

Protocol Category:	Protocol Title:	Protocol #:
Clinical	Clinical Masking for Audiometric Testing in Adults	PROT-QA-03
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## DEFINITIONS

**“Inter-aural attenuation (IA)”** means the reduction in intensity of sound presented to the one ear before it reaches the other ear.

**“Masking”** means the process by which the threshold of hearing for one sound is raised by the presence of another (masking) sound (American National Standards Institute [ANSI] as cited in Yacullo, 2000).

**“Minimum masking level”** means “the minimum level of noise that is needed in the non-test ear to eliminate its response to the test signal” Yacullo (2000, p. 97).

**“Maximum masking level”** means “the maximum level of noise that can be used in the non-test ear that can be used that will not change the true threshold or response in the test ear” Yacullo (2000, p. 98).

**“Occlusion effect” (in clinical testing, when masking for bone conduction)** means the effect created inadvertently when placing an earphone over or inserted into the non-test ear” Vento & Durrant, 2009, p. 55). During vocalization, bone-conducted energy results in vibration of the mandible and soft tissue located in close proximity to the external canal. This in turn causes vibration of the canal's cartilaginous walls, producing energy that is subsequently transferred to the volume of air within the canal. When the ear canal is occluded, much of this energy is trapped, causing an increase in the sound pressure level delivered to the tympanic membrane and, ultimately, to the cochlea (MacKenzie, 2006).

**“Overmasking”** occurs when “even with contralateral masking, the true threshold or response in the test ear has been changed” Yacullo (2000, p. 99).

**“Threshold”** means the minimum hearing level for detection of pure tone or speech stimuli at which an individual can just discern the presence of the stimuli 50% of the time (American Speech-Language-Hearing Association, 2014).

**“Undermasking”** occurs when, even with contralateral masking, the test signal continues to be perceived in the non-test ear (Yacullo, 2000, p. 93-95).

**“Vibrotactile threshold” (for mastoid location of the bone vibrator)**, may be as low as 25 dB at 250 Hz, 55 dB at 500 Hz, and 70 dB at 1000 Hz (Boothroyd & Cawkwell, 1970), although large variations may occur. Care must be taken not to misinterpret vibrotactile perceptions as hearing (British Society of Audiology, 2018).

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## PURPOSE

Part 2.1 of the Valente (2006) guidelines, *Auditory Assessment and Diagnosis*, indicate that the objective of the auditory assessment is to diagnose the type and magnitude of hearing loss and the need for treatment, including candidacy for amplification.

## SCOPE

All Registered Audiologists (RAUD), Registered Hearing Instrument Practitioners (RHIP), and dually registered RAUD, RHIP.

## BACKGROUND

To properly assess the type and magnitude of hearing loss, proper masking techniques may be required. Martin, Armstrong, and Champlin (1994) as well as Martin, Champlin, and Chambers (1998) suggested that many audiologists (and likely by extension, RHIPs) “use improper determinations for the need to mask and/or fail to mask using a logical method” (p. 18). The 1998 study suggested that many hearing health care providers continue to use inappropriate masking procedures.

It is generally accepted that masking is effective at the establishment of true air and bone conduction thresholds. It is also widely recognized that when one identifies the possibility of under masking or over masking, that the procedure be discontinued as a result.

The most common masking procedure is the plateau method (first described by Hood, 1960). In a survey by Martin (1994), 58% of survey respondents use some variant of this technique. The plateau method is well established in research literature. The original plateau method by Hood (1960) recommended establishing unmasked thresholds. If required, apply masking to the NTE and re-establish the threshold was recommended. The masking level should be increased in 10 dB steps until the measured threshold “remains constant with further additional incremental steps of 10 dB” (Hood, 1960, p. 1227).

Yacullo (1996) recommended the masking level be “increased over a range of at least 15 to 20 dB” (p. 73), while Roeser and Clark (2000) recommended 5 dB steps.

Turner (2004) defined the plateau method as: measure unmasked air conduction (AC) for each ear and an unmasked bone conduction threshold.

At each frequency, determine if masking is required using conventional criteria.

Set the initial masking level (IM) 10 dB above the AC threshold of the non-test ear (NTE) and re-establish threshold. The masking level is increased 10 dB and the threshold re-established.

When the making level is increased twice (20 dB range) with no change (poorer) in threshold, the masker is in the plateau, and the measured threshold is the actual threshold.

It is also well established that there is no one universally correct protocol or procedure for masking.

### ***Application Parameters***

When criteria are identified that point to the need for masking, masking must be used for both air conduction and bone conduction thresholds. Yacullo (2000) noted that “based on currently available

data, a conservative estimate of IA for supra-threshold earphones is 40 dB at all frequencies” (p. 81); “Based on currently available data, conservative estimates of IA for 3A insert earphones with deeply inserted foam ear tips are 75 dB at  $\leq 1,000$  Hz and 50 dB at frequencies  $> 1,000$  Hz” (p. 83); and “based on currently available data, a conservative estimate of IA for bone-conducted sound is 0 dB at all frequencies” (p. 85).

