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Acoustics — Hearing aid fitting management (HAFM)

Acoustique — Gestion des appareils de correction auditive

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The World Health Organisation (WHO) estimates that there are 360 million people with hearing impairment, approximately 5,3 % of the world population[22]. Hearing aids (HAs) are one of the most widely-used treatment options for people with a hearing loss[39][40]. For the proper use of HAs, hearing aid fitting management (HAFM) is a crucial issue for manufacturers, practitioners, hearing aid professionals and especially for HA users[39][42][43]. Individually optimized outcome of HA use is supported by comprehensive HA fitting protocols[42] and the impact of “poor fit and comfort” can lead to non-compliance, HA return[43] and additional hearing loss with over-amplification. Accordingly, the whole process of HA fitting should be optimized to achieve functional benefits, user satisfaction and cost-effectiveness.

Two observations are important to take into account when developing an HAFM standard. Firstly, the term "hearing aid fitting" is widely used[16][44]–[46] among service providers and industry sectors. Secondly, it has potentially conflicting interpretations: while guidelines for HA fitting have been written to tackle these issues by various national and professional bodies[17][18][23]–[32][34]–[37][47][48], many jurisdictions are still not covered worldwide and there is a need to promote a more common understanding of the HA fitting process. It is likely that different understanding of fitting has led to non-uniform care, outcome variability and, in many cases, dissatisfaction with the use of HAs.

The main purpose of this document is thus to provide a general framework for HAFM including the pre- and post-fitting stages to make it more explicit and transparent so that all related tasks, including professional services, administration and financial aspects can be systematized. The overall objective is to achieve the best possible hearing rehabilitation, which can only be accomplished through adequate knowledge, training and skills of the professional and a systematic approach to HA fitting in close collaboration with the client. The general framework of HAFM in this document is divided into six stages (client profile, counselling, hearing aid fitting, verification and validation, post-fitting counseling, and follow-up) based on the common practices of hearing aid professionals, and as recommended by various pre-existing guidelines.

By dividing the hearing aid fitting process into stages, HAFM service providers can systematically identify and administer the service components needed for high service quality, user satisfaction, client-centered services, client self-efficacy and compliance rates with HAs (e.g. consistently using HAs and attending follow-up appointments). The stages focus on the components of the framework to achieve high rehabilitation outcomes such as communication skills, speech intelligibility, perception of the acoustic environment, comfort for the HA users and sound quality. In addition, this document can be a basis for making cost assessments for each stage or component, which can help improve public health funding systems. Another possible application is to use this document as a minimum basis for the development of professional training programs in HAFM.

Acoustics — Hearing aid fitting management (HAFM)

1 Scope

This document applies to hearing aid fitting management (HAFM) services offered by hearing aid professionals (HAP) when providing benefit for their clients. The provision of hearing aids relies on the knowledge and practices of a hearing aid professional, to ensure the proper fitting and adequate service in the interest of the client with hearing loss.

This document specifies general processes of HAFM from the client profile to the follow-up through administering, organising and controlling hearing aid fitting through all stages. It also specifies important preconditions such as education, facilities and systems that are required to ensure proper services.

The focus of this document is the services offered to the majority of adult clients with hearing impairment. It is recognized that certain populations with hearing loss such as children, persons with other disabilities or persons with implantable devices can require services outside the scope of this document. This document generally applies to air conduction hearing aids and for the most part also to bone conduction devices.

Hearing loss can be a consequence of serious medical conditions. Hearing aid professionals are not in a position to diagnose or treat such conditions. When assisting clients seeking hearing rehabilitation without prior medical examination, hearing aid professionals are expected to be observant of symptoms of such conditions and refer to proper medical care.

Further to the main body of the document, which specifies the HAFM requirements and processes, several informative annexes are provided. Appropriate education of hearing aid professionals is vital for exercising HAFM. Annex A defines the competencies required for the HAFM processes. Annex B offers a recommended curriculum for the education of hearing aid professionals. Annex C is an example of an appropriate fitting room. Annex D gives guidance on the referral of clients for medical or other specialist examination and treatment. Annex E is a recommendation for important information to be exchanged with the client during the process of HAFM. Annex F is a comprehensive terminology list offering definitions of the most current terms related to HAFM.

It is the intention that these annexes be helpful to those who wish to deliver HAFM of the highest quality.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8253-1, *Acoustics — Audiometric test methods — Part 1: Pure-tone air and bone conduction audiometry*

ISO 8253-2, *Acoustics — Audiometric test methods — Part 2: Sound field audiometry with pure-tone and narrow-band test signals*

ISO 8253-3, *Acoustics — Audiometric test methods — Part 3: Speech audiometry*

IEC 60118-7, *Electroacoustics — Hearing aids — Part 7: Measurement of the performance characteristics of hearing aids for production, supply and delivery quality assurance purposes*

IEC 60645-1:2017, *Electroacoustics — Audiometric equipment — Part 1: Equipment for pure-tone and speech audiometry*

IEC 60645-5, *Electroacoustics — Audiometric equipment — Part 5: Instruments for the measurement of aural acoustic impedance/admittance*

IEC 61669, *Electroacoustics — Measurement of real-ear acoustic performance characteristics of hearing aids*

International Standard Classification of Education, ISCED. United Nations Educational, Scientific and Cutural Oganization, 2011, ISBN 978-92-9189-123-8, http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
auditory dynamic range
difference between the *hearing* (3.7) threshold and the uncomfortable loudness level (UCL)

3.2
client
person with *hearing loss* (3.8) being serviced by a *HAP* (3.13)

3.3
client profile
comprehensive record of a *client's* (3.2) auditory functionality, social situation, activity opportunities, needs and expectations as well as a client's audiological and medical history

3.4
ear impression
representation of the three-dimensional geometry of the relevant part of the concha and ear canal

3.5
fine-tuning
adjustment of the *hearing aid system* (3.10) to best match the needs and preferences of the *client* (3.2)

3.6
fitting system
set of devices typically comprising a computer, fitting software and a programming interface used to adjust *hearing aids* (3.9)

3.7
hearing
manner in which a person detects, discriminates, identifies and cognitively processes sounds

3.8
hearing loss
reduction of the *hearing* (3.7) ability

3.9
hearing aid
wearable electroacoustic instrument intended to process sounds in order to compensate for *hearing loss* (3.8)

Note 1 to entry: Hearing aids are medical devices and comply with the requirements of IEC 60601-2-66.

3.10
hearing aid system
customized structure consisting of one or two *hearing aids* (3.9), earmoulds and related components such as a remote control or interfaces to other information or communication systems

3.11
hearing aid fitting
systematic procedure for individualizing and optimizing a *hearing aid system* (3.10) to compensate for *hearing loss* (3.8)

3.12
hearing aid fitting management
HAFM
systematic process to administer, organise and control *hearing aid fitting* (3.11) through all stages

3.13
hearing aid professional
HAP
person who is appropriately trained and has proven competency in professionally assessing hearing, selecting, fitting and delivering *hearing aid systems* (3.10) and rehabilitation services to persons with *hearing loss* (3.8)

3.14
hearing rehabilitation
systematic process for improving functional hearing abilities and communication skills through *hearing aid fitting* (3.11), counselling, instruction, education, training and developing listening skills

Note 1 to entry: The term "habilitation" includes all rehabilitation processes with additional interventions to develop listening, speech and language skills for prelingually deafened individuals such as children which are outside the scope of this document.

