



# OTOSCOPY AND TYMPANOMETRY SCREENING



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# Otoscopy and Tympanometry Workshop

A comprehensive hearing-screening program consists of four major components, hearing history, visual inspection (both external and otoscopic), tympanometry and pure tone audiometry. This program will provide instruction for visual inspection, otoscopy and tympanometry only. Please refer to the MDH website ([www.health.state.mn.us/divs/fh/mch](http://www.health.state.mn.us/divs/fh/mch)) for instruction regarding hearing history and puretone audiometry.

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## **Tympanometry and Otoscopy Professional Recommendations**

The following are recommendations from two major authorities for hearing assessment in children, one is the American Speech-Language Hearing Association (ASHA) and the other is the American Academy of Pediatrics (AAP).

### **American Speech Language Association (ASHA):**

**Tympanometry** measures are an integral part of the pediatric assessment battery. Clinical decisions regarding middle ear function can be made based on the quantitative assessment of a tympanometry reading (tympanogram) which includes consideration of equivalent ear canal volume, peak acoustic admittance, and peak pressure. The components of tympanometry and otoscopy alone or in combination, have been used for many years to evaluate middle-ear function and to screen for middle-ear effusion. Do not use for children under the age of 4 months. When a tympanogram is used, care must be taken to ensure that the graphic representation corresponds to the absolute quantities indicated. With children, there are sometimes irregularities in the tympanogram shape (due to movement artifact, swallowing, vocalizing) that may be mistaken for a tympanometric peak by the instrument and can cause the absolute values that are provided to be misleading.

In addition, ear canal volume should be noted and taken into consideration when interpreting tympanograms. For example, equivalent ear canal volumes for ears with an intact tympanic membrane in children between 1 and 7 years of age range between 0.3 and 0.9 cc. Ear canal volumes for ears with a patent PE tube in the tympanic membrane for children between 1 and 7 years of age range between 1.0 and 5.5 cc.

### **Otoscopy**

The primary purpose of otoscopy in this population is to ensure that there are no contraindications to placing an earphone or probe in the ear canal.

Additionally, **visual inspection** for obvious structural abnormalities of the external ear structure and positioning as well as the external ear canal should be included.

### **Source:**

ASHA Guidelines for the Audiologic Assessment of Children From Birth to 5 Years of Age (2004).

### **American Academy of Pediatrics (AAP)**

**Tympanometry:** Tympanometry can be used to confirm the diagnosis of OME.

(This option is based on cohort studies and a balance of benefit versus harm.)

**Grade B:** Randomized, controlled trials or diagnostic studies with minor limitations; overwhelmingly consistent evidence from observational studies

### **Sources:**

Clinical Report. Hearing Assessment in Infants and Children: Recommendations Beyond Neonatal screening. (Pediatrics Vol. 111 No 2 Feb 2003).

American Academy of Family Physicians, American Academy of Otolaryngology-Head and Neck Surgery, American Academy of Pediatrics Subcommittee on Otitis Media with Effusion. Otitis media with effusion. Pediatrics 2004 May;113(5):1412-29.

# Otoscopy Screening

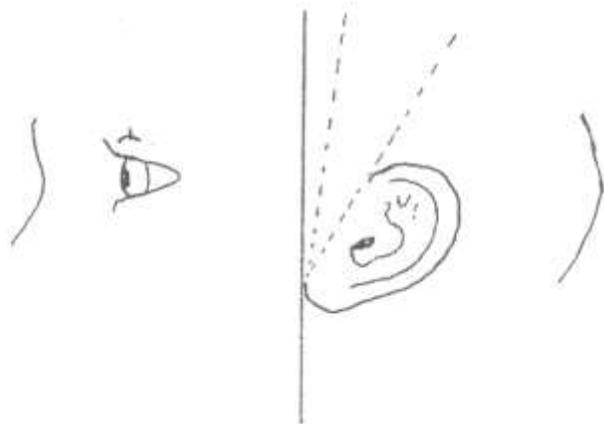
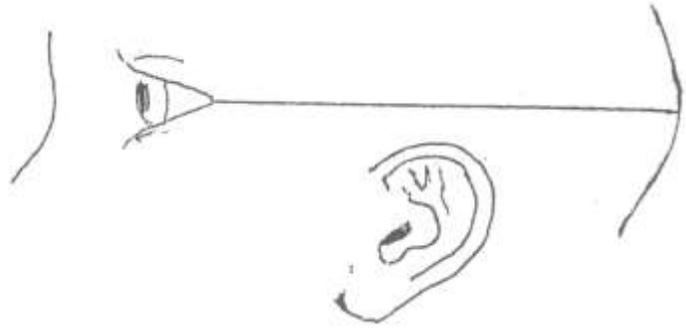