**Masking Rule Information**

**AC Test Ear – BC Nontest Ear  $>$  IA**

Contralateral masking is required during pure tone air-conduction audiometry when the unmasked air-conduction threshold in the test ear equals or exceeds the apparent bone-conduction threshold (i.e., the unmasked bone-conduction threshold) in the nontest ear by a conservative estimate of IA. (Yacullo, 2000, p. 85);

**AC Test Ear – AC Nontest Ear  $>$  IA**

Contralateral masking is required during pure tone air-conduction audiometry when the unmasked air-conduction threshold in the test ear (AC test ear) equals or exceeds the air-conduction threshold in the nontest ear (AC Nontest ear) by a conservative estimate of IA. (Yacullo, 2000, p. 87);

**Air-Bone Gap Test Ear  $>$  15 dB Where Air-Bone Gap = AC Test Ear – Unmasked BC**

The use of contralateral masking is indicated whenever the results of unmasked bone-conduction audiometry suggest the presence of an air-bone gap in the test ear (Air-Bone Gap Test Ear) of 15 dB or greater. (Yacullo, 2000, p. 87);

**Presentation Level Test Ear – Best BC Nontest Ear  $>$  IA**

Contralateral masking is indicated during speech audiometry whenever the presentation level of the speech signal (in dB HL) in the test ear (Presentation Level test ear) equals or exceeds the best pure tone bone-conduction threshold in the nontest ear (Best BC Nontest Ear) by a conservative estimate of IA. (Yacullo, 2000, p. 88)

**ST Test Ear – ST Nontest Ear  $>$  IA**

Contralateral masking is required during measurement of threshold when the speech threshold in the test ear (ST Test Ear) equals or exceeds the speech threshold in the nontest ear (ST Nontest Ear) by a conservative estimate of IA. (Yacullo, 2000, p. 89)

**NOTE: All the information above is from Yacullo (2000):**

When measuring the bone-conduction thresholds of lower frequencies, the occlusion effect must be considered. Research has shown several different correction-factor values used to account for the occlusion effect when using supra-aural/circum-aural headphones such as:

	250 Hz	500 Hz	1000Hz
Goldstein & Newman (1994)	15 dB	15 dB	10 dB
Yacullo (1996)	30 dB	20 dB	10 dB
Roeser & Clark (2000)	20 dB	15 dB	5 dB

The values for **properly placed** insert earphones are significantly smaller. Yacullo (1996) recommended 10 dB at 250 Hz and no other correction factors.

**NOTE:** Any threshold considered to be vibrotactile should be noted on the audiogram.

## ASSESSMENT AND/OR DIAGNOSIS OF CONDITION OR DISORDER

### *Masking Procedures Using Inserts and Standard Headphones*

Research has consistently shown that the plateau method is superior to other methods. It has not been able to show that one protocol is superior to another. The College of Speech and Hearing Health Professionals of British Columbia (CSHBC) advocates the use of the plateau method of masking for air and bone conduction as outlined here:

1. Select initial amount of masking for the non-test ear (i.e., air-conducted threshold of the non-test ear (ACq Nontest Ear + 10 dB HL), plus correction factor for occlusion effect, if applicable);
2. Re-establish threshold in the test ear with this initial amount of masking (e.g., ACq Non-test Ear+10);
3. Each time there is a response to the pure-tone signal presented to the Test Ear, increase the masking presented to the Non-test ear by 5 dB;
4. Each time there is no response to the tone presented to the Test Ear, increase the signal presented to the Test Ear by 5 dB steps until another response is observed;
5. Continue this procedure until a plateau is observed – that is, when three consecutive 5-dB increases in masking are given without an observed shift in the response (threshold) of the Test Ear;
6. Record the masked threshold and the final level of masking used on the audiogram.

## DOCUMENTATION

Starting and stopping points for masking used should be noted on the audiogram. Both unmasked and masked thresholds should be shown on the audiogram.

Documentation must be in compliance with the CSHBC standard of practice *Documentation and Record Management* (SOP-PRAC-01) and clinical practice guideline *Documentation and Record Management* (CPG-04).

## CLINICAL OUTCOMES

The clinical outcome is to correctly assess hearing loss magnitude and type.

## REFERENCES

American Speech-Language-Hearing Association. (2014). [\*Determining threshold level for speech\*](#).  
Boothroyd, A., & Cawkwell, S. (1970). *Vibrotactiel thresholds in pure tone audiometry*. *Acta Otolaryngologica*, 69(1/6): 381-387.

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## **CSHBC RELATED DOCUMENTS**

*Adult Ear-Related Red Flags: Referral Criteria for Medical Clearance (PROT-QA-01)*

*Audiological Management of Adult Hearing Impairment (Valente, 2006) (ACPG-06)*

*Documentation and Record Management (CPG-04)*

*Hearing Assessment and Hearing Instrument Fitting and Dispensing for Adults (POL-QA-05)*

*Documentation and Record Management (SOP-PRAC-01)*

*Real Ear Probe Microphone Measurement Verification of Hearing Aids in Adults (PROT-QA-02)*