3.15
maximum output
maximum sound pressure level at the output of a *hearing aid* (3.9) as adjusted by the *HAP* (3.13)

3.16
pre-setting of hearing aids
configuration and adjustment of a *hearing aid* (3.9) using a prescriptive rule and relevant audiological data

3.17
verification
provision of objective evidence that a given item fulfils specified requirements

Note 1 to entry: In the field of *hearing aid fitting* (3.11), the verification usually means evaluating physical, electroacoustic and psycho-acoustic aspects of a hearing aid fitting by presenting signals to *hearing aids* (3.9) in a hearing aid test box or a real-ear or by using functional gain measurement in accordance with ISO 8253-2.

[SOURCE: ISO/IEC Guide 99:2007, 2.44, modified - Examples removed, original Notes to entry replaced with Note 1 to entry.]

3.18
validation
verification (3.17), where the specified requirements are adequate for an intended use

Note 1 to entry: In the field of *hearing aid fitting* (3.11), the verification usually means a comprehensive evaluation of the user benefits of a hearing aid fitting using methods which include speech audiometry and subjective response questionnaires.

[SOURCE: ISO/IEC Guide 99:2007, 2.45, modified - Example removed, Note 1 to entry added.]

4 Service preconditions

4.1 General

For quality service provision, the following preconditions shall be fulfilled:

— educational requirements;

— facility requirements;

— equipment requirements;

— ethical requirements.

Further preconditions are given by local applicable laws and regulations.

4.2 Educational requirements

4.2.1 General

The competencies of persons delivering the service are essential to the quality of service and should be rooted in appropriate education from recognized educational institutions and organisations as well as relevant practical skills obtained in a structured process. Ongoing education is required as it is vital to maintaining the competencies, skill levels and knowledge needed for best practice.

In general, delegation of tasks to staff without the required education should not be permitted. More than one type of staff can perform certain tasks in accordance with their specific educational background following national or regional regulations. The overall responsibility of the service provision shall rest with a HAP with the education specified in 4.2.2.

In order to facilitate the acquisition of practical skills, practices may include trainees from educational programs in their staff. Services performed by trainees shall take place under the supervision of a qualified HAP who shall be present at the facilities and who remains responsible for all activities carried out by the trainee.

4.2.2 Requirements for hearing aid professionals

A minimum education level 5 according to the International Standard Classification of Education, ISCED, or equivalent is required in order to perform all stages of hearing aid fitting management. A level 6 education is recommended.

It is recommended that the educational program includes the following academic topics: basic mathematics and science including acoustics, anatomy and physiology, psychology and linguistics, audiology, hearing aid technology, hearing rehabilitation processes, hearing aid fitting.

The following practical skills should be obtained through training: client interaction, audiometric measurements, earmould management, hearing aid programming, fitting verification and validation, hearing aid modification and repair.

Suggestions for minimum competencies of the HAP and a suitable education program are given in Annexes A and B, respectively.

Any HAP shall have proven minimal competencies through testing in order to practice independently.

NOTE It is recognized that developing countries sometimes do not readily have access to this level of education.

4.2.3 Maintenence of competencies and skills of hearing aid professionals

Hearing aid professionals shall receive ongoing education to maintain the competencies and increase skill levels. Ten hours annually is the minimum, 20 hours or more is recommended.

Ongoing education can be acquired in multiple ways such as: in-class training, conferences, manufacturer's courses, e-learning, webinars and other recognized sources.

4.3 Facility requirements

4.3.1 General

Facilities for hearing aid provision should be of sufficient size to facilitate reception of clients, hearing assessment, hearing aid provision, and maintenance of hearing devices. The facilities shall have a size that can accommodate the clinician, the client and at least one accompanying person. Facilities shall be clean, safe and readily accessible for persons with disabilities. Facilities should also have access to running water and toilets. The practice should be clearly identifiable and provide access to contact via telephone, SMS, fax, website or email. Hours of operation should be publicly accessible.

Facilities for the cleaning and disinfection of equipment shall be available. Moreover, hand washing facilities and containers for the disposal of single use (and potentially contaminated) items should also be provided.

4.3.2 Room requirements

Any consultation area shall be sufficiently private so that any other persons within the facility are not able to overhear conversations taking place. In addition, an appropriate ventilation and temperature control sould be considered, since sound treated rooms can become warm and unpleasant.

Audiometric testing rooms/areas shall comply with maximum ambient noise levels in accordance with ISO 8253-1, and ISO 8253-3, to allow threshold levels to be measurable down to 20 dB HL for air conduction, and 30 dB HL for bone conduction. If it is desired to do sound field audiometry, the ambient noise levels shall be in accordance with ISO 8253-2 for measurable threshold levels down to 20 dB HL. Fitting areas also require a controlled acoustic environment where:

— the reverberation time should be less than 0,5 s at 500 Hz;

— the equivalent A-weighted sound pressure level of the ambient noise shall be less than 45 dB under usual operating conditions averaged over at least 30 s;

  The 30 s measurement period shall be representative of the steady-state ambient noise in the fitting area. If a longer measurement period leads to a different result, the averaging time shall be increased.

— no dominant pure-tone components are in the ambient noise;

— the minimum floor surface area is 10 m^2 and the minimum volume is 25 m^3.

An example of a fitting room is shown in Annex C.

4.4 Equipment requirements

4.4.1 General

In order to provide quality services, a range of equipment is required. The equipment cited below is considered the minimum requirement. All equipment shall be specific to the functions required and fit for purpose.

4.4.2 Audiometric equipment

For pure-tone audiometry, an audiometer shall be used for testing of air-conduction and bone-conduction thresholds using masking when required. The audiometer can be part of an integrated system with multiple functional modes. A pure-tone audiometer can also be used for measurement of the most comfortable loudness level (MCL) and uncomfortable loudness level (UCL).

The audiometer shall be a pure-tone audiometer of Type 1 or Type 2 as specified in IEC 60645-1:2017.

The performance of this equipment shall be checked and calibrated according to ISO 8253-1.

For speech audiometry, equipment fulfilling the requirements of IEC 60645-1 shall be available. Power amplifier and loudspeaker shall be available if sound field speech audiometry is performed. The performance of this equipment shall be checked and calibrated according to ISO 8253-3.

The maximum interval between objective periodical checks of the audiometric equipment shall not exceed 12 months. National or regional legislation can call for more frequent checks.

A tympanometer is recommended for impedance measurements to identify possible causes of conductive hearing loss and possible reasons for referral. The performance of this equipment shall be checked and calibrated according to IEC 60645-5.

4.4.3 Equipment for otoscopy and earmould impressions

For inspection of the ear-canal and tympanic membrane, an otoscope with ear specula of different sizes shall be available. Equipment for taking ear impressions shall also be available. For impression taking by moulding techniques the following shall be available: moulding syringes or moulding gun with suitable compounds for making earmould impressions; otoblock/cotton dam; hygiene products for hands and equipment. Ear impressions can also be taken by means of ear scanning systems.

4.4.4 Hearing aid programming equipment

A computer system with suitable hardware and software for hearing aid programming and storing of relevant client and fitting data shall be available.

4.4.5 Electroacoustic measurement equipment

Electroacoustic equipment for measuring hearing aid characteristics on an acoustic coupler or ear simulator (gain, output level, distortion, induction pick-up coil sensitivity, etc.) in accordance with IEC 60118-7 shall be available.

Equipment for in-situ measurement of real-ear acoustical characteristics of hearing aids fulfilling the requirements of IEC 61669 shall be available. The International Speech Test Signal (ISTS) as defined by IEC 60118-15 should be available for in-situ measurements.

A sound calibrator can be useful for in-practice calibration and checks of acoustic equipment.

It is recommended that the intervals between calibrations of electroacoustic measurement equipment do not exceed twelve months.