## VISUAL INSPECTION SCREENING PROCEDURES

- Ages:** Birth through 20 years
- Purpose:** To check for signs of ear disease and/or abnormal development.
- Description:** A systematic inspection of the external ear canal, surrounding tissue, ear canal, and tympanic membrane.
- Equipment:** External inspection - None.  
Internal inspection - Otoscope.
- Facilities:** A well-lighted area.
- Procedure:** **External:** Inspect the external ear structure for anomalies and the surrounding area for set (position) of the ears, skin tags or sinuses, tenderness, redness or edema, signs of drainage or wax build-up in the outer 1/3 of the canal.
- Internal:** With the otoscope, inspect the ear canal and tympanic membrane for: normal landmarks, signs of inflammation, drainage, wax build-up, or damage to the ear canal. If the screener lacks training and experience in using the otoscope, the visual inspection should be limited to the external visual inspection.
- Pass:** Normal appearance of all structures and no complaints of pain when the pinna or the tissue around the ear is being manipulated.
- Rescreen/  
Refer:** Refer any abnormality for medical examination. If tenderness, sign of drainage or foul odor are present, DO NOT proceed with audiometer screening, this would be an automatic referral.

## EXTERNAL VISUAL INSPECTION

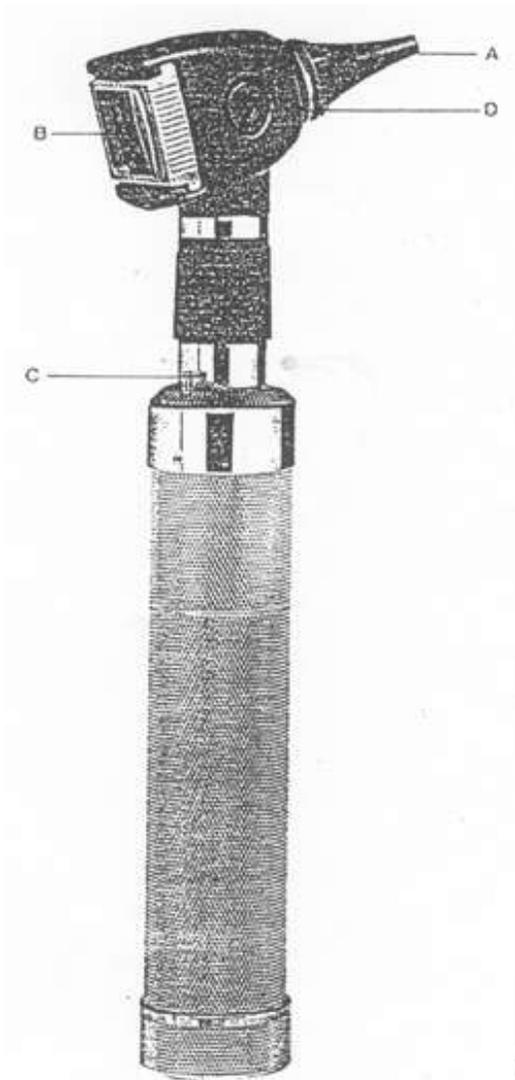
1. Discharge
2. Displacement
3. Discoloration
4. Deformity
5. Pain



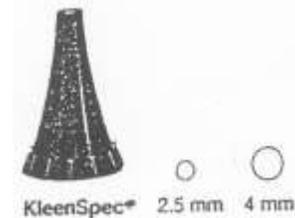
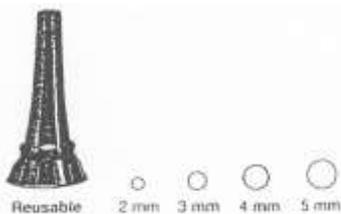
# The Otoscope

## Know your otoscope:

- 1. The Head**
  - Surgical
  - Diagnostic
- 2. Power Source**
  - Standard or Rechargeable Batteries
  - Incandescent (2.5v) or Halogen (3.5v) Bulb
- 3. Speculums**
  - Several sizes
  - Reusable or throw away
  - Use largest without discomfort



