate tasks displayed as tabs throughout the tool. Changing the security level for macros to run the Tool:

3.3.1. For Microsoft Office ……2003

- On the Main Menu, select Tools;
- Under Tools, select Options;
- Under Options, select Security;
- Under Security, select Macro Security;

- Under Security Level, select low security level.

3.3.2. For Microsoft Office ……2007

- On the Main Menu, select Office;
- Under Office, select Excel Options;
- Under Excel Options Popular, select Trust Centre;
- Under Trust Centre, select Microsoft Excel Trust Centre Settings;
- Under Macro Settings, select Enable Macros.

4. Installation

If the programme is to be played from a computer (using Windows Media Player® or similar), it is best to copy files to the computer's hard disk, to ensure proper playback. To avoid a reduction in the computer's performance, save the files to the C or D drive, rather than to the Desktop. To do so, proceed as follows:

1. Place the Memory Stick/CD in the computer's USB port/CD/DVD drive and select "Open folder to view files using Windows Explorer". Right-click on the HPD_TAS_Tool folder and select copy or, alternatively, click on the folder, then on "Edit" in the Toolbar at the top of the screen and select "Copy".
2. Right-click on the green START button at the bottom-left of the screen and select Explore. Select a folder on either the C or D drive in which to save the files. Alternatively, click on "File" at the top-left of the screen and select "New" and "Folder". Over-type "New Folder" with the desired name, e.g. "HPD_TAS_Tool". Alt-Tab back to the Memory Stick/CD/DVD (E) drive or select it from the Taskbar at the bottom of the screen. Right-click on the HPD_TAS_Tool folder and select "Copy".
3. Alt-Tab back to Explore or select it from the Taskbar. Right-click on the folder created in Step 2) and select "Paste" or, alternatively, click on the folder then on "Edit" in the Toolbar at the top of the screen and select "Paste".
4. Once all of the files have been copied to the selected folder (this may take several minutes), click on the folder, the files in the folder will be displayed as a list of file details or as icons, depending on which view has been selected in Explore. Right-click on the Hearing Protection Devices - Training_Awareness_Selection Tool file and select "Send to" and "Desktop (create shortcut.DeskLink).

5. Primary Outputs

Given the need to enhance the effectiveness of awareness and training materials and mine personal protection strategies while more systematic control measures are being implemented, this Tool has as its primary outputs;

1. Updated multimedia training, educational, awareness and motivational materials for the prevention/elimination of noise-induced hearing loss (NIHL), aimed at all levels of mine employees, particularly mineworkers comprising of a video programme in English, Xhosa, South Sotho and Zulu for coal, gold and platinum mines:
    i. Module 1: Educational/Motivational (15 minutes long), which conveys the message that loud noise is hazardous and illustrates the potential consequences of exposure;
    ii. Module 2: HPD training (10 minutes long), which reinforces educational and motivational aspects from Module 1 and demonstrates the correct use and care of various types of hearing protection devices (HPDs);
2. Handouts for trainees in the form of 16-page A-5 self-cover booklets illustrating the risks of excessive noise exposure, as well as the correct use and care of HPDs, produced in English and Zulu;
3. Four volumes of guidelines for trainers, comprising:
    i. A script for induction talks on the noise hazard, with a demonstration of the benefits of using HPDs in noisy areas and their correct use and care, with four supporting overhead transparencies;
    ii. Use of the training videos, with the scripts for Modules 1 and 2 appended;
    iii. Use of the handout booklet, with a reproduction of the booklet appended; and
    iv. Suggestions for ways of responding to reasons or excuses commonly given by mineworkers who neglect to use HPDs.
4. Compilation of frequency-specific attenuation data for all currently available HPDs (with manufacturers' and suppliers' contact details) for noise associated with various occupations, workplaces and machinery in the mining industry.
5. Other materials available from local and international sources comprising of;
    i. PowerPoint® presentation – Hearing Conservation – Stick to Basics
    ii. The NIOSH Hearing Loss Simulator
    iii. The NIOSH Noise Meter

6. HPD selection tables

Gen 011 (Franz et al., 1997) measured the noise exposure levels of employees in different occupations in the coal, gold and platinum mining industry. HPD selection tables were developed on the basis of the noise exposure levels of the occupations sampled. The HPDs that were listed in the selection tables were those available in South Africa in the mid-1990s. In order to make the NIHL prevention tools available to the mining industry relevant and up-to-date, the MHSC included the updating of this valuable HPD selection tool as part of the SIM 050501 Prevention of NIHL programme.

The research team used the web-based National Institute of Occupational Safety and Health (NIOSH) tool as the basis of the updating process. Information about all the HPDs on the NIOSH website that are available in South Africa were collected and used to develop an updated list of HPDs for 2009. The frequency-specific attenuation data supplied by the HPD manufacturers and suppliers was incorporated into the HPD selection tables available from GEN 011. The HPD selection tables were further updated by formulating the tables into a user-friendly Excel®-based version of a selection table for each occupation.

1. The HPD selection tables indicate:
    i. the expected noise exposure levels as measured by GEN 011
    ii. the average effective attenuation for each HPD available
    iii. whether the resultant average noise exposure with HPDs will result in noise exposure levels of above the Occupational Exposure Level (OEL)
    iv. if the average expected attenuation is likely to interfere with speech communication as a result of overprotection by the HPD.
2. The tool includes;
    i. A list of 97 HPDs available in South Africa in 2009, with tables indicating the effective attenuation that can be expected from each HPD at each central frequency;
    ii. Guidelines for the use of the HPD selection tables;
    iii. Coal mining occupations in surface workshops and general coal mining; and
    iv. Gold and platinum mining occupations, which include the surface workshops, surface plants and conventional or mechanised mining.
    v. The effect of wear time;
        a. when considering HPD’s with High and Low NRR Values
        b. on the Percentage Risk of Obtaining NIHL
        c. Cost associated with Hearing Impairment

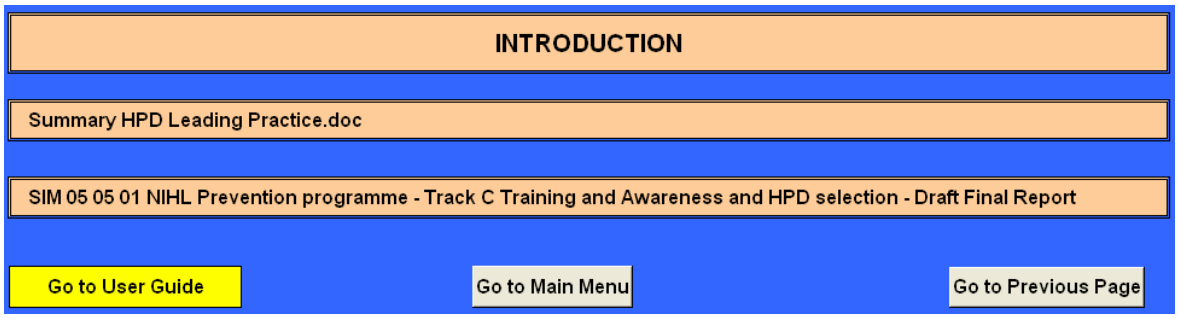
7. Guide to All Features

This section describes all of the Tool's functions available through its screens and menus.

7.1. Start-Up

When the program is first started, this start-up screen is displayed. Selecting the tab within the screen will allow you to view the Introduction screen.

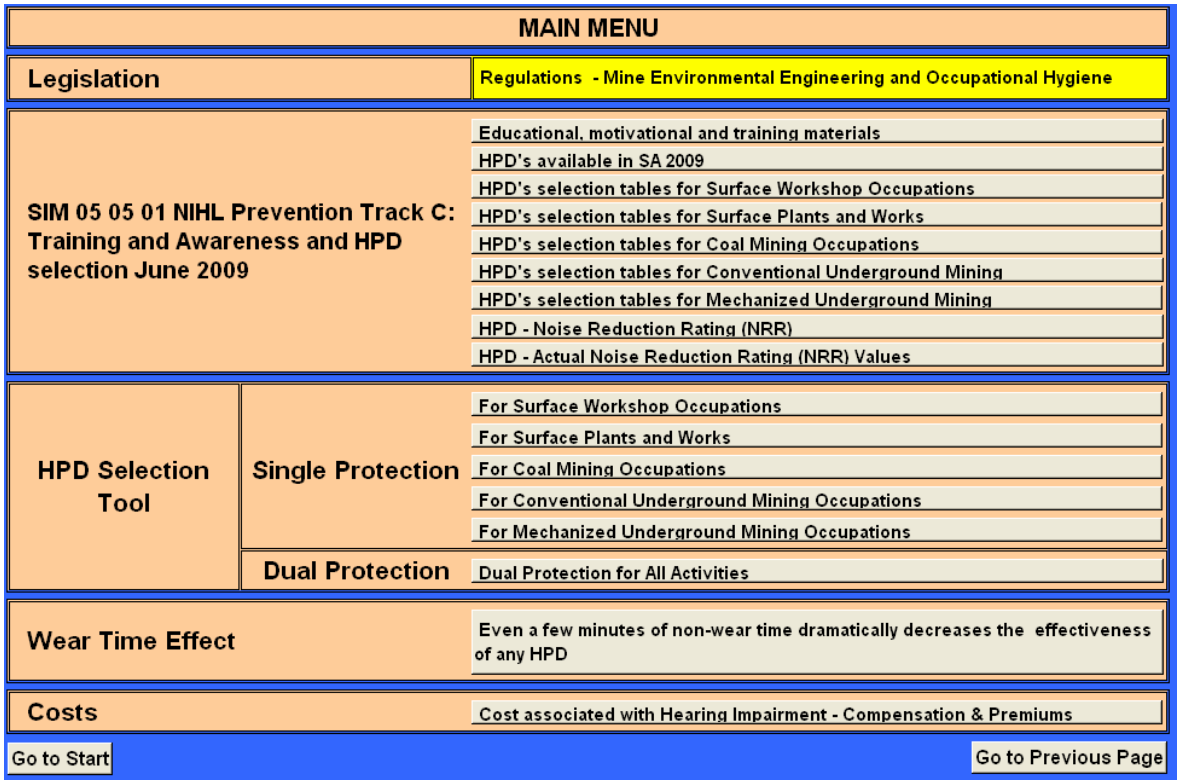
7.2. Introduction



Selecting the tabs within the screen will allow you the following options;

- view a summary of the Leading Practice;
- view the SIM 05 05 01 NIHL……. Report
- view the User's Guide (this document)
- go to the Main Menu screen
- go to the previous screen

7.3. Main Menu

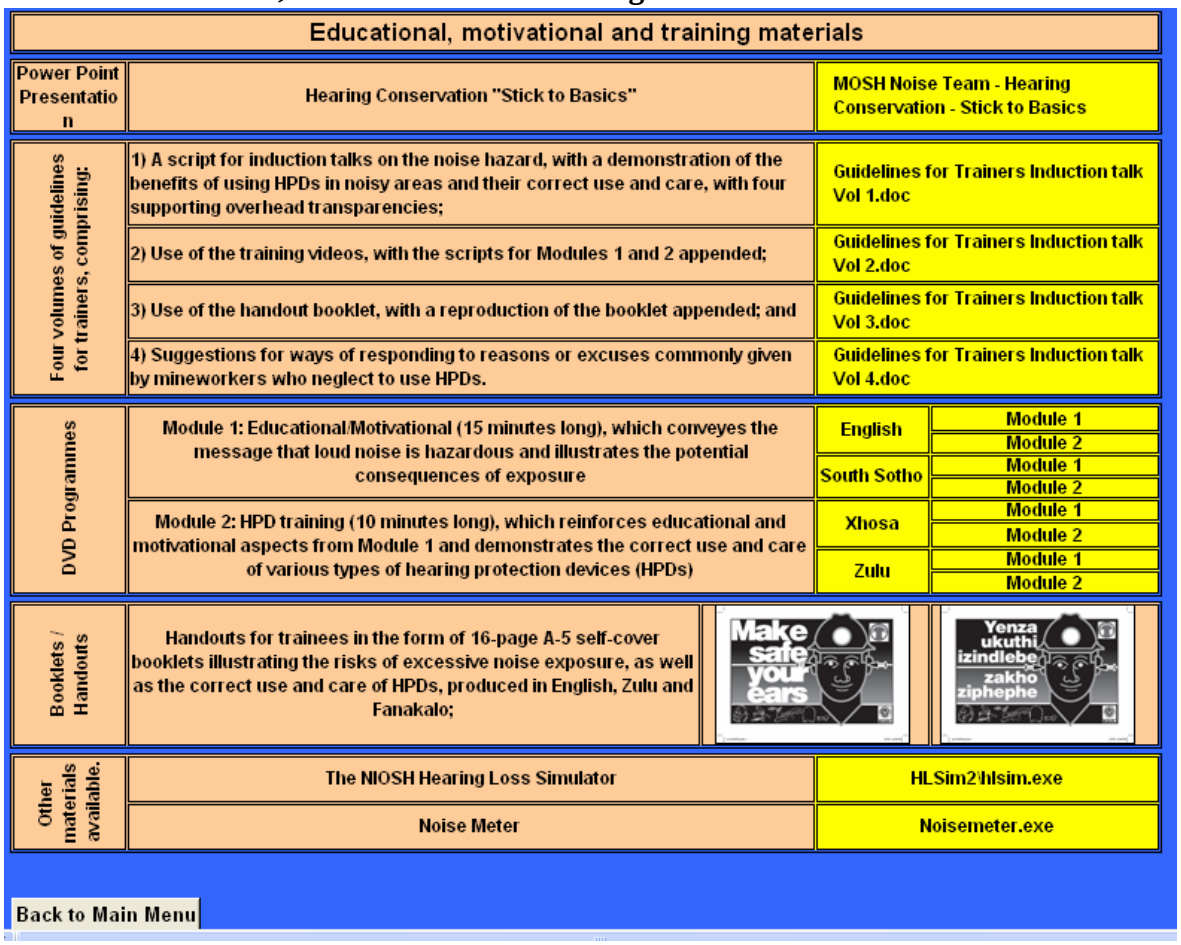


Selecting the tabs within the screen will allow you the following options;

- view the regulations pertaining to noise
- view the educational, motivational and training materials screen
- view the HPD's available in SA 2009 screen
- view the HPD's selection tables for Surface Workshop Occupations screen
- view the HPD's selection tables for Surface Plants and Works Occupations screen
- view the HPD's selection tables for Coal Mining Occupations screen
- view the HPD's selection tables for Conventional Underground Mining screen
- view the HPD's selection tables for Mechanized Underground Mining
- view the HPD - Noise Reduction Rating (NRR) screen
- view the HPD - Actual Noise Reduction Rating (NRR) Values screen
- view the HPD selection tool – single protection for Surface Workshop Occupations screen
- view the HPD selection tool – single protection for Surface Plants and Works Occupations screen
- view the HPD selection tool – single protection for Coal Mining Occupations screen
- view the HPD selection tool – single protection for Conventional Underground Mining Occupations screen

- view the HPD selection tool – single protection for Mechanized Underground Mining Occupations screen
- view the HPD selection tool – dual protection for All Activities screen
- view the effect of HPD wear time screen
- view the cost associated with Hearing Impairment - Compensation & Premiums screen

7.4. Educational, motivational and training materials



Selecting the tabs within the screen will allow you the following options;

a. view the MOSH Noise Team - Hearing Conservation - Stick to Basics Power Point Presentation

b. view the four volumes of guidelines for trainers, comprising of:

   i. Guidelines for Trainers Induction talk Vol 1.doc, A script for induction talks on the noise hazard, with a demonstration of the benefits of using HPDs in noisy areas and their correct use and care, with four supporting overhead transparencies.

   ii. Guidelines for Trainers Induction talk Vol 2.doc, Use of the training videos, with the scripts for Modules 1 and 2 appended.

iii. Guidelines for Trainers Induction talk Vol 3.doc, Use of the handout booklet, with a reproduction of the booklet appended.

iv. Guidelines for Trainers Induction talk Vol 4.doc, Suggestions for ways of responding to reasons or excuses commonly given by mineworkers who neglect to use HPDs.

c. view the DVD Programmes in either English, South Sotho, Xhosa or Zulu comprising of;

i. Module 1: Educational/Motivational (15 minutes long), which conveys the message

ii. that loud noise is hazardous and illustrates the potential consequences of exposure.

