

Technology for People Having Severe Hearing Losses **HEARING AIDS and ASSISTIVE TECHNOLOGY**

From 1967 through 1997 **The National Institute for Rehabilitation Engineering** (N.I.R.E.) had been custom-making and fitting HEARING AIDS and other ASSISTIVE AUDITORY DEVICES, with field testing and on-site user training in people's homes and places of work. We helped hundreds of people with severe hearing losses to lead better quality lives in their various social, employment and travel environments. This paper is based on data from the files of hundreds of clients successfully helped in the stated 30-year period ...plus new technologies developed through the year 2002.

The N.I.R.E. is a non-profit IRS section 501c3 organization supported by grants and contributions. It is devoted to using assistive technology to better the lives of people with permanent, incurable physical disabilities.

Many hearing aids had to be customized for each severely impaired person in order to be most effective. Some people with severe hearing losses were not aided sufficiently by hearing aids, alone, but needed and benefited from additional augmentative devices.

Developed by engineers from the telephone and telecommunications industries, the technology for designing, constructing and using augmentative devices for hearing impaired individuals has been highly successful, *not as a substitute for medical treatment or therapy* but as an additional way for functionally helping people whose hearing remains significantly impaired, even after all available medical, surgical and therapeutic efforts – and with hearing aids. In 1998, the N.I.R.E. closed its hearing clinics and stopped dispensing assistive equipment. Our focus changed from having people come to our clinics from all over the country. Now, we provide information, referrals, and technical support so that disabled people can be assisted locally, where they live, by local service providers who have access to our information and technical support.

This paper is written at typical high school graduate level for multi-disciplinary use. It is intended to be fully understood by hearing-impaired individuals and family members, by physicians, engineers, technicians, audiologists and hearing aid dispensers, and by educators, employers and employment counselors.

This Institute does not give medical advice. We urge that all hearing-impaired individuals be under the care of a qualified otolaryngologist (ear, nose & throat physician) and an ASHA certified audiologist before purchasing hearing aids or other augmentative equipment for hearing improvement. The purpose of this paper is to describe possible ways to help individuals with severe residual hearing losses to function more efficiently under varying environmental sound conditions than possible with conventional hearing aids alone.

Terminology ...and Other Background Information

Hearing Loss refers to the native physical state of a person's hearing ... without the use of hearing aids or other assistive technology. The two ears may be equally- or unequally- affected. The loss may be flat across the entire frequency spectrum or it may increase as the pitch or frequency increases. "Hearing Loss" can be defined by standardized audiograms. **Basic Types of Hearing Loss:** (1) *Conductive Loss* – this is usually completely correctible by an ear surgeon; (2) *Nerve Loss* – this is usually NOT correctible and requires the use of hearing aids and/or other augmentative devices; and (3) *Mixed Loss* - which is a combination of conductive and nerve loss. The ENT physician and audiologist, conferring together, can usually determine the ratios of the losses and whether surgery to correct the conductive losses would be beneficial enough to be worth undergoing. Hearing aids may still be needed by these patients, even after conductive loss repair surgery. Even so, hearing may be much better after surgery, in many cases, than it would have been without surgery – even with hearing aids. Some **Common Causes of Hearing Loss:** (1) *congenital defects* – often but not always non-repairable – sometimes runs in families but not always; (2) *infectious diseases* – such as mumps, measles, German measles, meningitis, etc. – resulting nerve losses usually not medically correctible – more likely to affect children than adults; (3) *exposure to excessive environmental noise* – long term or very intense, short term – resulting in non-correctible nerve damage; (4) *progressive conductive loss due to calcification of the middle-ear sound-conducting bones* – usually correctible surgically; (5) *progressive nerve loss due to diabetes - or chronic high-fat diet* - sometimes reversible with diet changes and/or medication; (6) *progressive nerve loss due to aging and/or unknown factors* – usually not medically correctible and requiring hearing aids and/or assistive technology; (7) *damaged eardrums* – usually correctible surgically; (8) fluid in middle- or inner- ear, usually correctible; and (8) *cochlear implants* – which upgrade from

deafness to hearing-impairment, requiring special assistive devices and speech discrimination training.