A. Speculum on distal end  
B. Wide viewing lens  
C. On/Off switch and rheostat control  
D. Insufflator port



## USING THE OTOSCOPE CORRECTLY

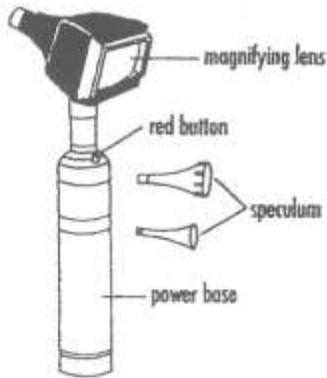


Illustration of proper  
technique for otoscope exam

Here are the steps for using the otoscope correctly:

1. Attach the otoscope head onto the Otoscope power base.
2. Find the largest speculum, which will allow you to see into the child's ear canal – usually a 3mm speculum. Gently twist the speculum onto the narrow end of the otoscope head in a clockwise direction.
3. Turn otoscope on by pressing the colored button and turning the otoscope head clockwise.
4. Hold otoscope in dominant hand with power base up, much like holding a pencil. Hold otoscope close to otoscope head, with thumb and first two fingers. Cushion the child's head with the heel of you hand to prevent trauma when the child moves.
5. With other hand, grasp the pinna of the ear. Pull gently up or back to straighten the canal. (The canal curves up, then curves down and forward.)
6. Watch carefully as you gently insert the speculum into the external canal. Stop when the speculum is 1/8" to 1/4" into the canal. (The canal is approximately 1" long.)
7. Now look into the magnifying lens and through the speculum. You should be able to visualize the external canal and tympanic membrane, as well as any cerumen or other obstacles.

# Tympanometry Screening



## Tympanometry Screening

### Overview:

Tympanometry measures the compliance or mobility of the tympanic membrane (TM) as a function of the TM when variable air pressures are introduced into the ear canal. It is not a test of hearing. Pure-tone hearing screening addresses how well the child hears the tones which are presented. The addition of tympanometry to the hearing screening protocol complements the overall objectives of a hearing screening program (visual inspection, pure-tone sweep screening, threshold and tympanometry). The American Academy of Pediatrics states that there is growing evidence of a connection between hearing impairment caused by middle ear disease and delays in the development of speech, language and cognitive skills<sup>1</sup>. Tympanometry is a valuable tool in the detection of medically related conditions of the ear. It is very useful to identify children with otitis media with effusion (OME), which has the potential to cause a conductive hearing loss.

Tympanometry screening is recommended as part of the hearing screening program for children 3 years through 8-9 years (Child and Teen Checkups [C&TC] setting), through 3<sup>rd</sup> grade (school setting), and others as indicated. It is important to remember that the purpose of tympanometry in the screening process is to identify possible disorders with the intention of referral. It is not to be used as a diagnostic tool.

Certain groups are at increased risk for OME. Because of the high prevalence of undetected OME in the preschool years, middle ear screening should routinely accompany pure tone screening.

Groups at increased risk for OME include:

- Children with developmental delays, including learning disabilities
- Children with delays in speech and language development
- Children with known sensorineural hearing loss
- Children who fail pure tone screening
- Children with craniofacial anomalies, including cleft lip/palate, Down syndrome
- Children of Native American heritage
- Children with known histories of acute otitis media (AOM)
- Children in group day care.

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<sup>1</sup> American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine. Hearing assessment in infants and children: recommendations beyond neonatal screening. 2009; 124(4):1253-1263.

## Parameters of Tympanometry Screening

Tympanometry is an objective measure of the mobility of the tympanic membrane (TM). By generating minute air pressure changes into the external ear canal, tympanometry determines the mobility of the eardrum, which is affected by whatever the air pressure is behind the eardrum. During the test, which only takes three seconds to complete, a soft rubber cuff on a probe is positioned at the entrance to the external canal of the ear. The probe provides a gentle seal, a soft tone is transmitted through the probe while the air pressure is changed in the external ear canal. The patient is not required to respond; results are automatically recorded in a graph form, called a tympanogram. The graph represents the underlying condition of the middle ear which is displayed as a type of curve or lack of a curve depending on the condition of the middle ear and functioning of the TM. It serves to identify conditions of the ear that may be missed by hearing screening alone.

