TM 262™
Auto Tymp

Operating Instruction Manual

April, 2008

Part Number 1738-0101 Rev 08

Welch Allyn

Electromagnetic Compatibility (EMC)

Electromagnetic compatibility (EMC)

Please refer to the Electromagnetic Compatibility Reference Guide on CD (part number 482-6387xx) for EMC information concerning your system.

Compatibilité électromagnétique (CEM)

Veuillez vous reporter au guide de référence de compatibilité électromagnétique sur CD (numéro de pièce 482-6387xx) pour des informations sur la CEM relatives à votre système.

Elektromagnetische Verträglichkeit (EMV)

Informationen über die EMV des Systems finden Sie im Referenz-Handbuch Elektromagnetische Verträglichkeit auf der CD (Teilenummer 482-6387xx).

Compatibilità elettromagnetica (EMC)

Vedere la guida alla consultazione per la compatibilità elettromagnetica contenuta sul CD (numero di parte 482-6387xx) per informazioni sulla compatibilità elettromagnetica relativa al sistema in dotazione.

Compatibilidad electromagnética (CEM)

Consulte la Guía de referencia sobre compatibilidad electromágnetica incluida en el CD (número de pieza 482-6387xx) para obtener la información sobre la CEM de su sistema.

Electromagnetic compatibility (EMC)

Please refer to the Electromagnetic Compatibility Reference Guide on CD (part number 482-6387xx) for EMC information concerning your system.

电磁兼容性 (EMC)

有关系统的 EMC 信息，请参阅 CD 上的电磁兼容性（EMC）参考指南（部件号 482-6387xx）。

電磁適合性 (EMC)

お使いのシステムに関するEMC情報については、CD（パーツ番号482-6387xx)の『電磁適合性(EMC)リファレンスガイド』を参照してください。

전자파적합성(EMC)

시스템에 관한 EMC 정보는 CD의 『전자파적합성(EMC) 가이드』(부품 번호: 482-6387xx)를 참조하십시오.

Compatibilidade Eletromagnética (EMC)

Favor consultar o Guia de Referência à Compatibilidade Eletromagnética no CD (número de peça 482-6387xx) para informações da EMC relativas ao seu sistema.

Warranty

Welch Allyn, Inc. warrants the TM 262 Auto Tymp, to be free of original defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of one year from the date of purchase. If this instrument or any component thereof is found to be defective or a variance from the manufacturer's specifications during the warranty period. Welch Allyn will repair, replace or recalibrate the instrument or component(s) at no cost to the purchaser.

This warranty only applies to instruments purchased new from Welch Allyn or its authorized distributors or representatives. The purchaser must return the instrument directly to Welch Allyn or an authorized TM 262 distributor or representative and bear the costs of shipping.

This warranty does not cover breakage or failure due to tampering, misuse, neglect, accidents, modification or shipping, and is void if the instrument is not used in accordance with manufacturer's recommendations or if repaired or serviced by other than Welch Allyn or a Welch Allyn authorized representative.

No other express or implied warranty is given.

Return of the instrument registration card is required for proof of purchase and warranty validation.

Service and Repair

Repair must be performed by authorized personnel. Failure to do so invalidates the TM 262 Auto Tymp warranty.

For customers in North America or Canada, please contact Welch Allyn for information regarding where to return your TM 262 Auto Tymp for service.

Technical Service Department
Welch Allyn, Inc.
4341 State Street Road
Skaneateles Falls, NY 13153-0220
Tel: 1-800-535-6663 (in U.S.A. only)

Technical Service Department
Welch Allyn, Inc.
160 Matheson Boulevard, East
Mississauga, Ontario, Canada L4Z 1V4
Tel.: 1-800-561-8797 (in Canada only)

Electromagnetic Compatibility (EMC) ..... **a**
Warranty ..... **b**
Service and Repair ..... **b**

Introduction 1

Introduction **1-3**
Tympanometry and Gradient 1-5
Gradient 1-6
Screening acoustic reflex 1-7
Manual audiometry 1-8
Recycling / disposal **1-9**
Glossary of terms **1-10**

Installation 2

Unpacking and Inspection **2-3**
Probe Indicators **2-4**
Front Panel Controls and Indicators **2-5**
Printer and Display **2-7**
Rear and Bottom Panel Labels and Connectors **2-9**
Initial set-up **2-10**
Loading the paper 2-10
Paper storage 2-11
PreTest Tymp checks **2-12**
Calibration 2-12
Altitude adjustment 2-13
Pre-Test Audiometric Checks (Models with Audiometer only) **2-15**
Noise recovery period 2-15
Elimination of ambient noise 2-15
Biological Check **2-16**

Operation 3

Preventive Maintenance **3-3**
Cleaning the system 3-3
Eartip care **3-3**
Probe care **3-4**
Probe nose cone cleaning 3-4
Earphone Care (Models with Audiometry only) **3-7**
Paper supply **3-7**
Tympanometry testing information **3-8**
Helpful hints 3-8

Obtaining a seal 3-8
Audiometry testing information 3-10
Instructing the patient/subject 3-10
Placement of earphones 3-10
Response handswitch (optional accessory) 3-10
Program Mode 3-11
Reflex format 3-11
Print header format 3-12
Audiometric format during printing 3-13
Normal box format 3-14
Audiogram range 3-14
Exiting the program mode 3-14
Tympanometry/Reflex Test Sequence 3-15
a. Tympanometry only mode 3-15
b. Tympanometry and Ipsilateral Reflex 3-16
c. Programming ipsilateral acoustic reflex test frequencies 3-18
Exit tympanometry/reflex 3-18
Audiometry Test Sequence (Models with Audiometer only) 3-19
Screening audiometry 3-21
Threshold audiometry 3-21
Exit audiometry 3-22
Tests in memory 3-23
Memory erase 3-23
Printing test results 3-24

Test Results 4

Ear Canal Volume 4-3
Normal 4-3
Abnormal 4-3
Compliance Peak 4-3
Normal 4-3
Abnormal 4-3
Pressure Peak 4-4
Normal 4-4
Abnormal 4-4
Gradient 4-4
Acoustic reflex 4-5
Normal 4-5
Audiometry 4-5
Special Messages and Error Codes 4-6
Sample Test Results 4-6

RS-232 Interface 5

Introduction **5-3**
Operation **5-3**
Record Formats **5-4**
General record format 5-4
Tympanometry and Reflex test results record 5-5
Audiometry test results record 5-9
Notes 5-9
Data Transmission Protocol **5-11**
Data Transfer Program Mode **5-12**
RS-232 Interface **5-13**
Interface configuration 5-13
Cable connections 5-13
Communications flow control 5-13

Bibliography 6

Specifications 7

Specifications **7-3**
Tympanometry/Reflex modes 7-3
Pneumatic system 7-3
Acoustic Reflex Stimuli 7-4
Probe LED Indicators 7-4
Audiometry mode 7-5
Power 7-5
Environmental 7-5
Mechanical 7-5
Intensity Levels 7-6
Tone Format: 7-6
Transducers 7-6
Printer 7-6
Supplied accessories 7-7
Optional Accessories 7-7
Catalog Listing 7-8

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Chapter 1
Introduction

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Introduction

The **TM 262 Auto Tymp** (hereafter referred to as '**instrument**' in this guide unless otherwise noted for clarity) is a versatile combination instrument that provides testing capability for tympanometry alone, tympanometry combined with screening acoustic reflex measurements, and screening audiometry.

Two different versions are available to meet your individual testing needs.

- The basic version provides two modes of operation, tympanometry alone and tympanometry plus screening ipsilateral acoustic reflex testing.
- The second version adds manual audiometry. It is possible to field retrofit the manual audiometer to the basic version after the time of original purchase.

An RS-232 port is also available as an option. This allows the transfer of data to a computer.

An optional soft-sided carrying case can be purchased if portability is required. Also, a dust cover, patient handswitch, patch cords, and earphone sound enclosures may be purchased as optional accessories.

WARNING **The TM 262 is designed to be used with a hospital grade outlet. Injury to personnel or damage to equipment can result when a three-prong to two-prong adapter is connected between the TM 262 power plug and an AC outlet or extension cord. Additionally, the TM 262 is equipped with a specific power transformer (8000-0246) and power cord, which should not be interchanged with any other transformer or supply and are for use only with the TM 262.**

The above symbol indicates the location of a service adjustment part and is intended for service personnel use only. The TM 262 is a specifically calibrated device and the periodic service and adjustments which the instrument may require should be done only by an authorized Welch Allyn service technician.

CAUTION **The TM 262 is designed to comply with the EMC requirements according to IEC 60601-1-2.**

Radio transmitting equipment, cellular phones, etc. shall not be used in the close proximity of the device since this could influence the performance of the device. Particular precaution must be considered during use of strong emission sources such as High Frequency surgical equipment and similar so that e.g., the HF-cables are not routed on or near the device. If in doubt, contact a qualified technician or your local representative. Refer to the Electromagnetic Compatibility (EMC) Guide on CD 482-638702.

Tympanometry and Gradient

Tympanometry is an objective technique used since the late 1960's to measure the mobility compliance) and the pressure within the middle-ear system. During tympanometry, a low pitch tone (i.e., 226 Hz probe tone) is presented to the ear canal via the light-weight probe. The probe tone is used to measure the compliance changes within the middle-ear system while air pressure within the hermetically sealed ear canal is varied from a positive to a negative value. A positive pressure within the ear canal space, in the absence of middle-ear pathology, causes the middle-ear system to stiffen up or become less mobile. This is caused by the pressure difference between the sealed ear canal space and the middle-ear space which forces the tympanic membrane to stretch inward. A stiffened middle-ear system displays little or no compliance. As the pressure within the ear canal is brought back toward atmospheric (ambient or 0 daPa) pressure, the pressure difference between the ear canal space and the middle-ear space is reduced in normal ears.

At or near atmospheric pressure (0 daPa), the greatest amount of sound (probe tone) enters the middle-ear system. In other words, this is the air pressure value where the middle-ear system displays the maximum amount of compliance (admittance).

When the air pressure within the ear canal is then reduced to a negative value with respect to the middle-ear space, a pressure difference is once again established and the middle-ear system becomes less compliant. Therefore, by varying the pressure within the ear canal, it is possible to make a series of compliance measurements by means of the probe tone. The tracing which depicts these compliance changes is referred to as a tympanogram. The point of the tympanogram which represents the point of maximum compliance (admittance) is the compliance peak of the tympanogram. The air pressure (pressure at the peak) where this compliance peak occurs approximates the pressure within the middle-ear system, since maximum mobility is only possible when there is little or no pressure difference between the ear canal and the middle-ear space. Compliance is measured with respect to the ability of an equivalent volume of air to conduct sound and the scientific quantity used is cm^3. Air pressure is measured in decaPascals (daPa).

NOTE: 1.02 mm H20 = 1.0 daPa

The presence of a pathological condition which interferes with the mobility of the tympanic membrane, the ossicular chain, or the air pressure within the middle-ear space can be detected during tympanometry. For example:

- If the air pressure within the middle-ear space becomes negative due to a blocked eustachian tube, tympanometry permits the measurement of this negative pressure and its effect on middle-ear compliance.
- If fluid builds up within the middle-ear space, this fluid will restrict the ability of the ossicular chain to conduct sound to the cochlea. If small air pockets exist within the fluid, the tympanogram will indicate the negative pressure where the restricted mobility occurs. With a totally fluid-filled middle-ear space, no mobility will be measured during tympanometry at any pressure value.
- In the case of a “glue-ear”, the ossicular chain is restricted in mobility but the air pressure within the middle-ear space is at atmospheric pressure. This tympanogram would depict a restricted compliance peak at or near 0 daPa.

Gradient

Gradient (width) measurements are used to describe the shape of a tympanogram in the vicinity of the peak. Often, the presence or absence of fluid in the middle ear is not clearly indicated by otoscopy and tympanometry alone. This evaluation is especially difficult when the peak pressure is in the normal range.

The presence of fluid within the middle-ear space alters the shape of a tympanogram, i.e., makes the tympanogram wider near its peak. A larger-than-normal gradient can indicate the presence of fluid in the middle ear when other parameters are within normal limits. In this way, the gradient acts as an adjunct to the tymp and ear canal volume measurements by helping to differentiate between tymps with similar peak values.

The instrument uses tympanometric width to determine the gradient by measuring the pressure interval at one-half of the tymp peak height. Differing tymp peak widths can point to different middle-ear conditions, even when peak height and pressure are within normal range. For example, middle-ear effusion brought on by secretory otitis media might result in an increased tympanogram width and, therefore, an increased gradient value. This would occur because the ossicular chain cannot react to the change in pressure introduced during the tympanogram in the same way that it would if the middle ear were properly aerated. The continued presence of effusion, leading eventually to a completely fluid filled middle-ear cavity, will reduce the magnitude of the tympanogram to the point where no change in compliance is detectable across the pressure range. Under this condition, no gradient measurement is possible.

Screening acoustic reflex

An acoustic reflex occurs when a very loud sound (stimulus) is presented to the auditory pathway. During acoustic reflex testing, the stimulus is presented to the ear canal through a probe (ipsilateral). This stimulus then travels through the middle ear to the cochlea. From the cochlea, frequency and intensity information is transmitted via the 8th nerve to the brain stem where a determination is made as to whether or not the intensity of the stimulus is high enough to elicit the reflex response. If it is, a bilateral response occurs i.e., the right and left 7th nerves innervate their respective middle-ear muscles (stapedial muscles) causing them to contract. As these muscles contract, they stiffen their respective ossicular chains. This stiffening of the ossicular chain reduces the compliance of each middle-ear system. As in tympanometry, a probe tone is used to measure this decrease in compliance.

During ipsilateral acoustic reflex testing, both the stimulus and the probe tone are presented via the hand-held probe. For best results, the air pressure within the ear canal where the probe is positioned is set to the pressure value measured at the point of maximum compliance for that ear during tympanometry with an offset of -20 daPa.

Acoustic reflex measurements are useful to determine the integrity of the neuronal pathway involving the 8th nerve, brainstem, and the 7th nerve. Since the acoustic reflex test is performed at high intensity levels and since it involves a measurement of middle-ear mobility, acoustic reflex testing is not a test of hearing.

The acoustic reflex also serves as a good validation of tympanometric results since an acoustic reflex cannot be measured in the absence of a compliance peak. In other words, if the tympanometric results indicate no mobility over the pressure range available with your instrument, no reflex can be measured. If the test results indicate a reflex response in the absence of a compliance peak, one has cause to question the validity of the tympanometric test results. This indicates that the tympanogram should be repeated.