Hearing Impairment refers to the functional state of the person *with hearing aids and/or assistive technology* and has to be defined separately for different living or working environments and varying functional conditions. Another term is: “**Residual Hearing Impairments for Defined Activities, Using Hearing Aids.**” This cannot be defined with standard audiograms. Instead, speech discrimination scores must be developed in the field for each of many different environmental situations. *Note: Some clinics can simulate these conditions for, testing purposes, to avoid having to take on-site measurements.*

Functional Benefits Needed include any one or more of the functions listed below. The most basic function is listed first and the most advanced function is last.

- (A) Ability to hear noises and sounds including horns, telephone bells, sirens, alarm clocks, telephone bells, etc.
- (B) Ability to recognize from which direction a warning sound is coming from. This requires nearly equal sensitivity and functioning of both ears and is important to have, if possible... for safety reasons.
- (C) Ability to hear and understand isolated speech without background noise or competing voices. One should be able to hear and understand voices of all pitches, i.e. the voices of children, adult women and adult men.
- (D) Ability to pick out a single voice to hear and understand, even when there are competing voices and/or distracting background noises. This requires nearly equal sensitivity and functioning of both ears. One should be able to understand voices of all pitches, i.e. the voices of children, adult women and adult men.
- (E) Ability to discriminate and recognize individual voices by their unique sounds. This is not always possible.

Benefits (A) through (D) are necessary for normal living in the hearing world. (E) is desirable but not absolutely necessary and not always attainable. *The most desirable solution for people with non-correctible hearing loss* is to be able to buy and wear hearing aids – to achieve Goals (A) through (D) with them and to NOT need additional augmentative devices for specific tasks. This most desirable solution is often attainable by people with mild-to-moderate hearing loss. *However, this most desirable solution may be attainable by people with severe hearing loss only with the use of hearing aids plus special training (such as lip-reading) plus the use of special augmentative devices for specific purposes.* Generally, this most desirable solution is not attainable by deaf people except, perhaps, for some who obtain cochlear implants, the necessary external accessories, and speech discrimination training.

Severe Hearing Impairment refers to situations where a person, even when using the best of hearing aids, has difficulty discriminating and understanding speech and is thus functionally impaired in social and employment situations. These people are often, functionally, on the borderline between “deaf” and “hearing” lifestyles. Often, special augmentative devices – also called “assistive technology” - can markedly improve the person’s quality of life. As explained later in this paper, there are many different variations among people with severe hearing impairment, such as the relative impairments of each of the two ears; age of onset of hearing loss; whether onset was sudden or gradual; whether loss is static or progressive; present age of person; previous and current lifestyles and occupations, whether or not there have been cochlear implants; etc.

Implants for Previously Deaf People who are surgically elevated to “Severe Hearing Impairment” are a new and growing category. Typically, the person was totally or near totally deaf – until undergoing **COCHLEAR IMPLANT** surgery. Then, using the external devices provided to work with the implants, the person can hear and discriminate sounds and noises. With special training, the person can learn to understand speech. People who could hear before becoming deaf can usually learn to discriminate speech sooner and more easily than always-deaf people. *Note: Cochlear Implants, originally developed at the House Institute in Los Angeles, are usually performed at teaching hospitals or large clinics which also provide the needed external attachments and auditory training for speech discrimination and understanding.* People who have had cochlear implants do not go to hearing aid dealers; they rely on the clinics or facilities where they underwent the surgery. Cochlear implants involve the placement of electrical wires directly into each inner ear where they directly deliver electrical audio signals to the hearing nerves and brain. An external sound pickup device is connected to the internal wiring via an electrical cable that passes through the person’s skin. This system does not substitute for hearing aids; it is an option

for deaf or near-deaf who cannot benefit from hearing aids and thus have no other help options.

ENT Physician refers to an “Ear, Nose, and Throat” specialist who is usually a medical doctor and surgeon. Another term for such specialists is “Otolaryngologist.” *A person with hearing loss should always see an ENT physician first, because this doctor may be able to completely correct an existing hearing loss. Even if he cannot completely correct the loss, he may be able to lessen the loss so that it can better be compensated with hearing aids.*

Audiologists are college educated hearing evaluators and therapists who provide diagnostic, training and non-medical therapeutic services relating to hearing. These professionals usually hold a Masters degree or higher plus certification in audiology by the American Speech and Hearing Association (ASHA). Audiologists may work in their own offices, in the office of an ENT physician or on the premises of a hospital, clinic or non-profit organization. When there is residual hearing loss after completing medical or surgical treatments, the next professional to see is the Audiologist. *Note: under rules of their certifying professional organization, audiologists may dispense hearing aids, but with certain profiting and advertising limitations. They are allowed to bill for time and professional services because of these limitations.* Some audiologists, themselves, dispense hearing aids – but many choose to not do so. Most audiologists are NOT electronics technicians or engineers. (A few are – so ask!)

