Guidelines for Manual Pure-Tone Threshold Audiometry was approved by the ASHA Legislative Council in November 1977. The following members of the ASHA Committee on Audiometric Evaluation developed these guidelines: Vincent Byers, Joseph B. Chaiklin, James T. Graham, Norma T. Hopkinson, Z. G. Schoney, Francis L. Sonday, and Wesley R. Wilson, Chairman. ASHA encourages the professional community to use these guidelines.

This set of Guidelines for Manual Pure-Tone Threshold Audiometry is the third of a series developed by the Committee on Audiometric Evaluation, under the office of Vice President for Clinical Affairs of the American Speech and Hearing Association (ASHA). The first in the series was the Guidelines for Audiometric Symbols (1974), adopted by ASHA in December 1973. The second was the Guidelines for Identification Audiometry (1975), adopted by the Association in November 1974.

Each of the guidelines presents a recommended set of procedures based on existing practice and research findings. The spirit of these guidelines is not to mandate a single way of accomplishing a clinical process; rather, they suggest standard procedures that, in the final analysis, will benefit the persons we serve. The intention is to improve interclinician and interclinic comparison of data, thereby allowing for a more effective transfer of information.

The ASHA Guidelines for Manual Pure-Tone Threshold Audiometry presents procedures for accomplishing hearing threshold measurement with pure tones that are applicable in a wide variety of settings. Diagnostic pure-tone threshold audiometry, used most often in clinical settings, includes manual air-conduction measurements at octave intervals from 250 Hz (125 Hz under some circumstances) through 8000 Hz plus bone-conduction measurements at octave intervals from 250 Hz through 4000 Hz as needed. When required, masking is used. Monitoring pure-tone threshold audiometry, used most often in industrial settings, includes manual air-conduction measurements at the frequencies of 500, 1000, 2000, 3000, 4000, and 6000 or 8000 Hz.

Scope

Pure-tone threshold audiometry is the measurement of an individual’s hearing sensitivity for calibrated pure tones. Two general methods are employed: (1) manual audiometry, also referred to as conventional pure-tone audiometry; and (2) discrete-frequency or sweep-frequency testing by automatic audiometry, referred to as Bekesy-type audiometry. The guidelines presented in this document relate only to manual pure-tone audiometry.

The historical antecedents of pure-tone audiometry were the classical tuning fork tests. The development of the audiometer made it possible to control signal intensity and duration in ways that were not possible with tuning forks. One cannot assume, however, that calibrated equipment insures that valid measurements are always obtained. Differences among measurement methods may affect validity and reliability in significant ways as pointed out by a number of authors (Hughson & Westlake, 1944; Reger, 1950; Watson & Tolan, 1949; Hirsh, 1952; Carhart & Jerger, 1959; Price, 1971; Newby, 1972).

These guidelines present a standard set of procedures that will minimize interest differences. These guidelines represent a consensus of recommendations found in the literature, with particular emphasis on the suggestions of Carhart and Jerger (1959) and Reger (1950). The American Speech and Hearing Association does not intend to imply that only one method is correct; variations in procedure may be demanded by
special clinical problems. For example, special populations such as very young children, severely mentally retarded persons, severely hearing-impaired persons, uncooperative persons, or neurologically handicapped persons may require modifications of the guideline procedures if the audiologist is to develop sufficient information for case management. When variations in procedure are necessary, they should be noted in a manner that allows other testers to understand how thresholds were obtained. The pure-tone guidelines are presented in three sections: (1) determination of pure-tone thresholds, (2) standard procedures for monitoring and diagnostic air-conduction measures, and (3) standard procedures for bone-conduction measures.

Determination of Pure-Tone Thresholds

Some of the factors that influence the manual assessment of pure-tone thresholds are (1) the instructions to the individual, (2) the response task required of the individual, and (3) the examiner’s interpretation of the individual’s response behavior during the test.

Instructions. The instructions shall be phrased in language appropriate to the listener and shall indicate:

1. the response task;
2. that the person is to respond whenever the tone is heard, no matter how faint it may be;
3. the need to respond as soon as the tone comes on and to stop responding immediately when the tone goes off;
4. that each ear is to be tested separately.

Response Task. Overt responses are required from the listener to indicate when the tone goes on and off. Any response task meeting this criterion is acceptable. Examples of commonly used responses are (1) raising and lowering the finger, hand, or arm and (2) pressing and releasing a signal light switch.

Interpretation of Response Behavior. The primary parameters used by the tester in determining threshold are latency of response, presence of on- and off-responses and number of false responses.