Clinical middle-ear instruments allow the measurement of the acoustic reflex threshold since they provide the ability to manually change the intensity of the stimulus to a level where a reflex response is just barely detectable for each patient tested. However, the instrument automatically presents the stimulus in a very definite stimulus intensity sequence. This preset intensity sequence may start at a level above an individual’s acoustic reflex threshold level. Also, since the instrument uses a hand-held probe and noise from hand motion can be detected by the instruments circuitry, the magnitude of a detectable response must be somewhat higher than the criterion generally used during clinical acoustic reflex threshold testing to avoid artifact caused by hand motion. Thus, the acoustic reflex measurements made with the instrument are referred to as screening acoustic reflex testing. The purpose of these screening reflex tests is to determine whether a reflex is detectable rather than to determine the lowest intensity at which the reflex occurs (i.e., threshold testing).

Manual audiometry

While tympanometry and acoustic reflex measurements check the integrity of the middle-ear system, audiometry provides a means for checking the integrity of the entire auditory pathway. Manual audiometry provides a method to check an individual's ability to hear a test signal at a particular intensity level or at the lowest possible intensity level without the use of masking.

During threshold audiometry, the test signal is generally presented through an earphone to the ear under test. Different screening test protocols define the frequencies and intensity sequence to be used to obtain a response. Audiometric testing requires a behavioral response for the individual being tested. This consists of having the individual raise a finger/hand or press a handswitch (optional) whenever the test signal is heard. The finger/hand is lowered or the handswitch is released when the test signal is no longer audible. Thus, the individual being tested must be able to understand a set of simple instructions and have the ability to provide some physical sign when the test signal is heard.

Recycling / disposal

CAUTION

Many local laws and regulations consider electric equipment-related waste as hazardous or requiring special procedures to recycle or dispose of. This includes batteries, printed circuit boards, electronic components, wiring and other elements of electronic devices. Follow all of your respective local laws and regulations for the proper disposal of batteries and any other parts of your system, such as monitors, amplifiers, keyboards, electrodes, etc.

To recycle or dispose of this product within the European Union, refer to Welch Allyn insert 704414 "Disposal of Non-Contaminated Electrical and Electronic Equipment." Directive 2002/96/EC WEEE.

Glossary of terms

Tympanometry - an objective measurement of middle-ear mobility and middle-ear pressure through the use of a low frequency sound (probe tone) and air pressure changes.

Tympanogram - the tracing which depicts the results of tympanometry.

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

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

Normal Box - range of pressure peak and compliance peak values associated with normal middle-ear function. (-150 daPa to +100 daPa, 0.2 cm^3 to 1.4 cm^3 per ASHA, 32, Supl. 2, 1990, 17-24).

Ear Canal Volume - volume measured between the tip of the probe and the tympanic membrane at the starting pressure for a tympanogram.

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

Acoustic Reflex - reflex arc elicited in the presence of very loud sounds which cause a decrease in middle-ear compliance as a protective mechanism for the cochlea.

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

Manual Threshold Audiometry - a hearing test performed with a variety of frequencies and intensities without the use of masking to determine if an individual can hear.

Chapter 2
Installation

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Unpacking and Inspection

Examine the outside of the shipping container for any signs of damage. Notify your carrier immediately if any damage is noted.

Carefully remove your instrument from its shipping container. Remove the plastic bag protecting the instrument. If the instrument appears to have suffered mechanical damage, notify the carrier immediately so that a proper claim can be made. Be certain to save all packing material so that the claim adjuster can inspect it as well. As soon as the carrier has completed the inspection, notify your Welch Allyn Distributor.

Probe Assembly	**Probe Eartips (6 sizes, 2 each)**
Power Module	**Paper (3 rolls)**
Test Headset model is with Audiometry only	**Test Cavity**
Instruction Manual	

Table 1: Accessories supplied

NOTE: Keep the original packing material and shipping container so the instrument can be well packaged if it needs to be returned to the local service center for repair or calibration.

Check that all accessories listed in Table 1 (per version ordered) are received in good condition. If any accessories are missing or damaged, notify your Welch Allyn Distributor or the factory immediately. See the ***Specifications*** chapter of this manual for the catalog numbers of accessories and also for a listing of optional accessories.

Probe Indicators

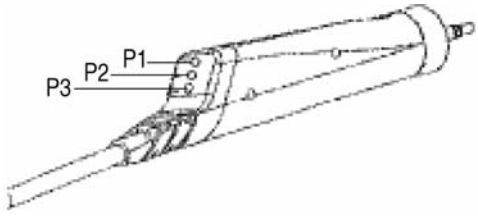

Figure 1: Probe indicators

P1 - Yellow: The probe is occluded. Remove the probe and inspect for cause of occlusion.

P2 - Green lamp: *Blinking* - The instrument is ready to begin a Tymp.
Steady green - test successfully started and in progress.

P3 - Orange: A pressure leak has been detected.

Front Panel Controls and Indicators

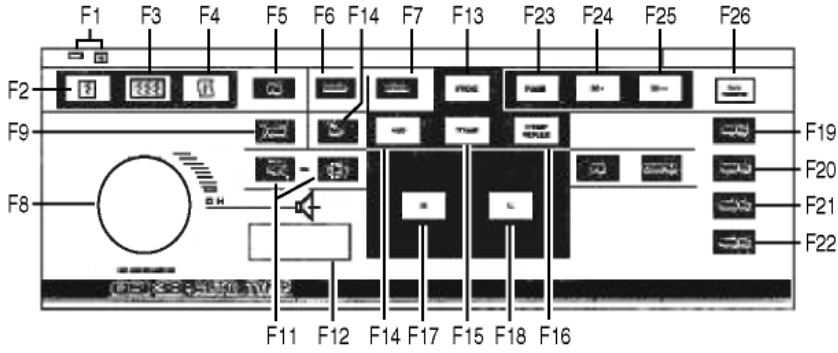

Figure 2: Front panel

Fl Power on indicator and label: Indicator is illuminated when the instrument is receiving power.

F2 Print Screen: Pushbutton used to print the currently displayed page of memory.

F3 Print All Memory: Used to print all pages of data from memory.

F4 Paper Advance: Causes paper to feed through printer; may be used to load paper or to provide space between printouts.

F5 FM: Used during the Audiometry mode to select a frequency modulated test tone when the present bar is depressed; causes the letters FM to appear on the display when selected.

F6 Steady: Used during Audiometry mode to select a continuous test tone when present bar is depressed; causes the steady symbol to appear on the display.

F7 Pulsed: Used during Audiometry mode to select a pulsed tone when the present bar is depressed; causes the pulsed symbol to appear on the display.

F8 Attenuator Knob (dB HL): Used to increase or decrease the intensity of the test tone presented in Audiometry mode; counterclockwise rotation causes the intensity to be lowered; clockwise rotation causes the intensity to be increased.

F9 +10 dB: Used to temporarily extend the intensity range by 10 dB; causes a large + sign to appear on the display indicating that the extended range has been selected.

F1O M+: Save key; during Audiometry mode, causes the threshold information per frequency to be saved on the display; during **Program** mode, causes option to be selected; during **Tymp/ Reflex** mode, causes frequency to be stored as a default parameter.

F11< and > **Hz:** Selecting < causes the cursor to move to the next lower frequency; selecting causes the cursor to move to the next higher frequency.

F12 Present Bar: Press to present test signal to appropriate earphone; release to turn test tone off.

F13 Prog(ram): Selects Program mode screen which lists settings available for reflex presentation format, printout header format, audiogram vs. tabular format, display normal box, and identity frequency range for Audiometry mode.

F14 Aud(iometry): Selects Audiometry mode.(Available in models with Audiometer only).

F15 TYMP: Selects Tympanometry only mode.

F16 Tymp Reflex: Selects Tympanometry and Reflex mode.

F17 R: Used to identify right ear under test so that data stored in memory and/or printed is properly identified. Used to select right earphone for audiometry.

F18 L: Used to identify left ear under test so that data stored in memory and/or printed is properly identified. Used to select left earphone for audiometry.

F19 500: Selects 500 Hz as a stimulus during reflex testing.

F20 1000: Selects 1000 Hz as a stimulus during reflex testing.

F21 2000: Selects 2000 Hz as a stimulus during reflex testing.

F22 4000: Selects 4000 Hz as a stimulus during reflex testing.

F23 PAGE: Scrolls through test results stored in memory.

F24 M -: Erases currently displayed page of data from memory.

F25 M - -: Erases all pages of data from memory.

F26 Data Transfer: Transfers test results to an attached computer.

⚠WARNING Only computers that meet the requirements of IEC 60950-1 shall be connected to the serial interface. The computer requires an isolation transformer.

Printer and Display

The display (Figure 3) indicates test mode, parameters for test and test results.

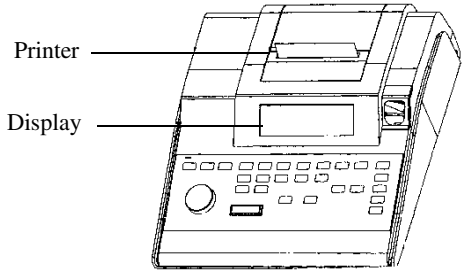

Figure 3: Printer and display

Figures 4 through 8 show the individual display format for each test mode.

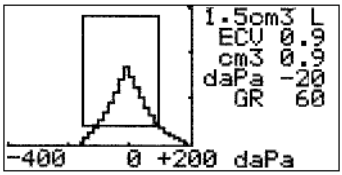

Figure 4: Display format for TYMP Only Test.

Figure 5: Display Format for TYMP/REFLEX Test (Reflex test results given as Yes or No).

Figure 6: Display for TYMP/REFLEX Test (Reflex test results given in dB HL).

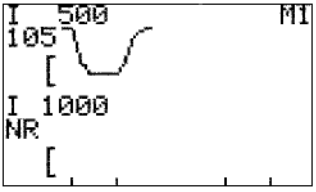

Figure 7: Display format TYMP/REFLEX Test (Reflex test results given in dB HL and also shown with a tracing.

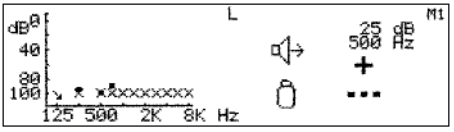

Figure 8: Display Format for AUDIOMETRY.

Rear and Bottom Panel Labels and Connectors

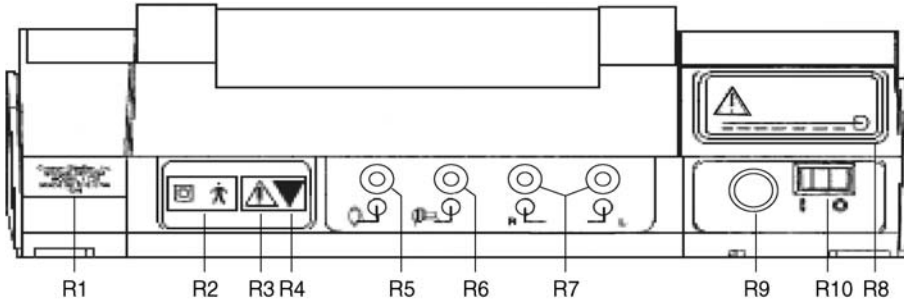

Figure 9: Rear and bottom panel labels and connectors.

R1: Company name, address, model, serial number and country of origin.

R2: Symbol denotes a Type B, Class II product per IEC 878 as referenced in IEC 60601-1.

R3: Symbol denotes Attention, consult accompanying documents.

R4: Symbol indicates a service adjustment part that is intended for service personnel use only.

R5: Connector for handswitch. Input impedance (47 K ohm pulls up to 5 volts).

R6: Connector for contralateral insert phone. Function not available.

R7: Connectors for right and left earphone. 130 ohm, 2.50 volts rms maximum open circuit.

R8: Label describing low input voltage and current from desktop power supply.

R9: Power Input Jack. 5-pin DIN connector for external desktop power supply.

R10: Power Switch with ON/OFF indicators.

NOTE: There is a symbol on the bottom panel (marked **B1** in Figure 10) that indicates entry by qualified service personnel only.

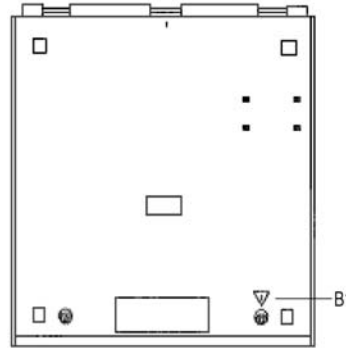

Figure 10: Bottom panel.

Initial set-up

Place the instrument on a stable counter or table where it will subsequently be used. The location should be near a properly grounded wall outlet. Carefully attach purchased accessories to their appropriately labelled connector on the rear panel of the instrument (see Figure 9).

Locate the **power** switch on the rear panel of the instrument and move the switch to the **On** position**.** Note that the lamp (**F1**) on the front panel is illuminated indicating the instrument is receiving power. Once the power switch is activated, the **TM 262 symbol** will appear on the display along with a listing of the revision number for the Tymp/Reflex and Audiometry (if purchased) software.

Next, the display will default to the Tymp/Reflex mode and the probe green lamp will begin to blink indicating that the instrument is ready to begin the tymp. If both the green and yellow lamps are illuminated at the same time following power on, the probe is occluded or the tymp/ reflex software did not get properly initialized. Simply move the power switch to the off position, inspect the probe tip or any signs of an occlusion, and reposition the power switch to **On.** If both green and yellow lamps are still illuminated and you are certain that the probe is not occluded, contact your local service representative or the Welch Allyn service department for repair. In the mean time, it is still possible to select the Audiometry mode (if purchased).

Allow the instrument to warm-up for about 5 minutes before conducting a test. This allows the electronic circuits to stabilize prior to use. If the storage temperature is lower than the room temperature, allow some additional time for the instrument to reach room temperature.

Loading the paper

Remove the printer cover by placing your fingers along the back edge of the printer and pulling upward on the cover. Cut the printer paper so that the leading edge of paper is straight across. Place the roll of paper inside the paper well so that the paper will unroll from the lower surface. See paper loading label for additional help (Figure 11).

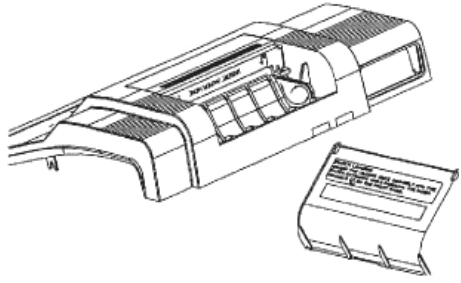

Figure 11: Paper loading.

Position the leading edge of the paper roll into the paper entrance. The printer will sense the paper and begin to autofeed. The paper will appear out the of the printer mechanism. Continue to advance the paper by pressing the paper **Advance** button until a section of paper is long enough to pass through the printer cover once it is repositioned over the printer.