Hearing Aid Dispensers are commercial dealers who sell and dispense hearing aids. Tested and licensed in most states, these dispensers may or may not be college educated. Typically, they have taken courses in hearing aid dispensing, have been trained by the manufacturers whose products they sell and have passed examinations administered by their state licensing agencies. Of necessity, hearing aid dispensers must test their clients’ hearing unaided and with various hearing aids that are fitted and programmed differently. In most areas, dispensers are not permitted to charge fees for time and professional services. Instead, they are allowed to earn high profits or markups on the sales of hearing aids, and they cover their time and overhead costs for testing and other services, out of the profits earned by sales. Because they are licensed and regulated, this usually proves fair and effective for the hearing aid buyers. All hearing aid dispensers have some technical training, usually by the manufacturers. Some may also have electronics technician or engineering backgrounds. ASK – because such experience can render particular dispensers more helpful with regard to augmentative devices, above and beyond the hearing aids.

Note: The Hearing Aid Dispenser often augments but does not replace the Audiologist.

Auxiliary Equipment Vendors are firms that manufacture and sell augmentative electronic systems and products such as amplifiers, loudspeakers, wireless broadcasting devices, special amplified telephones, etc. They usually sell these products by mail, from catalogs. Many hearing-impaired consumers may not benefit from their own mail order purchases of these products and should, therefore, have advice from their own local audiologist, hearing aid dispenser or independent technician.

Independent Electronics Technicians should be local people who may be employed as an electronics engineer, technician or electrician - or who may be an accomplished hobbyist – such as a radio ham or a computer hobbyist. It is good to have the on-site assistance of such a person to help install sound field amplification systems, amplified telephones, computer software and hardware accessories, TV and radio speech clarifiers, and other augmentative devices discussed in this paper.

Auxiliary Training or Education can also be very helpful. One with severe hearing loss might take courses in “Lip Reading” to better understand other people’s speech. Hearing impaired foreign language speakers can often improve their ability to understand spoken English by undertaking training in understanding spoken North American English. Some people raised in the deaf culture may be expert in signing yet communicate poorly in writing with hearing people. Their continued education in contemporary reading and writing can greatly facilitate better employment.

Hearing-, Deaf-, and Dual- Lifestyle Options are important choices that must sometimes be

made by a person with permanent and severe hearing loss. Options are for living, working and functioning in one of these three environments: (1) the HEARING world, (2) the DEAF world, or (3) a DUAL environment - with both deaf and hearing people. The best choice for each person usually takes into account whether or not he was raised in a deaf household; his present age and whether he was educated with deaf or hearing people; his present occupation and future occupational goals.

This paper is intended to assist people with severe hearing losses to function in “the hearing world” or in both the hearing and the deaf worlds ...using hearing aids, augmentative devices, and - where appropriate – certain procedures, skills, processes and appliances used by deaf people. Space does not permit us to detail life exclusively in “the deaf world.” People who desire to function exclusively in the world of deaf culture are respectfully referred to deaf support groups, schools and colleges for whatever information they may need.

Available Hearing Aid Types - Questions and Answers

Q. Should a person buy one or two hearing aids? **A.** TWO, if two are needed to equalize the functions of both ears. ONE if one ear is normal or near normal with only the other ear needing amplification and/or frequency equalization.

Q. Should the hearing aid equally amplify all frequencies or pitches? Or, should it be programmed for selective amplification of different pitches to different power levels. **A.** If the person’s hearing response is flat with equal loss for all frequencies, then flat or uniform amplification may be appropriate. If the hearing loss greatly increases as the pitch or audio frequency increases, then best results may be achieved using hearing aids programmed to provide greater power amplification to the higher frequencies than to the lower frequencies. However, this may not be possible in all cases because some people with severe hearing impairment have non-linear variations with pitch or frequency. Initially testing should be done by a qualified audiologist to make this determination. Starting with the audiologist’s specific findings and recommendations, the hearing aid dispenser will conduct his own tests; will try different programming schedules for the hearing aids, and will ultimately establish by comparative trial and error testing, the best program settings for the specific person’s hearing aids. Some hearing aid dispensers can, for testing purposes, simulate competing voices, one or more voices masked by background sounds or noises, speech as is typically heard from a radio or TV ... or in a theater, church or lecture hall. *This type of testing is most useful and important and must be done, either by the dispenser or by the client, in the field, during the 30-day money-back hearing aid trial period.* (This 30-day trial period is mandated throughout the U.S.A. by federal law.)