4.4.6 Maintenance tools

Tools and accessories required depend on the services offered. The following equipment is recommended for maintenance of hearing aid systems:

— tools for drilling and polishing;

— ultrasonic bath;

— set of screwdrivers, pliers and scalpel;

— scissors, forceps, disinfectant, sound tubes;

— picks and brushes;

— stethoscopic listening device;

— binocular magnifying glass or illuminated magnifying glass;

— vacuum pump, compressor or aerosol.

4.4.7 Demonstration samples

For demonstration of products, a selection of hearing aids, accessories and other assistive hearing devices should be available. Wireless connectivity devices such as wireless remote microphone systems (WRMS), TV-streamers, etc. should be part of the selection of accessories. An induction loop can also be useful for demonstration of telecoils.

4.5 Ethical requirements

4.5.1 General

The HAP shall always work with the goal of achieving the best possible solution for the client.

4.5.2 Professional competence

HAPs shall practice only within their scope of training, experience and competence. They should engage in the provision of hearing health care that represents the prevailing standard of practice and shall participate in a regular program of ongoing education.

Annex A gives a detailed suggestion for minimum competencies of the HAP.

4.5.3 Relationship with clients

In all dealings with clients, the HAP shall be respectful and keep all personal information gathered private and confidential.

The HAP shall treat clients with respect, honesty and not abuse or exploit the client psychologically, sexually, physically or financially.

4.5.4 Conflict of interest

The HAP is entitled to reasonable compensation for services to or on behalf of clients. The HAP shall not engage in practices and financial arrangements influencing decisions in the best interest of the clients. The HAP shall receive compensation only for services actually rendered to the client and not receive or pay a fee for making a referral. The HAP shall refrain from competition adverse arrangements that infringe the ethics of the profession. This includes collusion with medical practitioners, hearing aid manufacturers or other third-party health care professionals resulting in circumvention of normal competitive conditions.

When a HAP makes a written or oral public statement concerning a product of a company from which they receive compensation, or a company which holds a significant equity position in the practice or a company which they hold a significant equity position in, the HAP shall disclose the financial relationship with that company.

4.5.5 Relationship with medical and other health practitioners

Hearing aid professionals shall represent themselves and their credentials to the public in a truthful and honest fashion. A HAP should cooperate and communicate with other health care professionals in order to provide the best care possible to clients.

When a HAP recognises that communication and/or hearing problems can be caused by medical conditions that require medical treatment, they shall refer to an appropriate medical practitioner. Annex D gives guidance on indications that lead to a medical referral and how to interact with clients in these situations.

The HAP shall undertake to make available to the physician and other involved service providers all necessary and relevant documentation with consent of the client.

4.5.6 Relationship with colleagues

A HAP shall refrain from unjustifiable criticism of colleagues' judgement, training, knowledge or skills. A HAP shall not knowingly ignore professional misconduct or incompetence and shall report it to their superior, professional college or applicable authority.

4.5.7 Advertising

A HAP often advertises their services. The requirements related to such advertising are given in applicable national or regional directives and legislation.

5 General stages of HAFM

5.1 General

The stages of HAFM shall be performed by a hearing aid professional, to ensure the best possible outcome and adequate service in the interest of the client. These stages cover assessment of the client's needs and degree of hearing loss followed by the selection and fitting of suitable hearing aids, rehabilitation and short and long-term monitoring and support.

Hearing aid fitting shall consist of the delivery of the hearing aids, the fitting process and the related care. The efficacy of the hearing aid system depends on the type of device chosen, its fitting, the counselling and the follow-up.

Initially, the general process of HAFM shall be explained to the client, including the financial aspects. During the entire fitting process, decisions shall be made in a close dialogue with the client after counselling by the HAP (informed consent).

Annex E gives a comprehensive set of suggestions for how to communicate with the client in accordance with the principles of person-centered care.

The HAP shall pay particular attention to clients with no previous experience in using hearing aids.

The general framework of HAFM consists of six stages, as depicted in Figure 1: client profile, counselling, hearing aid fitting, verification and validation, post-fitting counselling and follow-up. This general framework includes all the necessary activities for best practice HAFM. The stages are listed in non-chronological order. The client may pass through these stages in a different order, with an overlapping with other stages, or multiple times due to an iterative approach.

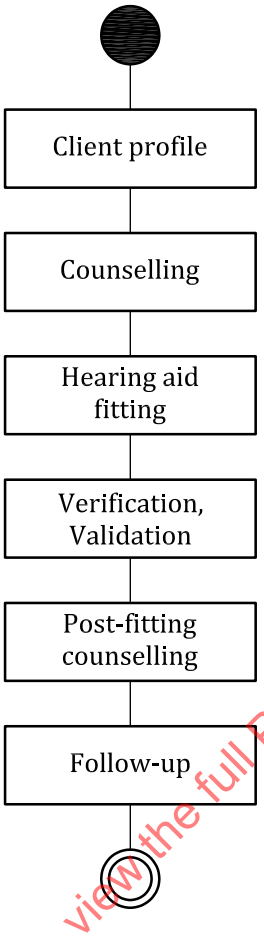


Figure 1 — General stage of HAFM

5.2 Client profile

5.2.1 General

The HAP shall make a client profile assessment that establishes an account for the client's auditory functionality, social situation, activity limitations, needs and expectations. All test results of the client profile assessment shall be recorded in the client file.

5.2.2 General assessment

The following conditions shall be considered for the client profile and properly documented:

— self-reported type, degree and history of the hearing loss;

— communication and hearing challenges, social consequences;

— relevant living conditions, and the need for assistive listening devices, hearing expectations and individual hearing situations;

— relevant medical history, including allergies, family history, medication, otalgia, otorrhoea, operations;

— history of excessive noise exposure, including occupational, leisure noise or acoustic trauma, etc;

— fine motor skill/dexterity, visual capabilities or other challenges;

— tinnitus, dizziness and hyperacusis;

— previous use of a hearing aid and other assistive devices.

The client profile should use the terminology of ICF (International Classification of Functioning, Disability and Health)[33] or equivalent to define the degree of hearing loss.

It is recommended to use validated questionnaires for the recording of these factors.

5.2.3 Audiological assessment

5.2.3.1 Hygiene

Proper hygiene precautions shall be taken to prevent cross-contamination.

5.2.3.2 Otoscopy

Otoscopy shall be carried out with an inspection of the external ear canal, eardrum and also pinna and area behind the ear to observe any signs of infection, skin cancers/lesions requiring medical investigation, the presence of cerumen or any other contra-indications to impression taking and to the fitting of a hearing aid. Cerumen shall be removed by a trained and authorized professional. Any abnormalities of the ear which should be considered during the hearing aid fitting process shall be noted.

5.2.3.3 Pure-tone audiometry

Pure-tone audiometry shall be carried out according to the test procedure described in ISO 8253-1.

Hearing thresholds (with masking if necessary) shall be determined at least at the following frequencies:

— air conduction: 250 Hz, 500 Hz, 1 000 Hz, 2 000 Hz, 4 000 Hz and 8 000 Hz;

— bone conduction: 500 Hz, 1 000 Hz, 2 000 Hz and 4 000 Hz.

Thresholds at intermediate frequencies (750 Hz, 1 500 Hz, 3 000 Hz and 6 000 Hz) shall be measured when there is a difference of more than 20 dB between two adjacent standard frequencies or a hearing aid fitting requirement that necessitates fitting precision.

To assess the auditory dynamic range, an ascending method for determining the uncomfortable loudness level (UCL) shall be carefully carried out at least for the following frequencies:

— air conduction: 500 Hz, 1 000 Hz, 2 000 Hz, 4 000 Hz, preferably with warbletones.