Paper storage

The instrument is supplied with a thermal printer. This type of printer requires a heat-sensitive paper to create an image. For maximum paper life, any spare rolls of paper should be stored as follows:

a. Store in the dark, i.e., in a drawer or cabinet
b. Do not store above 77 F (25 C)
c. Store at less than 65% relative humidity

The above recommendations are for the maximum paper life (greater than five years). Storing your thermal paper at high temperatures or high humidity levels will only shorten the total paper life somewhat, depending on the actual temperature and humidity the paper is subjected to. The paper will show some darkening if stored for 24 hours at 113 F (45 degrees C) and a relative humidity of greater than 90%, so avoid leaving your paper in a hot car or other hot area overnight. Always avoid storing unused paper or printed tests in a lighted area..

PreTest Tymp checks

For your convenience, a test cavity is provided with your instrument. This test cavity enables you to quickly verify, on a daily basis, the proper calibration of your unit. Welch Allyn strongly recommends that you make this quick check a part of your daily routine.

Calibration

NOTE: To initiate the quick check, select the Tymp only mode and insert the probe into the 0.5 cm^3 opening on the test cavity. See Figure 12.

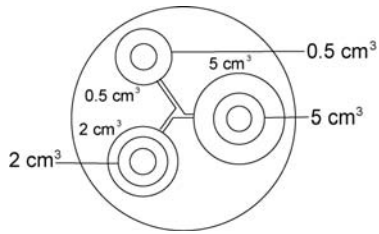

Figure 12: Test cavity

NOTE: Since the instrument is designed to start automatically, it is important that the probe is inserted as quickly and as smoothly as possible. During the calibration check, the probe must be held carefully and without movement. Do not place the probe on the same counter as the instrument or any moving object during this check as mechanical noise will be picked up by the probe and interfere with the calibration check.

The calibration check will start automatically if the probe has been inserted into the cavity properly. This is confirmed by the green lamp changing from blinking to a steady condition. If If the **orange** lamp is illuminated, the probe is not properly positioned within the cavity so that a large pressure leak exists. If the **yellow** lamp is illuminated, the probe tip has been occluded. In either case, remove the probe and wait for the blinking **green** lamp. Insert the probe once again. If necessary, clean the probe tip as described in Chapter 3.

When the test sequence is completed, the green lamp on the probe is no longer illuminated. Remove the probe from the test cavity and note that the green lamp is blinking once again. The display will indicate a flat line on the tympanogram along with the value of the test cavity next to the letters ECV (ear canal volume) i.e., 0.5. The letters NP will appear next to the labels cm and daPa and three dashed lines will appear next to the letters GR (gradient). Since the test cavity is a hard-walled cavity, the tympanogram should be a fiat line indicating that there is no mobility in the system. The instrument places the letters NP next to the cm and daPa headers to indicate that there is no peak compliance and, therefore, no peak pressure can be determined during the quick check. Also, since there is no compliance peak detected, it is not possible to calculate a gradient. Therefore, the instrument displays the dashed lines when a gradient calculation is not possible. Using the same sequence, place the probe in the test cavity opening labelled 2.0 cm^3. Note that the display looks the same as with the 0.5 cm^3 measurement except for the value placed next to the letters ECV 2.0. If you wish, the same sequence can be followed

with the 5.0cm^3 opening on the test cavity. To keep a record of this test cavity calibration check, simply press the **Print All** button on the front panel of the instrument.

Since sound pressure will vary with altitude and barometric pressure, some variation from the 0.5, 2.0 and 5.0 cm^3 readings may be observed. Your instrument is carefully calibrated at our factory, which is at approximately 250 feet above sea level. If you are located at an elevation of 1000 feet or higher, your instrument may need to be recalibrated to account for your elevation (see the next topic). It is not necessary to recalibrate for barometric pressure changes on a daily basis. Keep in mind that a change in barometric pressure (i.e., from low to high or vice-versa) will slightly affect the test cavity readings.

Altitude adjustment

The altitude calibration adjustment allows you to 'correct' the ear canal volume (ECV) measurement and test cavity volume measurement for variations due to altitude. Because the instrument is a pressure sensitive device that makes measurements relative to ambient air pressure, changes in air pressure due to weather or altitude will affect the ECV readout of the instrument. The slight pressure change resulting from changing weather conditions will usually yield volume readouts with ±0.1 cm^3 of the expected cavity value, but pressure changes due to altitude can shift these cavity values by as much as 30%. These changes in pressure do not affect the accuracy of the compliance measurement system in any way. However, you may prefer that the instrument gives ECV values as they would appear at sea level. The altitude calibration mode allows you to adjust the Auto Tymp without the services of a qualified Welch Allyn representative.

Altitude (ft.)	Altitude Table (cm^3)
0 - 1,500	2.0
2,000 - 3,500	2.1 ±0.1
4,000 - 6,000	2.2 ±0.1
6,500 - 7,500	2.3 ±0.1
8,000 - 9,000	2.4 ±0.1
9,500 - 10,000	2.5 ±0.1

Table 2: Altitude correction.

The altitude calibration mode can only be entered with the instrument is powered up from its **Off** state while the program mode (**PROG**) button is depressed. Hold the **PROG** button for approximately five seconds.

1. When entering the altitude mode, the display will read as follows:
   Altitude Mode
   ECV 2.0
   cm^3 9.99
   Standard

   (**E71**) is displayed in the bottom right of the display until the probe is in the 2.0 cm^3 cavity.
2. Place the probe into the 2.0 cm^3 cavity provided with the instrument and check cm^3 value against the altitude correction table for accuracy.
3. If the measured volume is not within the published table value ±/.1 cc, then you should exit the altitude mode by pressing the **PROGRAM MODE** button and contact field service. Providing the measured volume agrees with the published table ±/.1cc, you may proceed with the altitude adjustment.
4. With the probe still in the 2.0 cm^3 cavity, press the **PAGE** button to enter the custom calibration mode. Custom will appear on the fourth line of the display.
5. The value now displayed in the cm^3 display area is the volume measured and adjusted to the current altitude. If the value displayed is 2.0 cc, the volume is adjusted to the current site. If the value is not 2.0 cc ±.01, press the **SAVE** button **M+** to customize the volume measurement to the current altitude. The measured volume should now read 2.0 cc.
6. To exit the altitude mode, press the **PROG** pushbutton to return to normal mode.

Pre-Test Audiometric Checks (Models with Audiometer only)

Noise recovery period

Exposure to high levels of sound (e.g., unmuffled lawn mowers, loud music, gunfire) tends to create a temporary threshold shift (TTS) which diminishes with time after exposure. Any subject/patient tested soon after such exposure may exhibit a hearing loss that does not reflect his or her normal hearing threshold. It is, therefore, important that the testing procedure prescribe some time interval - usually at least 16 hours- between the last exposure to high-level sounds and the administration of any hearing test.

Elimination of ambient noise

Excessive noise in the test environment during audiometric testing such as that produced by conversation, typewriters, public address systems reduces test validity because it tends to mask the test signals particularly at the lower frequencies where earphone cushions provide less effective attenuation. An acoustically treated room may be required if ambient noise reaches objectionable levels i.e., sufficient to cause apparent hearing loss at the low frequencies. Also, Audiocups are available from Welch Allyn as an optional accessory. If the person being tested is in the same room as the audiometer, it is recommended that he/she be seated about three feet (1 meter) away from the instrument.

Maximum permissible noise levels are specified by the American National Standards - Criteria for Permissible Background Noise during Audiometric Testing, ears covered with earphones (S3.1 1991 revised). Table 3 shows the maximum background levels that can be present inside the room while a valid hearing test is being conducted. For more comprehensive information about hearing testing and hearing conservation the user is referred to the Bibliography.

Frequency (Hz)	Test Room Maximum dB SPL* in 1/3 Octave Band
125	29.0
250	17.5
500	14.5
750	16.5
1000	21.5
1500	21.5
2000	23.0
3000	28.5
4000	29.5
6000	33.0
8000	38.5

Biological Check

The best way to determine that your instrument is operating properly is to perform a daily check on a normal ear - your own ear if possible. This allows you to listen for the probe tone and the stimulus tone (during reflex) and to determine if the air pressure system is working properly. Keep a copy of your chart for a day-to-day reference in checking your instrument.

If you purchased the TM 262 with Audiometry, select the Audiometry (**AUD**) mode pushbutton located in the center section of the front panel. Note that the display changes from the tympanogram format to an Audiogram format. The **<** and **> Hz** buttons allow you to select each frequency and the **dB HL** knob allows you to alter the intensity of each frequency. Position the test headset on your head so that each earphone is covering the appropriate ear (i.e., **red** is right and **blue** is left). Select the right earphone by pressing the front panel button labelled **R** and check for the following while depressing the **Present bar**:

a. Depressing the **< Hz** button causes the frequency to change to a lower frequency; depressing the **> Hz** button causes the frequency to change to a higher frequency.
b. Each frequency or tone is pure: i.e., there is no distortion or cracking sound present.
c. Rotating the **dB HL** knob in a clockwise direction causes the tone to increase (become louder) in intensity; rotating the **dB HL** knob in a counterclockwise direction causes the tone to become quieter (less intense).

Chapter 3
Operation

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Preventive Maintenance

Preventive maintenance does not require access to the interior of the instrument and may be performed by the user.

For the TM 262, preventive maintenance consists of periodically cleaning and inspecting the exterior of the instrument. It is recommended that you develop a schedule for these purposes.

Cleaning the system

Turn **OFF** the system power before cleaning the instrument. Do not permit solutions or sterilization agents to seep into the electronic portions of the system. Take special care around controls, connectors and panel edges. Do not use any abrasive cleaners.

Remove any dust from the exterior of the system with a soft brush or cloth. Use a brush to dislodge any dirt on or around the connectors and panel edges. Remove stubborn dirt with a soft cloth slightly dampened with a mild detergent solution or cold sterilization agent.

Eartip care

Eartips may be washed with warm soapy water to remove cerumen after the eartip is removed from the probe. Use an alcohol swab to disinfect the eartips. Be sure that the eartips are completely dry before reuse.

NOTE: Eartips may crack or otherwise deteriorate if left submerged in alcohol for a long period of time. Eartips should not be placed in an autoclave as they will melt and lose their shape.

Probe care

With use, cerumen can work its way up inside the probe nose cone (probe tip). During the warm-up period each day and throughout the day, inspect the probe tip to make sure it is clean and free of cerumen. If any cerumen is detected, refer to the following instructions for cleaning and maintaining the instrument's probe.

Probe nose cone cleaning

Remove the nose cone portion of the probe:

1. Hold the body of the probe in one hand (e.g. left) near the tip and grasp the nose cone of the probe in the other hand (e.g. right).
2. Rotate the nose cone portion of the probe counterclockwise until the nose cone is completely separated from the probe (Figure 1).
3. Place the probe body securely on a table and inspect the nose cone for cerumen. Use a pipe cleaner to remove any cerumen by inserting the pipe cleaner through the back portion of the nose cone and pulling it through the front opening. It may be necessary to repeat this several times to remove all the cerumen.

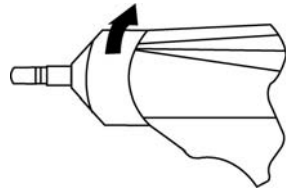

Figure 1: Probe nose cone removal

NOTE: The probe nose cone can be sterilized via many conventional methods including autoclaving.

The O-Ring

There is an O-Ring seated at the end of the threads on the probe. As a preventative maintenance measure, and to ensure that the nose cone of the probe unscrews easily, do not clean or remove the lubricant from the O-Ring. If the O-Ring appears to be void of any lubricant, or if the nose cone itself was difficult to remove, apply a high-quality synthetic lubricant such as those considered “food-grade.” Refer to Figure 2 and apply as described in the instructions that follow.

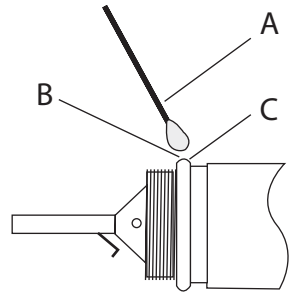

Figure 2: O-Ring care.

A: Cotton swab.
B: Lubricant
C: O-Ring (enlarged for detail).

1. Place a small drop of lubricant at the front outer surface of the O-Ring.
2. Using your finger or a cotton swab, spread a thin layer of lubricant completely around the front and outer surface of the O-Ring. Ensure that no lubricant spreads into the threaded area of the nose cone. Only a thin layer of lubricant is necessary. Excessive application or build-up may affect test results.

The probe wire

Inside the probe body there is a metal tube that contains a wire required for cleaning purposes.

1. Carefully remove this wire from the metal tube (Figure 3). This will pull any cerumen out of the metal tube.

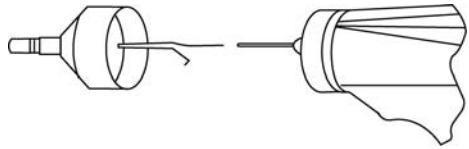

Figure 3: Probe wire removal.

2. Examine the wire for cerumen.
3. If necessary, clean the wire with a lint-free tissue.
4. Reinsert the wire into the metal tube and push it in as far as it can go.

NOTE: The wire must be inserted into the metal tube for the instrument to function properly.

Probe reassembly

After cleaning, reassemble the probe nose cone to the probe body by screwing the cone back onto the probe. Take care to align the threads on both the probe body and the nose cone before screwing the pieces together. Only screw the nose cone on until it is finger tight. You might find it helpful to gently squeeze the two sides of the probe case together while screwing the nose cone into place.

NOTE: The probe nose cone must be screwed firmly in place to guard against any air leaks.

Earphone Care (Models with Audiometry only)

The earphone and cords provided with the instrument versions 3 and 4 should last a long time with proper care. To clean the earphones and cords, use only a dry cloth or tissue. Moisture should not be allowed anywhere near the earphone itself as this will damage the diaphragm and grill cloth, requiring its replacement.

With extended use, earphone cords tend to fray internally at the connectors i.e., between the cord and the instrument's connector, and between the cord and the earphone connector. This fraying will ultimately either decrease the signal level or cause the signal to be intermittent. To check for this,

1. Position the test headset over your ears and select a frequency (e.g., 1000 Hz) at 35 dB HL.
2. Select the right earphone and press the **Present bar**.
3. While the present bar is depressed, flex the earphone cord next to the connector at both ends.
4. Listen for an intermittent signal, an abrupt change in signal intensity level or a scratchy sound superimposed over the selected frequency that coincides with the flexing of the cord. The presence of any of these conditions indicates that the cord should be replaced.
5. Also, examine the earphone cord for cuts or tears in the covering shield and the earphone cushion for signs of damage. If either problem is noticed, the earphone cord or cushion should be replaced. Both parts are easily replaced without the need for recalibration. However, if the earphone receives shock damage or is replaced for any reason, the instrument will need to be recalibrated.
6. Repeat this same sequence with the left earphone.