Q. Should one buy “digital” or “analog” hearing aids for best results? **A.** Ask the audiologist for advice on this question. An audiologist would have no financial interest in your choice and so might give the best unbiased advice. Also, have the dispenser trial-fit both types so that you can make comparative tests. Typically, the older style “analog” aids may cost only \$675 each as compared with the newer “digital” type aids which typically cost about \$2,500 each. In general, analog aids, when appropriately fitted, give more natural sounding amplification which, for some people, facilitates easier voice recognition. However, analog aids are less effective in helping the user to distinguish and discriminate speech when background noises are present. Digital hearing aids may be far more effective in facilitating speech discrimination with competing voices and/or background noise.

Q. What might the hearing aids look like? And how are they worn and used? **A.** Body type hearing aids, the most powerful, are rarely used nowadays. High-power hearing aids possibly to be needed by a person with severe hearing loss are “post-auricular” or “behind-the-ear” hearing aids. Two other forms are generally available and are most popular. These are: (1) tiny “ear canal” hearing aids; and (2) larger “in the bowl of the ear” hearing aids.

Type (1) tiny “ear canal” hearing aids cost more but are advertised to appeal to people’s vanity because, when in the ear canal, the device is not visible. We recommend AGAINST these devices because (a) they are difficult for many people to insert and remove, even with special tools. (b) They provide too little amplification power because of the small size of the battery, circuit board and transducer. (c) It is difficult to change batteries, especially for older people. And, the aids are too easily lost or damaged.

Type (2) the larger “in-the-bowl-of the ear” or “ITE” hearing aids, analog or digital, are most often recommended to overcome the disadvantages of the “canal aids.” For people whose hearing loss is likely to progress and worsen over time, more powerful hearing aids should be obtained initially to allow for later reprogramming for increased output power whenever power output increases may be needed. This avoids the expenses of frequent hearing aid replacements to obtain increased power output.

Q. Should I buy from a local dispenser or by mail order? **A.** Always buy from a reputable local dispenser and never by mail order. Because cleaning, repairs and other services are frequently needed, the hearing aids are best purchased locally rather than from even the most reputable dispenser who is far away. *This rule does not apply to cochlear implant patients who must receive their ongoing support from the clinic that provided the implants and accessories.*

Q. Will Medicare, Medicaid, VR or health insurance pay for my hearing aids? **A.** **Medicare** does NOT pay for hearing aids except in rare circumstances where necessary for emergency medical communications with physicians or nurses. **Medicaid** programs generally do pay for hearing aids and related services, in most states. The federal-state VR (**Vocational Rehabilitation**) program may pay for hearing aids and related services if they are needed to facilitate employment or self-employment **Health Insurance** programs and policies sometimes pay part or all of the costs for hearing aids and related services. One needs to read the fine print in their policies.

Q. What About “Ringing in The Ears?” **A.** This is called “tinnitus” and detracts from hearing and understanding adequately in many circumstances. It is usually treatable medically, so discuss this condition with an ear physician.

Q. What About “Dizziness” or “Vertigo?” **A.** This does not usually affect hearing. However, it is uncomfortable and disabling. Often, this is related to inner ear problems so an ear physician should be consulted.

Recommended Procedures for Obtaining Help ...for Severe Hearing Losses

A. If you have been hearing - impaired previously, then continue with your previous doctors, audiologist and hearing aid dispenser. Do, however, list and discuss with each of them, each activity or function with which you feel you need improved hearing, speech discrimination or understanding. Bring this paper or other applicable information to them and ask them to work with you to achieve the best possible results in terms of *your own lifestyle hearing needs*. Or ...