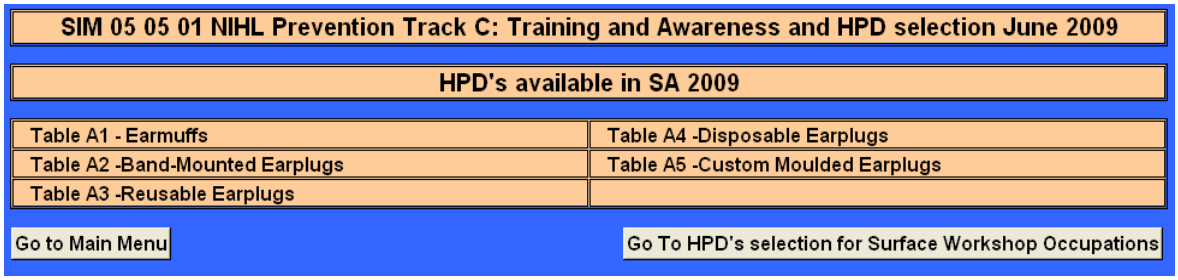
iii. Module 2: HPD training (10 minutes long), which reinforces educational and motivational aspects from Module 1 and demonstrates the correct use and care of various types of hearing protection devices (HPDs).

d. view the Handouts for trainees in the form of 16-page A-5 self-cover booklets illustrating the risks of excessive noise exposure, as well as the correct use and care of HPDs, produced in English and Zulu.

e. view the NIOSH Hearing Loss Simulator Tool

f. view the NIOSH Noise meter

7.5. HPD's available in SA 2009



The attenuation characteristics of HPDs listed in Tables A-1 through to A-5 were obtained directly from manufacturers/suppliers or their promotional literature. The attenuation characteristics were all documented as having been determined in accordance with one or more standards, some of which provide a more realistic indication than others of the level of protection that can be expected. These tables should not be interpreted as indicating that a particular HPD "passes" or "fails". They are, however, intended to provide a means of comparing the suitability of the various HPDs for use by workers in a particular occupation. Devices that do not provide sufficient attenuation for an extreme noise source may well be suitable for more moderate applications and, in such cases, would be more appropriate than higher attenuation devices.

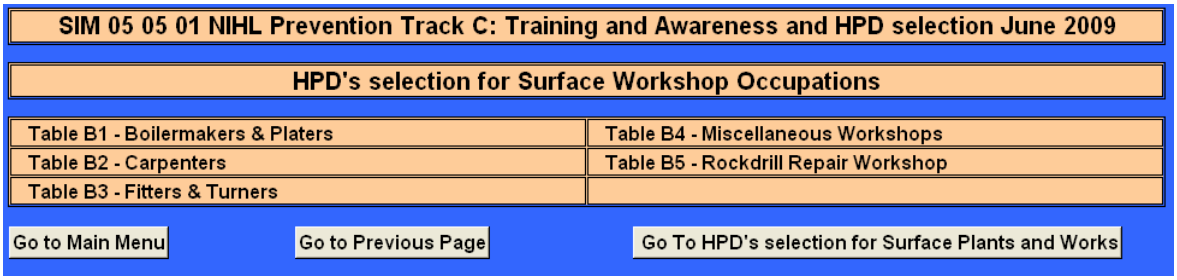
Selecting the tabs within the screen will allow you to view the frequency-specific mean attenuation and standard deviation values determined in accordance with various standards for;

1. Earmuffs
2. Band-Mounted Earplugs
3. Re-usable Earplugs
4. Disposable Earplugs
5. Custom Moulded Earplugs

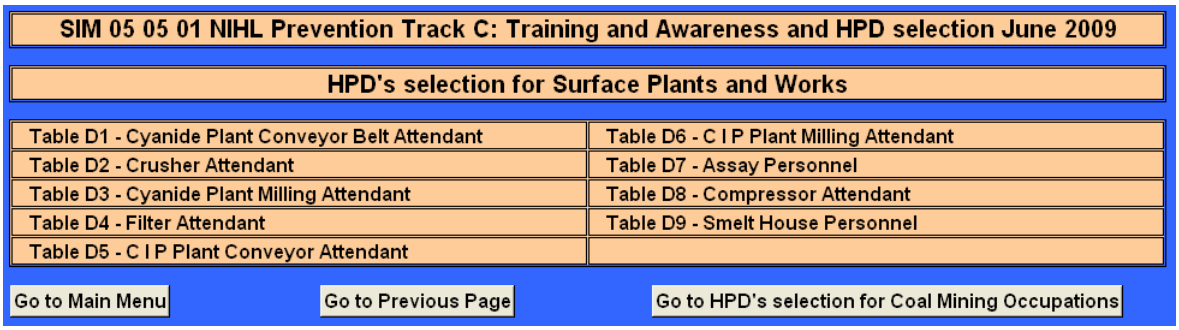
7.6. HPD's selection tables for various Occupations

By selecting the following screens you will be able to view the tables for the various occupations within that area/activity;

1. HPD's selection for Surface Workshop Occupations



2. HPD's selection for Surface Plants and Works Occupations



3. HPD's selection for Coal Mining Occupations

SIM 05 05 01 NIHL Prevention Track C: Training and Awareness and HPD selection June 2009

HPD's selection for Coal Mining Occupations

Table C1 - Coal Cutter Operators	Table C19 - Utility Vehicle Drivers
Table C2 - Coal Cutter Assistants	Table C20 - UG Bus Drivers
Table C3 - Coal Loader Operators	Table C21 - Land cruiser Occupants
Table C4 - Roof Bolter Operators	Table C22 - Dragline Machine Attendants
Table C5 - Electric Drill Operators	Table C23 - Overburden Drill Operators
Table C6 - Team Leaders Conventional Mining	Table C24 - Production Back actor Operators
Table C7 - Continuous Miner Operators	Table C25 - Coal Truck Drivers
Table C8 - Continuous Miner Assistants	Table C26 - Front-end Loader Operators
Table C9 - Shuttle Car Operators	Table C27 - Production Tyre Dozer Operators
Table C10 - Miners in Cont Mining	Table C28 - Rehab Bulldozer Operators
Table C11 - Team Leaders in Continuous Mining	Table C29 - Rehab Back actor Operators
Table C12 - Shearer Operators	Table C30 - Rehab Rear Dumper Operators
Table C13 - Shearer Assistants	Table C31 - Primary Breaker Attendant
Table C14 - Shield Support Operators	Table C32 - Raw Coal Screening House Attendant
Table C15 - Crusher Attendants	Table C33 - Crushing House Attendant
Table C16 - Team Leaders in Longwall Mining	Table C34 - Coal Prep Plant Attendant
Table C17 - UG Tractor Drivers	Table C35 - Continuous Miner Dual Scrubber
Table C18 - LHD Operators	Table C36 - Continuous Miner Standard Scrubber

Back to Main Menu | Go to Previous Page | Go to HPD's selection for Conventional Underground Mining

4. HPD's selection for Conventional Underground Mining Occupations

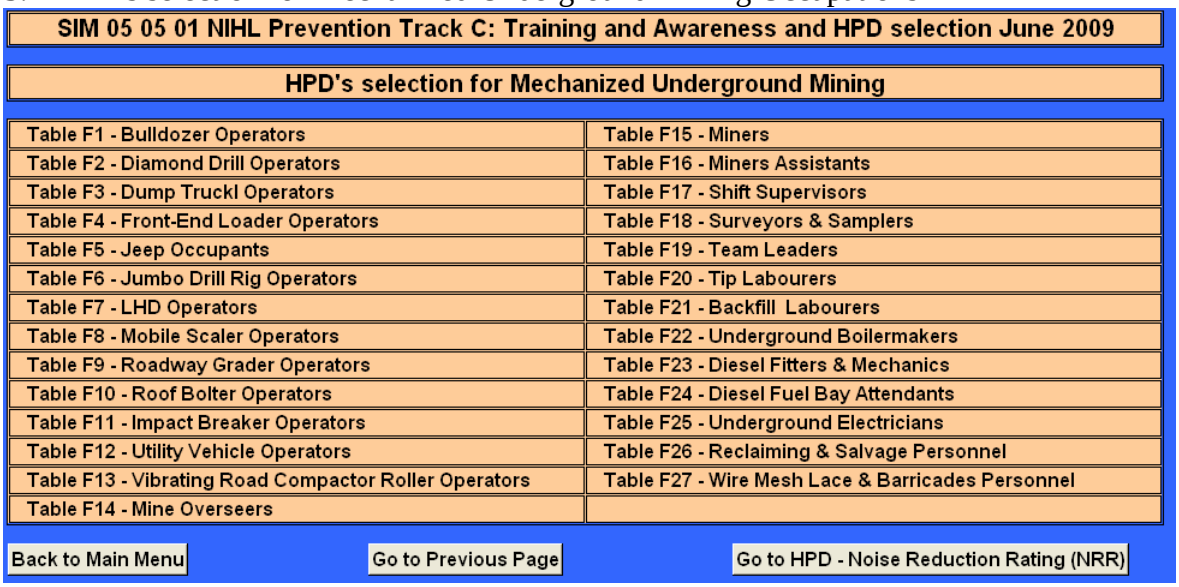
SIM 05 05 01 NIHL Prevention Track C: Training and Awareness and HPD selection June 2009

HPD's selection for Conventional Underground Mining

Table E1 - Development Teams	Table E18 - Electric Loco Operators
Table E2 - Pneumatic Loader Operators	Table E19 - Tramming Crews
Table E3 - Pipes Tracks & Ventilation Crews	Table E20 - Tip Attendants
Table E4 - Stope Teams	Table E21 - Onsetters Teams
Table E5 - Hydrojet Operators	Table E22 - Underground Artisans
Table E6 - Winch Operators	Table E23 - Main Fan Attendants
Table E7 - Winch Bell Operators	Table E24 - Pump Attendants
Table E8 - Survey Sampling Ventilation Personnel	Table E25 - Refrigeration Plant Attendants
Table E9 - Timber Crews	Table E26 - Refuge Bays
Table E10 - Nightshift Stope Teams	Table E27 - Pneumatic Disk Sampler Operator
Table E11 - Mine Overseers	Table E28 - Electric Drill Operator
Table E12 - Dayshift Supervisors	Table E29 - Development RDO's Muffled Pneumatic
Table E13 - Nightshift Supervisors	Table E30 - Development RDO's Unmuffeld Pneumatic
Table E14 - Miners	Table E31 -Development RDO's Waterhydraulic
Table E15 - Team Supervisors	Table E32 -Stope RDO's Muffled Pneumatic
Table E16 - Banksmen	Table E33 -Stope RDO's Unmuffeld Pneumatic
Table E17 - Diesel Loco Operators	Table E34 -Stope RDO's Water hydraulic

Back to Main Menu | Go to Previous Page | Go to HPD's selection for Mechanized Underground Mining

5. HPD's selection for Mechanized Underground Mining Occupations



SIM 05 05 01 NIHL Prevention Track C: Training and Awareness and HPD selection June 2009

HPD's selection for Mechanized Underground Mining

Table F1 - Bulldozer Operators	Table F15 - Miners
Table F2 - Diamond Drill Operators	Table F16 - Miners Assistants
Table F3 - Dump Truckl Operators	Table F17 - Shift Supervisors
Table F4 - Front-End Loader Operators	Table F18 - Surveyors & Samplers
Table F5 - Jeep Occupants	Table F19 - Team Leaders
Table F6 - Jumbo Drill Rig Operators	Table F20 - Tip Labourers
Table F7 - LHD Operators	Table F21 - Backfill Labourers
Table F8 - Mobile Scaler Operators	Table F22 - Underground Boilermakers
Table F9 - Roadway Grader Operators	Table F23 - Diesel Fitters & Mechanics
Table F10 - Roof Bolter Operators	Table F24 - Diesel Fuel Bay Attendants
Table F11 - Impact Breaker Operators	Table F25 - Underground Electricians
Table F12 - Utility Vehicle Operators	Table F26 - Reclaiming & Salvage Personnel
Table F13 - Vibrating Road Compactor Roller Operators	Table F27 - Wire Mesh Lace & Barricades Personnel
Table F14 - Mine Overseers	

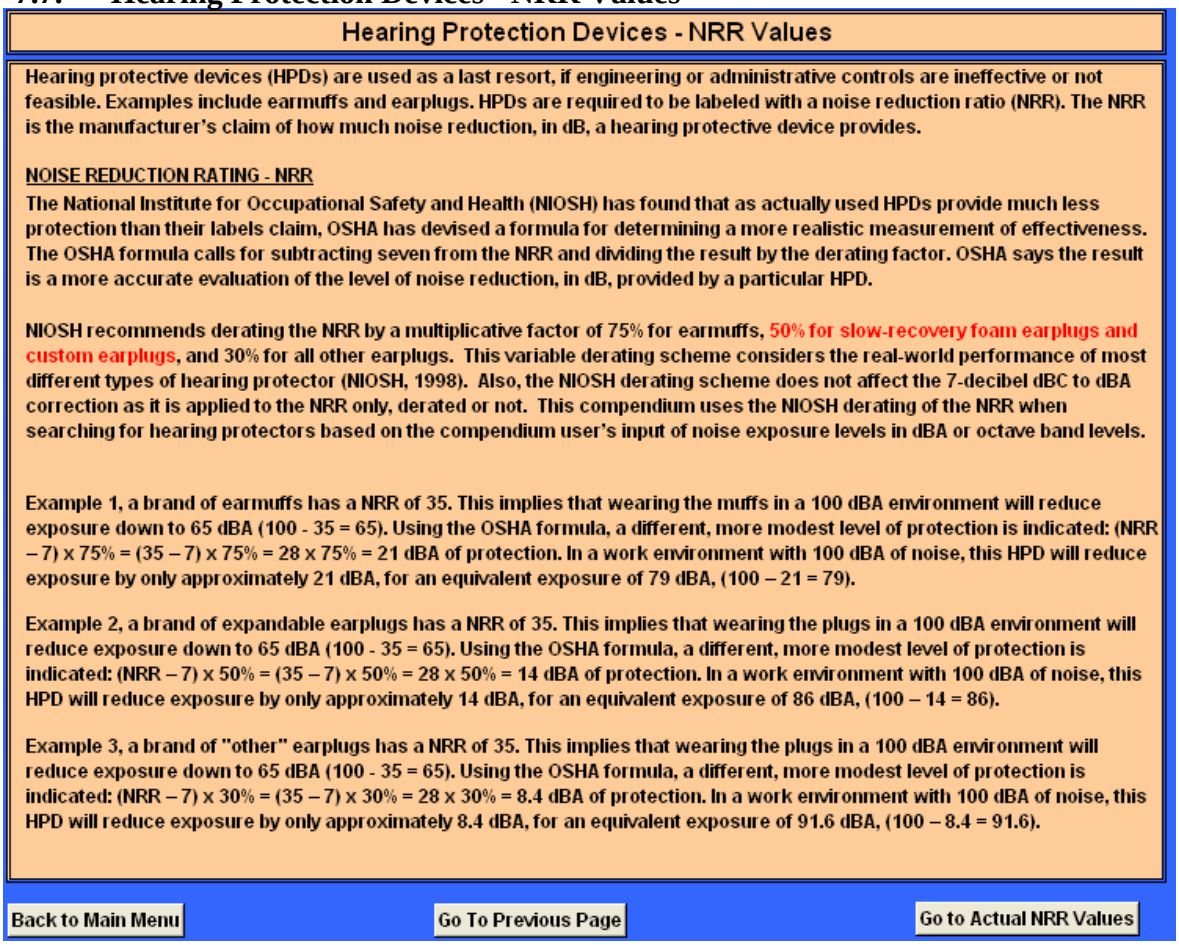
Back to Main Menu | Go to Previous Page | Go to HPD - Noise Reduction Rating (NRR)

Each of the HPD selection tables relates to a specific occupation or workplace. Along the top row of each table is a summary of personal noise exposure results for the occupation or workplace being considered. The top row of the table shows the mean, maximum and minimum noise exposure values for the occupation and the number of workers whose exposure in that occupation were measured.