For some individuals, the tolerance of louder sounds can be a significant problem and cause distress. In this case, the determination of the UCL requires special care.

5.2.3.4 Speech audiometry

The client's ability to discriminate speech is an important parameter for the audiological assessment and speech audiometry shall always be performed.

Standardized recorded speech test material developed and validated according to ISO 8253-3 should be used, if available. The speech signal may be presented monaurally through earphones or binaurally in a sound field.

NOTE It is important for reliable results to have speech material in the native language of the client.

Speech presented in a background of competing noise should be used since it represents a more realistic listening situation than speech in quiet.

5.2.3.5 Tympanometry

Hearing loss can be caused by middle ear conditions. As a supplement to otoscopic investigations, tympanometry should be performed to assess the condition of the middle ear, if a tympanometer is available.

5.2.3.6 Other audiometric tests

If deemed relevant, other audiometric tests shall be carried out. Such measurements can be:

— subjective audiometric procedures like: uncomfortable loudness level (UCL) for speech or other relevant signals beside pure tones, most comfortable loudness level (MCL), comfortable speech level (CSL), acceptable noise level (ANL), loudness scaling;

— objective audiological procedures, for example acoustic (stapedious) reflex measurement, auditory brainstem response (ABR), otoacoustic emission (OAE).

5.2.4 Medical referral

If the results of the audiological assessment and the client profile indicate a disease or other cause of the hearing loss likely to require medical or surgical treatment, the HAP shall refer the client to a medical specialist. Particular attention should be paid to clients with rapid or unexpected progression of hearing loss and asymmetries.

Annex D gives guidance on the indications that lead to a medical referral and how to interact with clients in these situations.

5.3 Counselling

5.3.1 General

At the end of the assessment of the client profile, the results shall be explained and discussed with the client. In particular, it is important to manage motivations and expectations with regards to achievable functionality. A report of the assessment shall be made available to the client. Also, the client shall be informed about how auditory training can support the rehabilitation process. Annex E gives a comprehensive set of suggestions of what topics should be covered in the information given to the client.

5.3.2 Selection of hearing aid system

Based on the client profile, the HAP shall inform the client about the suitable types of hearing aid systems. The various options in terms of models, styles, features including connectivity opportunities, control possibilities, accessories and prices shall be presented to the client and their respective advantages and limitations described. If no contra-indications are present and the client has some degree of hearing loss in both ears, bilateral fitting shall be recommended. The selection of the hearing aid system to be fitted as well as other assistive listening devices shall be based on informed consent by the client with all relevant information, including the financial aspects and the return policy. Product and cost documentation on the proposed solution shall be given to the client.

5.4 Hearing aid fitting

5.4.1 Ear coupling elements

If a custom earmould/earshell is needed for the hearing aid system chosen, an ear impression shall be made and the appropriate acoustic properties of the customized part should be considered. The ear impression is to be used for the production of the custom earmould/earshell with the desired acoustic properties.

5.4.2 Pre-setting of hearing aids

Depending on the type of hearing aid system chosen, certain preparations can be needed before the actual fitting can be carried out.

The HAP shall enter the following data in the fitting system provided by the manufacturer:

— data from the client profile;

— properties of acoustic coupling (e.g. earmould).

Based on this data, a pre-setting shall be programmed into the hearing aid to be the starting point for the fine-tuning of the fitting at least for the following parameters:

— gain;

— compression;

— frequency response;

— maximum output.

Where the hearing aid system includes storage for client specific data, data logging or data transmission system for data use, consent from the client has to be obtained before these systems are enabled.

Hearing aid performance may be verified by electroacoustic tests in accordance with IEC 60118-7.

5.4.3 Setting and fine-tuning of hearing aids

The hearing aid system is physically placed on the client so that the HAP with the client can verify the correct physical fit of the hearing aids and the coupling elements and these shall be modified until a proper fit is achieved.

The hearing aid shall be fine-tuned in close interaction with the client until a setting, accepted by the client, has been reached.

In cases where an acceptable fitting is not obtained, additional assessments shall be carried out to identify ways to improve the fitting. Methods detailed in the subclauses on verification and validation can be used to support fine-tuning, e.g. real-ear measurements or the presentation of soundscapes.

5.5 Verification and validation

Verification that a proper fitting has been achieved shall be made by evaluating the signal processing characteristics. At least one of the following shall be used:

— real-ear measurements in accordance with IEC 61669 shall be performed and preferably using the ISTS or similar speech-like stimulus at multiple stimulus levels representing soft, average and loud speech so that audibility and compression characteristics can be assessed;

— percentile analysis as defined by IEC 60118-15 using the ISTS signal or equivalent speech-like signal can also be useful to determine where the dynamic range of the speech signal falls with respect to the patient's threshold;

— functional gain evaluation in accordance with ISO 8253-2.

It shall be assured that the hearing aid user is protected against too loud sounds. This means the hearing aid output shall not exceed the individual's UCL for any input sounds. Usually, in this context, the hearing aid's compression and maximum output are considered for the verification. Simulated real-ear measurements via coupler-based measures that use acoustic transforms and that include the patient's real-ear-to-coupler difference measurements (RECD) can be used as an alternative method for hearing aid verification.

The client should be exposed to situations that will likely be part of the client's everyday life in accordance with the hearing profile. Further refinement to hearing aid adjustments can be made by using recordings of typical real-life sounds as long as levels are calibrated.

If the hearing aid system includes several hearing aid programs and additional features or devices, all configurations shall be verified. Validation of improvement in hearing sensitivity shall be performed. At least one of the following shall be used and the results reviewed with the client:

— speech audiometry in a sound field without and/or with noise, aided compared to unaided; to this end, standardized recorded speech test material developed and validated according to ISO 8253-3 should be used, if available;

— questionnaire concerning the perceived benefit of the hearing aid system. The questions may refer to before and after fitting or focus directly on perceived benefit. A scientifically validated questionnaire should be used, and it is recommended that the client has at least several weeks of everyday experience with the hearing aid system.

Other validation methods that can also be applied are:

— measurement of aided hearing threshold levels in sound field according to ISO 8253-2;

— localisation performance using loudspeaker arrays.

5.6 Post-fitting counselling

Before the hearing aid fitting stage can be considered completed, the client shall be given a comprehensive introduction to the hearing aid systems fitted and available assistive listening devices, in particular clients who have no experience of using a hearing aid. This shall at least include:

— product-specific instructions and demonstrations;

— instructions and demonstrations on how to place and operate the hearing aids;

— instructions and demonstrations on how to manage batteries and other energy sources;

— hearing tactics: teaching and training of individual behavioural patterns to cope with difficult hearing situations;

— advice on the use of the hearing aid with accessory devices or systems such as: induction loops, hearing enhancement systems within buildings, wireless connectivity devices and applications (apps), remote care, etc;

— instructions on how to clean and maintain hearing aids and earmoulds;

— support for acclimatization including auditory training if needed.

5.7 Follow-up

The purpose of the follow-up services is for periodic verification and validation of technical and auditory aspects as well as further support to optimize hearing aid system benefit.

A first follow-up appointment shall be scheduled in one to six months after the first fitting sessions. The objective of the follow-up appointment is to check the hearing aid system fitting after the client has completed a period of adaptation in the client's everyday environment.

Conditions that shall be considered are:

— state of outer ear by otoscopy including cerumen problems;

— physical appearance and fit;

— operational issues in the use of the hearing aid system;

— auditory performance;

— satisfaction and benefits.

If needed, adjustments of the hearing aid settings shall be performed to improve hearing aid system performance. Moreover, the progress or the possibility of auditory training should be reviewed with the client.