B. If you are newly hearing - impaired, ...or just recently noticed difficulties in hearing and understanding, then we suggest you follow these steps:

- (1) See your primary physician or ear specialist. Ask to have both ears examined for the presence of ear wax and/or damaged eardrums. The physician should remove wax and visually inspect the eardrums. Many people accumulate wax and temporarily lose much of their hearing. Miraculously, many of these people regain their hearing instantly when the wax is removed. This may fully- or partly- correct your hearing loss problem. If either or both eardrums are damaged, this would likely be a major cause of hearing loss. Fortunately, eardrum damage or perforation can be repaired. “Fluid retention in the ear” is another possible cause of hearing loss and is correctible. Your doctor can determine if this is your problem.
- (2) Ask your doctor to take blood tests, such as those for elevated sugar, triglycerides, cholesterol, etc. Many people with high levels of blood sugars and/or fats develop hearing deficits which may be reversible by diet or medication. Some people with poorly controlled diabetes experience symptoms of impaired hearing. This type hearing loss may be partly or fully reversible, with treatment.

- (3) Be sure to explain to both the doctor and the audiologist the reasons why you feel your hearing is impaired. ***It is important to make a written list of the types of situations in which you feel your ability to hear and understand is impaired.*** Prioritize the list, writing the most important (to you) function, activity or situation first ... and the least important last. Most physicians and audiologists evaluate patients' hearing to their own office standards without knowing or taking into account the patient's personal lifestyle activities, hearing needs and hearing problems. For people with severe hearing losses, it is especially important and helpful for the patient to provide clear written notes describing the specific situations and activities for which better hearing is desired.
- (4) Auditory testing is advised before and after any treatments such as those mentioned in (1) and (2) above. Some doctors provide audiometric testing, in their own offices. Others refer patients to a certified audiologist who may have an office elsewhere. Basic testing for "screening purposes" may cover a limited pitch range as 750 Hz to 4000Hz. While satisfactory for screening purposes, these data are not enough to establish a basis for future comparisons. We recommend more comprehensive audiometry, as described below, to establish a data base that will help give early predictions of future hearing losses.
- (5) Recommended auditory testing: (a) AIR CONDUCTION (via earphones) - every 500 Hz for the frequency range: 500 Hz to 10,000 Hz. If all readings are within the "normal" range, then additional testing may not be needed. If any of the readings are significantly out of the normal range, then (b) BONE CONDUCTION testing should be undertaken. *By comparing the results of both Air- and Bone-Conduction tests, the doctor and audiologist can determine the overall hearing loss in each ear, and what percentage is due to CONDUCTIVE LOSS (which is surgically correctible) and NERVE LOSS which often is not correctible.* (Remember, hearing losses not correctible by medical or surgical treatment can often be helped functionally with hearing aids and/or other assistive technology.) Ask the doctor or audiologist to discuss with you a comparison of the test results for each of the two ears. This is important because "balanced hearing is always better hearing" for best possible speech discrimination and comprehension. For those people who have severe hearing loss in one ear and normal or near normal hearing in the other ear, there may be useful help using special techniques to balance the ears with differently programmed hearing aids..
- (6) Surgery as an option: If most or all hearing loss is "conductive" – then opinions should be from one or more ear surgeons as to whether the conductive loss should be surgically repaired. Ask for an estimate of how much you can reasonably expect your hearing to improve if you undergo the recommended reparative surgery. If favorable results are predicted, then seriously consider having the surgery.
- (7) **Hearing Aids are The Preferred Option** for losses that cannot be corrected medically or surgically. Hearing aids are also the preferred option for people who still have significant residual hearing losses AFTER completing medical or surgical treatments. ***The best solution is to have hearing aids that provide enough pickup sensitivity, most effective spectral compensation, and enough power output to adequately restore hearing functionality for all of the person's daily social and work activities.*** It is important to have hearing aids fitted so well that there is no need for additional assistive technology – if this goal can be attained. For this reason, it is very important for each hearing impaired person to expend the time and effort to be trial fitted, to field test hearing aids and, if necessary, to try and compare different hearing aids in the field. *It is to this end that federal regulations ensure 30-day trial periods during which new hearing aids can be returned for exchange or refund.*
- (8) **Hearing Aids Should Always Be Telephone Compatible** if at all possible. Always insist, when being fitted for hearing aids, that you be fully tested using several different telephones. It is a responsibility of the hearing aid dispenser to assist with such testing. There are two possible ways to use a hearing aid with a telephone. **The first method is acoustic coupling with the telephone receiver near one ear** (that with the best hearing) and allows the hearing aid's microphone to pick up the sound waves from the earpiece of the telephone. To minimize howling due to acoustic feedback it may be necessary