1. The latency of the on-responses should be consistent. If the first response to a tone in an ascending series is slow, present a 5-dB higher tone and the response should be without hesitation.
2. Each suprathreshold presentation should elicit two responses: an on-response at the start and an off-response at the end of the tone. Listeners who are unable to signal correctly the termination of the tone, following proper instruction and reinstruction, may be demonstrating auditory problems and be in need of more detailed testing.
3. False responses may be of two types: (1) a response when no tone is present (false-positive), or (2) failure to respond when a tone that is audible to the listener is present (false-negative). Either type complicates the measurement procedure. Reinstruction may reduce the rate of either type. The rate of false-positive responses may also be reduced by such techniques as varying the time between audible tones, pulsing or warbling of the signal, or using pulse-counting procedures.

Determination of Threshold

The basic procedure for threshold determination consists of (1) familiarization with signal and (2) threshold measurement. The procedure is the same regardless of frequency, output transducer, or ear under test.

Familiarization. The listener should be familiarized with the task prior to threshold determination by presenting a signal of sufficient intensity to evoke a sharp and clear response. The step of familiarization assures the examiner that the listener understands and can perform the response task. The following two methods of familiarization are commonly used:

1. Beginning with the tone continuously on but completely attenuated, gradually increase the sound-pressure level of the tone until a response occurs.
2. Present the tone at a hearing level of 30 dB. If a clear response occurs, begin threshold measurement. If no response occurs, present the tone at 50 dB Hz and at successive additional increments of 10 dB until a response is obtained.

Neither method requires the tester to make a prior assumption about the listener’s threshold, in contrast with some methods in common use. The American Speech and Hearing Association recommends a method not requiring such an assumption.

Threshold Measurement. The method described is recommended as a standard procedure for manual pure-tone threshold audiometry.

1. Tone Duration. Threshold exploration is carried out by presenting continuous tones of 1-2 sec in duration.
2. Interval Between Tones. The interval between tone presentations shall be varied but not shorter than the test tone.
3. **Level of First Presentation.** The level of the first presentation of tone for threshold measurement is 10 dB below the level of the listener’s response to the familiarization presentation.

4. **Levels of Succeeding Presentations.** The tone level of succeeding presentations is determined by the preceding response. After each failure to respond to a signal, the level is increased in 5-dB steps until the first response occurs. After the response, the intensity is decreased 10 dB and another ascending series is begun. (Note: An exception is as explained previously under Interpretation of Response Behavior—Latency.)

5. **Threshold of Hearing.** Threshold is defined arbitrarily as the lowest level at which responses occur in at least half of a series of ascending trials with a minimum of three responses required at a single level.

   When variations in the standard method are used, the audiogram form shall indicate the nature of the variation. Examples of variation to be noted are:
   
   1. Threshold determined by descending presentations method,
   2. “Pulsed tone substituted,” and
   3. “Warbled tone substituted.”

### Standard Procedures for Monitoring and Diagnostic Air-Conduction Measures

**Instrumentation and Calibration.** Air-conduction audiometry shall be accomplished with an audiometer and earphones that meet the specifications of the American National Standard Specifications for Audiometers S3.6-1969, and appropriate to the technique being used: monitoring or diagnostic.

**Test Environment.** The test environment shall meet the specifications for allowable ambient noise detailed in *The American National Standard Criteria for Permissible Ambient Noise During Audiometric Testing* S3.1-1977. When the ambient noise exceeds the allowable value for a specific frequency, the threshold for that frequency may be recorded if the obtained threshold exceeds by 10 dB the difference between the ambient noise level and the allowable ambient level.

   In the interest of listener and examiner comfort, the test room and examiner’s work area should provide for proper control of temperature, air exchange, and humidity. In the interest of listener and examiner safety, sound-isolated areas must be provided with either or both visual and auditory warning systems. These warning systems should be connected to the building warning system (fire, civil defense).

**Earphone Placement.** The ear canal should be checked for blockage by cerumen or for collapse of canal without or with earphones. The earphones should be held in place by a headband with the earphone grid directly over the entrance to the ear canal. The earphones should be placed by the tester, not the listener. Long hair and other obstacles should be clear of the space under the earphone.

**Frequency.** The frequencies tested differ, depending on the technique used.

1. **Monitoring Technique.** Threshold assessment shall be made at 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, and 6000 or 8000 Hz.

2. **Diagnostic Technique.** Threshold assessment shall be made at octave intervals of 250 Hz to 8000 Hz, except when a low frequency hearing loss exists, in which case threshold shall be assessed at 125 Hz, as well. When the difference between the values at any two adjacent octave frequencies from 500 Hz to 8000 Hz is 20 dB or more, intraoctave measurements should be completed.

**Order.** When appropriate information is available, the better ear should be tested first. The initial test frequency should be 1000 Hz, and then either higher or lower frequencies shall be assessed sequentially followed by a retest of 1000 Hz and the remaining frequencies. Selection of 1000 Hz as the initial test frequency rests largely on past convention rather than on substantial research evidence. Until evidence is developed in support of a different initial frequency, no persuasive reason exists to change past convention except for special populations (for example, severely hearing impaired) that may require a different initial frequency.