Paper supply

To streamline each testing session, it is a good idea to check the amount of paper left inside the printer compartment. Extra rolls of paper should be kept nearby.

NOTE: The number of tests per roll of paper will vary with the version Auto Tymp being used and the type of tests being performed. See ***Printer Description*** in the ***Specification*** chapter for approximations. Replacement paper can be purchased from your local Welch Allyn Distributor or from the factory.

Tympanometry testing information

As mentioned, it is a good idea to perform a test on a normal ear each day to make certain that your instrument is functioning properly. See ***Biological Check*** in Chapter 2 for details.

Helpful hints

Tympanometry and acoustic reflex testing can be performed at any age. However, the technique used will vary with age. From three years through adult, tympanometry can be performed with little difficulty due to the cooperative nature of this age group. With the under-three-year population, a bit of ingenuity is required to keep the patient relatively quiet during the seconds required for the test. In all cases, distraction is the key to success. Anything which provides a sound and/or visual distraction should work.

Sucking on a pacifier or a bottle will help with the younger population. However, the tympanogram tracing will not appear as smooth due to the movement artifact. Having a parent hold an infant during testing will also help.

The key to success in all cases is to make sure that you are at eye level with the ear canal. Keep your hand steady and your eyes on the ear canal and probe lights until the test is over. It is a good idea upon first receiving your instrument to practice on a cooperative patient to gain confidence in its use. Once you feel comfortable with the probe, you are ready to handle any situation. Remain calm and success will follow.

Obtaining a seal

Six different size eartips are provided with your instrument. The size eartip will vary with skeletal size of the individual it is to be used on. Generally speaking, the following criteria applies:

- Preemie -8 mm
- Newborn -8 mm, 11 mm
- Pre-school -11 mm, 13 mm
- School age -11 mm, 13 mm, 15 mm
- Adult -15 mm, 17 mm, 19 mm

NOTE: Before attempting to seal the entrance of the ear canal, visually inspect the opening to make sure that the canal is free of any obstruction. If the canal is completely plugged at the entrance or if fluid is running from the ear canal, tympanometry should not be attempted until the condition is cleared.

NOTE: Damage to the probe can result if fluid is pulled up into the probe with negative pressure.

1. Slip the appropriate size eartip onto the nose cone of the probe, making sure the rounded tip of the eartip sits flush with the tip of the nose cone (Figure 4).

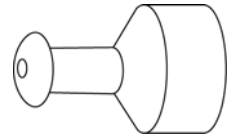

Figure 4: Positioning the eartip

2. Move any hair away from the ear and pull upward and back on the pinna of the ear on an adult (pull downward and back on the pinna of a young child.) This tends to straighten out the ear canal and ensure better results. Keep the pinna in this position throughout the test sequence.
3. Make sure that the green lamp on the probe is blinking.
4. Position the probe up against the entrance of the ear canal, applying a gentle pressure to maintain a tight seal (Figure 5).

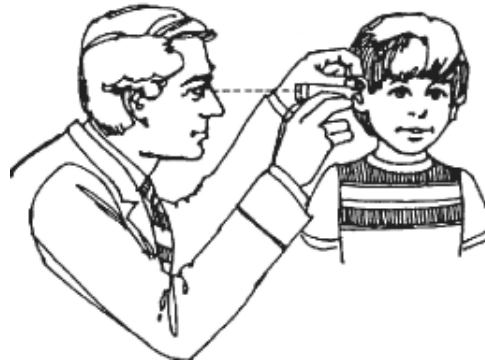

Figure 5: Positioning the probe.

5. Watch the probe lamp. As soon as a good seal is obtained, the blinking green lamp will change to a steady glow and remain steady while the test is in progress.
6. Once the test sequence is over, all lamps on the probe will be turned off and the test result can be viewed on the instrument display before printing it out. It is now possible to remove the probe from the ear canal.
7. Note that the green lamp is now blinking again, signifying that you can run another test.

   Should you run into difficulty during the test, the probe lamps will inform you of a problem as follows:
   - **Green lamp**: Still blinking - seal has not been obtained to initiate the test sequence.
   - **Orange lamp**: The ear canal is not properly sealed and a large pressure leak exists.
   - **Yellow lamp**: The probe tip is occluded with cerumen or you are pressing too hard against the ear canal so that you have collapsed the canal at the tip of the probe.

   In all cases, it is best to remove the probe, examine the tip for cerumen and clean it if necessary. A change of eartip size may also be appropriate. Start the test again.

Audiometry testing information

Prior to testing, ensure that the earphone cords are plugged into their appropriate connectors on the rear panel of the instrument. Select the desired tone type (i.e., pulsed, steady, or FM).

CAUTION Always handle earphones with care. Neither drop them nor permit them to be squeezed together. Severe mechanical shock may change their operating characteristics and require their replacement. Insert the earphone cords between the ear-phone cushions during storage to prevent damage from mechanical shock.

Instructing the patient/subject

You should put the patient/subject as much at ease as possible before the test begins. In addition, it is important to try to make them understand how the test is to be conducted and what they will hear. For sake of uniformity, an unvarying explanation is advisable, for example:

"I am going to place these earphones over your ears. You will hear a variety of tones - some high, some low, some loud, and some very soft. Whenever you hear, or think you hear one of these sounds raise your hand. Lower your hand when you no longer hear the sound."

"Remember that although some of the tones will be easy to hear, others will be very faint. Therefore, you should listen very carefully and raise your hand whenever you think you hear the tone."

NOTE: Modify the instructions accordingly if the optional handswitch is to be used.

Placement of earphones

The most important thing to remember is that a good seal is required between the earphone cushion and the patient's/subject's head and ears. To increase the likelihood of a good seal:

a. Eliminate all obstruction between the earphones and the ears e.g., hair, eyeglasses, earrings, hearing aids, etc.
b. Adjust the headband so that it rests solidly on the crown of the subject's head and exerts firm pressure on both ears.
c. Center the earphones carefully over both ears. The earphone with the red connector goes on the right ear. Take care to eliminate any visible gaps between the earphone cushions and portions of the individual's head and the ear on which the cushion rests.

Response handswitch (optional accessory)

If the optional handswitch is to be used, be sure that the handswitch connector is properly inserted into the jack on the rear panel. The instrument will display an appropriate symbol whenever the handswitch is operated.

Program Mode

To enter the program mode, press the **PROG**ram pushbutton located on the front panel. The following screen appears the first time you enter the Program mode after you receive your instrument from the factory. These are the default settings used at the factory during production.

Program Mode - User Selections

*** Reflex HL + Curve**	*** Print - Audiogram**
Reflex HL only	**Print - Aud Table**
Reflex Yes/No	*** Normal Box ASHA**
*** Prn Header Welch Allyn**	**Normal Box Off**
Prn Header Off	*** Aud Range Normal**
Prn Header Custom	**Aud Range Narrow**

Note that these selections fall into five different groups of controls:

- Reflex format for printer
- Print header format
- Audiometric test result format
- Status of normal box
- Audiogram frequency range

The default setting for each group of controls has an asterisk (*) prefix so that it is easy to scan the settings selected for each group.

Reflex format

Reflex test results can be displayed and printed in any of the following three different ways:

- reflex dB HL plus curve
- reflex dB HL only
- reflex yes/no

The default setting for this grouping is reflex dB HL plus curve. This means that all reflex test results will appear on the display and the printout with the following information:

a. **I** (Ipsi)
b. **Frequency**: 500, 1000, 2000, or 4000 Hz
c. **Intensity** level where response was detected
d. **Tracing** of actual response curve.

If **reflex HL** only is selected, the same information as shown above (except for d) will appear on the display and the printout.

If **reflex yes/no** is selected, **item d** will not appear and **item c** will be replaced with the word **yes** (response detected at one of three levels) or **no** (no response detected).

To select a different setting for reflex format, note that a square cursor is located next to the reflex HL + curve option.

1. Use the **< Hz** button to cursor down to the setting that you wish to select for your own default criterion.
2. While the square cursor is positioned in front of your desired setting, press the **M+** button.

   Note that the word SAVED appears in the lower right margin of the screen. Also, this will cause the asterisk (*) to be deleted from in front of the prior default setting (e.g., Reflex HL + curve) and to be repositioned in front of the new setting.

Print header format

Three options to choose how the print header will be handled:

- **Print header = TM 262**

  This is the default setting for this feature which means that each time the print screen or print all tests in memory buttons are pressed, the printout will begin with the label “TM 262.”

- **Print header = off**

  If this option is selected, no header will be printed before any test results, which will save printout space and printout time.

- **Print header = custom**

  Select this option to design a custom header, which might be the name of your own facility, department or company name.

Use a similar procedure to that described above to deselect the **Welch Allyn** header and select no header or a custom header.

1. With the **<** or **> Hz** pushbutton, position the square cursor in front of the desired new setting
2. Press **M+** to select it as the new default setting. The word SAVED appears in the lower right margin.

   If **custom** header is selected, a line cursor will begin to flash at the left-hand margin below the words Prn Header Custom. To “type” in the desired header, use the dB HL knob. Rotating this knob clockwise will sequence you through the alphabet in the forward direction and rotating this knob counterclockwise will sequence you through the characters in a reverse direction. The available character set is: A -Z; 0 - 9; and a blank space. The blank space can be used to erase an unwanted letter or number. A total of 35 character spaces are available.

NOTE: If you want to center the header, it will be necessary to consider the length of the name to be inserted and calculate from the left margin where you want the header to begin. Otherwise, if you begin to enter the characters for the header from the left margin, the header will be printed from the left margin on the printout.

If you had previously entered a custom header:

1. Position the square cursor next to the asterisk (‘) in front of Pm Header Custom.
2. Press **M+** to display the left-hand margin along the bottom of the display. The word SAVED will appear at the lower right margin indicating that the custom header is still selected.

To move the cursor from the left-hand margin without inserting a letter or a number:

1. Select the character that represents a space (i.e., rotate the knob one position to right of the letter A).
2. Use the **> Hz** pushbutton to move over to the next character position.
3. Repeat this sequence until the cursor is moved over to the desired start position for the first character to appear in your header.
4. Rotate the **dB HL** knob to select the appropriate characters to spell out the desired header.
5. After selecting each character, use the **> Hz** pushbutton to move over to the next character position.
6. Once all of the header characters have been added, press the **M+** pushbutton to save your header in memory. The word SAVED will appear on the right-hand margin indicating that your header is now saved. The square cursor will reappear next to Prn Header Custom.
7. It is now possible to exit the program mode or to sequence on to the next selection.
8. To exit the program mode, press **PROG**. Enter a single test result and select print screen to see how the custom header looks.

Audiometric format during printing

The audiometric test results can be printed out in an audiogram format (**PRINT - AUDIOGRAM**) or in a tabular format (**PRINT - AUD TABLE**). The default setting for this function is the audiogram format.

NOTE: When a specific frequency is deselected for testing, the result will be a break in the audiogram line at that frequency. This eliminates the assumption that a threshold exists at that untested frequency.

1. Move the **<** or **> Hz** pushbutton to position the cursor in front of the description PRINT - AUD TABLE.
2. Press the **M+** button to save this format as the new default parameter. Note that the word SAVED appears in the lower right-hand corner of the display to indicate that this new setting has been saved. With the PRINT - AUD Table selected, all audiometric test results will appear in a table with the frequency range typed horizontally along the top of the table followed by two lines of test data. The test results for the right ear will appear next to the letter R and below each frequency tested. Similarly, the test results from the left ear will follow below the right ear results.

NOTE: The PRINT - AUD setting selects the format for the printout only. An audiogram always appears on the screen while in this mode.

Normal box format

It is possible to have the normal box, as described by ASHA, appear on the tympanogram screen and printout. The boundaries for this normal box are -150 daPa to +100 daPa and 0.2 cm to 1.4 cm^3.

NOTE: A compliance value of 1.5 cm^3 or greater will automatically turn off the ASHA normal box.

The normal box is the default setting. To deselect this normal box:

1. Move the **square cursor** with either the **<** or **> Hz** button so that it is placed in front of the words **Normal Box Off**.
2. While the cursor is in this position, select the **M+** pushbutton to save this feature as the new default setting.

   Note that the word SAVED appears in the lower right-hand margin. This message assures you that the normal box will not appear on the tymp screen or printout.

Audiogram range

All eleven frequencies are available during audiometry or the range can be abbreviated to eight frequencies. The default setting is Aud Range Normal. To select the abbreviated frequency range:

1. Position the **square cursor** in front of the feature **Aud Range Narrow**.
2. Press the **M+** button to save this narrow range for audiometric testing.

   Note that the word SAVED will appear in the lower right-hand margin and the asterisk now appears in front of the narrow range selection. The normal range of frequencies includes 125 Hz through 8000 Hz. The narrow range of frequencies includes 500 Hz through 6000 Hz. Please note that in the **Aud** mode, if the narrow range is selected, the **<** and **> Hz** buttons will allow you to scroll through this abbreviated frequency range only. Both the screen and printout will still be labelled with the full range of frequencies i.e., 125 Hz through 8000 Hz.

Exiting the program mode

1. Press the **PROG** button to exit the program mode and return to the test mode that was operational prior to entering the program mode.

Tympanometry/Reflex Test Sequence

a. Tympanometry only mode

1. Select the **Tymp only** mode by pressing **Tymp** on the front panel. The display will immediately show the format for the tympanogram along with the summary information headers ECV, cm^3, daPa, and GR. The default scale for compliance is 1.5 cm^3. If a compliance peak greater than 1.5 cm^3 is measured, the instrument automatically scales the compliance axis to 3.0 cm^3 so that more of the tympanogram data can be seen.
2. Determine which ear is to be tested and select the appropriate ear (**R** or **L**) button so that the test results will be labeled properly.
3. Examine the ear canal of the ear to be tested to determine the appropriate size eartip for the test and position the eartip on the probe. Be certain that the eartip is pushed as far down the probe tip as possible so that the eartip is flush with the tip of the probe. Position yourself so that you are at eye level with the test ear.
4. Note that the green lamp is blinking, which indicates that the instrument is ready to begin the test.
5. Place the probe up against the entrance of the ear Canal so that its opening is completely covered with the eartip and no visible leaks are apparent.
6. The test sequence begins once the instrument determines that a volume between 0.2 cm^3 and 6.0 cm^3 is present. This is indicated by the green lamp changing from blinking to a steady state. From this point on, hold the probe securely in this same position without any hand motion. Keep your eyes on the probe and the individual's ear.

   At the start of the test, the pressure system establishes a pressure of +200 daPa within the ear canal. When this pressure is achieved, the instrument makes a measurement of ear canal volume. This information is valuable since it indicates whether a good seal has been established and since it helps differentiate between two similar Tympanogram (i.e., a fluid-filled middle-ear system and a perforated tympanic membrane). After the ear canal volume (ECV) is obtained, this compliance value is subtracted from the remaining compliance measurements so that a direct reading of the tympanogram compliance peak is possible.