to hold the earpiece a distance away from the ear. This extra distance reduces the intensity of the sound being picked up and amplified, thus reducing intelligibility of the speech. If the person on the other end of the telephone has a high pitched voice (a child or woman) the signal loss is likely to be even greater. Another problem with this coupling method is that the hearing aid's microphone will pick up and amplify all background noises. These sounds and noises, amplified with the speech, further reduce the person's ability to discriminate, hear and understand the incoming telephone speech. **The second method is magnetic coupling** to pick up the magnetic variations of the telephone receiver with the hearing aid's microphone switched off so that background noises are not picked up and amplified. Only the magnetic impulses of the speech from the earphone are picked up and amplified. ***Magnetic couplings is the preferred method for all hearing aid users.*** Generally, the larger ITE hearing aids can be gotten with this feature – magnetic pickup and input selector switch. The smaller canal type hearing aids rarely are available with this feature. Even though a magnetic coupled hearing aid helps a person effectively on some telephones there may still be problems with some public and private telephones which emit no magnetic signals. The hearing aid user will encounter some telephones for which acoustic coupling is the only option because they emit no magnetic signals. **When testing a hearing aid for telephone use**, remember you can hold a standard telephone to only one ear – so do so with the better ear. Try the magnetic coupling mode first because, if it works, it gives the best results. Use the acoustic mode only if a particular telephone does not emit magnetic signals. Try listening on the telephone to men, women and children to determine if you can do so satisfactorily for all voice pitch ranges. ***CONCLUSIONS:*** The person with severe hearing loss is very fortunate if he or she can use any telephone satisfactorily with one of the hearing aids, in magnetic or acoustic mode and for listening to voices of any pitch. If one can do this, then augmentative telephone accessories are not needed. ***If satisfactory telephone test results are not obtainable with the single hearing aid, then additional assistive technology is needed.***

- (9) **Other Hearing Aid Tests** should also be made to determine whether or not additional assistive technology is required. The person should test for speech reception, discrimination and understanding by engaging in: (a) face to face conversation with men, women and children in a quiet environment; (b) by conversing in environments having loud, continuous background noise; (c) by conversing in environments where there are multiple competing voices from which the person must follow one particular voice; (d) by listening to voices in a church, theater and classroom. Additional testing should be done listening to the radio, listening to the TV sound, etc. using only the hearing aids and no augmentative equipment.
- (10) **Hearing Tests Without Hearing Aids** should also be conducted. When in bed for the night, without the hearing aids, can a person hear and recognize: (a) the smoke or fire alarm? (b) the telephone bell? (c) The alarm clock? If any of these tests are failed, then the person should consider augmentative devices to facilitate the passing of these tests without the use of hearing aids.

TRAINING for Better Hearing, Understanding, Education and Employment: There are additional options for people whose hearing losses are so severe that hearing aids, alone, prove insufficient for normal speech reception and understanding. The training issues are rather basic.

(A) **LIP-READING** training can help a person to better understand speech when the speaker's lips are visible. Lip-reading skills can be learned in classes or from borrowed, rented or purchased courses on video tape or DVD. (Such courses are available by mail from: "Speechreading Laboratory, Inc." tel. 1-800-433-6370). Lip-reading can help in person-to-person speech, when watching TV or a movie, or for listening to public speakers at meetings, or in a classroom. However, it does not help when listening to a voice on the telephone or the radio. Therefore, assistive technology may be needed for audio-only functions.

(B) **"ENGLISH AS A SECOND LANGUAGE" TRAINING** with emphasis on phonics can be invaluable to hearing impaired people whose primary language skills are other than North American English. This training, especially with lip-reading, can make a major difference in a person's ability to understand spoken English.