In the row labelled "without HPD" the mean value (LAeq) measured for each centre frequency is listed. These are the A-weighted sound pressure levels to which unprotected workers in that occupation or workplace are likely to be exposed. Under the column labelled "LAeq" along the row labelled "without HPD" is the mean equivalent continuous A-weighted sound pressure level for the occupation or workplace being considered.. In the last column (labelled Lavg) along the same row, is the expected equivalent noise exposure for unprotected ears calculated from the noise exposure measurements and rounded to the nearest integer.

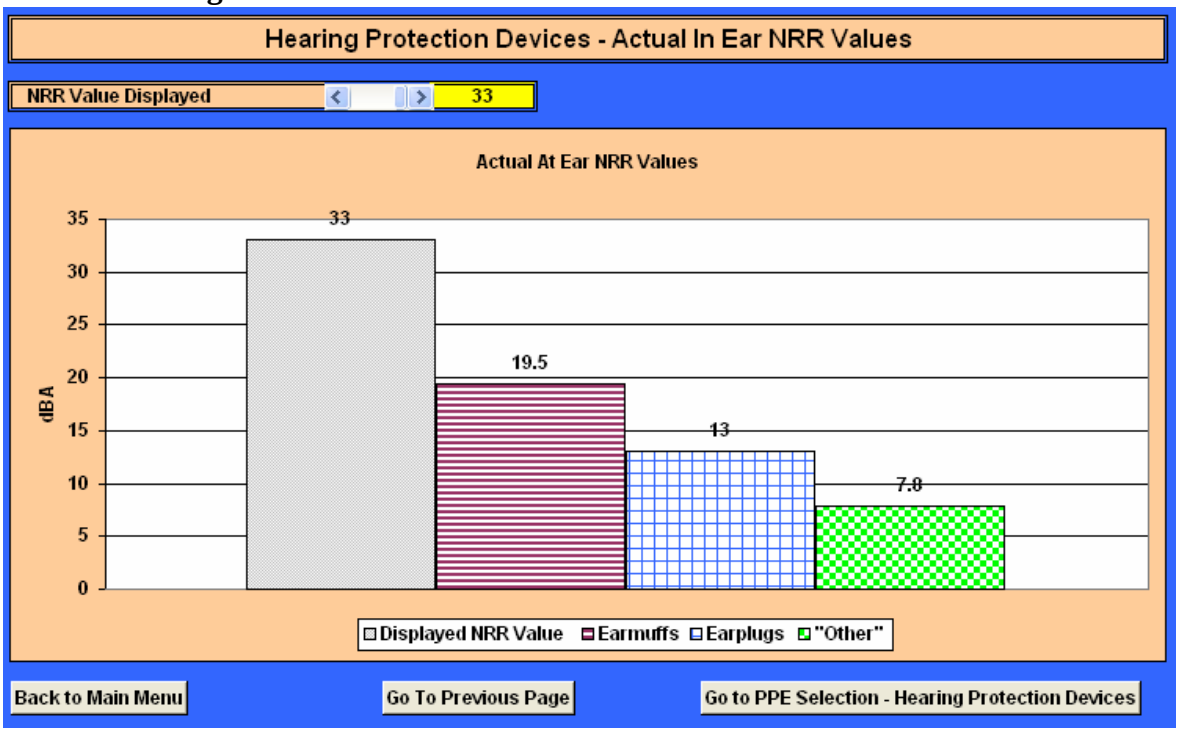
The subsequent rows (with the name of each HPD being considered) display the effective attenuated values calculated for workers wearing the particular HPD. Where the effective Lavg exceeds 85 dBA, an indication that the particular HPD is inadequate for the occupation or workplace being considered, the value is displayed as >nn<. Where effective Lavg is less than 70 dBA, an indication that the HPD may overprotect and interfere with communication, the value is displayed as ((nn)).

7.7. Hearing Protection Devices - NRR Values



HPDs are required to be labelled with a noise reduction ratio (NRR). The NRR is the manufacturer's claim of how much noise reduction, in dB, a hearing protective device provides. By viewing this screen you will be able to view an explanation on the variable derating scheme considering the real-world performance of most different types of hearing protectors.

7.8. Hearing Protection Devices - Actual In Ear NRR Values



In this screen you will be able to view the actual effect of the variable derating scheme on the various HPD styles when selecting different NRR values. In this example the selected NRR value is 33. Applying the derating scheme the actual at/in ear protection value acquired are for;

Earmuffs – 19.5

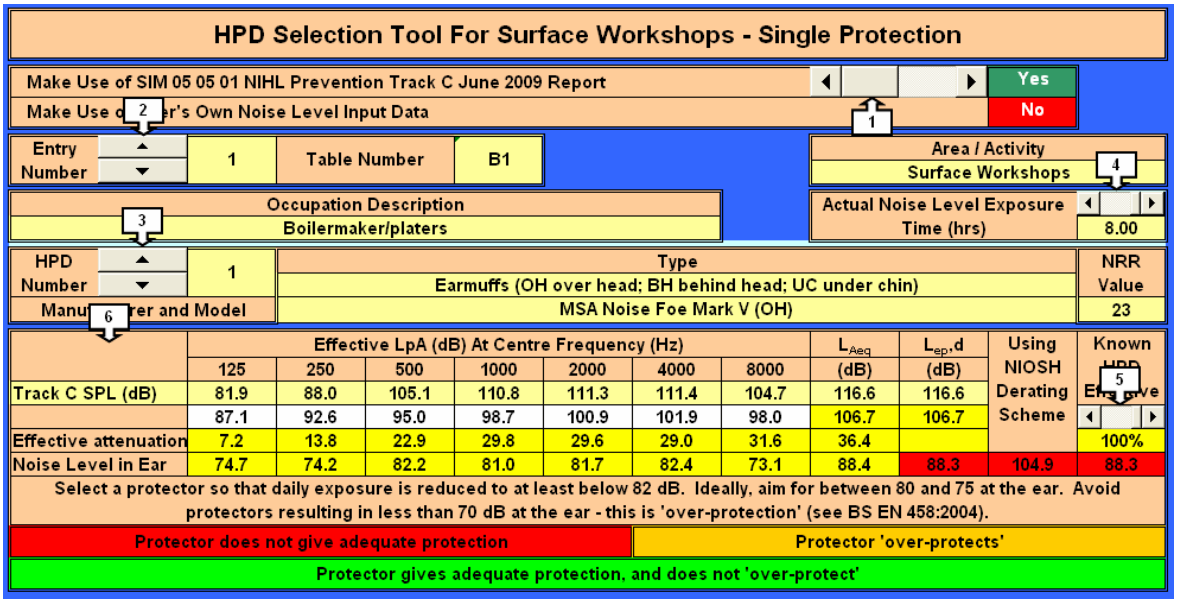
Earplugs – 13

“Other” – 7

This implication is very important as it stipulates the “real word” scenario and on this basis the importance on correct application, type/style and availability of different types/styles for the user to choose from cannot be stressed enough.

7.9. HPD Selection Tool - Single Protection for the various Activities/Areas

These screens will allow you to select the correct single protection HPP style/type in the various activities/areas and occupations found in the mining industry.



HPD Selection Tool For Surface Workshops - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report: Yes
Make Use of User's Own Noise Level Input Data: No

Entry Number	Table Number	Area / Activity	Occupation Description	Actual Noise Level Exposure Time (hrs)
1	B1	Surface Workshops	Boilermaker/platers	8.00

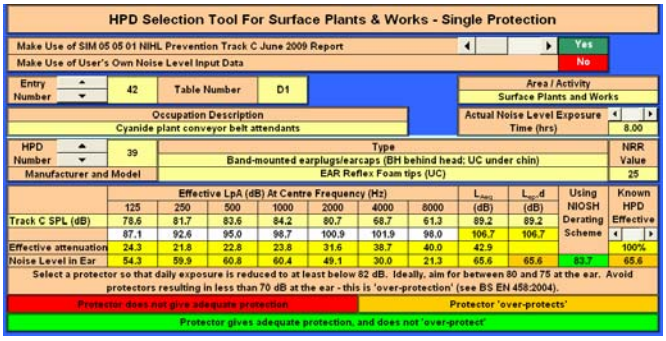
HPD Number	Type	NRR Value
1	Earmuffs (OH over head; BH behind head; UC under chin)	23
Manufacturer and Model	MSA Noise Foe Mark V (OH)	

	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	81.9	88.0	105.1	110.8	111.3	111.4	104.7	116.6	116.6		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	7.2	13.8	22.9	29.8	29.6	29.0	31.6	36.4			100%
Noise Level in Ear	74.7	74.2	82.2	81.0	81.7	82.4	73.1	88.4	88.3	104.9	88.3

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'



HPD Selection Tool For Surface Plants & Works - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report: Yes
Make Use of User's Own Noise Level Input Data: No

Entry Number	Table Number	Area / Activity	Occupation Description	Actual Noise Level Exposure Time (hrs)
42	D1	Surface Plants and Works	Cyanide plant conveyor belt attendants	8.00

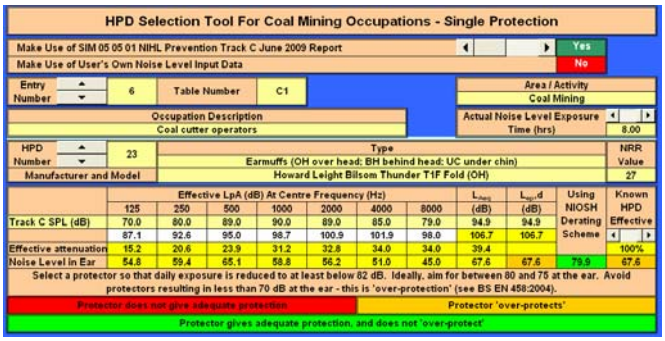
HPD Number	Type	NRR Value
39	Band-mounted earplugs/earcaps (BH behind head; UC under chin)	25
Manufacturer and Model	EAR Reflex Foam tips (UC)	

	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	78.6	81.7	83.6	84.2	80.7	68.7	61.3	89.2	89.2		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	24.3	21.8	22.8	23.8	31.6	38.7	40.0	42.9			100%
Noise Level in Ear	54.3	59.9	60.8	60.4	49.1	30.0	21.3	65.6	65.6	83.7	65.6

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'



HPD Selection Tool For Coal Mining Occupations - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report: Yes
Make Use of User's Own Noise Level Input Data: No

Entry Number	Table Number	Area / Activity	Occupation Description	Actual Noise Level Exposure Time (hrs)
6	C1	Coal Mining	Coal cutter operators	8.00

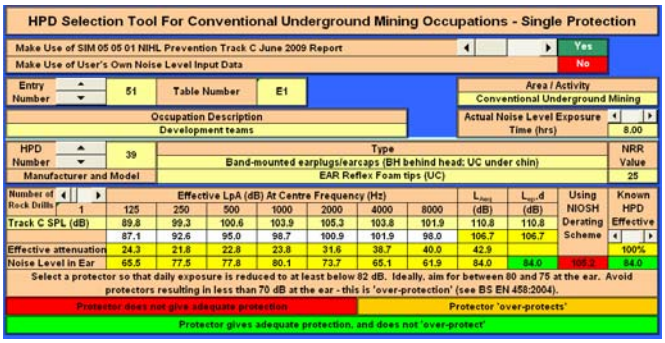
HPD Number	Type	NRR Value
23	Earmuffs (OH over head; BH behind head; UC under chin)	27
Manufacturer and Model	Howard Leight Bilsom Thunder T1F Fold (OH)	

	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	70.0	80.0	89.0	90.0	89.0	85.0	79.0	94.9	94.9		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	15.2	20.6	23.9	31.2	32.8	34.0	34.0	39.4			100%
Noise Level in Ear	54.8	59.4	65.1	58.8	56.2	51.0	45.0	67.6	67.6	79.9	67.6

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'



HPD Selection Tool For Conventional Underground Mining Occupations - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report: Yes
Make Use of User's Own Noise Level Input Data: No

Entry Number	Table Number	Area / Activity	Occupation Description	Actual Noise Level Exposure Time (hrs)
51	E1	Conventional Underground Mining	Development teams	8.00

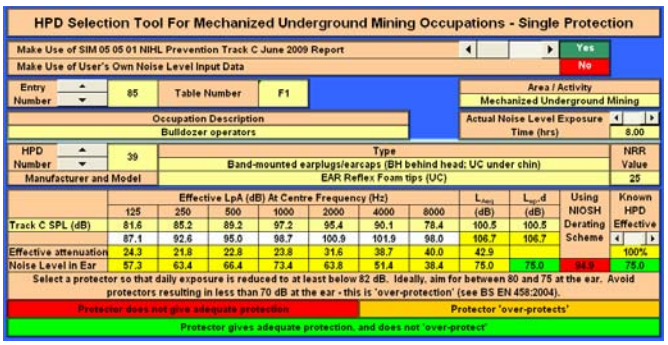
HPD Number	Type	NRR Value
39	Band-mounted earplugs/earcaps (BH behind head; UC under chin)	25
Manufacturer and Model	EAR Reflex Foam tips (UC)	

Number of Rock Drills	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
1	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	89.8	99.3	100.6	103.9	105.3	103.8	101.9	110.8	110.8		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	24.3	21.8	22.8	23.8	31.6	38.7	40.0	42.9			100%
Noise Level in Ear	65.5	77.5	77.8	80.1	73.7	65.1	61.9	84.0	84.0	105.2	84.0

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'



HPD Selection Tool For Mechanized Underground Mining Occupations - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report: Yes
Make Use of User's Own Noise Level Input Data: No

Entry Number	Table Number	Area / Activity	Occupation Description	Actual Noise Level Exposure Time (hrs)
85	F1	Mechanized Underground Mining	Bulldozer operators	8.00

HPD Number	Type	NRR Value
39	Band-mounted earplugs/earcaps (BH behind head; UC under chin)	25
Manufacturer and Model	EAR Reflex Foam tips (UC)	

	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	81.6	85.2	89.2	97.2	95.4	90.1	78.4	100.5	100.5		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	24.3	21.8	22.8	23.8	31.6	38.7	40.0	42.9			100%
Noise Level in Ear	57.3	63.4	66.4	73.4	63.8	51.4	38.4	75.0	75.0	94.9	75.0

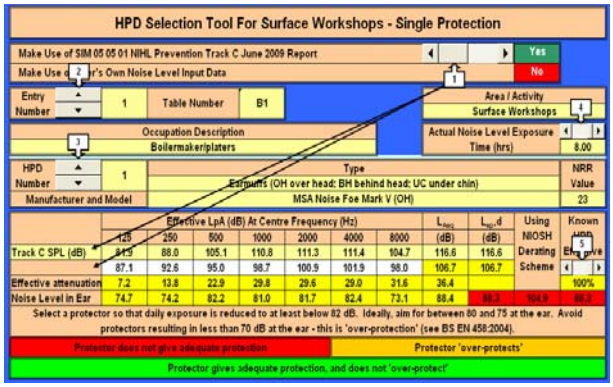
Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