**Masking for Diagnostic Audiometry.** When the air-conduction threshold obtained in one ear exceeds the apparent bone-conduction threshold in the contralateral ear by 40 dB or more, appropriate masking shall be applied to the non-test ear. Since the procedures for masking are not confined to pure-tone measures, these procedures are not discussed in this set of guidelines.

**Recording of Results.** Results may be recorded in graphic or tabular form or both. Separate forms to represent each ear may be used.

1. **Audiogram Form.** When the graphic form is used, the audiogram shall be on cross-section paper, with the abscissas being frequencies on a logarithmic scale and the ordinates being hearing levels in decibels on a linear scale. It is recommended that one octave on the frequency scale be linearly equivalent to 20 dB on the hearing level scale. The vertical scale is to be desig-
nated hearing level (Decibels); the horizontal scale is to be labeled Frequency in Hz.

2. **Audiogram Symbols.** When the graphic form is used, the symbols presented in ASHA’s *Guidelines for Audiometric Symbols* (1974) should be used (see Figure 1 for sample).

Other pertinent information describing the test situation should be reported on the audiogram or test results form.

---

**Standard Procedures for Bone-Conduction Measures**

*Instrumentation and Calibration.* The testing should be accomplished with a wide-range audiometer as defined by ANSI specification S3.6-1969. The bone-conduction vibrator is to be calibrated to the Interim-Threshold Calibration Values (Appendix A, Table A4) of the American National Standard Specifications for Artificial Head-Bone for the Calibration of Audiometer Bone Vibrators S3.13-1972 and should incorporate the appropriate calibration for either frontal or mastoid placement. (Note: In addition to this standard, one may use comparison values for other artificial mastoids [Wilber, 1972]).

Standard bone-conduction vibrator placement should allow mastoid or forehead placement. The test ear should never be covered for standard bone-conduction measurements. The contralateral ear will be covered when masking is being used. The tester is to place the transducer(s), not the listener.

**Frequencies.** Thresholds should be obtained at octave intervals of 251 Hz to 4000 Hz. Testing at frequencies below 500 Hz demands excellent sound isolation for cases with normal or near normal sensitivity, but may be accomplished when such an environment is available.

**Order.** The initial frequency tested shall be 1000 Hz and then either higher or lower frequencies shall be tested sequentially followed by the remaining frequencies.

**Masking.** If the unmasked bone-conduction threshold is 10 dB better than either air-conduction threshold at the frequency, masking must be used. Since the threshold values on which the calibration of bone vibrators is based were measured with masking noise in the contralateral ear, the tester may prefer always to use masking in the testing procedure.

**Recording of Results.** Results may be recorded in graphic or tabular form. A standard set of symbols has been delineated in *Guidelines for Audiometric Symbols* (1974) and is to be used with the graphic form (audiogram). See Figure 1 for an example of recommended bone-conduction symbols.

---

**Figure 1.** Sample audiogram form with symbols.
Conclusions

The guidelines for manual pure-tone threshold audiometry are:

1. Instructions. Indicate response task in language appropriate for the listener.
2. Response Task. Use any overt response signaling both tone on and tone off.
3. Determination of Threshold:
   A. Familiarization is accomplished by presentation of a signal at suprathreshold level.
   B. Threshold exploration involves ascending presentations of short-duration tones with level based on response to preceding presentation. After each failure to respond, the level is raised 5 dB until a positive response is obtained. After a response, the intensity is decreased 10 dB and another ascending series initiated.
   C. Threshold is defined as the lowest level at which responses occur in at least half of the ascents with a minimal of three responses required at a single level.
4. Frequencies:
   A. Monitoring audiometry includes air-conduction thresholds at the frequencies of 500, 1000, 2000, 4000, and 6000, or 8000 Hz.
   B. Diagnostic audiometric includes both air-conduction and bone-conduction thresholds.
      i. Air-conduction threshold is measured at the octave intervals of 250 Hz to 8000 Hz (plus 125 Hz in the case of low frequency hearing impairment) and at intraoctave intervals of any two successive octaves between 500 and 8000 Hz that differ by 20 dB or more.
      ii. Bone-conduction threshold is measured at the octave intervals of 250 Hz to 4000 Hz.
5. Instrumentation and Calibration. Audiometers are to be maintained to the current ANSI specifications.*

References


* Note: When the following guidelines and standards referred to in this document are superseded by an approved revision, the revision shall apply:
1. American Speech and Hearing Association Guidelines for Audiometric Symbols (1974);
2. American National Standard Specifications for Audiometers S3.6-1969 (R 1973);
3. American National Standard Specifications for Artificial Head-Bone for the Calibration of Audiometer Bone Vibrators S3.13-1972; and