(C) ENHANCED READING, WRITING, TYPEWRITING & COMPUTER skills can more than compensate in the workplace for a person's difficulties in hearing and understanding speech. Many people with severe hearing losses are weak in some or all of these skills. Almost every village, town and city offers adult education programs that can enhance and build these skills. With high level skills in these activities, it is much easier to obtain a higher paying job even if, with hearing aids, a person's understanding abilities are poor. *Sometimes laborers with impaired hearing and weak skills in these areas, become physically disabled and unable to continue as laborers. By improving their office skills, they can often obtain and succeed at office employment which would not otherwise be open to them.*

(D) SIGNING - AMERICAN SIGN LANGUAGE skills can be helpful in either of two ways. For people from a deaf home or who were schooled with the deaf, signing is a valuable and necessary skill which should be learned and used (in addition to, not in lieu of education in conventional reading and writing) . However, signing is often of little benefit to individuals with no connections to the deaf community. However, there is one circumstance in which it can be very worthwhile and beneficial for a person with severe hearing impairment to learn sign language. Most schools and colleges are required by law to provide a qualified interpreter in the classroom at the school's expense, to sign everything the teacher says and everything said by other students, visitors, movies, the TV set, etc. Learning sign language for this purpose is recommended only to and for individuals whose hearing losses are so severe that they still cannot understand adequately what is said in the classroom, even with their hearing aids and augmentative devices.

Assistive Technology and Augmentative Devices ... to help people with **Severe Hearing Losses** may require specific devices or systems for specific communications functions. It is important that people NOT have to frequently insert and remove their hearing aids ... but that they wear and use their hearing aids as much as possible when not in bed. *For maximum safety and convenience, it is best that most augmentative devices that are used when out of bed, function well with the hearing aids.* Some examples: (1) amplified single-earphone telephone receivers; (2) dual earphone telephone receivers; (3) dual earphone radio and TV sound output devices; (4) paging speakers and (5) sound field amplification systems. *Note: Hearing aids should not be worn in bed or when sleeping because doing so can result in irritations or ear infections.*

Catalogs for Products for Hearing-Impaired People

Hundreds of augmentative hearing devices are available from various commercial vendors. These are usually in one of two categories: (1) "consumer products" intended to be purchased directly by hearing-impaired consumers ... And (2) "technician products" which usually require the services of a local on-site technician for installation or setup. When purchasing products, know which category they are in, of the two described above.

SEVERE HEARING LOSSES often mandate use of products intended for the deaf while in bed - without hearing aids. Such products, sold by the vendors listed below, are to monitor the doorbells, the telephones, the smoke and fire alarms, and even the alarm clock. The output signals should be distinctive so the user knows the meaning of the perceived signal. The output signal can be a loud sound or vibrations of the bed or to the skin. *Once out of bed with hearing aids inserted, some people with severe hearing losses will not require augmentative devices; others will require one or more augmentative devices or systems for specific purposes. READ THE CATALOGS for more information about each of the many devices and systems available for specific functions.*

Below are listed four vendors whose catalogs can be viewed on the internet or can be gotten cost-free in the mail by calling toll-free telephone numbers. Most of the products sold by these vendors are suitable for purchase by non-technical end users. (We list these vendors of consumer products for convenience but do not recommend these or any particular vendors or products. Expensive products are best ordered with advice from a person with electronics experience.)

CONSUMER PRODUCTS:

Hear-More 42 Executive Blvd. Farmingdale, NY 11735

Tel. 1-800-881-4327 FAX 1-631-752-0689 TTY 1-800-281-3555
http://www.hearmore.com email: inquiries@hearmore.com

Assistech, Inc. 2738 N. Cambell Avenue, Tuscon, AZ 85614
Tel. 866-674-3549 - TT 866-674-3549 - Fax 520-883-3172.
http://www.azhearing.com email: info@azhearing.com

Harris Communications 15155 Technology Drive
Eden Prairie, MN 55344-2277 Tel. (800) 825-6758
http://www.harriscomm.com email: mail@harriscomm.com

NFSS Communications P.O. Box 230 Lake Villa, IL 60046-0230
Telephone Toll Free 888-589-6670 - Fax 847-265-8044
http://www.nfss.com email: info@nfss.com

Radio Shack Store - Visit a local RS store near you
for amplified telephones & cell phones, for wireless microphones,
for public address and sound field systems. Ask employees for
advice, demonstrations and trials. (For some items, technician
assistance may be needed at place of use.)

TECHNICIAN PRODUCTS:

MFJ Enterprises, Inc. 300 Industrial Pk. Rd. Starkville, MS 39759
Tel. (662) 323-5869 or 1-800-647-1800 <http://www.mfjenterprises.com>
Recommended product to enhance speech discrimination while listening to
sound from radio, tv or telephone: **“MFJ Speech Intelligibility Enhancer”**
(Notes: Technician installation may be required. Earphones are used with or
without hearing aids - as you select them and set up the system.)