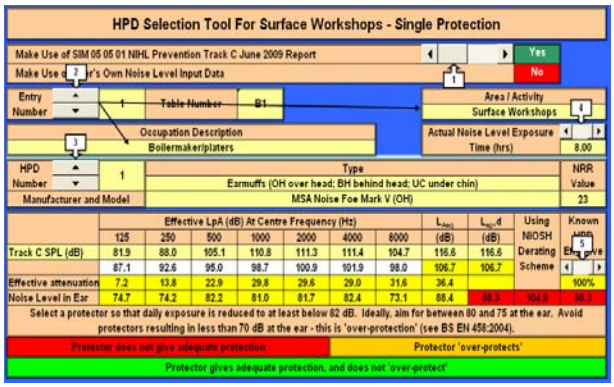
Protector gives adequate protection, and does not 'over-protect'

7.10. Tab functions; the tab functions throughout these five screens are all similar.

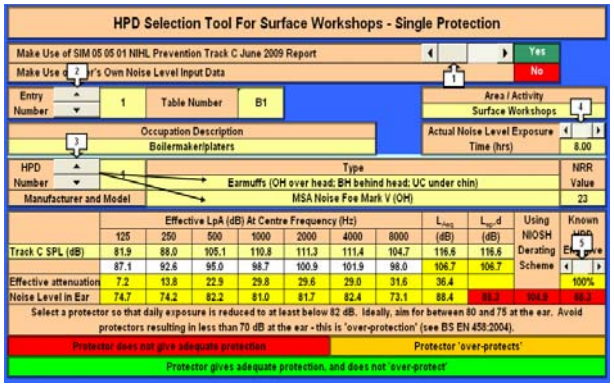
Tab 1: This tab will allow you to choose using the SIM report frequency analysis or own input



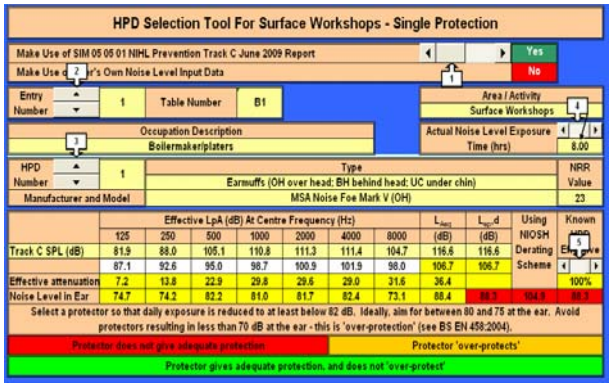
Tab 2: This tab will allow you to select the mining type/activity and occupation.



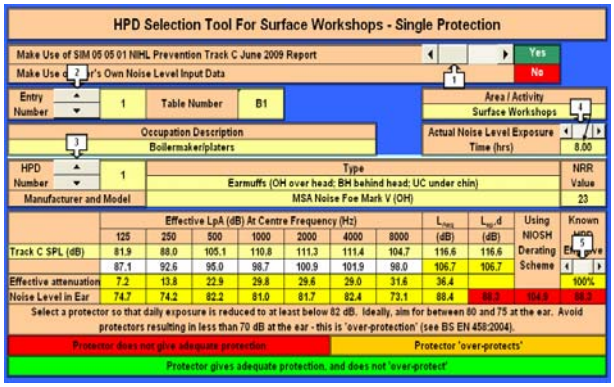
Tab 3: This tab will allow you to select the HPD style/type.



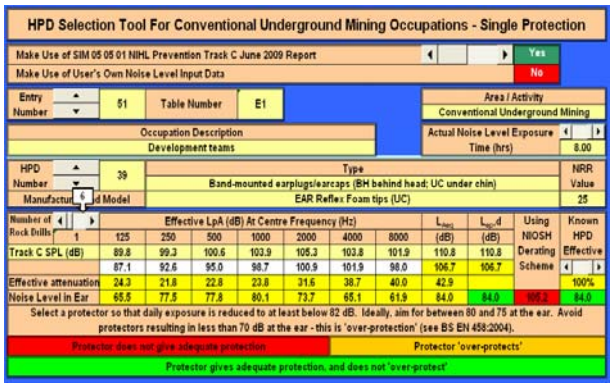
Tab 4: This tab will allow you to set the expected noise exposure time for the selected occupation.



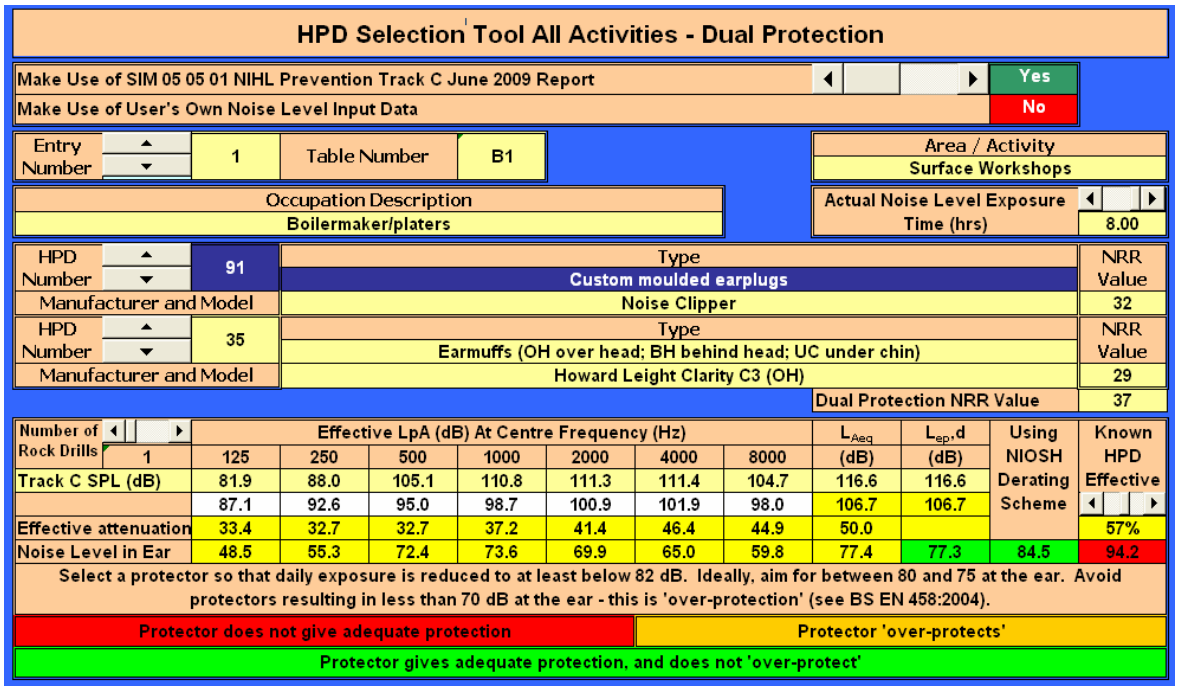
Tab 5: This tab will allow you to set the “known” HPD usage compliance/effectiveness.



Tab 6: This tab is only displayed in the conventional underground mining operations screen and is only functional for drilling occupations and you are able to set the number of rock drills from 1 to 6.



7.11. HPD Selection Tool All Activities - Dual Protection

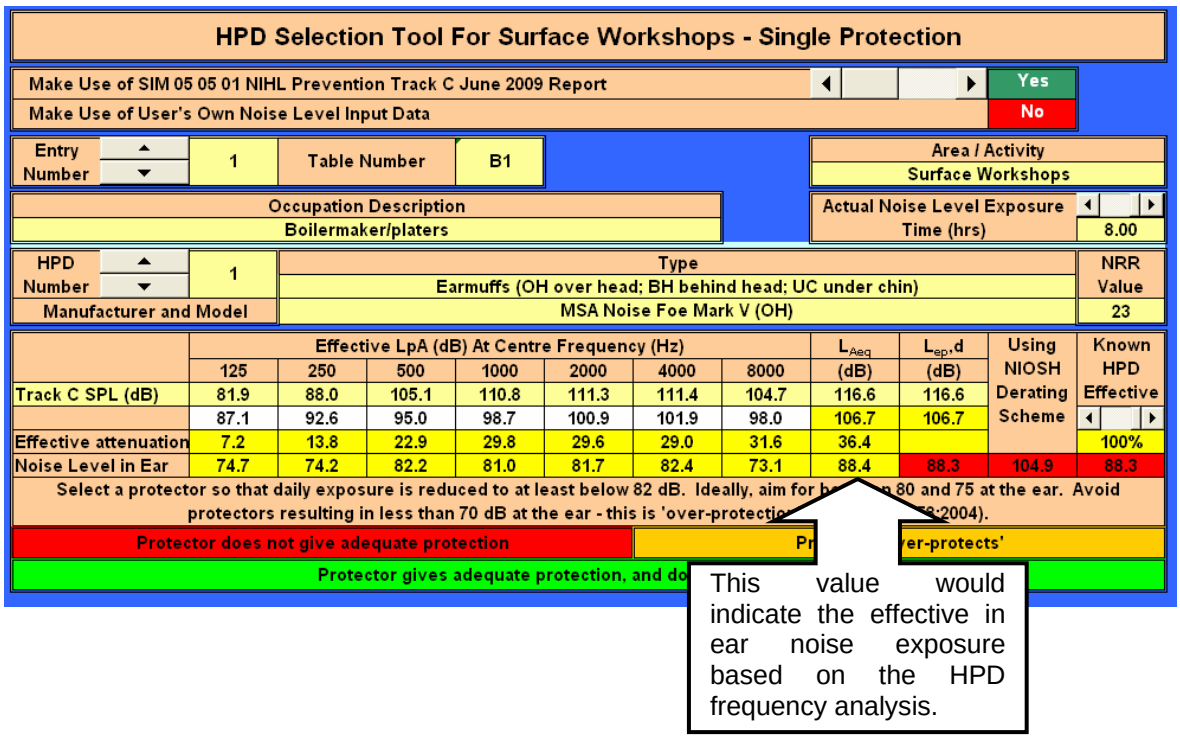


HPD Selection Tool All Activities - Dual Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report																		Yes	
Make Use of User's Own Noise Level Input Data																		No	
Entry Number	1	Table Number	B1												Area / Activity: Surface Workshops				
Occupation Description: Boilermaker/platers															Actual Noise Level Exposure Time (hrs)			8.00	
HPD Number	91	Type: Custom moulded earplugs																NRR Value	
Manufacturer and Model		Noise Clipper																32	
HPD Number	35	Type: Earmuffs (OH over head; BH behind head; UC under chin)																NRR Value	
Manufacturer and Model		Howard Leight Clarity C3 (OH)																29	
															Dual Protection NRR Value			37	
Number of Rock Drills	1	Effective LpA (dB) At Centre Frequency (Hz)								L_{Aeq} (dB)	$L_{ep,d}$ (dB)	Using NIOSH Derating Scheme	Known HPD Effective						
		125	250	500	1000	2000	4000	8000											
Track C SPL (dB)		81.9	88.0	105.1	110.8	111.3	111.4	104.7		116.6	116.6								
		87.1	92.6	95.0	98.7	100.9	101.9	98.0		106.7	106.7								
Effective attenuation		33.4	32.7	32.7	37.2	41.4	46.4	44.9		50.0			57%						
Noise Level in Ear		48.5	55.3	72.4	73.6	69.9	65.0	59.8		77.4	77.3	84.5	94.2						
Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).																			
Protector does not give adequate protection													Protector 'over-protects'						
Protector gives adequate protection, and does not 'over-protect'																			

This screen will allow you to interrogate the effect of dual protection by selecting an earmuff and complimenting it with another style of HPD. The “Dual Protection NNR value” displayed would be the higher NRR value plus 5. Al other tab functions would remain the same a for the single protection screens.

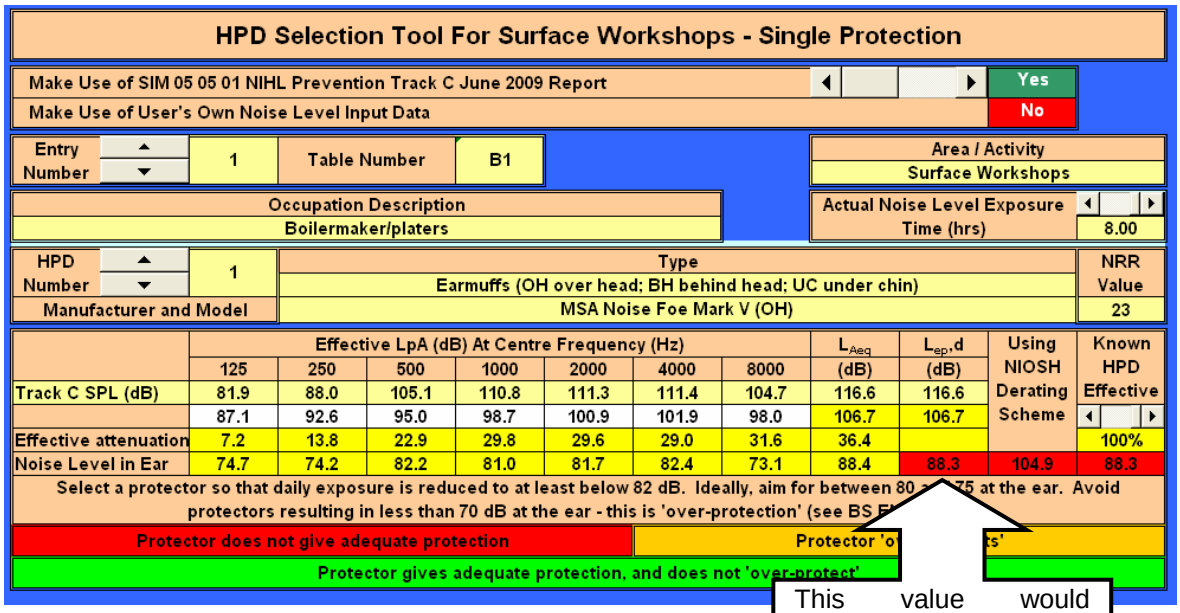
8. Outputs



HPD Selection Tool For Surface Workshops - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report																		Yes	
Make Use of User's Own Noise Level Input Data																		No	
Entry Number	1	Table Number	B1												Area / Activity: Surface Workshops				
Occupation Description: Boilermaker/platers															Actual Noise Level Exposure Time (hrs)			8.00	
HPD Number	1	Type: Earmuffs (OH over head; BH behind head; UC under chin)																NRR Value	
Manufacturer and Model		MSA Noise Foe Mark V (OH)																23	
		Effective LpA (dB) At Centre Frequency (Hz)								L_{Aeq} (dB)	$L_{ep,d}$ (dB)	Using NIOSH Derating Scheme	Known HPD Effective						
		125	250	500	1000	2000	4000	8000											
Track C SPL (dB)		81.9	88.0	105.1	110.8	111.3	111.4	104.7		116.6	116.6								
		87.1	92.6	95.0	98.7	100.9	101.9	98.0		106.7	106.7								
Effective attenuation		7.2	13.8	22.9	29.8	29.6	29.0	31.6		36.4			100%						
Noise Level in Ear		74.7	74.2	82.2	81.0	81.7	82.4	73.1		88.4	88.3	104.9	88.3						
Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).																			
Protector does not give adequate protection													Protector 'over-protects'						
Protector gives adequate protection, and does not 'over-protect'																			

This value would indicate the effective in ear noise exposure based on the HPD frequency analysis.



