

## HOW TO USE MACSUG IN OCCUPATIONAL HEARING CONSERVATIONIST COURSES

The Manual Audiometer Computer Simulator User Gizmo (MACSUG) training software<sup>1</sup> is an educational resource that can be used to simulate and illustrate techniques and principles of manual audiometry and audiogram review. The Council for Accreditation in Occupational Hearing Conservation (CAOHC) has reviewed this software and found MACSUG to be a useful tool for use by Course Directors (CDs) of CAOHC-approved Occupational Hearing Conservationist (OHC) courses. This document offers a summary of some of the ways that a CD might use MACSUG to expand the scope and quality of training provided in a CAOHC-approved OHC course.

**SUMMARY** MACSUG simulates generic screen displays of a typical microprocessor audiometer. Using MACSUG, a computer and a computer-projection system, CDs can demonstrate the process of manual pure-tone audiometric testing to more than one student at a time. Using MACSUG and a computer, students may refine their newly-learned basic audiometric techniques or (with techniques described below) improve their skills while “testing” simulated cases that are more challenging. MACSUG may also be used to teach concepts of audiogram review, concepts of hearing threshold shifts (with and without age corrections), and when retests or further review are needed.

When the executable application software for MACSUG has been downloaded<sup>2</sup>, a comprehensive set of instructions will be found in its HELP file. The list of ideas given here are specific recommendations, provided by CAOHC, to offer CDs some possible uses for MACSUG in effective and innovative CD training. These uses include:

1. **BASIC AUDIOMETRIC TECHNIQUE**. Effective and clear instruction of manual audiometric techniques is critically important in OHC courses, since OHCs must learn manual testing techniques, even if their worksite relies on microprocessor audiometers. For example, employees who have tinnitus often have difficulty with the audiometry process, so the OHC should be capable of performing manual audiometry, in order to get the employee through the testing process. The MACSUG may be a functional tool for the instructor in “Audiometric Techniques”, “Audiometric Practicum” and “Review of Audiometric Evaluation” blocks of instruction of an OHC training course. For example, the instructor can use MACSUG to:

- a. Teach the fundamentals of ascending-descending audiometry technique to find hearing thresholds. (Students can see the projected screen display and visualize the process of choosing stimulus frequencies and intensity levels, the ear to be tested, and when to “accept” a response as valid.)

<sup>1</sup> MACSUG was developed and produced by NASA Glenn Research Center Acoustical Testing Laboratory, in collaboration with the NASA Johnson Space Center’s Audiology and Hearing Conservation Clinic.

<sup>2</sup> For more information and a free copy of the MACSUG software, see <http://acousticaltest.grc.nasa.gov>. (Hearing Conservation > Resources).

b. Teach the decision-making processes involved in selection of hearing threshold when performing the ascending-descending technique. (The use of MACSUG’s “tally” option can help students initially track responses to ascending and descending presentation levels, and then determine when to choose a “hearing threshold” after confirmation of correct responses on ascending sweeps.)

c. Reinforce concepts taught in lectures (e.g., frequency and intensity levels learned in “Physics of Sound”; baseline/periodic and termination audiograms discussed in “The Audiogram”, and audiometric data taught in “Recordkeeping”). MACSUG displays easy-to-see visualizations of concepts like determination of Standard Threshold Shifts, with- and without- age corrections.

d. Teach the concept of reliability when retesting 1000 Hz. (MACSUG displays an error message if the thresholds recorded in this retest differ from the initial test by more than 10 dB.)