Other Types of Technician Products and Systems are more likely to be
needed for the workplace than for the home. Sound field amplification systems, for
example, may be needed in classroom settings. Personalized earphones or speakers
may be needed in church, theater or auditorium settings. Amplified telephone handsets
may be needed in the workplace. It is best when well-fitted hearing aids prevent the need
for such augmentative devices or systems. However, when augmentative equipment is
necessary to facilitate hearing and understanding speech, then these devices and systems
need to be considered, tested and – if proven useful – purchased and installed.

Workplace Accommodations for People with Severe Hearing Losses

To cover this topic fully would require one or more thick textbooks because of the many different types of work situations and their varied interactions with people having different types and different degrees of functional hearing loss, using the best possible hearing aids with optimal programming, for each person’s situation. Accordingly, this paper will only address a few examples. Some readers with job accommodation problems due to residual hearing impairments may benefit from having an audiologist, hearing aid dispenser or technician visit them in the workplace.

Example 1 – A Hearing-Impaired BANK TELLER wears two hearing aids but still has difficulty understanding customers with low-volume, high-pitched voices. Background noise in the bank and the security windows between teller and customer worsen the problem. Possible SOLUTIONS: (a) Learn to lip-read and there will be much better understanding, even under the same conditions. (b) Ask the employer to install an open grill, at face level, in the security window or to remove the barrier the window completely to create a better face to face sound path between

teller and customer. Or (c) Arrange for teller reassignment to the automobile drive-up window. The advantages here are reduced background noise and increased customer speech volume due to the outside microphone and inside amplifier – loudspeaker.

Example 2 – A Hearing-Impaired TEACHER who is in a classroom with young children who have high-pitched voices that are often difficult to understand. This teacher might be in an age range from 50 to 65 and might have a progressive high frequency loss which has just recently become problematic in the classroom (despite the teacher having the best possible hearing aids that are optimally programmed). This situation is one of the most difficult ones to deal with - and so is used as an example.

Possible SOLUTIONS: (a) To learn and become proficient at lip-reading and then to have the children recite slowly, facing the teacher, (b) Arrange for a lectern-with-microphone to be set up in the classroom ... and have each child stand or sit at the lectern and speak into the microphone when reciting. The wireless microphone's signal might be picked up by a receiver worn on the teacher's body, with the amplified output applied directly to her ears, with or without hearing aids. Or, (c) A wired microphone is used and is directly connected, through an amplifier, to wall-mounted loudspeakers in the classroom. All the students AND the teacher (with hearing aids) benefit from the amplified student recitations. This arrangement can be used for students with normal hearing – and for a hearing impaired teacher. But, it offers another advantage to the school and the community because – using this setup – hearing impaired students can be placed in the same class and benefit just as the teacher benefits. Note: If hearing impaired students are present, a second microphone can be connected to the amplifier to pick up and amplify the teacher's voice. This can be a wired lectern type microphone ... or a wireless microphone worn by the teacher on a headband to facilitate complete mobility in the classroom while speaking.

Example 3 – A TELEPHONE INTERVIEWER with high-frequency losses may need help to hear and understand many people with varied voice characteristics. Possible SOLUTIONS: (a) A good hearing aid in the better ear, properly programmed, with a magnetic telephone pickup coil and switch. This is used with a telephone receiver or headset that has magnetic output. (b) An amplified telephone receiver for use without a hearing aid, in one ear. (c) A dual-earphone headset for use with hearing aids in both ears. (The hearing aids compensate the high frequency losses.) Or, (d) A dual-earphone headset for use without hearing aids. The signals to these earphone are equalized by a special equalizer-amplifier (speech intelligibility enhancer) such as that manufactured by MFJ Enterprises (listed above).

CAUTION: Extensive on-site testing is always necessary to establish the actual functional benefits of augmentative devices or systems for any given person and in each specific work situation. Never assume that any particular product or device that can be bought by mail or in a store will solve the problems adequately. When buying, always do so with the understanding the device(s) can be returned within a reasonable period if found to not meet the needs.

Readers are invited to contact this Institute for questions or for additional information. There are no costs or obligations of any kind - because grants and contributions fund our service activities.

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