HPD Selection Tool For Surface Workshops - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report	Yes
Make Use of User's Own Noise Level Input Data	No

Entry Number	1	Table Number	B1	Area / Activity	Surface Workshops
Occupation Description	Boilermaker/platers			Actual Noise Level Exposure Time (hrs)	8.00
HPD Number	1	Type	Earmuffs (OH over head; BH behind head; UC under chin)		NRR Value: 23
Manufacturer and Model			MSA Noise Foe Mark V (OH)		

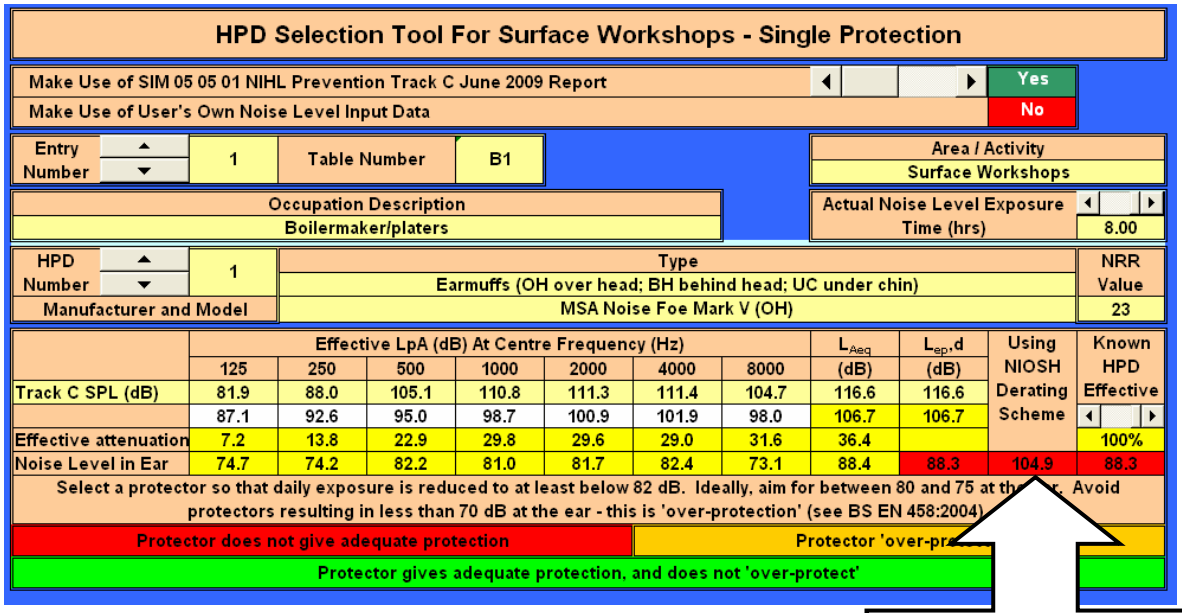
	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	81.9	88.0	105.1	110.8	111.3	111.4	104.7	116.6	116.6		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	7.2	13.8	22.9	29.8	29.6	29.0	31.6	36.4			100%
Noise Level in Ear	74.7	74.2	82.2	81.0	81.7	82.4	73.1	88.4	88.3	104.9	88.3

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'

This value would indicate the effective in ear noise exposure dose based on the HPD frequency analysis and exposure time.



HPD Selection Tool For Surface Workshops - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report	Yes
Make Use of User's Own Noise Level Input Data	No

Entry Number	1	Table Number	B1	Area / Activity	Surface Workshops
Occupation Description	Boilermaker/platers			Actual Noise Level Exposure Time (hrs)	8.00
HPD Number	1	Type	Earmuffs (OH over head; BH behind head; UC under chin)		NRR Value: 23
Manufacturer and Model			MSA Noise Foe Mark V (OH)		

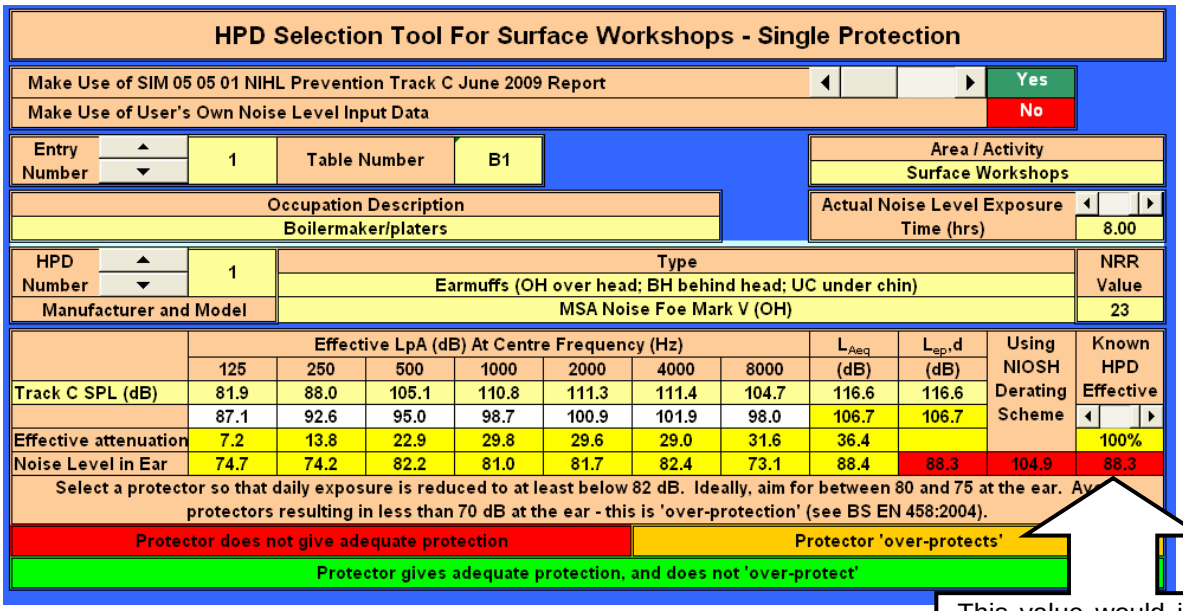
	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	81.9	88.0	105.1	110.8	111.3	111.4	104.7	116.6	116.6		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	7.2	13.8	22.9	29.8	29.6	29.0	31.6	36.4			100%
Noise Level in Ear	74.7	74.2	82.2	81.0	81.7	82.4	73.1	88.4	88.3	104.9	88.3

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Avoid protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004)

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'

This value would indicate the effective in ear noise exposure dose using the NIOSH derating scheme and based on the exposure time.



HPD Selection Tool For Surface Workshops - Single Protection

Make Use of SIM 05 05 01 NIHL Prevention Track C June 2009 Report	Yes
Make Use of User's Own Noise Level Input Data	No

Entry Number	1	Table Number	B1	Area / Activity	Surface Workshops
Occupation Description	Boilermaker/platers			Actual Noise Level Exposure Time (hrs)	8.00
HPD Number	1	Type	Earmuffs (OH over head; BH behind head; UC under chin)		NRR Value
Manufacturer and Model			MSA Noise Foe Mark V (OH)		23

	Effective LpA (dB) At Centre Frequency (Hz)							L_{Aeq}	$L_{ep,d}$	Using NIOSH Derating Scheme	Known HPD Effective
	125	250	500	1000	2000	4000	8000	(dB)	(dB)		
Track C SPL (dB)	81.9	88.0	105.1	110.8	111.3	111.4	104.7	116.6	116.6		
	87.1	92.6	95.0	98.7	100.9	101.9	98.0	106.7	106.7		
Effective attenuation	7.2	13.8	22.9	29.8	29.6	29.0	31.6	36.4			100%
Noise Level in Ear	74.7	74.2	82.2	81.0	81.7	82.4	73.1	88.4	88.3	104.9	88.3

Select a protector so that daily exposure is reduced to at least below 82 dB. Ideally, aim for between 80 and 75 at the ear. Av... protectors resulting in less than 70 dB at the ear - this is 'over-protection' (see BS EN 458:2004).

Protector does not give adequate protection | Protector 'over-protects'

Protector gives adequate protection, and does not 'over-protect'

This value would indicate the effective in ear noise exposure dose set to the to "known" HPD usage compliance/effectiveness and based on the exposure time.

9. Colour coding of output results:

Protector does not give adequate protection

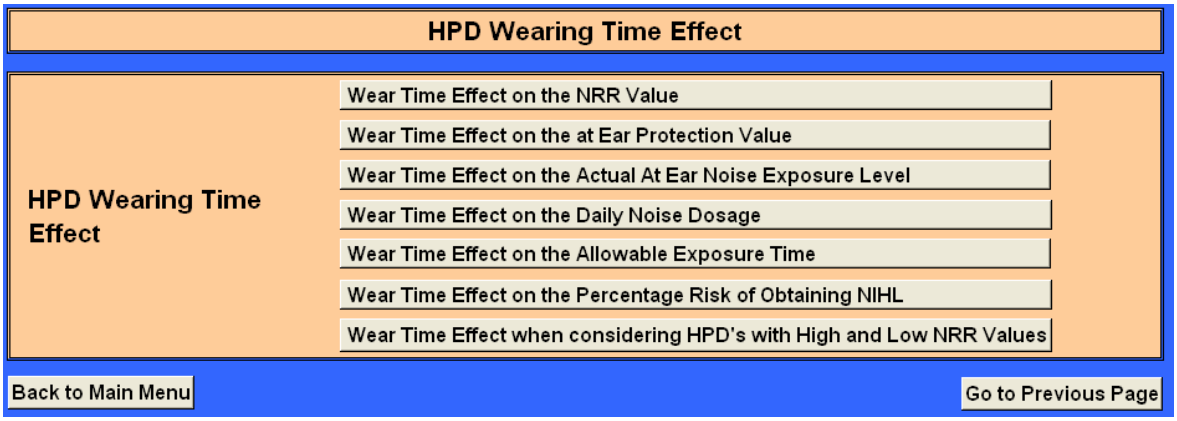
Protector gives adequate protection, and does not 'over-protect'

Protector 'over-protects'

10. HPDs' - Default Values to Demonstrate Wear Time Effect

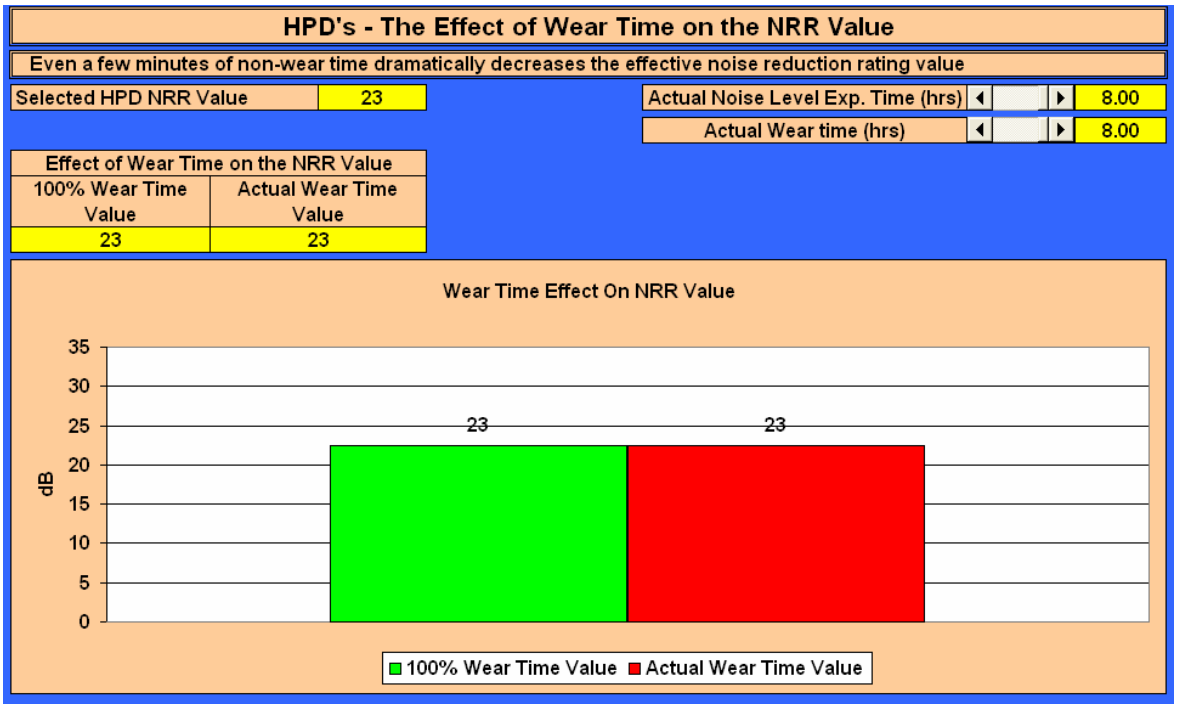
On this screen you will be able to view the implication on the actual at ear protection supplied by a specific style/type of HPD compared to the end user's effective percentage application. The values submitted here will also serve as the default values to demonstrate the effect of HPD non-wear time.

10.1. HPD Wearing Time (WT) Effect



The tabs on this screen will allow you to demonstrate the effect of actual HPD non-wear time, i.e. the effect of not wearing HPD's throughout the course of the users shift.

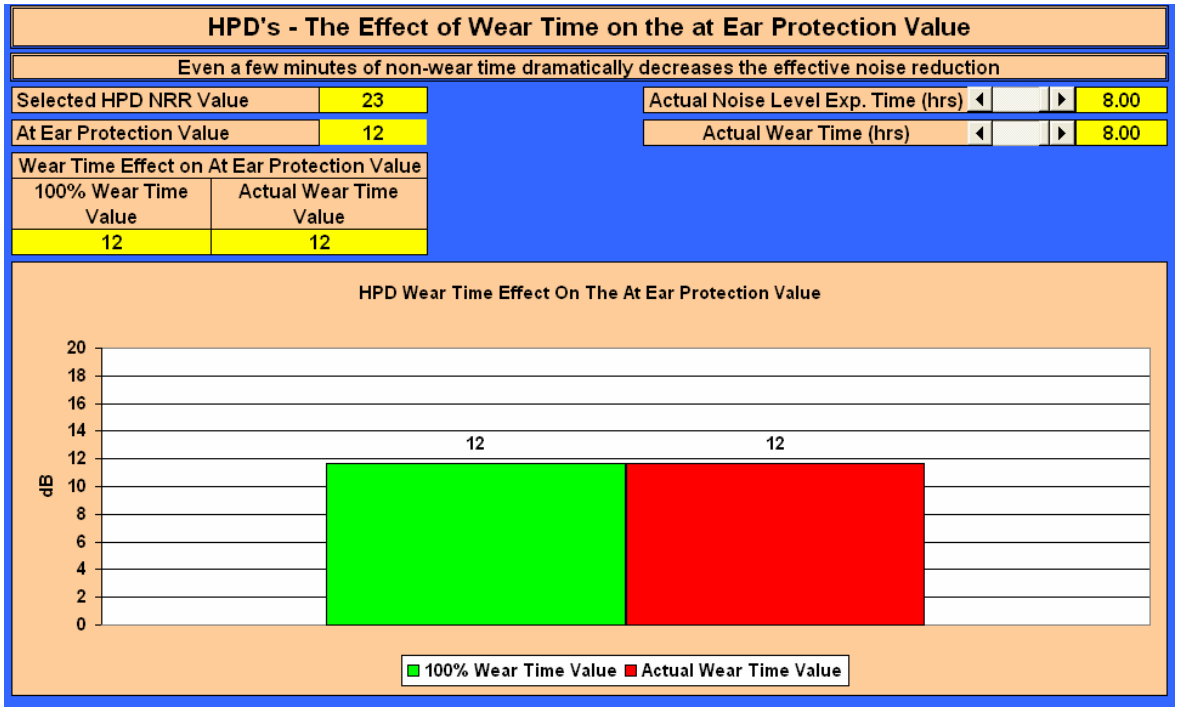
10.2. HPD's - the Effect of WT on the NRR Value



On this screen you will be able to demonstrate the effect of wear time on the NRR value.