Additional follow-up appointments shall be suggested to the client. At each follow-up appointment, the statements by the client and the solutions provided shall be added to the client record.

Follow-up visits shall also be scheduled in response to clients reporting on situations where the hearing aid system is not performing satisfactorily. Further adjustments of the hearing aids may also be performed by the HAP using a teleaudiology system.

6 Quality of service

6.1 General

It is of high importance that the services of a HAP be of high and consistent quality. Therefore, the services offered by a HAP should be covered by a quality management system to help ensure adequate hearing and communication rehabilitation utilising state of the art technical systems and audiological knowledge. The quality management system should comprise the following elements:

— quality management objectives;

— procedures to monitor the fitting quality, and if necessary, initiate corrective measures;

— measures to ensure the client's protection, safety and satisfaction.

It is recommended that the HAP apply a quality management system according to ISO 9001 or ISO 13485.

6.2 Documentation

The HAP shall maintain a client file system where all activities and interactions with a client are recorded. More specifically, the record shall include at least the following elements:

— demographic information;

— referral source;

— medical affiliations;

— diagnostic findings;

— hearing profile;

— fitting appointments;

— fitting settings;

— verification;

— validation;

— follow-up adjustments;

— hearing aid type and serial number for traceability;

— if individual modifications were made or custom-made devices were produced, relevant details need to be documented;

— hearing aid system repair history;

— report for the client, other specialists involved (e.g. physician, speech therapist, etc.) or as documentation for reimbursement.

The file system can be either paper or computer-based.

The HAP shall maintain a file where all periodic checks and calibrations of equipment are documented, including results and identity of the laboratories that performed the checks.

6.3 Client evaluation of services

The HAP should carry out periodical client satisfaction surveys designed to measure the client satisfaction with the services provided.

The collection of data should be carried out by means of a satisfaction questionnaire. Survey results should be available in the service unit.

6.4 Customer complaint handling

The HAP shall:

— facilitate the expression and collection of complaints, for example by means of complaints files, satisfaction surveys, etc.;

— record, study and attempt to resolve (answer) all complaints received whether orally or in writing. The client filing a complaint shall be given a first response as fast as possible which should be no later than 5 working days after the filing;

— report serious product malfunction back to the hearing aid manufacturer;

— report serious client injuries due to product malfunction to health authorities.

6.5 Corrective actions

The HAP shall strive for continuous improvement of service provision by actively seeking input from clients in the form of complaints as well as client evaluation of services. The areas of improvement identified shall be analysed and addressed by appropriate corrective actions.

Annex A
(informative)

Minimum competencies of the hearing aid professional (HAP)

A.1 Description of competencies

This document defines the minimum competencies recommended for a hearing aid professional, which enable him/her to properly perform the services covered by this document. The detailed specification of the competencies is composed to correspond to all the processes described within this document.

An educational program for hearing aid professionals should develop the competencies defined in this document through a combination of theoretical and practical training.

Certain competencies like noise protection or pediatric hearing aid fitting are not included as they are not within the scope of this document.

A.2 General competencies

The HAP should be capable of:

— assessing client communication needs;

— assessing hearing sensitivity;

— selecting, adjusting and fitting hearing aid systems;

— monitoring the effectiveness of the fitted system;

— counselling on the choice and use of hearing aids;

— servicing hearing aids;

— delivering the services in dialogue with the client;

— documenting services performed and measurement results.

A.3 Audiological assessment — Hearing measurements and ear inspection

The HAP should be capable of:

— inspecting the ear by otoscope;

— performing pure-tone audiometry with and without masking, air-conduction as well as bone conduction, aided and unaided;

— performing speech audiometry, in quiet and in noise, aided and unaided;

— performing other relevant tests such as tympanometry, UCL, MCL and loudness scaling;

— identifying conditions that require medical or other professional intervention;

— interpreting documents related to the audiological assessment from prior investigations (referrals).

A.4 Hearing profile — Relevant factors beyond the audiological assessment

The HAP should be capable of procuring and documenting information on:

— type, degree and history of the hearing loss;

— communication and hearing disabilities, social consequences;

— relevant living conditions, hearing expectations and individual hearing situations;

— relevant medical history including allergies and medication;

— dexterity challenges;

— tinnitus, dizziness and hyperacusis;

— previous hearing aid use;

— history of noise exposure.

A.5 Selection, fitting, verification, validation and provision of hearing aids

The HAP should be capable of:

— maintaining up-to date familiarity with hearing aid technology, including types, specifications, performance characteristics and applications;

— selecting appropriate hearing aids in accordance with the results of the audiological assessment and hearing profile;

— selecting appropriate type of ear coupling elements for the hearing aids selected;

— programming the hearing aid using the manufacturer's fitting software;

— measuring the hearing aid characteristics electroacoustically to ensure proper functionality and suitability;

— fitting the hearing aid system on the client's ear and adjusting the mechanics and acoustics of the hearing aid;

— fine-tuning the hearing aid in co-operation with the client;

— verifying the fitting of the hearing aid system by appropriate methods;

— validating the efficacy of the fitted hearing aids system by appropriate methods;

— instructing the client on how to use the hearing aid system.

A.6 Selection, manufacturing, modification and maintenance of earmoulds

The HAP should be capable of:

— assessing the anatomical and physiological characteristics of the client's ear for selecting and manufacturing an earmould;

— taking ear impressions;

— prescribing earmoulds with the most appropriate material, shape and acoustic characteristics according to the type of device required;

— modifying earmoulds for appropriate physical fit;

— advising the client on cerumen management.

A.7 Modification and maintenance of hearing aids, accessories and assistive devices

The HAP should be capable of:

— examining hearing aids for proper functionality;

— cleaning hearing aids and ear coupling elements;

— performing electroacoustic measurements to verify functionality;

— repairing and modifying hearing aids;

— offering accessories to enhance the utility of hearing aids;

— offering assistive devices and systems to complement hearing aids.

A.8 Interaction with clients for proper rehabilitation

The HAP should be capable of:

— applying communication, behavioural and relational patterns suitable for specific groups of population, especially for elderly people;

— taking the psychosocial condition of the client into account as part of the general assessment prior to hearing aid service provision;

— providing the client with complete information on the steps required to carry out tests and fitting of a hearing aid system, the duration of the process and the financial implications;

— applying adequate counselling techniques directed to correctly manage the expectations of the client about the outcome of the rehabilitation strategy;

— providing the client and the people accompanying him/her with all of the information they require in order to handle relevant administrative and social security documents properly;

— providing the client with relevant information about hearing tactics and supplementary systems and services that can improve the utility of the hearing aid system.

Annex B
(informative)

Recommendation for organisation of education and training for hearing aid professionals (ISCED level 5)

A HAP should have completed an education and training programme of at least three years. The education and training programme should be distributed as shown below. Local conditions and traditions can cause variations in the organisation of the education. Furthermore, a supplementary education module for managing a HAP practice is also provided. See Table B.1.