Two components of tympanometry are considered in interpreting results and making referrals. The parameters are *Compliance (mobility)* of the ear drum and *Pressure* (measured in decaPascals (daPa) at which the ear drum moves best). Other parameters that can be measured on the tympanometer include *Ear Canal Volume (ECV)*, *Acoustic Reflexes (AR)*, and *Gradient [GR]* (ratio of height to width ½ way down). Since the AR and GR are more for diagnostic purposes rather than screening, these parameters are not part of MDH screening guidelines.

### A. Ear Canal Volume

**Ear Canal Volume (ECV)** provides a measurement of the amount of air volume contained in the space between the probe tip of the tympanometer and the tympanic membrane. This measurement is only used as part of MDH referral criteria (see table below) when the tympanogram tracing is flat.

If the ECV measurement is <0.3, it may indicate that the probe is being placed against the side of the ear canal or against wax in the ear canal. Occasionally, the ear canal may be completely occluded by wax, which could result in a low volume measurement.

Volume measurements above 2.0 ml may indicate that the cavity being measured is larger than the ear canal volume. This could occur if there is a patent (open) PE tube in the tympanic membrane or if there is a perforation of the tympanic membrane. The reason for a large physical measurement should be considered when determining the need for referral.

**B. Compliance (Mobility) of the Middle Ear System**

<b>PHYSICAL VOLUME VALUES CHART<sup>2</sup></b>	
<b>Value</b>	<b>Age</b>
0.4 to 1.0 ml	Normal Child
0.6 to 1.5 ml	Normal Adult

A normal middle ear system has a tympanic membrane and attached ossicular chain (Malleus, Incus, Stapes) that vibrate easily, allowing the transmission of sound energy to the inner ear by converting the sound waves to mechanical motion.

- ◆ In tympanometry, the freedom of movement (mobility or compliance) of the tympanic membrane and ossicular chain is determined by measuring the amount of energy necessary to move them. On the tympanogram, it is represented by the height of the peak and is expressed in milliliters (ml).
- ◆ Some conditions of the middle ear cause the mobility of all or part of the middle ear system to be reduced. Other conditions may allow excessive motion. Extremely low or extremely high mobility may indicate a condition that needs further attention.
- ◆ A compliance peak from 0.3 to 0.9 (children) and 1.4 (adults) is within the normal range of MDH criteria. A compliance measurement of less than 0.3 ml indicates the middle ear is stiffer than normal. A compliance measurement of greater than 1.5 ml may indicate a hyper-flaccid tympanic membrane. A value greater than 3.0 ml may indicate a disarticulated ossicular chain (ossicles that are not connected to each other).

<b>COMPLIANCE MEASUREMENTS<sup>2</sup></b>	
<b>Value</b>	<b>Interpretation</b>
0.3 to 0.9 ml	Normal Child
0.3 to 1.4	Normal Adult

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<sup>2</sup> American Speech and Hearing Association (ASHA). 1990. Guidelines for screening hearing and impairment and middle ear disorders. *ASHA*, 32(Suppl. 2)17-24.

### C. Air Pressure

In a normal middle ear system, the Eustachian tube will open, allowing air to move into and out of the middle ear cavity. This keeps air pressure behind the tympanic membrane roughly equal to the atmospheric or ambient air pressure in the ear canal. If the Eustachian tube does not function normally, a negative or occasionally a positive pressure may develop in the middle ear. The results are expressed in daPa (decaPascals) or mmH<sub>2</sub>O (millimeters water pressure). Most tympanometers measure values from positive 200 daPa to negative 400 daPa.

PRESSURE MEASUREMENTS <sup>3 4</sup>	
Value	Interpretation
+ 50 to - 150 daPa	Normal Child
+ 50 to - 150 daPa	Normal Adult

#### Calibration:

Refer to the MDH Calibration website at:

<http://www.health.state.mn.us/divs/fh/mch/hlth-vis/calibration/index.html>

Instrumentation and recording should be in compliance with the American National Standards Institute (ANSI) standards (ANSI S3.39, 1987).

**Note:** Otoscopic inspection should occur prior to tympanometry to identify obstruction of the ear canal, the presence of Pressure Equalization (PE) tubes or any obvious signs of external or middle ear disease.

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<sup>3</sup> Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. Joint Committee on Infant Hearing Pediatrics, 120, pp. 898-921.