   The pressure sweep begins at the starting pressure of +200 daPa and proceeds in the negative direction at a rate of 600 daPa/second. Measurements of compliance are made continuously as the pressure sweep continues in the negative direction. The slope of the tympanogram increases as the measurement approaches the compliance peak. This signals the instrument to slow down the rate of pressure sweep to 200 daPa/second to ensure a more accurate reading of the compliance peak. After the peak compliance and pressure values are detected and stored, the tympanogram dips downward toward the baseline (i.e., 0 cm^3) and the pressure sweep rate increases back to 600 daPa/second. The tymp sweep ends automatically when the compliance value returns to baseline and the pressure is at least -100 daPa. Only when the middle-ear pressure is very negative is it necessary for the pressure sweep to continue all the way down to -400 daPa. This automatic stop when the tymp compliance returns to baseline eliminates unnecessary pressurization of the ear and shortens the test time.

When the tympanogram is completed and the test is finished, the steady green lamp turns off and the display displays the complete tympanogram results.

7. It is now possible to remove the probe from the ear and to view the test results on the display.

   The test results are automatically stored in a page of memory. The actual memory location number is determined by the number of tests that preceded this current test. For example, if this is the first test to be stored in memory, it will be assigned the number Ml. If it is the third test to be stored in memory, it will be numbered M3, etc.

   In addition to the tympanogram tracing, the screen displays the test summary information. This data includes the ear canal volume (ECV), the compliance peak in cm^3, the pressure at the peak of the tympanogram in daPa, and the gradient (GR) as a pressure width value. This test result can be printed out immediately as a single test by selecting the pushbutton labeled print screen only or other tests can be run and saved before all tests in memory are printed via the print all pushbutton.

b. Tympanometry and Ipsilateral Reflex

The default parameters for this test are tympanometry followed by an ipsilateral acoustic reflex test at 1000 Hz. To change this default setting, select the desired frequencies for the test as described in the next topic, *b. Programming ipsilateral acoustic reflex test frequencies*.

Once a seal is obtained, the tympanometry sequence is initiated. (See topic *a. Tympanometry only mod*e earlier in this chapter for detail.s As long as no large leak is encountered during tympanometry (orange lamp illuminated) and no occlusion is detected (yellow lamp illuminated), the test automatically sequences on to the reflex portion of the test as follows.

a. The pressure from the tympanogram peak compliance is re-established within the ear canal and is offset by -20 daPa so as to avoid any problems with extremely sharp tympanogram slopes.
b. With the air pressure held constant throughout the reflex test sequence, the lowest intensity level for the starting frequency is presented and a measurement of compliance change is made. If the compliance decreases by at least 0.05 cm, this reflex intensity level is stored in memory.
c. If no other frequencies were selected for the test, the Tymp Reflex sequence ends here. The display will indicate the reflex test result as a Yes, as an HL value, or as an HL value plus a tracing of the reflex response curve. The default setting established in the Program mode determines the manner in which the reflex result is displayed. See *Program Mode* earlier in this chapter. Note that the green lamp is no longer illuminated indicating that it is time to remove the probe from the ear.
d. If no response is measured (i.e., a compliance decrease of at least 0.05 cm^3 was not detected) at this lowest intensity level, the intensity level of the stimulus is automatically increased by 10 dB. During this second presentation, a measurement of compliance change is also made. If a response is detected, the test sequence for this frequency ends and either the result is displayed on the screen or the test proceeds on to the next frequency selected. However, if once again no response is detectable, the intensity level is increased by 10 dB (e.g., 1000 Hz Ipsi = 105 dB HL) and the stimulus is presented.

e. After the compliance measurement is made and a response is detected, the highest intensity level is stored as the reflex test result and displayed on the screen. If no response is detectable at this third and highest intensity level, either a No or an NR (depending upon Program mode setting) is indicated on the screen next to the frequency tested label. If during any of the three stimulus presentations a large pressure leak develops, an NT will appear on the screen next to the frequency where it occurred and the test sequence is aborted.

f. The same sequence is followed for each test stimulus selected. The first stimulus presentation occurs at the lowest level available for the stimulus selected. If a compliance change of 0.05 cm^3 or greater is detected, the test sequence for this particular test stimulus ends at this lowest level. If no compliance change of at least 0.05 cm^3 is detected, the test automatically increases the stimulus intensity by 10 dB and this same frequency is repeated at this next higher level. Once again if a compliance change of 0.05 cm^3 is detected, this sequence ends at this level and the intensity level is stored.

g. Finally, if there is no detectable response at the second intensity level, the test automatically increases the stimulus intensity by another 10 dB and the same stimulus is repeated for a third and final time. If a response is detected, this third level is stored in memory as the test result. If no response is detectable at this third and highest intensity level, the test is considered a no response (NR) or as a No depending upon the program mode default setting. In other words, for each test stimulus selected, a maximum of three different stimulus intensity levels are available for the test. The test sequences through each of the intensity levels only if required to obtain a measurable result. Thus, if the individual being tested responds to the lowest level, there is no addition-al stimulus presentation necessary for this particular stimulus. This test protocol aims to save test time and to limit the number of circumstances where the higher level stimulus presentations are made.

The three intensity levels available vary with the frequency selected ipsilaterally as follows:

IPSI	Intensity Levels
500 Hz	80, 90,100 dB HL
1000 Hz	85, 95,105 dB HL
2000 Hz	85, 95,105 dB HL
4000 Hz	80, 90, 100 dB HL.

NOTE: Although four frequencies are available during the tymp and ipsilateral reflex test mode, most situations require only one or two frequencies to be tested. You can choose from a selection of the most commonly used frequencies. However, it is strongly recommended that you select only one to two frequencies per test since holding the probe in the same position for the length of time it takes to test four frequencies may become a problem for both you and the individual being tested.

c. Programming ipsilateral acoustic reflex test frequencies

As mentioned earlier, the instrument defaults to a 1000 Hz test stimulus when the **TYMP REFLEX** button is first pressed after receipt from the factory. However, any combination of the four available frequencies (500, 1000, 2000, 4000 Hz) can be selected either temporarily or as revised default parameters. To temporarily modify the default condition:

1. Press the **Tymp Reflex** button.
2. Select the desired **frequencies** by selecting or deselecting the appropriate frequency buttons after. In this way, the actual test stimuli presented will be determined by the frequency pushbuttons selected prior to beginning a test i.e., sealing the ear canal.

   Each frequency selected will be indicated on the display as it is chosen. For example, if 2000 Hz is selected along with 1000 Hz, the label I 1000 will appear at the top of the first column of numbers for reflex and I 2000 will appear directly below it. If 500 is also selected, the screen will be modified so that I 500 appears at the top of the first column of reflex numbers, I 1000 will appear directly below I 500 and I 2000 will appear at the top of the second column of reflex numbers and directly to the right of I 500 and so on.

NOTE: There is a very definite pattern to the way in which these frequencies are positioned on the screen; namely, the lowest frequency will be placed at the top of the first column for reflex results followed by the next lowest frequency. If more than two frequencies are selected, the third and fourth frequencies will be placed in the second column for reflex results in a ow to higher frequency order.

To change the default frequencies for the Tymp Reflex mode:

1. Select the desired frequencies as described above.
2. Once you have reviewed them and are certain that they are the desired parameters, press the **M+** pushbutton. Note that the word SAVED appears on the display screen. Now every time that you re-enter the Tymp Reflex mode, these revised default parameters will be selected automatically. As mentioned above, it will still be possible to temporarily alter the frequencies selected by choosing the desired frequencies. However, in this case each time that the Tymp and Reflex test mode is exited and re-entered, the default parameters will reappear. There is no limit to the number of times that the default frequencies can be modified. It is a good practice to keep a record of the reflex default frequencies.

Exit tympanometry/reflex

To exit **Tymp Only Mode**:

1. Select **Tymp Reflex** or **Audiometry Mode**. Note that the appropriate screen appears on the display.

To exit **Tymp/Reflex Mode**:

1. Select **Tymp** or **Audiometry Mode**. Note that the appropriate screen appears on the display.

Audiometry Test Sequence (Models with Audiometer only)

To enter the audiometry mode:

1. Press the **AUD** button. Note that the display changes from a tymp or tymp and reflex format to an audiogram format.

The default settings for the frequencies available during audiometry are set in the Program mode as 125 through 8000 Hz (normal) or 500 through 6000 Hz (narrow). The default setting is the normal frequency range of 125 through 8000 Hz. Upon entering the audiometry mode, the starting frequency is automatically selected to be a steady signal of 1000 Hz at 0 dB HL. You can change the signal format temporarily from steady (continuous) to a pulsed or frequency modulated tone. These alternative tone formats remain selected as long as you remain within that audiometric test. Once you leave that specific test by selecting either Tymp or Tymp Reflex, or by initiating the next test, the tone type returns to steady. In other words, the tone format is re-initialized to the steady tone format.The display indicates a continuous bar when steady is selected, a dashed bar when pulsed is selected, and the letters FM when frequency modulation is selected. Note that the audiometry test defaults to testing the right ear first. To start with the left ear, it is necessary to press the **L** button after entering the audiometry mode. Since the audiometry mode defaults to 1000 Hz at 0 dB HL, the cursor is positioned at the corresponding location on the audiogram. Please note that even though you may have selected the tabular format for the audiometric test results on the printout, the screen always appears in the audiogram format.

To change to a frequency above 1000 Hz:

1. Press the **> Hz** pushbutton.

   If the **> Hz** button is pressed once momentarily, the frequency increases to the next frequency in the range i.e., 1500 Hz.

   If the **> Hz** button is held down continuously, it is possible to quickly scroll through the available frequencies. Note that if the button is held down past the 8000 Hz in the normal range (6000 Hz for the narrow range), the frequency scroll wraps around to the lowest frequencies (i.e., 125 Hz with the normal range and 500 Hz with the narrow frequency range). The reverse occurs if the **< Hz** pushbutton is pressed.

   In addition to changing the cursor position on the audiogram, the **<** and **> Hz** pushbuttons cause the frequency value on the right-hand side of the display screen to change as well.

To change the intensity level of the test tone:

1. Rotate the **dB HL** knob in the clockwise direction to increase the intensity level in 5 dB steps; rotate the knob in the counterclockwise direction to decrease the intensity level in 5 dB steps.

   Note that cursor moves up and down accordingly. Also, note that the dB level displayed above the frequency value on the right-hand side of the audiogram changes as well.

For each frequency, there is a fixed intensity range normally available while rotating the **dB** HL knob as follows:

Frequency	Intensity Range
125 Hz	-10 to 50 dB HL
250 Hz	-10 to 70 dB HL
500 to 6000 Hz	-10 to 90 dB HL
8000 Hz	-10 to 70 dB HL

However, in addition, it is possible to extend the intensity range per frequency by 10 dB simply by pressing the **+10 dB** button. This +10 dB button may only be selected when the intensity level is set to the highest value in the normal range. For example, with the test tone of 1000 Hz, the normal intensity limit is 90 dB HL. Note that, when the intensity knob is rotated clockwise to select beyond 90 dB HL, the intensity value above the 1000 Hz to the right of the audiogram flashes indicating that the normal intensity limit has been reached. To go beyond 90 dB HL, select the **+10 dB** button. Note that a large **+** sign appears on the screen below the 1000 Hz value. Now, the **dB HL** knob can be rotated through two additional positions, namely, 95 and 100 dB HL. If you rotate the dB HL knob to the next position beyond 100 dB, the intensity value 100 flashes on the screen to the right of the audiogram; thereby, indicating that the maximum dB HL for the extended range has been reached. If the dB HL is rotated one more position beyond the flashing 100 dB position, the letters NR appear next to the letters dB above the 1000 Hz. This permits the selection of the no response symbol on the audiogram during testing. The extended range remains selected until either the intensity level for that particular frequency (e.g., 1000 Hz) is brought down 5 positions below the maximum dB HL value (e.g., 65 dB HL for 1000 Hz) or the frequency is changed. To save the threshold value per frequency, press the **M+** button. Note that the appropriate symbol (**0** for right ear and **X** for left ear) for the ear under test is positioned at the correct location on the audiogram. If no response (NR) was detectable over the intensity range available, an arrow is attached to the 0 or X symbol on the audiogram. It is possible to repeat a threshold check for any frequency by returning to that frequency by way of the **<** and **> Hz** buttons. In this instance, the last threshold obtained and saved with **M+** button becomes the value saved in memory and is the value printed out on the audiometric test results.

To present each test tone to the selected test ear, press the **Present** bar. A speaker symbol with an arrow pointing from it appears on the screen between the audiogram and the dB/ Hz values for as long as the **Present** bar is depressed.

NOTE: Although the printout will combine the right and left ear test results on the same audiogram or table, the screen can display only the results from one ear at a time. Therefore, if an ear pushbutton (**R** or **L**) is selected while you are still testing a particular ear, the screen will change to a new audiogram. Once this happens, it is not possible to return to the incomplete audiogram to complete the test sequence.

Screening audiometry

1. Carefully position the earphones over the individual's ears so that the **red phone** covers the right ear and the **blue phone** covers the left ear.
2. Be sure that nothing is obstructing each earphone such as earrings, eye glasses or a hearing aid.
3. Instruct the person being tested to raise a hand or a finger (or press the optional **Handswitch**) whenever a tone is heard.
4. Encourage the patient to respond even if he/she is not sure whether a tone is heard.
5. Select the ear to be tested with the **R** (right) or **L** (left) button.
6. Select the desired screening intensity by rotating the **dB HL** knob to the appropriate position. The American Speech Language and Hearing Association recommends 20 dB as the screening level for school-age children.
7. Select the desired frequency at which to start the test by pressing the **<** or **> Hz** pushbuttons.
8. Present the selected intensity via the **Present** bar.
9. If the individual fails to respond, increase the intensity by 10 dB and try again. Press the **M+** pushbutton at the intensity level where the individual responded.
10. Continue the procedure for all the desired frequencies.
11. These results can be printed in an audiogram or tabular format. Check the **Program** mode to determine which setting has been selected.

Threshold audiometry

1. As described earlier, carefully position the earphones and select the ear to be tested first.
2. Familiarize the individual with the test protocol by presenting a tone of 40 dB HL at 1000 Hz.
3. Decrease the intensity in 10 dB steps until the person no longer responds or until you reach 0 dB HL.
4. When you believe the individual understands the procedure, (i.e., raise your hand/finger when you hear a tone) proceed with the test protocol. The level of the first presentation generally is 10 dB below the level at which the individual responded during the familiarization procedure.
5. Starting at the desired test frequency, present the tone for a period of one or two seconds.