Table B.1 — Exemplary curriculum for hearing aid professionals

Exemplary curriculum for hearing aid professionals (ISCED level 5)						
Category	**Sub-category**	**Subject**	**Hours per subject**	**Hours for sub-category**	**Hours for category**	**Total hours for examplary curricum**
Theory	Basic knowledge	Mathematics, informatics, statistics	100	180	1 420	2 590
		Physics, basic acoustics, building acoustics	40			
		Electronics, magnetism and signal processing	40			
	Bio medicine	Anatomy, physiology, pathology in general and related to hearing	85	145		
		Biology, genetics	30			
		Neurology and other relevant medical disciplines	30			
	Human/ Social science	Psychology	80	170		
		Gerontology	20			
		Linguistics, phonetics	50			
		Speech language pathology	20			
	Audiology	Psycho-acoustics of impaired hearing	40	245		
		Functional audiology	40			
		Evaluation of hearing	40			
		Pediatric audiometry	30			
		Noise and hearing loss	25			
		Medical conditions associated with hearing and balance problems	70			

Table B.1 *(continued)*

Exemplary curriculum for hearing aid professionals (ISCED level 5)						
Category	**Sub-category**	**Subject**	**Hours per subject**	**Hours for sub-category**	**Hours for category**	**Total hours for examplary curricum**
	Hearing aid technology (from basic knowledge)	Acoustical measurement and calibration, general	50	300		
		Electroacoustics, transducers, tubing	100			
		Signal processing	100			
		Coupler and real-ear measurements	50			
	Hearing rehabilitation systems	Hearing rehabilitation systems, air and bone conduction, implants, assistive devices	80	130		
		Composition and repairs of hearing aid systems	50			
	Earmould and custom in the ear devices	Types and indications	30	90		
		Acoustics and vents	30			
		Materials and manufacturing	30			
	Selection and fitting of hearing aid systems and evaluation of fitting	Selection and fitting of hearing methodologies, programming	80	160		
		Verification, audiometric, perceptive and questionnaires	40			
		Rehabilitation, instructions, hearing tactics and auditory training	40			
Practical training	Hearing aid fitting	Diagnostic procedures	150	655	830	
		Fitting	430			
		Production of earmoulds and custom devices	75			
	Repair	Repair of hearing aid systems	75	75		
	Final project	Final project	100	100		
Supplementary education	Managing a HAP practice	General management	140	340	340	
		Responsibilities and legislation	70			
		Qualilty management	30			
		General studies (economics, politics, social science)	100			

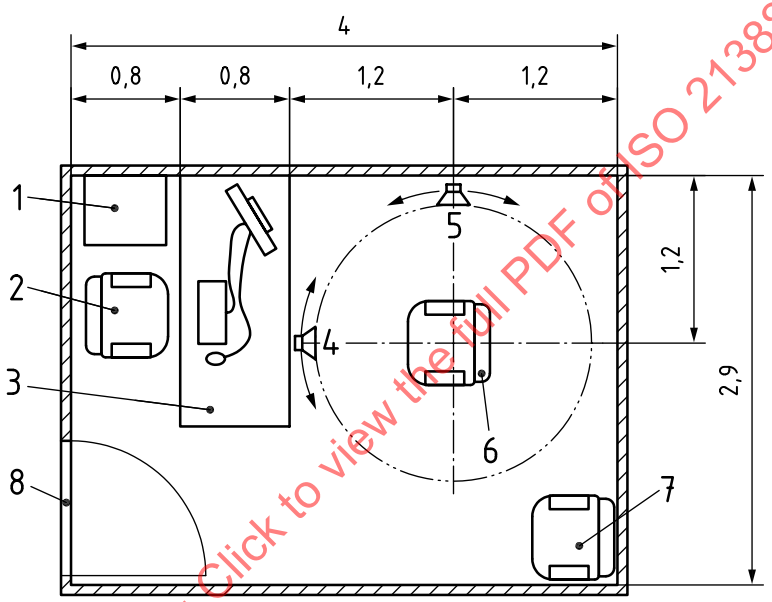
Annex C
(informative)

Fitting room example

This annex provides an example of a fitting room which fulfills all conditions defined in 4.3.

The example shows how an appropriate fitting room can look like. It should not be regarded as the ideal configuration or dimensions.

Dimensions in metres



Key

1 area for hearing aid test box
2 seat of the hearing aid professional
3 desk with computer and audiometer interface
4 speaker 1
5 speaker 2
6 seat for the client
7 seat for an accompanying person
8 door

Figure C.1 — Example of a fitting room

The fitting room example has a floor surface area of 11,6 m^2 (4 m × 2,9 m), and a height of 2,7 m, which results in a volume of approx. 31 m^3. The door is 1 m wide so that wheelchairs can pass it (see Figure C.1, item 8). Furthermore, the door provides acoustic attenuation to a degree that prevents conversations in the fitting room to be heard in other parts of the facility, and likelwise prevents noise from the outside to impair the fitting process.

Inside the room, three chairs are available for the client, an accompanying person and the HAP (see Figure C.1, items 6, 7, 2). The HAP sits behind a desk, which carries a PC and all interfaces of the audiometer (see Figure C.1, items 2, 3). The position of the computer display enables an unrestricted view between the HAP and the client. Beside the desk, a hearing aid test box is located to perform electroacoustic tests with the hearing aid (see Figure C.1, item 1).

Around the chair of the client, speakers are positioned at a distance of 1 m from the centre of the client's head. The height of the speakers is the same as that of the client's ears when the client is seated on the chair. In Figure C.1, items 4 and 5 show two speakers with arrows indicating position variation possibilities. The position of the speakers depends on the test performed. Other speaker arrangements may also be used.

Annex D
(informative)

Recommendation on the referral of clients for medical or other specialist examination and treatment

The HAP should establish any requirement for the referral of a client for a medical opinion and/or treatment. Whenever the client reports or the HAP finds an exceptional change in hearing or in any condition arising in or related to the auditory or vestibular systems, the opinion of a suitably qualified professional should be sought.

The primary criteria for the referral of a client for a medical or other specialist opinion and/or treatment are as follows:

— visible congenital or traumatic deformity of the ear;

— history of active drainage from the ear in the previous 90 days;

— history of sudden or rapidly progressive hearing loss in one or both ears within the previous 90 days;

— acute or chronic dizziness;

— audiometric air-bone gap equal to or greater than 15 dB at 500 Hz, 1 000 Hz and 2 000 Hz;

— visible evidence of significant cerumen accumulation or a foreign body in the ear canal;

— pain or discomfort in the ear;

— abnormal appearance of the eardrum and ear canal such as

  — inflammation of the external auditory canal,

  — perforated eardrum;

— other abnormalities which the audiologist believes are of medical concern.

The HAP may decide that referral is not appropriate or in the best interests of the client when the following applies:

— when there is sufficient evidence that the condition has been fully investigated by a medical specialist and any possible treatment has been provided;

— the condition has not worsened or changed significantly since the previous investigation and/or treatment.

If the client has given their informed and competent decision not to accept advice to seek a medical opinion, it is permissible to proceed to recommend appropriate hearing aid systems subject to the following considerations:

— the recommendation will not have any adverse effects on the client's health or general wellbeing;

— the records confirm that all necessary considerations about the client's best interests have been made.

If legally required, the client has signed a disclaimer to confirm that the referral advice has not been accepted and that it is an informed decision.

Annex E
(informative)

Informational counselling to support hearing aid fitting management

Person centred principles and strategies for effective information sharing should be applied. The key principles are:

— practice active listening, ask open-ended questions that facilitate a dialogue with clients;

— involve and encourage family members or important communication partners to be a part of the process;

— express empathy;

— consider the client's individual needs and preferences;

— enable shared decision making that will empower the client and allow for effective self-management of hearing loss.

Strategies for effective informational counselling comprise the following guidelines:

— present most important information first;

— present information in simple terms, avoid technical jargon;

— do not overwhelm client with information, provide a few elements and ask if they would like to receive more;

— categorize information: procedures, test results, diagnosis, recommendations, available options, resources, etc;

— offer client the option of asking questions before moving to the next category;

— recommendations should be specific and not vague, e.g. "*Try to wear your hearing instrument for 2 hours on the first day, 3 hours the second day, and work your way up until you are able to wear it for all waking hours" vs "Take your time to get used to your hearing instruments and gradually wear them in"*;

— provide written, pictorial, and/or graphical hearing aid information that the client can take home;

— emphasize important information;

— repeat most important information.