<sup>4</sup> Dhar, S & Hall JW III. (2010) *Otoacoustic Emissions: Principles, Procedures, and Protocols*. San Diego: Plural Publishing.

## Tympanometer Overview

**PRESSURE:** +200 through – 400 daPa

**AMPLIFIER:** 226 Hz @ 85 dB

**MICROPHONE:** (Test cavity)



## MDH TYMPANOMETRY GUIDELINES

- Ages/Grades:** Ages 5 through 9 (C&TC setting) or Kindergarten through 3<sup>rd</sup> grade (school setting), and others as indicated.
- Purpose:** To check middle ear function.
- Description:** Measurement of movement of the tympanic membrane and middle ear system under varying air pressures.
- Equipment:** Tympanometer.
- Facilities:** Well-lighted area.
- Procedure:** Seal the ear canal and start the tympanometer according to the manufacturer's instruction. (Most tympanometers have a light system to indicate if the probe is placed correctly). Most equipment will automatically print out a tympanogram (please note, that if a box is on the printout, it is probably not programmed to MDH referral guidelines). Instruct the child not to swallow or talk during the procedure.
- Pass:** Ears that demonstrate normal pressure –compliance curves.  
Pressure (daPa): +50 to –150 for children/adults.  
Compliance (cm<sup>3</sup>/ml): 0.3 to 0.9 (child)  
0.3 to 1.4 (adult)  
Ear Canal Volume (ECV): 0.4 to 1.0 (child)  
0.6 to 1.5 (adult)
- Rescreen/Refer:** Pressure and/or compliance falls outside the guidelines above.  
**Rescreen in 4-6 weeks if tympanometry alone did not** pass otherwise rescreen in 2-3 weeks along with the pure tone rescreen. If the tympanogram is still the only procedure outside the guidelines at the later date, a referral should be made to primary care provider.

**SCREENING PROTOCOL  
FOR MASS  
HEARING & TYMPANOMETRY SCREENING**

**Initial Screening:**

Hearing Results	Tympanometry Results	ACTION
Pass	Pass	Pass
Pass	Not within normal limits	Rescreen in 4-6 weeks
Not within normal limits	Pass	Rescreen in 14-21 days

**Rescreening:**

Hearing Results	Tympanometry Results	ACTION
Pass	Pass	Pass
Pass	Not within normal limits	Refer
Not within normal limits	Pass	Refer
Not within normal limits	Not within normal limits	Refer

1.5			<b>PEAK PASS AREA (-150 —+50)</b>					
1.0								
.5								
0								
	-400	-300	-200	-100	0	+100	+200	

**\*\*Note: Tympanogram peak should fall within the peak pass area as noted on the diagram**

## **MIDDLE EAR PROBLEMS AND POSSIBLE TYMPANOMETRIC PATTERNS**

1. Retracted eardrum
  - a. Negative pressure from –100 to –400
  - b. Possible pass on hearing testing
2. Bulging eardrum or fluid line
  - a. Flat tympanogram
  - b. Rounded tympanogram, low compliance, very negative pressure
  - c. Usually a hearing loss
3. Perforated tympanic membrane – Refer immediately to primary care provider  
For screening: May see signs of otitis externa, refer immediately to primary care provider
  - a. Flat tympanogram
  - b. No pressure
  - c. Large volume
  - d. Hearing from normal to mild-moderate loss
4. Broken or disarticulated ossicular chain
  - a. Variable pressures
  - b. High compliance
  - c. Hearing loss
5. Tympanic Membrane scarring
  - a. Varied pressure
  - b. Low compliance
  - c. Hearing from normal to moderate loss
7. Pressure Equalization (PE) tubes
  - a. No pressure
  - b. High volume
  - c. Flat tympanogram
  - d. Hearing from normal to some loss

## GLOSSARY

**Acoustic Reflex** – reflex arc elicited in the presence of very loud sounds that causes a decrease in middle-ear compliance. This acts as a protective mechanism for the cochlea.

**Compliance Peak** – the point of maximum mobility in a tympanogram that indicates the degree of mobility within the middle-ear system.

**Contralateral Acoustic Reflex** - the acoustic reflex elicited when the stimulus is presented to the opposite ear from where the response is measured.

**Ear Canal Volume** - volume measured between the tip of the probe and the tympanic membrane at the start of the tympanogram.

**Gradient** – an indication of the shape of the tympanogram by measuring the pressure width at one-half of its peak height.