2. **“PAPER PATIENT” TECHNIQUE.** Most students in an OHC course usually have relatively normal hearing sensitivity, so the experience provided when testing these students in an OHC course’s audiometric practicum may not realistically represent the challenge of testing people with hearing loss (more typical of workers in occupational hearing conservation programs). Using MACSUG’s versatility, CDs can expand the variety of hearing losses seen by OHC students, using “paper patients” (that is, simulated mock patients, with common hearing losses). This use of MACSUG, during the “Audiometric Practicum” and “Review of Audiometric Evaluation” blocks of instruction, can also challenge students who become bored by seeing only “normal” audiograms during the practicum. One suggested method of using the “paper patient” technique is as follows:

a.. One student is provided an audiogram (e.g., showing substantial hearing loss) and acts as the *paper patient*.

b. The other student in the team will act as the *examiner* and operates the MACSUG controls (as if it were an actual audiometer).

c. The *examiner* will use the MACSUG to seek audiometric thresholds of the *paper patient*, using the appropriate ascending-descending technique. The *paper patient* will actively observe the *examiner’s* use of MACSUG and respond (e.g., raising a finger) to the stimuli presentations, when appropriate, in accordance with the thresholds found on the audiogram provided.

d. This process engages the active attention of both students, who can help each other (or challenge each other, if necessary) in the process of determining thresholds. For example, the *paper patient* might respond inconsistently near “threshold”, as would be the case if a real patient wasn’t sure if the tone was present. Rather than just WATCHING someone conduct a test or just LISTENING to tones, the second person (when acting as the *paper patient*) must stay alert and attentive, to recognize when threshold-determination criteria can be applied (or when an error has been made).

3. **AUDIOGRAM REVIEW** MACSUG may also be used to review concepts of Standard Threshold Shift (STS), OSHA-reportable hearing loss, and use of age

corrections during “The Audiogram and Employee Follow-Up” and “Review of Audiometric Evaluation” blocks of instruction. MACSUG includes a collection of examples of **audiogram (.agm) files** (representing a single ear, which can be opened and used as data for either the left or right ear) and **case (.mcf) files** (which contain data for both ears) that may be opened from within the program. The CD can also modify those files to make new audiogram or case files. These audiometric configurations may be used to illustrate principles typically considered during classroom instruction, self-study, and practicum sessions. For example, such audiometric configurations might be used as baseline or current audiograms, to illustrate the following descriptions (and *audiograms* or *cases* found pre-loaded in MACSUG’s files):

- a. Effect of excessive background noise on audiometric thresholds:  
**Audiograms**> [there are many examples, labeled: “MILDLOW...”]
- b. Noise-induced hearing loss (of any degree)
  - 1) **Audiograms**> [there are many examples, labeled: “MILDNOTCH...”, “MODNOTCH...” and “SEVNOTCH...”]
  - 2) **Cases**> “NIHL\_but NO STS.mcf”, “CASE 2.mcf”, and “OSHA\_REC\_BSLN\_LOSS.mcf”
- c. Results that might be a “shadow” of opposite ear:  
**Audiograms**> [combine one of the “WNL...” audiograms with”FLAT1; flat\_config;possible\_malingerer,PTA=50.agm” or “FLAT1;flat\_config;possible\_malingerer,PTA=61.7.agm” ]
- d. Low-frequency conductive hearing loss  
**Audiograms**> [there are many examples, labeled: “MILDLOW...”]
- e. Malingering
  - 1) **Cases**> “NO\_RESPONSE.mcf” and “INVALID\_AUD1.mcf”
  - 2) **Audiograms**>”FLAT1;flat\_config;possible\_malingerer,PTA=50.agm” or “FLAT1;flat\_config;possible\_malingerer,PTA=61.7.agm”
- f. Current audiogram results are “much better” than baseline  
**Cases**> IMPRV.mcf
- g. Severe hearing loss, exceeds maximum output range of audiometer  
**Audiograms**> [several examples, labeled: “NR...”]
- h. Questionable audiometric results
  - 1) Lack of data, audiometric thresholds not recorded
    - i. NO\_DATA1.mcf (no data, 3000 and 6000 Hz)
    - ii. NO\_DATA2.mcf (no data, 4000 Hz)
  - 2) Audiometric results questionable
    - i. Audiograms>INVALIDAUD1;config\_suggests\_testing\_errorsPTA=25.agm
  - 3) Audiometric results questionable (ALL zeroes? Was a test actually done, or did someone simply write in a zero because “that’s what someone with normal hearing should have” (sometimes called “gun-decking” because all the zeroes look like portholes for guns on a Navy ship)
    - i. Audiograms>GUN\_DECK\_zero.agm