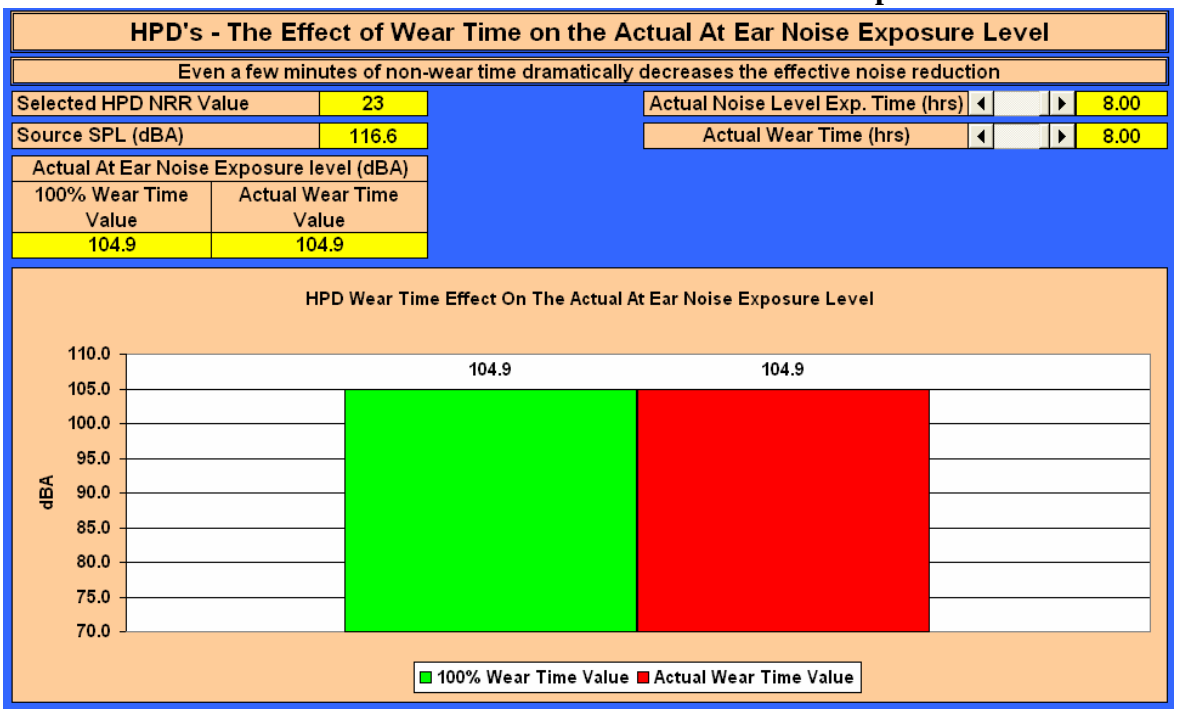
The tabs on this screen will allow you to select the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an "error" message will be displayed.

10.3. HPD's - The Effect of WT on the at Ear Protection Value



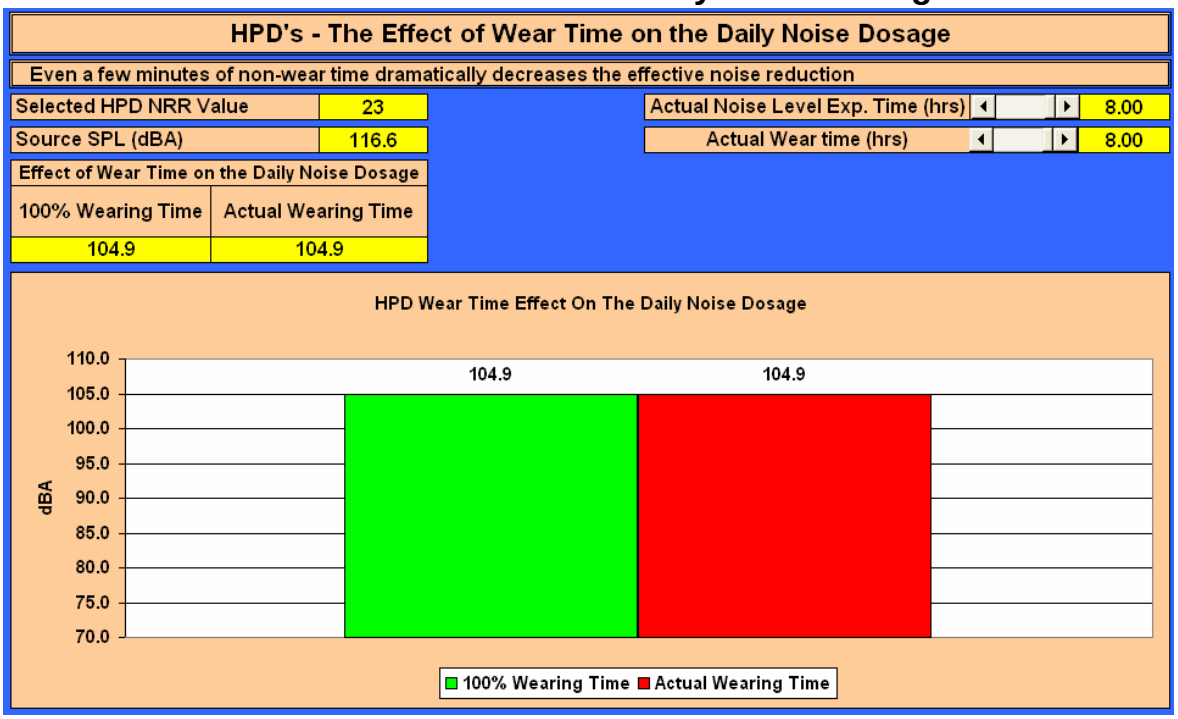
On this screen you will be able to demonstrate the effect of wear time on the at ear protection level. The tabs on this screen will allow you to select the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an “error” message will be displayed.

10.4. HPD’s - the Effect of WT on the Actual at Ear Noise Exposure Level



On this screen you will be able to demonstrate the effect of wear time on the actual at ear noise exposure level. The tabs on this screen will allow you to select the source SPL, the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an “error” message will be displayed.

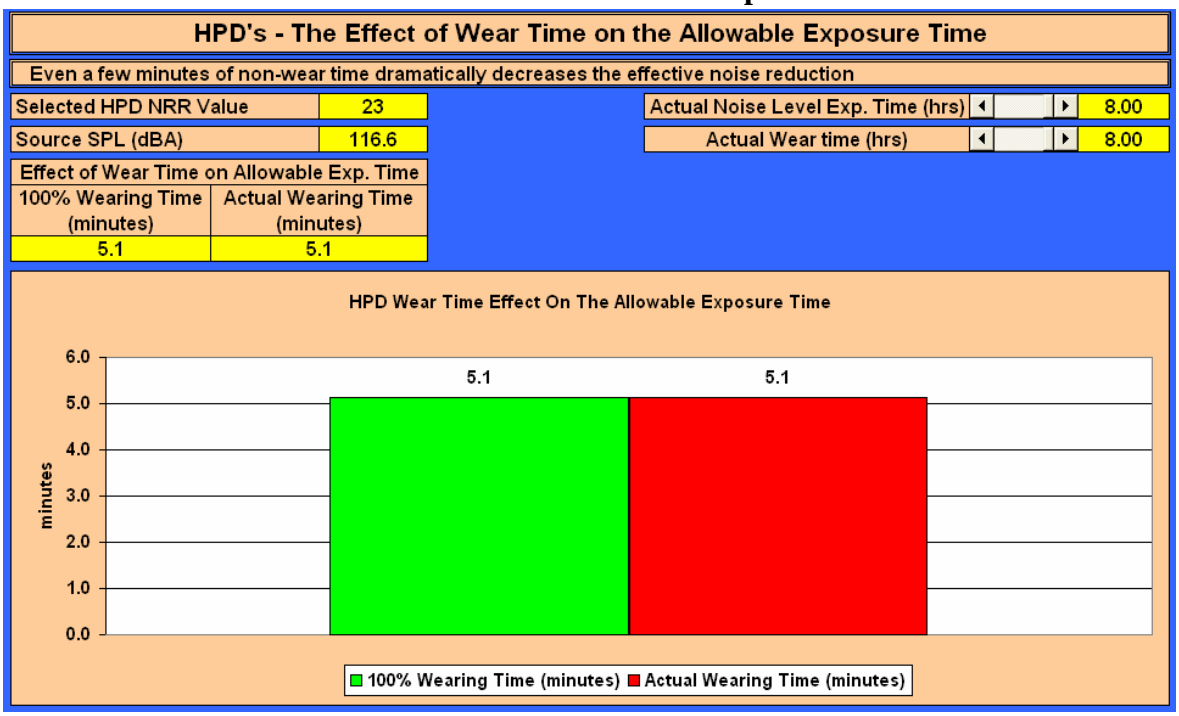
10.5. HPD's - the Effect of WT on the Daily Noise Dosage



On this screen you will be able to demonstrate the effect of wear time on the daily noise dosage.

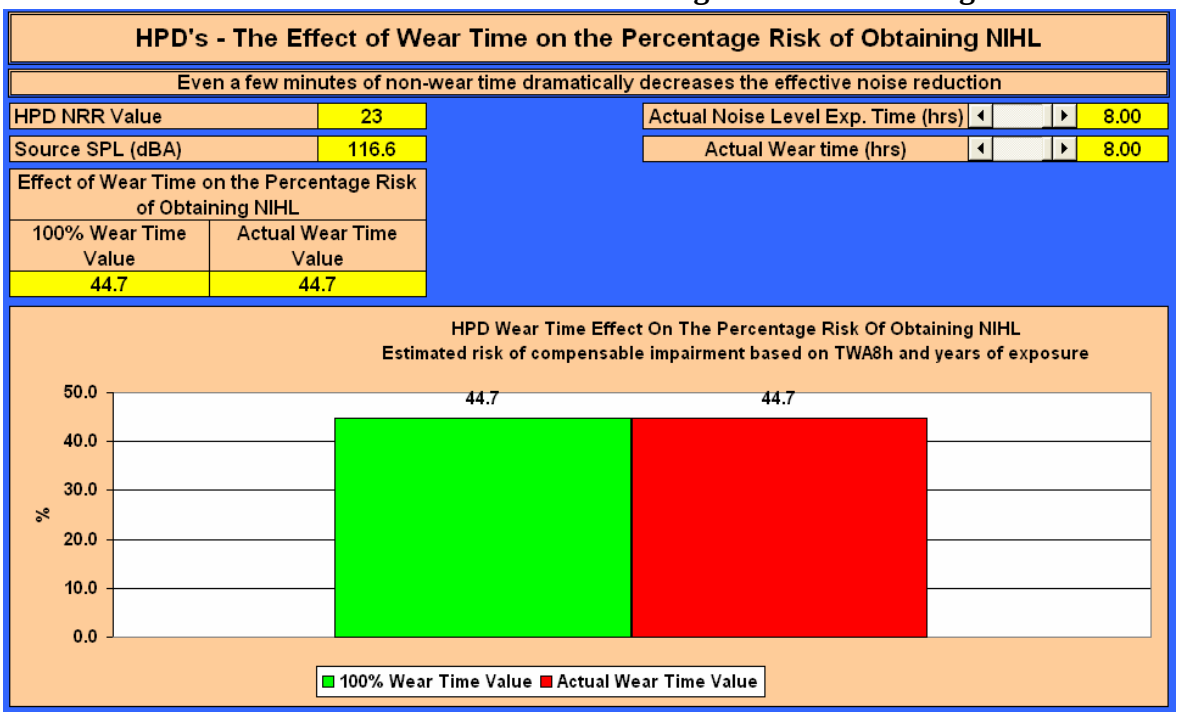
The tabs on this screen will allow you to select the source SPL, the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an "error" message will be displayed.

10.6. HPD's - the Effect of WT on the Allowable Exposure Time



On this screen you will be able to demonstrate the effect of wear time on the daily allowable exposure time. The tabs on this screen will allow you to select the source SPL, the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an “error” message will be displayed.

10.7. HPD’s - The Effect of WT on the Percentage Risk of Obtaining NIHL



On this screen you will be able to demonstrate the effect of wear time on the percentage risk of obtaining NIHL. The tabs on this screen will allow you to select the source SPL, the actual noise exposure time and the effective HPD wear time. The results will vary as the times are changed. You are not able to select an exposure time greater than the effective HPD time; an “error” message will be displayed.

10.8. The Effect of WT when considering HPD's with High and Low NRR Values

The Effect of Wear Time when considering HPD's with High and Low NRR Values

HPD with Higher NRR Value	
HPD Selected	70
Type Selected	Disposable earplugs
Manufacturer & Model	EAR Classic superfit 33
NRR Value (dBA)	33
At Ear NRR Value	13
Source Noise Level	110.0
Employee in Ear Noise Level	97.1
Actual Noise Exp. Time (hrs)	6.00
Actual HPD Wear Time (hrs)	5.00
Daily Noise Dosage	102.0
Allowable Exposure Time per Day (minutes)	10.0
Allowable Exposure Time per Day (hours)	0.17

HPD with Lower NRR Value	
HPD Selected	72
Type Selected	Disposable earplugs
Manufacturer & Model	Peltor Next Nitro
NRR Value (dBA)	29
At Ear NRR Value	11
Source Noise Level	110.0
Employee in Ear Noise Level	98.9
Actual Noise Exp. Time (hrs)	6.00
Actual HPD Wear Time (hrs)	6.00
Daily Noise Dosage	97.5
Allowable Exposure Time per Day (minutes)	27.5
Allowable Exposure Time per Day (hours)	0.46

On this screen you will be able to demonstrate the effect of wear time when considering HPD's with High and Low NRR Values, i.e. you will be able to demonstrate that a HPD with a higher comfort and acceptance level by the users although having a lower NRR value will supply more protection than a HPD with a higher NRR value but with lower comfort and acceptance levels.