6. If a response is indicated,
   a. decrease the intensity of this same test frequency by 10 dB and present the tone again for one to two seconds.
   b. If no response is indicated, increase the intensity by 5 dB. Present the tone again.
   c. If no response is indicated, increase the intensity by another 5 dB.
   d. If a response is indicated, this is the second time that the individual responded to the same intensity level. Repeat the sequence of down 10 dB and up in 5 dB increments to determine if a correct response is again detected at the same intensity level. The threshold is considered to be the minimum level at which a response has occurred two out of three times. Press the **M+** button when this intensity level is indicated on the screen above the test frequency to signify that the threshold level for that frequency has been reached. Note that the appropriate symbol (**0** = right, **X** = left) appears at the correct intensity level where the threshold was determined.
7. Repeat this test sequence for each frequency to be tested.
8. Once the thresholds have been obtained for all the desired frequencies, select the other ear and repeat the sequence. Note that the display changes to a new screen for storing the second ear's results. The test protocol follows a down 10 dB and up 5 dB sequence to arrive at the threshold level.

Exit audiometry

There are two ways to exit the audiometry mode:

a. Select the **Tymp** mode button

- or -

b. Select the **Tymp Reflex** mode.

Note that the appropriate screen appears on the display.

Tests in memory

The Tymp and Tymp Reflex test results are automatically stored in memory when the test sequence ends. Audiometric test results are stored in memory when **M+** is pressed. A total of eight memory locations are available with the TM 262. Each test result is assigned a memory location number in order of sequence obtained starting with **Ml** and continuing up to **M8**.

To review the individual test results, press the **PAGE** button. Note that the screen contains the appropriate format for each test type stored (e.g., tympanogram or audiogram). The memory number is located in the upper right-hand corner of each screen. If, for example, only five tests were stored in memory, only five memory locations can be scanned. The memory can be scanned a page at a time by pressing the PAGE pushbutton once and observing the result. The entire memory can be scrolled through by holding the PAGE pushbutton down continuously.

Memory erase

If there is a particular test result that you wish to delete before printing, **PAGE** to this test result and press **M-**. This erases that particular test result from memory. The LCD displays a blank screen for erased memories with the memory location number located at the top right corner. Upon exiting from the Erase mode, the stored memories reshuffle and replace the empty memory with the remaining tests in the order in which they were run. The Erase mode will be exited once you press the **PRINT ALL** or **ERASE ALL** buttons or any pushbutton that would normally begin the setup of a new test. Please note that when the Erase mode is entered, a current audiogram is no longer accessible to change or to store new HL values.

NOTE: The instrument is programmed to default to the right ear at 0 dB and 1000 Hz upon selection of a new audiometric test.

If you should wish to erase all tests from memory, press the **M--** (ERASE ALL) pushbutton. For example, the test results have been printed and you wish to test another person.

NOTE: Be certain that you wish to remove all tests from memory before pressing the **M--** pushbutton because the erasure occurs immediately upon pressing the **M--** pushbutton!

Printing test results

The printout will begin with a header if it is selected during the program mode (i.e., TM 262 or a custom header designed by you). The next two lines contain space for entering the individuals name and the test date. This is followed by the test results in the order that they were obtained/ selected.

Either a single test can be printed from memory or the entire group of tests in memory can be printed. To print a single test from memory, use the **PAGE** button to arrive at the desired test result to print. Once this test is displayed, press the **PRINT SCREEN** button.

To print all tests in memory, press the **PRINT ALL** button. When **PRINT ALL** is pressed and two audiogram tests are stored in memory, they will combine under the following conditions. There must be one left test and one right test sequentially stored in memory. A left and right audiometric pair of tests will not be combined if they are separated in the memory by a Tymp test. Therefore, when tests are erased, the resorting could cause a change in left, right or right, left sequence with Audiometric tests. This would result in the wrong audiometric tests being combined when **PRINT ALL** is selected. Prior to selecting **PRINT ALL** you should scroll through the tests in memory to determine where the audiometric tests are located. This will help you avoid combining tests from different patients.

Chapter 4
Test Results

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Ear Canal Volume

Normal

As a general rule, values for ear canal volume should be between 0.2 and 2.0 cm^3. However, the normal values will vary with age and bone structure.

Abnormal

An ear canal value of less than 0.2 cm^3 indicates an abnormal condition. If the probe is partially plugged with cerumen or if the probe is positioned up against the ear canal wall, a smaller than expected value will be measured. Also, if an individual has a relatively large bone structure for his/her age group and a smaller than expected value is measured, the probe could also be partially occluded or up against the canal wall. It is also possible to collapse the canal if the probe is held too firmly against it. Examine the Tympanogram and the reflex results to confirm your suspicions. If they are abnormal as well, it is good practice to repeat the test.

An ear canal volume greater than 2.0 cm^3 also may indicate an abnormal condition. An important application of the ear canal volume measurement is to determine if there is a perforation of the tympanic membrane. If there is a perforation due to trauma or due to the presence of a pressure-equalization (P-E) tube, the measured ear canal volume will be much larger than normal since the combined volume of the ear canal and the middle-ear space is being measured.

Compliance Peak

Normal

The range of normals for compliance is 0.2 cm^3 to approximately 1.4 cm^3. Some groups use a larger range up to 1.8 cm^3. A measured compliance peak within this range indicates normal mobility within the middle-ear system.

Abnormal

A compliance value of less than 0.2 cm^3 indicates a pathological condition as the middle-ear system is stiffer than normal. To distinguish the probable cause of the stiffening, the pressure value where this stiffened compliance peak occurs needs to be considered. For example, normal pressure along with a stiff middle ear system is indicative of a “glue-ear”, otosclerosis, a severely scarred tympanic membrane or a layer of plaque across the tympanic membrane. On the other hand, abnormal pressure along with a stiffened middle-ear system is consistent with a poorly functioning eustachian tube with possible effusion (serous otitis media).

NOTE: If the measured compliance value is less than 0.1 cm^3, the letters NP will be printed next to the heading cm^3 on the screen and printout. The letters “NP” indicate a poorly defined or flat Tympanogram. The Tympanogram may depict a very shallow peak.

A compliance value greater than 1.4 cm^3 (or 1.8 cm^3) indicates a hyperflaccid tympanic membrane or a possible disarticulation depending upon how far above the normal range the value is. Generally speaking, a compliance value of greater than 3.0 cm^3 is indicative of a disarticulated ossicular chain. Further testing is necessary to confirm this suspicion.

NOTE: If a compliance value is measured to be greater than 1.5 cm, the instrument changes the range assigned to the graph automatically and the tympanogram is traced to 3.0 cm.

The validity of tympanometry and acoustic reflex testing is dependent upon a healthy tympanic membrane. A pathological condition at this membrane can mask the true condition of the middle ear.

Pressure Peak

Normal

Strict rules for middle-ear pressure indicate a normal range of ±50 daPa. However, for most applications, a normal range of -150 daPa to +100 daPa is used.

Abnormal

Very rarely will you obtain an extreme positive pressure condition. Some researchers have reported high positive pressures at the onset of acute otitis media.

Pressure values more negative than -150 daPa are indicative of a poorly functioning eustachian tube. The severity of this condition is determined by how negative the pressure is and its impact on the compliance peak.

If no pressure peak is measured over the pressure range of +200 daPa to -400 daPa, then the letters NP will appear on the screen and the printout. This indicates that no pressure peak was detected over this pressure range.

Gradient

Normal

When testing a child, the normal range for the gradient is between 60 and 150 daPa. (Infants may show higher gradient values due to the mobility of their ear canals.) The range of normal is somewhat narrower for adults i.e., 50 to 110 daPa.

Abnormal

A high gradient value (greater than the high end of the normal range per age group) is indicative of middle-ear effusion. The reduced compliance values and negative middle-ear pressure characteristic of developing or resolving otitis media with effusion (OME) will be manifested in a broad tympanogram with a large gradient value. However, abnormal gradient values may also be found in the absence of abnormal parameters. This could indicate a transient OME, so a retest after several weeks may be recommended.

When the middle ear's mobility is reduced to near 0 cm^3, due to viscous effusion or a "glue-ear" condition, no gradient value can be measured. In this case, dashes (—) will be displayed next to the letters GR.

Very low gradient values are associated with a flaccid middle ear system. These low values should be taken into consideration with the ear canal volume and compliance peak values to determine the probable use of the flaccid condition.

Acoustic reflex

Normal

For screening purposes, an ipsilateral reflex measured at any one of the three levels available per frequency can be considered normal. Obviously, the lowest values are desired. However, without knowing the hearing threshold level of the individual per frequency, it is difficult to make a more definite statement. Generally speaking, the reflex is reported to occur at between 70 and 90 dB HL above the hearing threshold in normals. Remember that these values apply to reflex threshold measurements and that your instrument does not permit reflex threshold measurements due to the use of a hand-held probe. The presence of a reflex in the absence of a compliance peak suggests that the tympanometric results should be considered invalid and the test repeated. This is true because if there is no compliance measured during tympanometry, it is not possible to measure any stiffening affect during the reflex stimulus presentation.

Abnormal

If a pressure leak occurs during the reflex testing and the pressure system is unable to correct for this leak, the reflex test sequence is aborted. When this occurs, the test results are assigned the letters NT (Not Tested).

If no response is obtained at the third and final stimulus level, the instrument will indicate this with the letters NR or No. More detailed testing at the frequency where this occurred is required to determine the reason for the no response.

Audiometry

Normal

A normal response from a child should be at or below 20 dB HL. A normal response from an adult will be somewhat higher at or below 25 dB HL. Remember that these normal values assume a quiet environment during testing.

Abnormal

In children, a failure to respond to a 20 dB HL (or lower) stimulus presentation during a retest performed four to six weeks after the initial test would indicate the need for more extensive diagnostic testing to determine the cause.

In adults, a failure to respond at or below 25 dB HL when the room noise levels are low indicates the need for more evaluation. However, the age and employment history of the individual must also be considered.

Special Messages and Error Codes

Error code numbers and other “special” messages may be displayed on the screen or on the printout. These messages appear whenever an instrument error occurs or, in some instances, to apprise the operator of certain situations. For example, if there is no test result on the screen and the print screen pushbutton is pressed, the printer will indicate “No Test To Print”

Error codes will appear as a two-digit number prefixed by the letter “E”. If an error code appears, please repeat the operation that caused the error code to appear. If the error code appears for the second time, make a note of it and contact your Welch Allyn Service Representative, giving him/her the exact error code number.

Sample Test Results

Figures 1 through 10 illustrate test results from sample TM 262 Auto Tymp printouts. The smoothness of the tympanogram tracing is determined by the amount of movement during the testing. Little or no movement during the testing provides a smoother tracing. Moving, talking or crying during testing leads to a more erratic looking tracing but does not dramatically affect the test results.

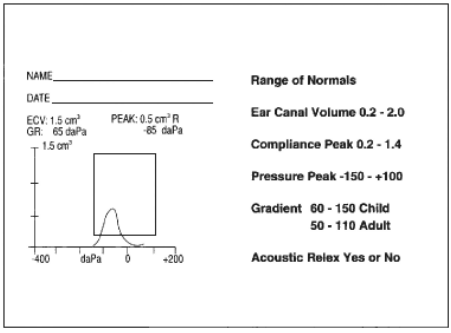

Figure 1: Range of Normals

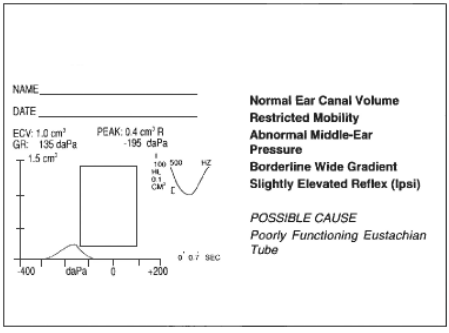

Figure 2: Abnormal Tymp

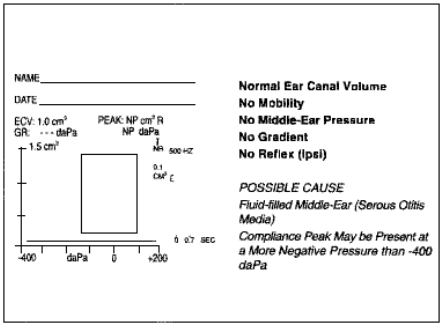

Figure 3: Abnormal Tymp

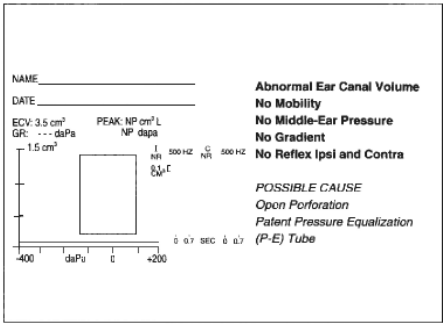

Figure 4: Abnormal Tymp

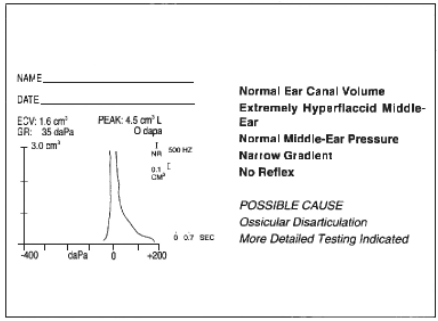

Figure 5: Abnormal Tymp

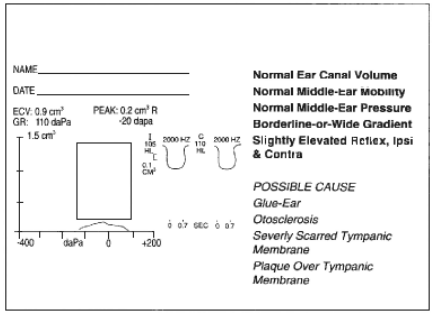

Figure 6: Abnormal Tymp

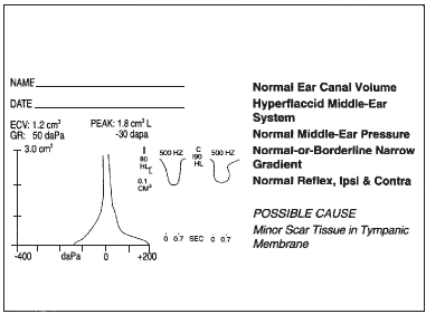

Figure 7: Abnormal Tymp

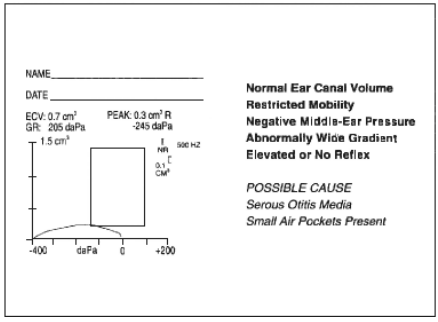

Figure 8: Abnormal Tymp

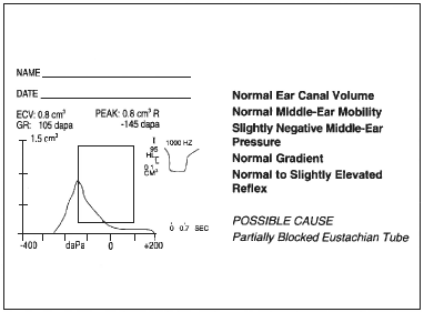

Figure 9: Abnormal Tymp

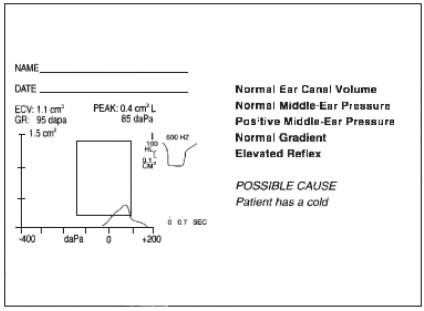

Figure 10: Abnormal Tymp

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Chapter 5
RS-232 Interface

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Introduction

The RS-232 Interface option provides the capability of transferring stored test results from the instrument to an external computer or data collection device via an optically isolated serial interface.