**Ipsilateral Acoustic Reflex** – the acoustic reflex elicited when the stimulus is presented to the same ear where the response is measured.

**Pressure Peak** – pressure value where maximum mobility occurs in a tympanogram; approximates pressure within the middle-ear space.

**Probe Tone** – low pitch (226 Hz) tone used to measure middle-ear mobility

**Screening Audiometry** – a hearing test performed at a fixed intensity level to determine if an individual can hear at this particular level.

**Otitis Media with Effusion (OME)** – a common cause of conductive loss. It may arise as the result of a head cold, allergies, or other conditions that impair eustachian tube function. The condition is characterized by the accumulation of clear, thin fluid within the middle ear cavity, which serves to impair sound conduction. It is also known as serous otitis media or “fluid ears”.

**Threshold Audiometry** – a hearing test performed with a number of frequencies and at intensity levels where hearing levels are measured as each tone is just audible to the person being tested.

**Tympanogram** – a graphic representation of the numeric measures of tympanometry.

**Tympanometry** – an objective measurement of middle-ear mobility and middle ear pressure through the use of sound (probe tone) and air pressure.

## Tympanometry Reading Explanation

- 1. Ear Canal Volume-** measured in  $\text{cm}^3$ , indicates the volume from the probe tip to the tympanic membrane at a pressure of +200 daPa.
- 2. Compliance Peak-** expressed in daPa, indicates the amplitude of the peak. This value can vary from NP (no peak) to  $6.0 \text{ cm}^3$ .
- 3. Pressure Peak-** measured in  $\text{cm}^3$ , indicates the pressure at which equalization occurs on both sides of the tympanic membrane. It also indicates the pressure at which peak compliance or maximum mobility is attained. This corresponds to the value on the horizontal axis of the graph.
- 4. The Scale of Reference-** measured in  $\text{cm}^3$ , is dependent on the amplitude of the tympanometric peak measurement. This scale is either  $1.5 \text{ cm}^3$  or  $3.0 \text{ cm}^3$ . Should the peak measure 1.5 or less in amplitude, the scale reading will be  $1.5 \text{ cm}^3$ . If it is 1.6 or greater, the scale will read  $3.0 \text{ cm}^3$ . The change in scale size merely allows a greater distribution of the graph on the chart. A tympanometer peak reading of "NP" will automatically cause the scale reading to be 1.5, which is indicative of no peak.

**5. Normal Box-** indicates the range of pressure peak and compliance peak values associated with normal middle-ear function. MDH Guidelines (Normal box) are different from most manufacturer guidelines in order to avoid over referrals for non infectious middle ear fluids that usually resolve on their own.

MDH<sup>5</sup>: +50 daPa to -150 daPa,  $0.4 \text{ cm}^3$  to  $1.4 \text{ cm}^3$

ASHA: -150 daPa to +100 daPa,  $0.2 \text{ cm}^3$  to  $1.4 \text{ cm}^3$  (ASHA, 32, Suppl. 2, 1990, 17-24).

The next two readings are beyond the scope of screening, they are included here for reference only.

**6. Gradient-** expressed in daPa, is the tympanometric pressure width at 50% of the compliance peak. Infants may show higher gradient values due to the mobility of their ear canals.

**7. Acoustic Reflex-** expressed as a yes/no, dB HL or dB HL and a curve, signifies the level at which the acoustic reflex causes the stapedial muscle to contract. This value will depend upon the level or intensity at which the acoustic reflex is detected at a given frequency.

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<sup>5</sup> Year 2007 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs. Joint Committee on Infant Hearing Pediatrics, 120, pp. 898-921.

## Infection Control For Otoscopy and Tympanometry Screening

The purpose of this recommendation is to reduce the risk of contracting or spreading disease by using appropriate infection control procedures during Tympanometry and Otoscopy Screening. Personnel who screen in schools or health care facilities are at risk for exposure (or exposing others) to contagious diseases. When performing otoscopy and tympanometry, precautions should be taken for controlling contaminants in the environment. Exposure to contaminants may occur when performing a visual inspection, handling and placing tympanometer probe tips in ears, etc. The use of gloves is indicated in the presence of blood, mucus, ear drainage, or other body fluids.