There are broadly seven stages [a) to g) below] involved during the hearing aid fitting process where information should be shared effectively during each stage with the aim of empowering the client to make the best decisions about their hearing care.

a) Client motivation, expectations and needs exploration prior to the first appointment:

   1) it is recommended to send the client online or hard copy resources to explore communication situations where it is important for them to hear well. Ask them to describe their current management strategies and obtain the viewpoint of the spouse / partner / family member / close friend;

   2) ask client to think about important communication partners and what questions they would like to ask during the first appointment with their HAP;

3) provide means to send the information to the HAP ahead of appointment or bring along to the appointment.

b) Greeting and general information:

1) business name of the practice, address, telephone, fax and email, web page, hours of operation;

2) introduction to the staff of the practice in general and the professional taking care of the client;

3) explanation of the overall flow of the process: recording of client profile including motivation, expectations and communication needs assessment, audiometric tests, discussion of results, shared decision making about treatment options.

c) Client profile and assessment:

1) discuss and explore results of motivation, expectations and communication needs as completed prior to appointment and provide answers to client's questions. If these have not been completed prior to appointment, provide opportunity at start of appointment to explore these. Use the principles of person centred care throughout;

2) ask the client if they would like to know the results of the hearing test and what level of detail they require for the explanation;

3) present different types of management options including hearing instruments, assistive listening devices, communication strategies, auditory training, psycho-social support. Shared decision making about hearing aid options should be included in their hearing care plan;

4) for hearing aids, explain different types of hearing aids and their benefits, limitations and prices, as well as opportunities for reimbursement.

d) Hearing aid fitting:

Provide informational counselling regarding the below and using the above-mentioned principles. Consider discussing some of these topics outside of the fitting appointment (e.g. prior to fitting or at the follow-up appointment) and provide it in written form. Avoid information overload.

1) Client experience and support issues:

— the client's acoustic and listening experience with hearing aids;

— hearing aid operation, care and maintenance instructions;

— adaptation process and comfort with hearing aids;

— adjustment procedure and testing period;

— future follow-up procedure.

2) Technical and financial issues:

— mutual engagements and return conditions (for both hearing aids or in-the-ear devices);

— price list and different possible financial aids;

— available accessories;

— guarantees and maintenance unit;

— items covered by the guarantee;

— possible loans of hearing aids in case of repairing;

— insurance offers in case of breakage or loss.

3) Adjustment and invoicing:

   — mention the possibilities of complementary multidisciplinary assistance available;

   — client file: report of examination, hearing diagnostic, fitting, adjustment, satisfaction questionnaires;

   — necessary documents for reimbursements (e.g. forms, invoices and prescription).

e) Verification:

Verify hearing aid fittings using evidence-based procedures and prescription algorithms for probe microphone measures in accordance with international best practice guidelines.

f) Validation:

1) validate hearing aid fittings using a variety of outcome measures including benefit, satisfaction, hearing aid usage, listening effort, speech in noise testing, sound quality, quality of life, impact on significant other (third-party disability), etc.;

2) validation can be reported by

   — direct measures of performance,

   — self-report scales and questionnaires,

   — daily logs.

g) Follow up:

1) discuss need and schedule for follow-up services. Agree individual follow-up programme;

2) re-instruct client on essential topics covered during the fitting appointment and include topics that were saved for the follow-up appointment (e.g. need for assistive listening technologies). Provide opportunity to ask questions;

3) counsel client on need for and details of any necessary adjustments / fine-tuning;

4) enquire about use time, client benefits and satisfaction, include views of communication partners;

5) enquire about any additional support required e.g. hearing aid insertion, training of nursing staff, etc.;

6) counsel about peer support and refer (e.g. client organisations, online support groups);

7) counsel about use of communication strategies and provide resources (e.g. see Reference [53]);

8) consider vocational support;

9) enquire about success using the telephone.

Annex F
(informative)

Terminology

This annex provides a comprehensive list of terms related to HAFM that can prove useful to practitioners.

A

acoustic coupler

cavity of specified shape and volume used for the calibration of earphones or microphones in conjunction with a calibrated microphone adapted to measure the sound pressure developed in the cavity

[SOURCE: ANSI S3.20:2015]

acoustic feedback

whistling sound produced by a hearing aid; the return of some of the energy of the output signal from the hearing aid receiver to the input transducer

acoustic reflex test

test measuring middle-ear muscle responses elicited to intense acoustic stimulus, usually including ipsilateral and contralateral reflex thresholds

acoustics

1) science of sound, including its production, transmission, and effects, including biological and psychological effects

2) those qualities of a room that, together, determine its character with respect to auditory effects

[SOURCE: ANSI S1.1:2013]

aided dynamic range

difference between the hearing threshold and the uncomfortably loud hearing level for a given hearing aid input

air conduction

transmission of sound through the external and middle ear to the inner ear

[SOURCE: ISO 8253-1:2010]

air conduction threshold

hearing threshold for a pure-tone signal transmitted via air conduction

air-bone gap

for the ear of an individual at a specified frequency, the difference between the hearing threshold levels for air conduction and bone conduction

Note 1 to entry: Unit decibel (dB).

[SOURCE: ANSI S1.1:2013]

amplifier

electronic device for increasing the magnitude of an electrical signal

analog hearing aid

hearing aid with conventional circuitry that processes the signal in a continuous fashion in the time domain

assessment

process to serve as a pre-fitting stage that consists of preparatory components including counselling, hearing evaluation, hearing aid selection, and taking of ear impression if necessary

assistive listening device, ALD

device that supports or expands the effectiveness or functionality of hearing

audiogram

presentation, in graphical or tabular form, of the hearing threshold levels of the ears of the test subject, determined under specified conditions and by a specified method, as a function of frequency

[SOURCE: ISO 8253-1:2010]

audiologist

hearing health care professional who identifies, assesses, and manages hearing and/or balance disorders and provides related services including hearing aid fitting

audiometer

instrument for the measurement of certain characteristics of hearing, particularly the hearing threshold level

[SOURCE: IEC 60050-801:1994]

audiometric measurement

assessment of hearing abilities

audiometric test room

specifically designed sound proofing test enclosure in which hearing tests are performed

audiometrist

audiology technician, who may conduct basic hearing tests and assist with hearing aid fittings and repairs

audiometry

measurement of hearing, including aspects other than hearing sensitivity

[SOURCE: ANSI S3.20:2015]

auditory brainstem response

electrical activity evoked by acoustic or vibratory stimulation arising from the auditory nerve and brainstem recorded with electrodes

auditory evoked potentials

electrical activity evoked by acoustic or vibratory stimulation arising from auditory portions of the peripheral or central nervous system recorded with electrodes

auditory nerve

nerve, consisting of two sets of fibers: the anterior branch or cochlear nerve and the posterior branch or vestibular nerve. Afferent fibers of the nerve conduct neural signals from the inner ear to the central nervous system; efferent fibers transmit signals from the central nervous system to the inner ear.