10.9. Cost Associated with Hearing Impairment - Compensation & Premiums

Cost Associated with Hearing Impairment - Compensation & Premiums

Employees Noise Exposure Level		Exposure time per shift		No. of years of exposure	
118	dBA	4.00	hours	20	years

Average settlement cost per claim	% of premiums collected by insurer for adm. cost
R 12,740	15%

HPD Number	70	Type	NRR Value (dB)	Derated NRR Value (dBA)
Manufacturer and Model		Disposable earplugs EAR Classic superfit 33	33	13

	Without HPD	With HPD	Variance
Employees equivalent Noise Exposure Level (dBA)	115	102	13
Estimated Risk of compensable impairment (%)	89.5	50.9	39
Number of compensation claims per 100 employees so exposed.	89.5	50.9	39
Value of compensation claims per 100 employees so exposed.	R 1,140,230	R 648,466	R 491,764
Cost to be paid in premiums by employer to cover claims	R 1,311,265	R 745,736	R 565,529

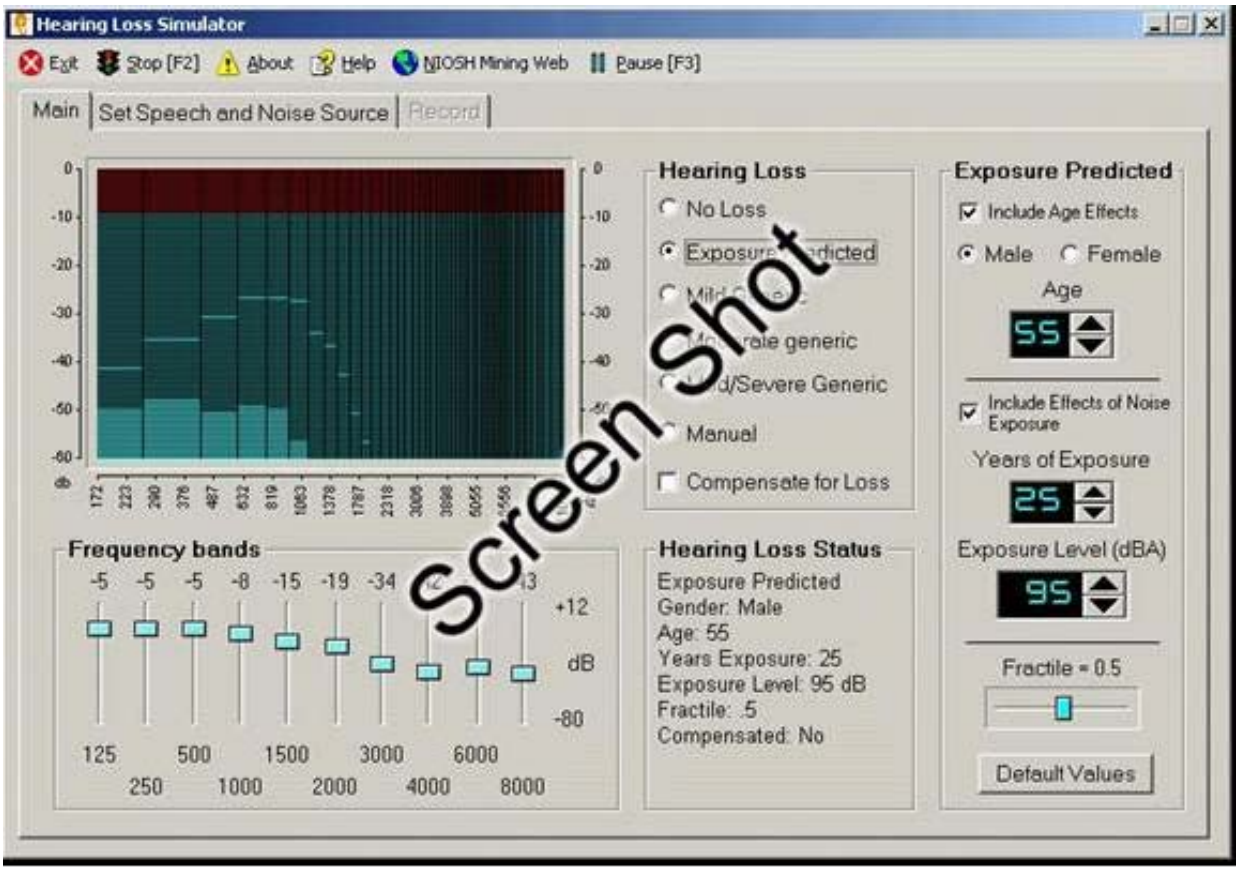
Following the tabs on this screen will allow you to demonstrate the cost associated with NIHL and the premiums payable to the insurer.

11. Other materials available in the tool from local and international sources

11.1. PowerPoint® presentation – Hearing Conservation – Stick to Basics

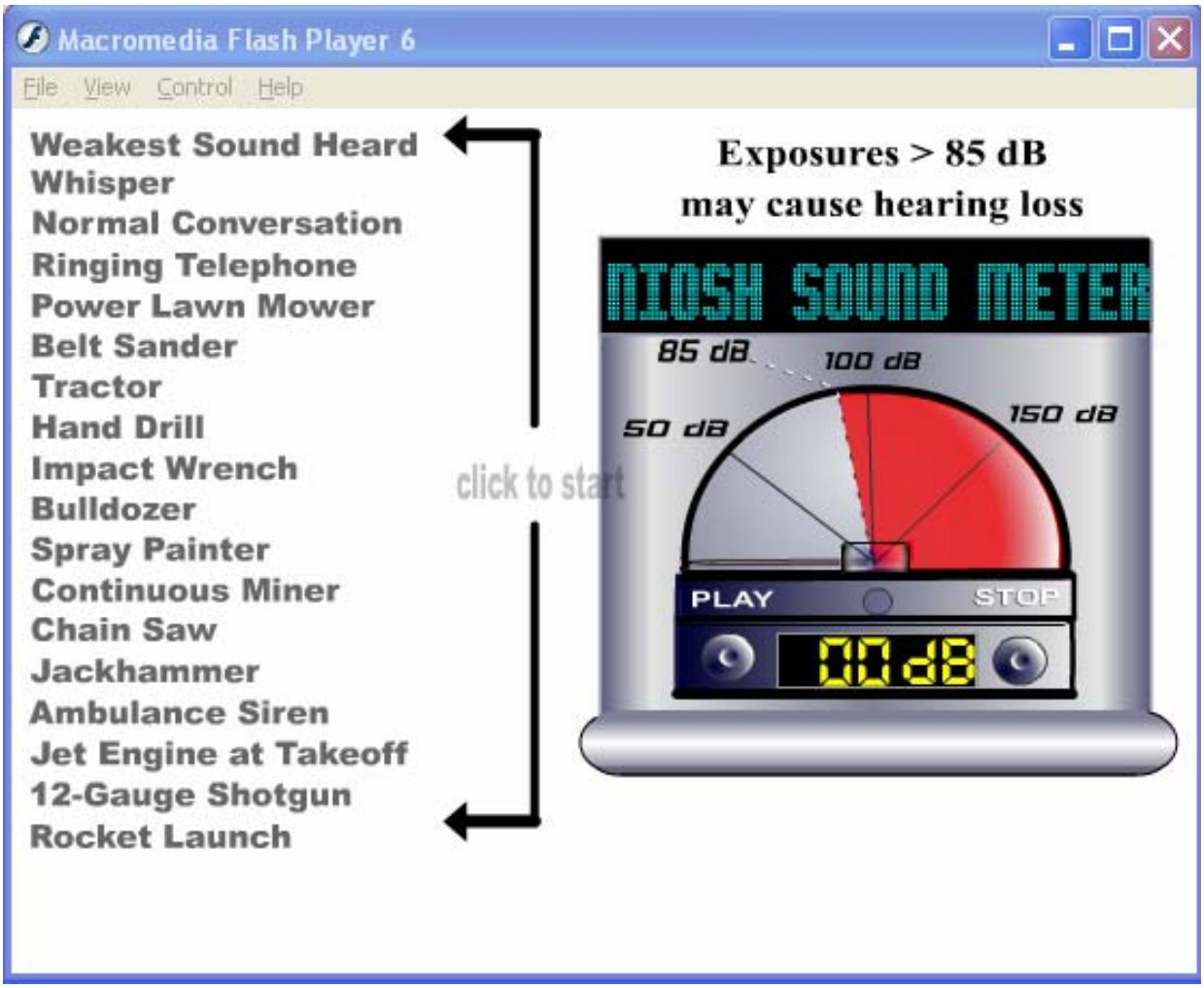
The PowerPoint® presentation allows the presenter to demonstrate, what sound is, what noise is, the working of the ear, how the ear is damaged and that noise induced damage is irreversible and totally isolates one from the world. The presentation also evaluates the various HPD styles available in the mining industry.

11.2. The NIOSH NIHL Simulator



The NIOSH Hearing Loss Simulator is a software training and communication tool for promoting hearing conservation. It allows a user or trainer to demonstrate the effects of noise exposure on hearing without experiencing an actual noise-induced hearing loss. Estimates of the effects of different levels of noise exposure are based on the American National Standard Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Impairment otherwise known as ANSI S3.44. This standard specifies the predicted hearing loss for noise-exposed populations of individuals on the basis of risk factors that include sex, age, exposure levels (in A-weighted decibels or dBA), and years of exposure.

11.3. The NIOSH Noise Meter



The NIOSH Noise Meter is a software training and communication tool for promoting hearing conservation. It allows a user or trainer to demonstrate to the trainees the different sounds and sound intensities of everyday objects.

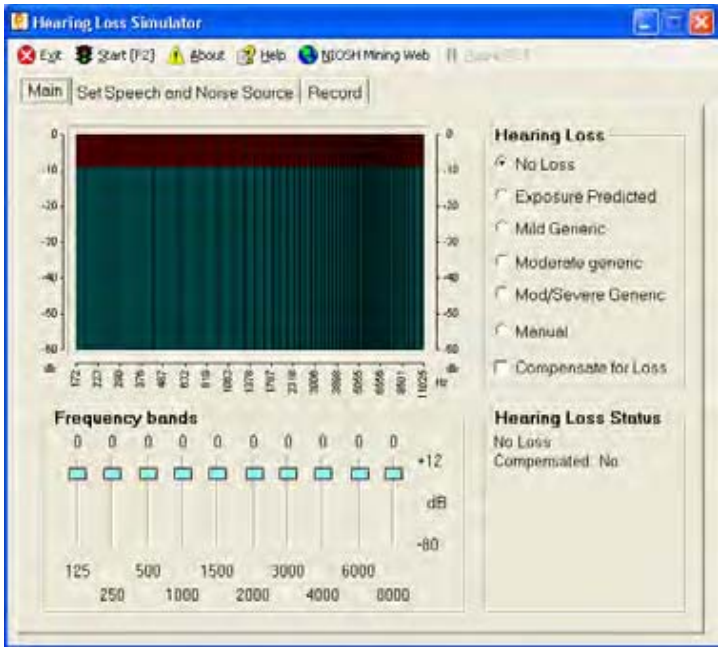
12. The NIOSH Hearing Loss Simulator – Guide to All Features

12.1. Installation:

Web: Download and run the simulator installation program from the NIOSH Web site: www.cdc.gov/niosh/mining/products/product47.htm Run the installer with administrator rights in Windows 2000, XP, or Vista. For both versions, follow the on-screen prompts. When complete, the program can be run from an icon in your Start menu or (optionally) on the desktop.

12.2. Main Screen

When the program is first started, this main screen showing the basic functions is displayed. From here you can use tabs below the menu bar to select other screens to change or record sounds played by the program. Adjust the volume on your computer so the spoken message is at a comfortable listening level that's audible to every listener. Then select Exposure Predicted from the Hearing Loss list.

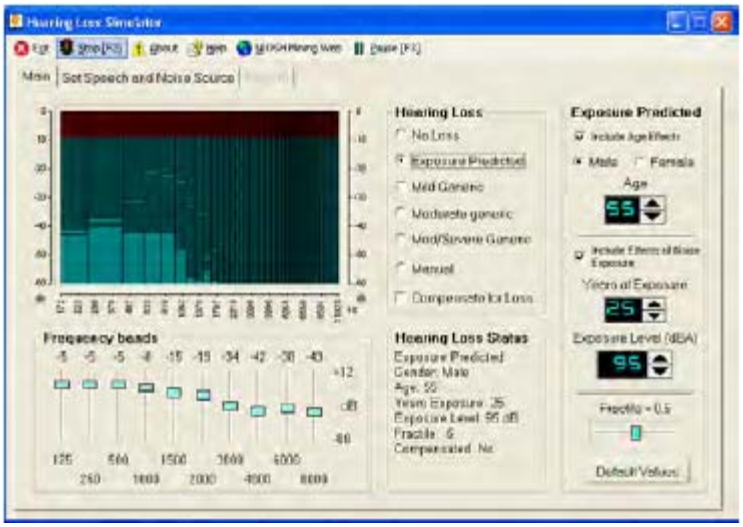


Quick start tip: Click Start [F2] on the top menu to start sounds playing.

12.3. Main Screen with Exposure

Selecting the Exposure Predicted option changes the main screen by adding controls to adjust the amount of noise exposure being simulated.

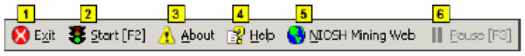
In the sample screen shown here, the default exposure settings have been selected, and sound playback has started.



12.4. Toolbar

Toolbar

The toolbar appears at the top of all screens.



1 **Exit** - Exits the program.

2 **Start/Stop Toggle** - Controls the playback of the speech and noise sources. The F2 key also performs this function.

3 **About** - Information about the Hearing Loss Simulator (version number, technical support, etc.).

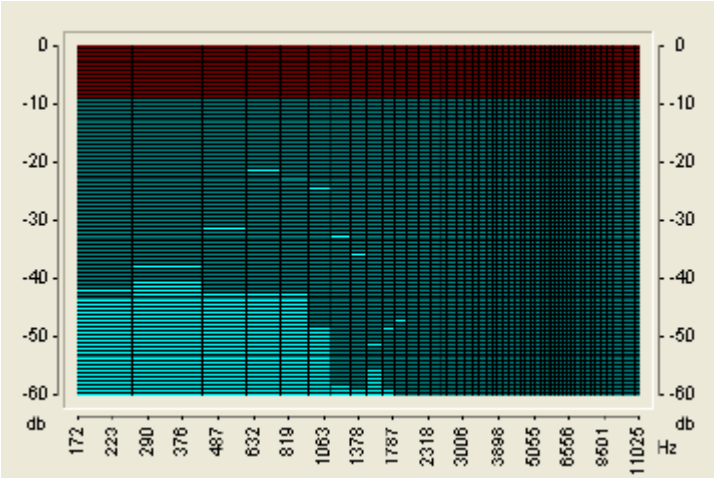
4 **Help** - Displays HLSim help, documentation, and sample scenarios.

5 **NIOSH Mining Web** - Opens the default browser to the NIOSH Mining Web site.

6 **Pause** - Pauses playback of the sound file. The F3 key also performs this function.

12.5. Graphical Display

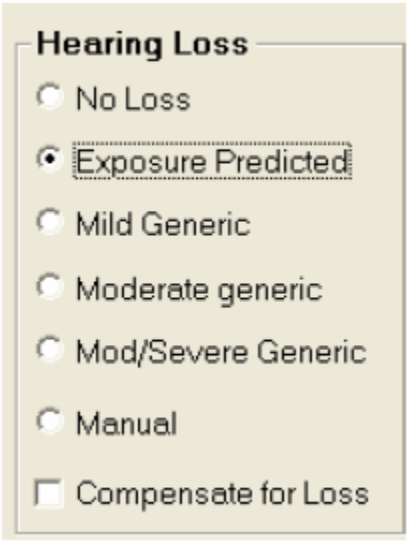
This graphical display shows current instantaneous levels of sound across the frequency spectrum. This is useful for showing the amounts of low- and high-frequency sound in the recording. For instance, for the female voice the high-frequency bars toward the right side of the graph will show higher peak levels than the male voice. The display also



demonstrates the loss of high-frequency information when a noise-induced hearing loss is simulated.

12.6. Hearing Loss choices

This panel is used to select how the program simulates a hearing loss.

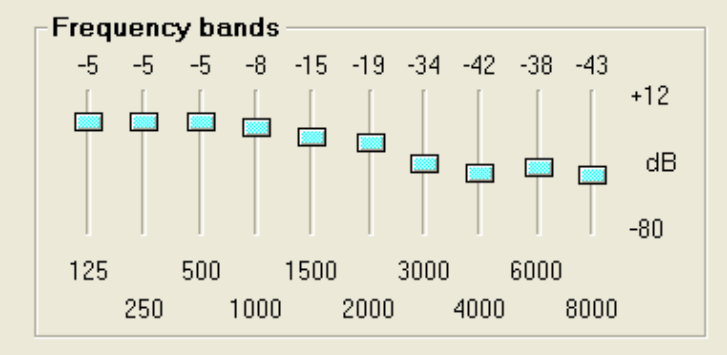


1. No Loss - Removes all hearing loss.
2. Exposure Predicted - High noise exposures cause much more hearing damage than lower exposures. This option applies the effect of different levels of noise exposure combined with age, gender, and other variables. When this option is selected, the main screen expands to show additional exposure controls.
3. Mild Generic - Applies a “mild” level of noise-induced hearing loss: 20 dB hearing level at 4000 Hz with surrounding frequencies impaired to a lesser extent.
4. Moderate Generic - Applies a “moderate” level of noise-induced hearing loss: 30 dB hearing level at 4000 Hz with surrounding frequencies impaired to a lesser extent.
5. Mod/Severe Generic - Applies a “moderate to severe” level of noise-induced hearing loss: 40 dB hearing level at 4000Hz with surrounding frequencies impaired to a lesser extent.
6. Manual - Activates the frequency band sliders so you can apply a hearing loss manually.
7. Compensate for Loss - Once a loss is simulated, it can be “compensated” for. This has the effect of boosting the sound by an amount equivalent to the loss. To an imperfect extent, the boosted playback can compensate for a hearing loss to give trainees an idea of what it would be like to regain their normal hearing.