⚠WARNING Only equipment that meet the requirements of IEC 60601-1-1 rating may be connected to the Serial interface. Computers should meet the requirements of IEC 60950-1 and be connected through an isolation transformer. Users should take precautions to not touch the patient and equipment connected to the serial interface.

Operation

Press the **DATA TRANSFER** button to transfer test results stored in memory. During data transfer, the message "DATA TRANSFER" will appear on the LCD screen.

Transferring during normal operation

During normal testing operation, pressing the **DATA TRANSFER** button will transfer all stored test results sequentially. The test results are transferred with one record for each memory location in the order in which they are stored. Any test results which have been erased will not be transferred.

Transferring from memory pages

If the **PAGE** button is used to review individual test results stored in any of the eight memory locations, the **DATA TRANSFER** button will transfer only the currently displayed stored test results. There is one exception to this rule: If the last (most recent) test result is displayed, the instrument assumes normal testing operation, and transfers all test results.

Other LCD screen messages

"INVALID SELECTION

This message appears if the **DATA TRANSFER** button is pushed during any of the following circumstances:

- During presentation of an audiometric tone
- During a tympanometry test
- During a reflex test
- During Printing

NO DATA AVAILABLE

This message appears if the **DATA TRANSFER** button is pressed and **no result**s are stored.

NOT AVAILABLE

This message appears if the **DATA TRANSFER** button is pressed and the RS-232 interface is **not** installed.

Record Formats

General record format

All output records are transmitted in a predefined, fixed length format. The generic format for all records is:

":"	**Record Type**	**Record Sequence Number**	**Record Index Number**	**Total Record Number**	**Data Fields**	**Checksum**	**"CR" "LF"**

Each record contains only printable ASCII characters, other than the terminating "CR" "LF" characters. Each record consists of fixed length data fields with any unused data fields filled with a value of 0. The Record Sequence Number is a value from 0 to 9, which is incremented by 1 for each new record transmitted. This value will wrap around from 9 to 0. A record will be retransmitted with the same sequence number if retransmission is necessary due to a communications error.

The Record Index Number is a value from 0 to 8 which indicates the record number within a group of records when all test results are transmitted. For example this value will identity a record as Record 1 of 5 or Record 7 of 8 when used in conjunction with the Total Record Number. If only the currently displayed record is being transferred, this value will be 1.

The Total Record Number is a value from 1 to 8 which indicates the total number of records to be transmitted in a group when all tests results are transmitted.

The Checksum is calculated as the mod 256 sum of all preceding characters in the record, including the ":" prefix, with the most significant bit = 0 and stored as two Hex ASCII characters.

Tympanometry and Reflex test results record

Character Number	Number of Characters	Data Type	Field Name	Field Description
1	1	ASCII	Start of record	"."
2	1	ASCII	Record Type	"x"
3	1	ASCII	Record Sequence Number	"0" to "9"
4	1	ASCII	Record Index Number	"1" to "8"
5	1	ASCII	Total Record Number	"1" to "8"
6	5	ASCII	Reserved	Reserved for future use. Defaulted to "------"
11	2	uChar	Ear	Ear under test Bit 0 = 1 = Left ear under test = 0 = Left ear not under test Bit 1 = 1 = Right ear under test. = 0 = Right ear not under test Bits 2-7 = Not used Either the RIGHT ear is selected OR the LEFT ear is selected. Both ears selected or no ear selected is invalid.
13	4	uint	ECV	Ear canal volume in cm^3 measured at +200daPa, stored as ECV x M. Range = 0.00 to 6.00 cm^3
17	4	uint	Peak Compliance	Peak compliance in cm^3, stored as compliance x 64. Range = 0.00 to 6.00 cm^3
21	4	sint	Peak Pressure	The pressure where the peak compliance occurred, stored in daPa. Range = 399 to 200 daPa
25	4	sint	Gradient	Gradient value calculated as the pressure difference at the compliance half-peak points stored in daPa. Range = -1 to 500 daPa -1 = No gradient has been calculated yet 0 = No gradient could be calculated.
29	2	sChar	End Index	The data index where the last compliance data point is stored. Range = -1 to 87 -1 = No data was stored.

Character Number	Number of Characters	Data Type	Field Name	Field Description
31	2	sChar	Slow Index	The data index where the last compliance data point measured at 600 daPa/sec before the rate changes to 200 daPa/sec is stored. -1 = No rate change occurred
33	2	sChar	Fast Index	The data index where the first compliance data point measured at 600 daPa/sec after changing back to 600 daPa/sec from the 200 daPa/sec rate is stored. -1 = No rate change back occurred
35	2	uChar	Tymp Data [0]	Tympanometry compliance data point #0 in cm^3, stored as: compliance X 64. Range = 0.00 to 3.98 cm^3. A maximum of 88 data points are stored per Tympanometry test.
:	**:**	**:**	**:**	**:**
209	2	uChar	Tymp Data [87]	Tympanometry compliance data point #87 in cm^3, stored as: compliance X 64
211	2	uChar	Tymp Scale	Tympanometry compliance axis scale. 15 = 1.5 cm^3 30 = 3.0 cm^3
213	2	uChar	Number of Reflex Tests	The number of reflex tests performed Range = 0 to 4
215	2	uChar	Reflex Test Parameters	**Reflex test selection parameters.** **Bit 0 = Ispi status:** **0** = Not selected **1** = Selected **Bit 1 = Contra status:** **0** = Not selected **1** = Selected **Bit 2 = 500 Hz status:** **0** = Not selected **1** = Selected **Bit 3 = 1000 Hz status:** **0** = Not selected **1** = Selected **Bit 4 = 2000 Hz status:** **0** = Not selected **1** = Selected **Bit 5 = 4000 Hz status:** **0** = Not selected **1** = Selected **Bits 6 & 7** = Not used

Character Number	Number of Characters	Data Type	Field Name	Field Description
217	2	uChar	Reflex #1 Result	Results of Reflex test #1 **Bits 1 & 0 = dB level tested:** **00** = Low dB level **01** = Middle dB level **10** = High dB level **11** = Invalid **Bits 3 & 2 = Reflex tests status:** **00** = NT = Not Tested **01** =YES = Yes, a reflex was detected **10** = NR = No Reflex detected **11** = NT_CAL = Not Texted due to a CALibration data error **Bits 5 & 4 = Test frequency:** 00 =500 Hz 01 = 1000 Hz 10 = 2000 Hz 11 = 4000 Hz **Bits 6 = Test type:** 0 =IPSI 1 = Contra Bit 7 = Not used
219	4	uint	Reflex #1 Baseline Average	Average baseline compliance, in cm^3 X 256
223	4	uint	Reflex #1 Reflex Average	Average reflex compliance, in cm^3 X 256
227	4	uint	Reflex #1 Reflex [0]	Reflex compliance data point #1 of 4, in cm^3X 256.Bit 15 = Noise indicator0 = Quiet data measurement1 = Noisy data measurement, potentially unreliable
:	**:**	**:**	**:**	**:**
239	4	uint	Reflex #1 Reflex [3]	Reflex compliance data point #4 of 4, in cm 3 X256.Bit 15 = Noise indicator0 = Quiet data measurement1 = Noisy data measurement, potentially unreliable
243	4	uint	Reflex #1 Recovery [0]	Reflex recovery compliance data point #1 of 6measured after the stimulus is turned off, in cm^3 X 256,Bit 15 = Noise indicator0 = Quiet data measurement1 = Noisy data measurement, potentially unreliable
:	**:**	**:**	**:**	**:**

Character Number	Number of Characters	Data Type	Field Name	Field Description
263	4	uint	Reflex #1 Recovery [5]	Reflex recovery compliance data point #5 of 6measured after the stimulus is turned off, in cc X 256,Bit 15 = Noise indicator0 = Quiet data measurement1 = Noisy data measurement, potentially unreliable. The recovery points #5 and #6 are only included when the recovery is slow and there was no recovery according to the first four recovery data points. If not included, their values will be 0.
267		asst	Reflex #2	See Reflex #1 format.
317		asst	Reflex #3	See Reflex #1 format.
367		asst	Reflex #4	See Reflex #1 format.
417	2	uChar	Checksum	The hexadecimal sum of characters 1 to 416
419	2	ASCII	Package Terminator	“CR, “LF”

Audiometry test results record

Character Number	Number of Characters	Data Type	Field Name	Field Description
1	1	ASCII	Start of record	"."
2	1	ASCII	Record Type	"y"
3	1	ASCII	Record Sequence Number	"0" to "9"
4	1	ASCII	Record Index Number	"1" to "8"
5	**1**	**ASCII**	**Total Record Number**	**"1" to "8"**
6 **11**	**5** **2**	**ASCII** **uChar**	**Reserved Ear**	**Either the RIGHT ear is selected OR the LEFT ear is selected. Both ears selected or no ears elected is invalid.**
13	**4**	**sint**	**HL Threshold 125 Hz**	**-10 to +100 dB HL x 2 NR = Any value in the range of 231 to 450 NT = 32,768 (0x8000 Hexadecimal)**
:	**:**	**:**	**:**	**:**
53	**4**	**sint**	**HL Threshold 8000 Hz**	**-10 to +100 dB HL x 2 NR = Any value in the range of 231 to 450 NT = 32,768 (0x8000 Hexadecimal)**
57	**2**	**uChar**	**Checksum**	**The hexadecimal sum of characters 1 to 56**
59	**2**	**ASCII**	**Package Terminator**	**"CR", "LF"**

Notes

1. "uChar" & "sChar" designate unsigned and signed characters respectively, single bytes represented in Hexadecimal by two ASCII characters.

   Example: OxE9 is sent as: "E", "9"

2. "ulnt: and slnt" designate unsigned and signed 16-bit integers respectively, expressed in HiByte/ LowByte sequence by four Hex ASCII characters.

   Example: OxE196 is sent as: "E", "1', "9", "6"

3. Tympanometry compliance values are stored in the record scaled by 64. To convert to cm^3, divide by 64.

   Example: Tymp Data[0] = "4", "2" = 0x42=66 decimal scales X64 = 66/64 = 1.0-3 cm^3

4. Reflex compliance values are stored in the record scaled by 256: To convert to cm^3, divide by 256.

Example: Reflex #1 Reflex [0] = “0”, “3”, “0”, “D” = Ox3OD = 781 decimal scaled X 256 = 781 /256 = 3.051 cm^3

5. Audiometry Threshold values are stored scaled by 2 in the sequence of 125 Hz, 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000 and 8000 Hz.

   Example: HL Threshold 125 Hz = “0”, “0”, “9”, “6” = 0x96 = 150 decimal scaled x 2 = 150/2 = 75 dB

6. The pressure at which a Tympanometry compliance value was measured at is not contained in the data record but may be calculated.

   At the start of each pressure sweep, the pressure sweep rate is 600 daPa/sec. If the compliance begins to rapidly increase, the pressure sweep rate changes to 200 daPa/sec and remains at that rate until the compliance rate of change has sufficiently slowed down to allow the pressure sweep rate to return to 600 daPa/sec.

   While the pressure sweep rate is 600 daPa/sec, a compliance data point is stored at every 12 daPa drop in pressure and at 200 daPa/sec a compliance data point is stored at every 3 daPa drop in pressure. The Slow Index and Fast Index values in the data record indicate where the pressure sweep rate changes, if any occurred.

7. Reflex compliance values are stored in three groups: 1 Reflex Baseline Average value which is the reference measurement performed before the stimulus is presented, 4 Reflex compliance data points which are measured while the stimulus is presented and stored as the relative compliance change form the Baseline Average value, and 4 to 6 Reflex recovery compliance data points which are measured after the stimulus is turned off and stored as the relative compliance change form the Baseline Average value.

Data Transmission Protocol

The RS-232 Interface uses a Auto Repeat Request (ARQ) communications protocol to ensure the reliable transfer of data. With this protocol. the instrument will transmit a data record and then wait for a response from the external device. If the external device receives the record correctly, is should respond with an acknowledge “ACK” character (ASCII control character ACK). If the record is not received correctly, the external device should respond with a **N**ot **A**c**K**nowledge “NAK” character (ASCII control character NAK.)

If an ACK is received within 3 seconds of the completion of the transmission, the transmission has been completed successfully. The “DATA TRANSFER” message is erased and normal operation resumes.

If after the transmission of a record there is no response within three seconds, the record is retransmitted with the same Record Sequence Number. If such a timeout occurs after the second attempt, then the message “NO RESPONSE” is displayed, any pending transmissions are aborted, and normal operation resumes

If a NAK response is received during a transmission or within three seconds after the transmission is completed, the record is retransmitted with the same Record Sequence Number. If the transmission is not acknowledged within three attempts the message ‘TRANSFER NOT COMPLETE” is displayed for about three seconds, any pending transmissions are aborted, and normal operation resumes.

The NAK responses and timeouts are treated independently. Thus, when a combination of errors is happening, the NAKs and timeouts are being counted separately. If the transfer is not successful, the error message displayed corresponds to the failure condition that occurs first.

The only expected response from the external device to your instrument is an ACK or a NAK character. When a series of records are transmitted, the external device must ACK or NAK after each record.

Data Transfer Program Mode

The Data Transfer Program mode is used to modify the RS-232 interface configuration parameters to match the computer's RS-232 parameters. To enter the Data Transfer program mode,

1. Enter the User Selections Program mode by selecting the **PROG**ram pushbutton.

   Press the **DATA TRANSFER** button.

   The following screen appears the first time the Data Transfer Program mode is entered showing the default settings set at the factory.