[SOURCE: ANSI S3.20:2015]

auditory steady-state response

auditory evoked potential in which the response waveform has a repetition frequency the same as the rate of stimulation

auditory training

process to aid the capability of hearing perception by focusing on various rehabilitative aspects including auditory perception, communication strategies, and individual needs

auditory verbal therapy

training method for a person with hearing loss focusing on listening and speaking

auricle

external and visible portion of the ear comprising an ovoid-formed, skincovered, fibro-cartilaginous appendage that is attached to the head around the opening of the external auditory meatus

[SOURCE: ANSI S3.20:2015]

automatic gain control

means (other than peak clipping) by which the gain is automatically controlled as a function of the level of the signal being amplified

[SOURCE: IEC 60118-7:2005]

B

battery

source of electrical energy obtained by the direct conversion of chemical energy

[SOURCE: ISO 6426-2:2002]

behavioral assessment

tests that involve some form of participation or response from the subject to indicate that an auditory stimulus such as a pure tone or speech was heard and understood

bone conduction

transmission of sound to the inner ear primarily by means of mechanical vibration of the cranial bones

[SOURCE: ISO 8253-1:2010]

bone conduction threshold

hearing threshold for a pure-tone signal transmitted via bone conduction

C

calibration

operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

[SOURCE: ISO/IEC Guide 99:2007]

central hearing loss

hearing impairment that occurs when there is damage to or dysfunction of the central auditory pathways

[SOURCE: ANSI S3.20-2015]

cerumen

waxy substance secreted by the ceruminous glands in the ear canal, which may cause conductive hearing loss if impacted

cochlea

spirally coiled, tapered cavity within the temporal bone consisting of about two and three-eighths turns in humans

[SOURCE: ANSI S3.20:2015]

cochlear nerve

anterior branch of the vestibulocochlear (8^{th} cranial) nerve

[SOURCE: ANSI S3.20:2015]

comprehensive report

process documenting and filing substantial information occurred during the whole hearing aid fitting management process for informative reports and future references

compression

feature of a hearing aid that defines the relationship between input and output levels

conductive hearing loss

impairment of hearing that occurs when there is interference of sound transmission through the external and/or middle ear

[SOURCE: ANSI S3.20:2015]

configurable hearing aid program

hearing aid program that can be adjusted by a HAP by means of fitting software

critical feedback condition

situation where feedback causes a whistling noise at the output of the hearing aid

cross hearing

perception of sound in an ear that is transmitted by either air conduction or bone conduction across or through the head from the contralateral ear under test

custom earmould

earmould which is made from an ear impression, or scan, to fit a specific ear

custom hearing aid

hearing aids such as in the ear, in the canal, and completely in the canal that are made for specific individuals from an ear impression

D

deafness; deaf

condition caused by a hearing loss which results in a person's inability to use auditory information effectively for communication or other daily activities, even with amplification

[SOURCE: ANSI S3.20:2015]

difference limen

minimum change in a stimulus that can be correctly judged as different from a reference stimulus in a specified fraction of trials

[SOURCE: ANSI S3.2:2015]

digital hearing aid

hearing aid utilizing digital technology to process the signal

E

ear

organ of hearing

[SOURCE: ANSI S3.20:2015]

ear coupling

customized part such as earmould/earshell needed for the hearind aid system chosen

ear simulator

device for measuring the acoustic output of sound sources where the sound pressure is measured by a calibrated microphone coupled to the source so that the overall acoustic impedance of the device approximates that of the normal human ear at a give location and in a given frequency band

[SOURCE: ISO 8253-1:2010]

earmould

device used to couple an electroacoustic transducer to the ear

[SOURCE: ANSI S3.20:2015]

earshell

hollow structure used to contain a custom in-the-ear hearing aid

external auditory canal

canal that directs sound from the auricle to the tympanic membrane

[SOURCE: ANSI S3.20-2015]

external ear

combination of the auricle and the external acoustic meatus

[SOURCE: ANSI S3.20:2015]

F

feedback

return of some of the energy of the output signal from the hearing aid to the input of the same hearing aid which can lead to whistling of the hearing aid

feedback reduction

feature of the signal processing of hearing aids to reduce or completely avoid the occurrence of the critical feedback condition

frequency modulation (FM) system

assistive listening device that conveys sound from a sound source to a listener by means of a carrier wave with a sinusoidally varying frequency; designed to enhance signal to noise ratios

follow-up

process to serve as a post-fitting stage that consists of subsequent procedures including outcome measures, and comprehensive report with or without auditory training

functional gain

the differences in dB between unaided and aided thresholds

G

gain-frequency response

gain of a system expressed as a function of frequency, for example for an electrical amplifier

H

hearing evaluation

process to conduct various relevant tests to identify information about hearing loss and select appropriate hearing aids

hearing aid adjustment

alteration of the physical or electroacoustic aspects of hearing aids

hearing aid band

feature of the signal processing of hearing aids that enables individual adjustement of gain for a certain frequency range

hearing aid channel

feature of the signal processing of hearing aids that enables individual adjustment of the gain and the parameters of an automatic gain control for a certain frequency range

Note 1 to entry: A hearing aid channel may consist of multiple hearing aid bands.

hearing aid program

predefined set of parameters, defining the signal processing of a hearing aid, that can be manually selected by the hearing aid user and/or that is automatically selected by the hearing aid to adapt the signal processing to specific listening situations

hearing aid selection

decision-making processes associated with multiple features of hearing aids by considering device features, and anatomic characteristics and cosmetic factors of potential hearing aid users to determine earmould, style, vent, and other physical and acoustical properties of hearing aids

hearing aid test box (system)

apparatus used to measure the electroacoustic characteristics of a hearing aid

hearing aid trial

process of experiencing amplification by wearing demonstration samples to establish realistic expectations before making a decision to acquire hearing aids

hearing profile

comprehensive account of a client's auditory problems, social situation, activity limitations, needs and expectations

hearing situation

situation in which a hearing aid user requires a specific signal processing which could be achieved by activating a hearing aid program

I

immittance (test)

generic term for the flow of energy through the middle ear, including impedance and admittance, usually indicating battery of tests used to assess middle ear function, including tympanometry, static admittance, and acoustic reflex thresholds and decay

induction loop

loop of wire in part or all of a room designated as an assistive listening area; sound is transmitted by electromagnetic (inductive) energy, along with an amplifier and a microphone from the sound source

inner ear

portion of the ear, located within the petrous part of the temporal bone, containing the cochlear and vestibular systems

[SOURCE: ANSI S3.20:2015]

input-output characteristic

single frequency plot of coupler sound pressure level (SPL) on the ordinate as a function of input SPL on the abscissa with equal decibel scale divisions on each axis

[SOURCE: IEC 60118-7:2005]

L

linear signal processing

system that produces equal gain for all input levels

lip reading; speech reading

deriving meaning from a person's speech by observing the speaker's lips, gestures, and facial expressions

loudness

perceived magnitude of a sound, which depends on the acoustic properties of the sound and the specific listening conditions, as estimated by otologically normal persons

[SOURCE: ISO 532-1:2017]

M

masked threshold

threshold of hearing for a specified sound in the presence of another (masking) sound

[SOURCE: IEC 60050-801, modified]

masking

process by which the hearing threshold of a given ear for a particular sound is raised by the presence of another (masking) sound

[SOURCE: ISO 8253-1:2010]

mel

unit of pitch

Note 1 to entry: A pure tone frontally presented, having a frequency of 1 000 Hz and a sound pressure level of 40 dB, causes a pitch of 1 000 mels.

[SOURCE: IEC 60050-801:1994]

microphone

transducer that converts an acoustic signal into an electrical signal

middle ear

air-filled cavity within the mastoid portion of the temporal bone typically described as containing the eardrum and ossicles and inner opening of the Eustachian tube

[SOURCE: ANSI S3.20-2015]

middle ear muscle

muscles of the middle ear, which respond to an intense acoustic stimulus with contractions typically monitored as a change in tympanic membrane mobility during acoustic immittance testing

mixed hearing loss

reduction in hearing sensitivity resulting from the interference of sound transmission through the conductive and sensorineural components