   The limitations of any mechanical playback system and the complexity of the auditory system make it impossible to exactly reverse a hearing loss. Also, in cases of severe hearing loss, boosting the sound enough to compensate for a large deficiency and playing the resulting sounds through a high-power loudspeaker or headphone system could potentially generate very loud and unpleasant sound levels. In extreme cases, the levels could even become hazardous, so use this feature with caution — turn the volume down first and bring it up gradually.

12.7. Frequency Band Sliders

These 10 sliders control different frequency bands. When the program is simulating a predicted hearing loss, these sliders are automatically adjusted to reflect a predicted hearing level as a result of noise exposure.

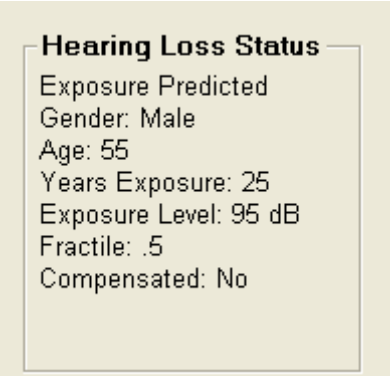


When you set the Hearing Loss to “Manual” you can manipulate the sliders directly. You might do this to enter the results of an actual audiogram. Then, others who have no hearing loss could, in effect, hear an approximation of the person’s hearing whose test results were entered. This is only an approximation. Individuals with sensory-neural hearing loss often have altered loudness perception and other subjective effects that are difficult to simulate accurately.

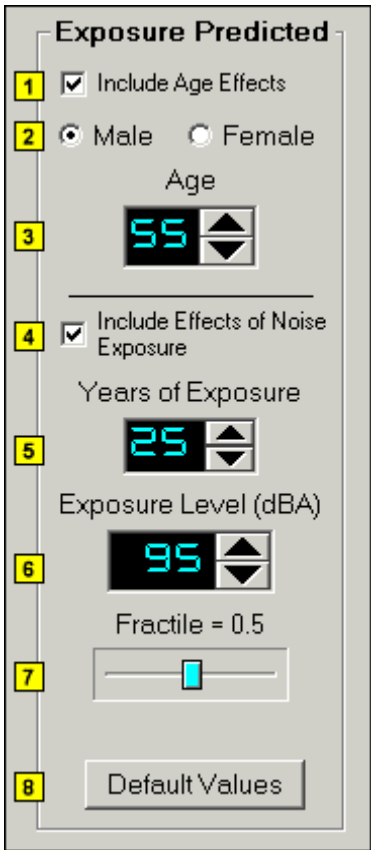
Also, since each slider can be manipulated independently, you can pinpoint the effects of hearing loss in each frequency band. For instance, a warning beeper may become much less audible as a result of a loss in a single frequency band.

12.8. Hearing Loss Status

This portion of the screen contains information about status of the Simulator, including current hearing loss settings.



12.9. Exposure Predicted Loss Parameters



1. Include Age Effects - When checked, the effects of age are included in the hearing loss calculation. This provides a convenient way to demonstrate the effect that noise alone has on hearing loss, apart from aging.
2. Gender - Males tend to have higher levels of hearing loss than females who have had the same noise exposure, so the program allows the user to specify the simulated worker's sex.
3. Age - Some hearing loss occurs as people age, but deafness or even a severe hearing loss is not inevitable. One of the major lessons to be learned from the Simulator is that aging usually causes much less hearing loss than does noise exposure. The simulated individual's age in years can be entered to show how older people tend to have a gradual loss in the high frequencies, i.e., an older worker who has not been exposed to loud noise will typically have worse hearing at 8000 Hz than at any lower frequency. On the other hand, a worker exposed to large amounts of noise will typically have a "notch" in their hearing sensitivity around 4000 Hz or 6000 Hz, and will have better hearing at 8000 Hz.
4. Include Effects of Noise Exposure - When checked, the effects of Years of Exposure, exposure level and fractile are included in the hearing loss calculation. This provides a convenient way to demonstrate the effect that age only has on hearing loss.
5. Years of Exposure - Time is the second major ingredient of exposure. This is set in years to represent a noisy period in the simulated individual's life. It can cover just a noisy portion of a career (e.g., 10 years of working in a mill) or multiple noisy periods. The years represent working days, not continuous exposure. This value should be kept to the 0–40 year range for Exposure Level (dBA) - As expected; high-intensity sound levels cause much more hearing damage than lower levels. The effect of different levels of noise can be simulated by entering the desired A-weighted sound level in decibels. The A-weighting scale is used for all the key sound pressure level measurement standards in the Mine Safety and Health Administration

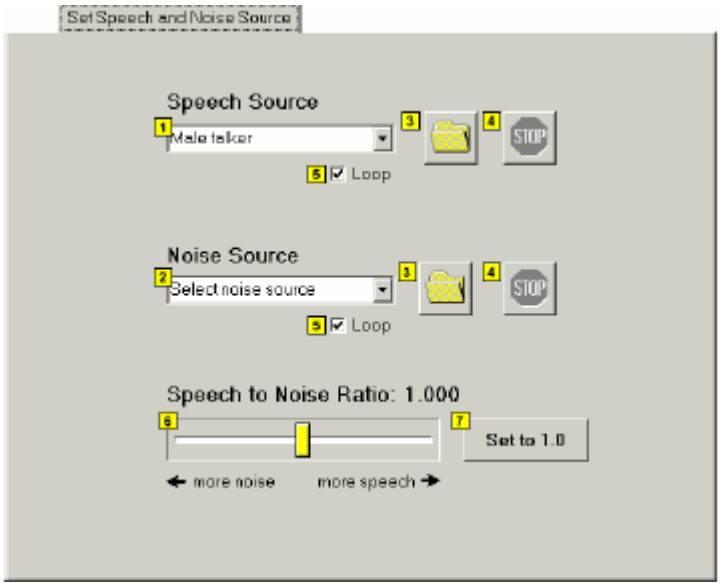
(MSHA) and Occupational Safety and Health Administration (OSHA) regulations, so it should be familiar to both trainers and trainees. This value should be kept to the 75–100 dBA range for predictions supported by the data behind the ANSI S3.44 standard. For simplicity, a single dBA number is set in the simulator, although employees may correctly point out that the sound levels they are exposed to vary considerably over time. Because of this, the dBA value should represent an estimate of the average predictions supported by the data behind the ANSI S3.44 standard.

6. Exposure Level (dBA) - As expected, high-intensity sound levels cause much more hearing damage than lower levels. The effect of different levels of noise can be simulated by entering the desired A-weighted sound level in decibels. The A-weighting scale is used for all the key sound pressure level measurement standards in the Mine Safety and Health Administration (MSHA) and Occupational Safety and Health Administration (OSHA) regulations, so it should be familiar to both trainers and trainees. This value should be kept to the 75–100 dBA range for predictions supported by the data behind the ANSI S3.44 standard. For simplicity, a single dBA number is set in the simulator, although employees may correctly point out that the sound levels they are exposed to vary considerably over time. Because of this, the dBA value should represent an estimate of the average exposure over the simulated time period, commonly referred to as the “time-weighted average” (TWA).
7. Fractile (population distribution) - Noise does not affect everyone to the same extent. To account for variations within the population, the ANSI S3.44 standard specifies expected hearing loss for different population fractiles. The program allows the user to specify the 0.1, 0.25, 0.5, 0.75, and 0.9 fractiles. For instance, a worker at the 0.1 fractile would have more hearing loss than 90% of the equally exposed population. Those at the 0.75 fractile would have more hearing loss than just 25% of the population. By changing this control to the low (0.1 or 0.25) settings, a trainer can show that lower exposure levels can still be dangerous for some workers, even if they are relatively “safe” for the average worker. Since most workers do not have a way of knowing their individual susceptibility, this allows them to err on the side of caution.
8. Default Values - Sets all the exposure predicted variables to their default values.

12.10. Set Speech and Noise Source

This screen is reached by selecting the tab for "Set Speech and Noise Source." You can return to the main screen at any time by selecting the "Main" tab.

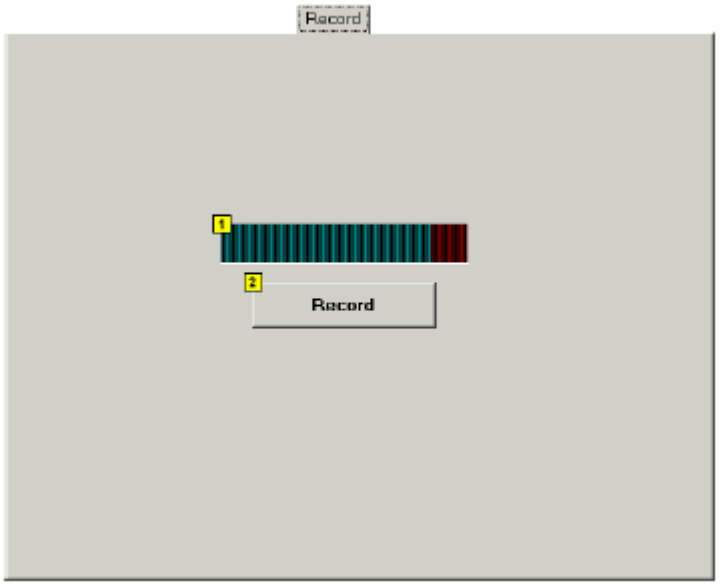
1. Speech Source (foreground sound) - Human speech is provided as both the most complex and important foreground sound most workers need to perceive. You can choose either a male or female voice recording from the dropdown list.



2. Noise Source (background sound) - Background sounds often severely tax a listener's ability to hear and/or comprehend the intended message. The simulator allows the choice of several types of background sounds, including some recorded worksite sounds (continuous miner, haulage machine, drill) and some more generic standard background noises (male or female "speech babble," white noise, etc.).
3. Browse for a Sound File - Select a Windows WAV file for playback in place of one of the sounds in the dropdown list.
4. Stop Playback - Stop the playback of the sound file.
5. Loop - Makes the sound repeat indefinitely.
6. Speech to Noise Ratio - The Speech to Noise Ratio control affects the loudness of the background noise source relative to the foreground sound. Use this to demonstrate how increasing background noise interferes more with understanding the foreground speech recording.
7. Set to 1.0 - Resets the Speech to Noise Ratio to the default value of 1.0.

12.11. Record Screen

This screen is reached by selecting the “Record” tab. You can return to the main screen at any time by selecting the “Main” tab.



1. Recording Level - Displays the input sound level while making a recording. Adjust the computer’s input controls so that the loudest peak levels stay below the red area to the right.
2. Record - Click this button to start recording a standard Windows WAV sound file for use as either foreground or background source.

   This can be used to record a different foreground voice message customized for trainees or to record a special machine or warning signal that’s common at the trainees’ worksite.

The program will ask for a file name before saving the recording. This feature requires a microphone or other sound source attached to the PC sound input.

13. The NIOSH Hearing Loss Simulator Training Scenario

The NIHL simulator includes various devices used to convey the impact of NIHL as discussed in the sub-sections below.

13.1. Instructive scenarios

The full power of the simulator is shown by working through some instructive scenarios. Some of the scenarios suggested are:

a. Older worker, noise exposed – A hypothetical older worker is described. The program can simulate the range of 55 to 65 years old with 35 to 45 years of exposure to 90-100 dBA.

Selection of numbers in these ranges can depend on what is typical in the user's workplace or industry. The trainer can demonstrate the significant hearing loss this worker will have going into retirement.

b. Older worker, no exposure – Immediately following a demonstration about a hypothetical noise-exposed older worker, the trainer can set the exposure years to zero and simulate an equivalent worker with no exposure. This will serve to counter any assumption that the first worker's hearing loss was a natural consequence of aging. Instead, users will see that a relatively small amount of high frequency loss is expected in older workers, but that noise exposure is responsible for much more of the damage.

c. Mid-career worker – Especially if there are a large number of mid-career trainees, a worker with 10 to 20 years of exposure may be simulated. On the basis of this worker, several progressions can be followed. For instance, additional exposure years can be added to show the accumulation of more hearing loss. The noise simulator also allows comparison with an older non-noise-exposed worker, which then allows the trainer to make the point that, with enough exposure, a 30-year-old worker may have, in effect, 50-year-old ears.

d. Individualised – The simulator can also be used as an individualised training and counselling tool. The trainer can show a worker how his/her hearing test results can be entered directly into the simulator. Using the frequency band sliders and selecting the "invert loss" function, the trainee can be given a hint of what his/her hearing would be like if the hearing loss had been avoided. Switching back to the original loss profile, the trainer can then drag the sliders down to show the additional loss that would occur after further noise exposure.

Another useful aspect of the simulator is the graphical display that shows the current instantaneous levels of sound across the frequency spectrum. This shows the relative amounts of low- and high-frequency sound in the recording; for example, for the female voice the high-frequency bars toward the right side of the graph will show higher peak levels than for the male voice. The display also demonstrates the loss of high-frequency information when a noise-induced hearing loss is simulated. This may not be relevant for all levels of education nor for all workplace requirements and would need to be included only when necessary.

13.2. Predicted loss on the basis of exposure

Prediction of hearing loss is based on the ANSI S3.44 standard. Parameters used in the prediction include

e. Effects of age – Some hearing loss occurs as people age, but deafness or even a severe hearing loss is not inevitable. One of the major lessons to be learned from the simulator is that aging usually causes much less hearing loss than does noise exposure. The simulated individual's age in years can be entered to show how older people tend to have a gradual loss in the high frequencies, i.e. an older worker who has not been exposed to loud noise will typically have worse hearing at 8000 Hz than at any lower frequency.
f. Gender – Males tend to have higher levels of hearing loss than females who have had the same noise exposure, so the program allows the user to specify the simulated worker's sex.
g. Years of exposure – Time is the second major ingredient of exposure. This is set in years to represent a noisy period in the simulated individual's life. It can cover just a noisy portion of a career (e.g. ten years of working in a mill) or multiple noisy periods. The years represent working days, not continuous exposure.
h. Exposure level (dBA) – As expected, high-intensity sound levels cause much more hearing damage than lower levels. The effect of different levels of noise can be simulated by entering the desired A-weighted sound level in decibels. The value represents an estimate of the average exposure over the simulated time period, commonly referred to as the "time-weighted average" (abbreviated as TWA).
i. Fractile (population distribution) – Noise does not affect everyone to the same extent. To account for variations within the population, the ANSI S3.44 standard specifies expected hearing loss for different population fractiles. The program allows the user to specify the 0.1, 0.25, 0.5, 0.75 and 0.9 fractiles. For instance, a worker at the 0.1 fractile would have more hearing loss than 90 per cent of the equally exposed population. Those at the 0.75 fractile would have more hearing loss than just 25 per cent of the population. Most workers will have no way of knowing their susceptibility to noise, so this control should usually be set on the expected population median of 0.5.

13.3. Predictive impact on the basis of the listening environment

A "Speech and Noise Source" screen in the simulator takes into account the following aspects that will influence the impact of the hearing loss on the person's quality of life:

a. Speech Source (foreground sound) – Human speech is provided as both the most complex and important foreground sound most workers need to perceive. The trainer can choose either a male or female voice recording from the dropdown list.

b. Noise Source (background sound) – Background sounds often severely tax a listener's ability to hear and/or comprehend the intended message. The simulator allows the choice of several types of background sounds, including some recorded worksite sounds (continuous miner, haulage machine, drill) and some more generic standard background noises (male or female "speech babble", white noise, etc.).
c. Speech-to-Noise Ratio – The speech-to-noise ratio control affects the loudness of the background noise source relative to the foreground sound. This can be used to demonstrate how increasing background noise interferes more with understanding the foreground speech recording.