PROGRAM MODE - DATA TRANSFER

19.2 kBAUD	*** NO PARITY + 8-BIT DATA**
*** 9600 BAUD**	**ODD PARITY + 7-BIT DATA**
4800 BAUD	**EVEN PARITY + 7-BIT DATA**
2400 BAUD	**SPACE PARITY + 7-BIT DATA**
1200 BAUD	*** XON/XOFF FLOW DISABLED**
600 BAUD	**XON/XOFF FLOW ENABLED**

These selections fall into three difference groups of control:

- Baud rate
- Parity and data bits
- Flow control

The default setting for each group has an asterisk (*) before it so that it is easy to scan the settings for each group.

Selecting difference default settings for any of the groups is done in the same manner as the Program mode.

1. Use the **<Hz** or **>Hz** buttons to move the solid square cursor down or up to the setting that you wish to select.
2. Press the **M+** pushbutton. The word SAVED will appear in the lower right margin of the screen and the asterisk (*) will be repositioned in front of the new setting.

Exit the Data Transfer Program mode by selecting either the DATA TRANSFER or PROGram pushbuttons. This will return you to the User Selections Program mode which can be exited by selecting PROGram a second time.

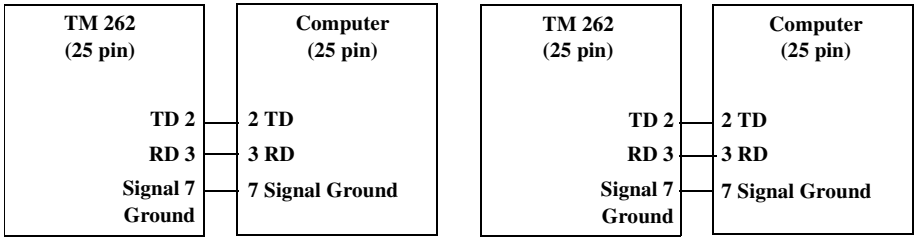
RS-232 Interface

Interface configuration

The configuration of the TM 262 RS-232 interface must be set to match the interface configuration of the computer. The TM 262 defaults to 9600 baud, no parity, 8 data bits, 2 stop bits and no communications flow control. The default settings for the baud rate, parity, number of data bits and flow control may be modified using the ***Data Transfer Program Mode*** explained earlier in this chapter.

Cable connections

The RS-232 interface provides a serial interface consisting of RxD (Received Data) and TxD (Transmitted Data) using a standard DB-25 female connector. A straight through cable can be used to connect to either a 25 pin or 9 pin (using an appropriate adapter) connector on the external device.



Communications flow control

Software XON/XOFF flow control is available to allow software commands from the external computer to start and stop the flow of data from your instrument. No hardware flow control is provided. Sending XOFF (ASCII control character [DC3]) to the instrument pauses its transmission.

Sending XON (ASCII control character [DC1]) to your instrument resumes the transmission.

Once XOFF is received by the instrument, XON must be received within six seconds. If not received within this time, then the message “NO RESPONSE” is displayed for about three seconds, transmission is aborted, and normal operation resumes.

After an XOFF timeout, the next transmission waits for XON to be received within six seconds as described above.

These commands are valid only during data transmission and when enabled in the Data Transfer Program Mode.

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Chapter 6
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U.S. Department of Labor, Occupational Noise Exposure, CFR 1910.95, March 8, 1983.

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Chapter 7
Specifications

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Specifications

Standards: UL 60601-1 Medical Electrical Equipment Requirements for Safety
IEC/EN 60601-1 General Requirements
CSA C22.2 No.601-1-M90
ANSI S3.39-1987 Aural Acoustic Impedance Admittance (Type 3) IEC 1027-1991 Aural Acoustic Impedance/ Admittance (Type 3 ANSI S3.6-1989 Audiometers (Type 4)
IEC 60645-1 Pure Tone Audiometers (Type 4)
PTB Certificate No. 15.11-94/53 Pure Tone Audiometers (Type 4)

Protective Classification: This system is intended for continuous operation and has a protective classification of Class II, Type B.

Class II  **Type B**  equipment symbols

Tympanometry/Reflex modes

Probe Tone: 226 Hz, ±3%

Sound Pressure Level: 85.5 dB SPL, ±2.0 dB, measured in a 2.0 cm^3 coupler

Harmonic Distortion: <5%

Admittance (Compliance) Range: 0 to 1.5 cm^3
0 to 3.0 cm^3

NOTES:
1. The range is automatically selected based upon the amplitude of the compensated (tymp only) tympanogram.
2. The maximum uncompensated (ECV + tympanogram peak) admittance (compliance) range is 0 to 5.0 cm^3.
3. ECV/cavity limits for initiating pressurization is 0.2 to 6.0 cm^3. Compliance Accuracy: ±0.1 cm^3 or ±5%, whichever is greater

Pneumatic system

Pressure Range: +200 to -400 daPa

NOTES:
1. daPa = 1.02 mmH20
2. Pressure sweeps to at least -100 daPa. To save test time, pressure
3. Sweep stops once tympanogram returns to baseline after -100 daPa.
4. Full pressure sweep for 6 cm^3 from sea level to 7000 ft. altitude with no leak.

Pressure Accuracy: ±10 daPa or ±15%, whichever is greater

Rate of **Sweep:**	600 daPa/sec except near tympanogram peak where sweep rate slows to 200 dapa/sec to provide better definition of peak compliance.
Direction of Sweep:	Positive to negative
Tymp Test Time:	Approximately 1 second **NOTE**: High compliance tympanograms will take somewhat longer.
Gradient:	Tympanogram pressure with at 50% of peak compliance.

Acoustic Reflex Stimuli

Frequencies:	500, 1000, 2000, and 4000 Hz
Accuracy:	±3%
Total Harmonic Distortion:	<5%
Rise/Fall Time:	5 to 10 msec
Output Levels:	
IPSI:	**500 and 4000 Hz**80, 90,100 db HL **1000 and 2000 Hz**85, 95, 105 dB HL **NOTES:** 1. psi stimuli are time multiplexed with probe tone (106 mS ON, 53 mS OFF). 2. Stimuli are presented at lowest level first. If there is no response, the intensity is increased by 10 dB until a response is detected or the maximum dB HL is reached.
Pressure:	Automatically set to pressure at peak compliance with an offset of -20 daPa.
Reflex Determination:	Compliance change of 0.05 cm^3 or greater.
Reflex Test Time:	1 to 12 seconds depending upon the number of ipsi test frequencies selected (4 maximum) and intensity required.

Probe LED Indicators

Steady yellow:	Occlusion
Blinking green:	Ready to start
Steady green:	Testing test in progress
Steady orange:	Leak

Audiometry mode (Model No. 26230, No. 26230-RS, No. 26235, No. 26235-RS only - marked “Version 4”)

Frequencies: 125, 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000, 8000 Hz

Accuracy: ±3%

Total Harmonic Distortion: < 3% (125 to 3000 Hz measured acoustically at maximum dB HL; 4000 and 6000 Hz measured electrically)

Power

Line Voltage: 100 - 240 VAC (±10%)

NOTE: Desktop power supply.

Frequency Range: 47 - 63 Hz (±5%)

Line Voltage Current: 0.2 A at 120 VAC or 0.1 amps at 240 VAC

Power Consumption: 30 watts maximum while printing. Low voltage input for desktop power supplies 12 VDC, 2.5 A

Environmental

Temperature:

Operating: 60 to 105 deg. F (15 to 40 deg. C)

Relative Humidity: 20-80% noncondensing

NOTE: Warm-up time is required if storage temperature is different from room temperature.

Storage: -30 to 149 deg. F (-34 to 65 deg. C)

Humidity: 5% to 90%

Shipping Conditions:

Normal instrument shipping conditions may exceed recommended storage and operating specifications. Original instrument packaging has been designed to allow shipment and storage in typical shipping conditions for up to 60 days.

Typical shipping conditions may range in temperature from -34 degrees C to 65 degrees C, and humidity levels may vary from 15% - 95%, noncondensing.

Mechanical

Dimensions: 13.15" W x 14.5" D x 4.3" H

33.66 cm W x 35.56 cm D x 9.53 cm H

Weight: 10 lbs (5.0 kg) net

14 lbs (5.0 kg) shipping

Intensity Levels

125 Hz	-10 to 50 dB HL **500 to 6000 Hz**-10 to 90 dB HL **250 and 8000 Hz**-10 to 70 dB HL **NOTE:** An additional +10 dB is available per frequency via the +10 dB pushbutton.
Accuracy:	125 to 4000 Hz ±3 dB 6000 and 8000 Hz ±5 dB
Step Size:	5 dB
Signal-to-Noise Ratio:	> 70 dB in 1/3 octave; less than -10 dB HL for levels less than 60 dB HL
Rise/Fall Time:	20 to 50 msec

Tone Format:

Tone is normally off until present bar is depressed.

Continuous	Steady when present bar is depressed
Pulsed	2.5/sec (i.e., 200 msec ON, 200 msec OFF)
FM (frequency modulated)	5 Hz, ±5%

Transducers

IPSI:	Welch Allyn design
Audiometric Headset:	Pair TDH-39 earphones with MX41AR cushions (60 ohms impedance) Headband force per ANSI S3.6 and IEC 645 (4.5 ±0.5)N (Model No. 26230, No. 26230-RS, No. 26235, No. 26235-RS only - marked “Version 4”)

Printer

Paper Roll Length:	Approximately 80 feet (960")
Tests/Roll:	
Versions 1 and 2:	Approximately 420 Tymps/Reflex or 210 people
Versions 3 and 4:	Approximately 230 tests or 115 people
Assumption:	2 Tymps/Reflex + 1 Audiogram per person)
Speed:	Approximately 1.5 minutes to print three screens: Tympanogram Tympanogram + reflex (4) Audiogram

Supplied accessories

Probe (all versions)	1738-3200
TDH-39 Headset (model numbers 26230/26235 only)	#23223
Test Cavity (all versions)	#26241
Eartips, (Probe) 6 sizes, 2 each (all versions)	#26100
Paper 5 rolls thermal 3" wide (all versions)	#52601 qty: 5

Optional Accessories

Carrying Case	#05260
Dust Cover	#26240
Patch Cord (1)	#23221
Subject Response Handswitch	#23220
Earphone Sound Enclosures	#23222
RS-232 Cable (10' - DB-25 M/F Straight Through)	#26243
RS-232 Cable Adaptor (DB-25M/DB-09F)	#26244
Eartips	
8mm, 1 box of 25	#26008
11mm, 1 box of 25	#26011
13mm, 1 box of 25	#26013
15mm, 1 box of 25	#26015
17mm, 1 box of 25	#26017
19mm, 1 box of 25	#26019
Replacement Paper	#52601

Catalog Listing

Tymp and Ipsi Reflex	
TM 262 Auto Tymp (USA)	#26200
TM 262 Auto Tymp (Export, specify country and voltage)	#26205
TM 262 Auto Tymp (Includes RS-232 Interface) (USA)	#26200-RS
TM 262 Auto Tymp (Includes RS-232 Interface) (Export, specify country and voltage)	#26205-RS
Tymp and Ipsi Reflex and Manual Audiometer	
TM 262 Auto Tymp (USA)	#26230
TM 262 Auto Tymp (Export, specify country and voltage)	#26235
TM 262 Auto Tymp (Includes RS-232 Interface) (USA)	#26230-RS
TM 262 Auto Tymp (Includes RS-232 Interface) (Export, specify country and voltage)	#26235-RS

A
Accessories supplied 2-3
Acoustic reflex 4-5
Altitude adjustment 2-13
Ambient noise 2-15
Audiogram range 3-14
Audiometric Checks (Models with Audiometer only) 2-15
Audiometric format during printing 3-13
Audiometry 4-5
Audiometry test results record 5-9
Audiometry Test Sequence (Models with Audiometer only) 3-19
Audiometry testing information 3-10

B
Bibliography 6-1
Biological Check 2-16
Bottom Panel Labels and Connectors 2-9

C
Cable connections 5-13
Calibration 2-12
Cleaning the system 3-3
Communications flow control 5-13
Compliance Peak 4-3
Connectors 2-9
Controls and Indicators 2-5

D
Data Transfer Program Mode 5-12
Data Transmission Protocol 5-11
Display 2-7

E
Ear Canal Volume 4-3
Earphone Care (Models with Audiometry only) 3-7
Eartip care 3-3
Electromagnetic Compatibility (EMC) 1-a
Elimination of ambient noise 2-15
EMC 1-a
Error Codes 4-6
Exit audiometry 3-22
Exit reflex 3-18
Exit tympanometry/reflex 3-18
Exiting the program mode 3-14

F
Formats 5-4
Front Panel Controls and Indicators 2-5

G
General record format 5-4
Glossary of terms 1-10
Gradient 1-5, 1-6, 4-4
Green lamp 2-12

H
Helpful hints 3-8

I
Indicators 2-5
Initial set-up 2-10
Inspection 2-3
Installation 2-1
Instructing the patient/subject 3-10
Interface configuration 5-13

L
Labels 2-9
LCD screen messages 5-3
Loading the paper 2-10

M
Maintenance 3-3
Manual audiometry 1-8
Memory erase 3-23

N
Noise recovery period 2-15
Normal box format 3-14

O
Obtaining a seal 3-8
Operation 3-1
Orange lamp 2-12
O-Ring 3-5

P
Panel Controls and Indicators 2-5
Paper storage 2-11
Paper supply 3-7
Placement of earphones 3-10
Pressure Peak 4-4
Pre-Test Audiometric Checks (Models with Audiometer only) 2-15
PreTest Tymp checks 2-12
Print header format 3-12
Printer and Display 2-7
Printing test results 3-24
Probe care 3-4
Probe Indicators 2-4
Probe nose cone cleaning 3-4
Probe reassembly 3-6
probe wire 3-6
Program Mode 3-11

R
Rear and Bottom Panel Labels and Connectors 2-9
Record Formats 5-4
Recycling / disposal 1-9
Reflex 5-5
Reflex format 3-11
Reflex test results record 5-5
Reflex Test Sequence 3-15
Repair 1-b
Response handswitch (optional accessory) 3-10
RS-232 Interface 5-1, 5-13

S
Sample Test Results 4-6
Screening acoustic reflex 1-7
Screening audiometry 3-21
Service and Repair 1-b
Special Messages 4-6
Specifications 7-1

T
Tests in memory 3-23
Threshold audiometry 3-21
TM 262 1-3
Transferring during normal operation 5-3
Transferring from memory pages 5-3
Tympanometry and Gradient 1-5
Tympanometry and Reflex test results record 5-5
Tympanometry testing information 3-8
Tympanometry/Reflex Test Sequence 3-15

U
Unpacking and Inspection 2-3

W
Warranty 1-b

Y
Yellow lamp 2-12