- **Disinfection:**

- Disinfection is acceptable on non-critical items, including headphones, otoscope specula, probe tips and any object that is not contaminated with obvious blood or ear drainage (bodily fluids).
- The most appropriate disinfectant for audiology materials is an Environmental Protection Agency (EPA) approved tuberculocidal hospital-grade disinfectant which may be used in the form of a towelette or a spray. Tympanometry probes can be soaked in a disinfectant such as Cavicide and requires soaking for 7 minutes.
- Rubbing alcohol is not recommended on audiology equipment as its chemical composition may cause damage to those materials.

- **Sterilization**

- Sterilization is recommended for items that contain blood or mucus. Cerumen is not usually an infectious substance, but if it contains fresh or dried blood or mucous, it should be considered potentially infectious. Since it may be difficult to determine if dried blood is present, disposable otoscope tips are recommended.
- Tympanometry probe tips that are contaminated may be sterilized in a soaking solution. Caution should be taken with the use of glutaraldehyde products which may be toxic to people and require special ventilation. An example of a non-glutaraldehyde product is called Sporex which requires 6 hours of soaking.

### References: (Accessed April 2011)

American Speech-Language-Hearing Association. (1990, December). Committee on Quality Assurance. Report Update: AIDS/HIV: Implications for Speech-Language Pathologists and Audiologists. *ASHA*. 32(12) 46-48.

Ballachanda, BB, Roeser, RJ, & Kemp, RJ. (1996). Control and prevention of disease transmission in audiology practice. *American Journal of Audiology*, 5(1), 74-82.

CDC: Sterilization & Disinfection in Healthcare Settings <http://www.cdc.gov/hai/>

Cuttler, S. & Adams, V.L. (April 28, 2008). Audiology and HIV: Developing best clinical health practices. *Audiology Online*. Retrieved from, [http://www.audiologyonline.com/articles/article\\_detail.asp?article\\_id=2017#ceuarticle](http://www.audiologyonline.com/articles/article_detail.asp?article_id=2017#ceuarticle)

## HEARING RESOURCES ON THE WORLD WIDE WEB

Hearing Resources	Websites (Accessed April 2011)
American Academy of Audiology	<a href="http://www.audiology.org">www.audiology.org</a>
American Academy of Pediatrics	<a href="http://www.aap.org">www.aap.org</a>
American Speech-Language & Hearing Association	<a href="http://www.asha.org">www.asha.org</a>
CDC Early Hearing Detection & Intervention	<a href="http://www.cdc.gov/ncbddd/ehdi/default.htm">www.cdc.gov/ncbddd/ehdi/default.htm</a>
Center for Hearing & Communication	<a href="http://www.lhh.org">www.lhh.org</a>
Ear Infections: Overview	<a href="http://www.nlm.nih.gov/medlineplus/earinfections.html">www.nlm.nih.gov/medlineplus/earinfections.html</a>
Minnesota Department of Health (MDH), Hearing & Vision Screening	<a href="http://www.health.state.mn.us/divs/fh/mch/hlth-vis/index.html">www.health.state.mn.us/divs/fh/mch/hlth-vis/index.html</a>
Minnesota Early Childhood Screening Statutes	<a href="http://www.revisor.leg.state.mn.us/stats/121A/17.html">www.revisor.leg.state.mn.us/stats/121A/17.html</a>
MDH, C&TC, Online Hearing Training Program	<a href="http://www.health.state.mn.us/divs/fh/mch/webcourse/hearing/index.cfm">www.health.state.mn.us/divs/fh/mch/webcourse/hearing/index.cfm</a>
MDH, Newborn Screening Program	<a href="http://www.health.state.mn.us/newbornscreening">www.health.state.mn.us/newbornscreening</a>
My Baby's Hearing	<a href="http://www.babyhearing.org">www.babyhearing.org</a>
National Center for Hearing Assessment and Management	<a href="http://www.infanthearing.org">www.infanthearing.org</a>
The National Hearing Conservation Association	<a href="http://www.hearingconservation.org">www.hearingconservation.org</a>
The National Institute on Deafness and Other Communication Disorders (NIDCD)	<a href="http://www.nidcd.nih.gov/health/wise/index.htm">www.nidcd.nih.gov/health/wise/index.htm</a>
NIOSH - A Practical Guide to Preventing Hearing Loss - 96-110	<a href="http://www.cdc.gov/niosh/docs/96-110/default.html">www.cdc.gov/niosh/docs/96-110/default.html</a>
Sight & Hearing Association	<a href="http://www.sightandhearing.org">www.sightandhearing.org</a>