



Recommended Procedure

Determination of uncomfortable loudness levels

Date: 24th September 2011

Due for review: September 2018

General foreword

This document presents a Recommended Procedure by the British Society of Audiology (BSA). A Recommended Procedure provides a reference standard for the conduct of an audiological intervention that represents, to the best knowledge of the BSA, the evidence-base and consensus on good practice given the stated methodology and scope of the document and at the time of publication.

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1. Introduction

The purpose of this document is to describe the recommended procedure for determining an uncomfortable loudness level (ULL). The object of this test is to identify the minimum level of sound that is judged to be uncomfortably loud by the subject. The terms loudness discomfort level (LDL) and ULL are sometimes used synonymously; the preferred term is ULL.

This document supersedes the recommended procedure given in British Society of Audiology (BSA) (2004). The ULL procedure once again appears in its own document, primarily to enable more efficient review of this procedure independently to that for audiometry. The reader is referred to the Recommended Procedure for pure-tone audiometry (BSA, 2011) for general recommendations regarding calibration, equipment, test environment and subject preparation.

It is not the purpose of this document to provide specific guidance on when ULLs should be determined or how they should be interpreted. It is essential that the competent person carrying out the test (i.e. the 'tester'), or responsible for it, uses her/his professional judgement when deciding on when and how extensively to determine the ULLs of the person being tested ('subject') given the specific circumstances and the recommendations here. Further, this recommended procedure may require modification and even greater care when testing special populations, such as children and subjects with tinnitus or hyperacusis; the tester will also require greater competency. Any modification shall be recorded with the results.

The term 'shall' is used in this document to refer to essential practice, and 'should' is used to refer to desirable practice.

Unless stated otherwise, the procedure described here represents the status of the current evidence base, taking into account other factors that influence desirable procedure, as interpreted by the Professional Practice Committee of the BSA in consultation with its stakeholders (see Appendix A). The document was developed in accordance with BSA (2003).

2. General considerations

2.1 Limitations of the test

It is important to recognise that the pure-tone signal typically used in ULL testing may not reflect the signal from which the subject may experience discomfort. There is also debate in the literature regarding the value of ULL testing in hearing-aid fitting (e.g. see review by Mueller & Bentler, 2005) and the assessment of tinnitus and hyperacusis (e.g. cf. Baguley & Andersson, 2007, and Jastreboff & Hazell, 2004), including concerns regarding its test-retest reliability.

2.2 Cautions

Particular care shall be taken with a subject reporting tinnitus, unusual distress from particularly loud sounds or exhibiting symptoms of hyperacusis or related conditions. See also Section 4.1.

3. Subject instructions

Prior to testing, the tester shall explain the procedure to, and obtain informed consent (e.g. verbally) from, the subject or person responsible for the subject. The tester shall inform the subject that the subject can discontinue the test at any point (e.g. if (s)he becomes uncomfortable) and how to signal this to the tester.

The exact instructions given have a considerable effect on the outcome of the test. It is also important that clear and accurate instructions are given, taking into account possible communication difficulties (e.g. hearing impairment and language capability). Instructions should be given verbally. Written instructions can also be provided and should be used where there is doubt that the subject has understood the verbal instructions. The following instructions or equivalent should be used:

“I will gradually make the sound louder in your ear, and you must press the button (or raise your hand) *as soon as* the sound becomes uncomfortable (uncomfortably loud). This is not a test to find the loudest sound you can tolerate; it is a test to find what level of sound you find uncomfortable. You should press the button (or raise your hand) only when the sound becomes uncomfortable; but make sure you press (raise) it as soon as the sound reaches that level.”

The test shall not proceed if there is doubt that the subject understands the instructions. If necessary, the subject should be encouraged to stay at ease during the test. Unlike pure-tone audiometry, the subject can be told which ear is to be tested before starting.

4. Determining the ULL

4.1 Stimulus

The usual stimulus is a pure tone. Alternatively, a frequency-modulated tone can be used, as with audiometry; if used, this shall be recorded with the results. While tones may not be the most relevant stimulus, as noted in Section 2.1, the use of alternative stimuli is not recommended at this time given the absence of reference levels for calibration.

The tester, or person responsible for the test, shall consider for each subject her/his potential risk from sound exposure¹ and balance this against the potential clinical benefits obtained from ULL testing. This includes considering sound exposure from other audiometric testing (e.g. masking in pure tone audiometry, real-ear measures, acoustic reflex testing). For pure tones and frequency-modulated tones, presentation levels above 110 dB HL shall not be used² and levels above 100 dB HL should be used with caution².

The test should be conducted on one ear at a time. Testing at two frequencies may be sufficient for some subjects, such as a low and high frequency (e.g. 500 and 2000/4000 Hz).

4.2 Procedure

The tester shall:

1. Monitor the subject's face throughout the test and monitor the subject for the signal to stop testing. It does not matter if the subject can see what the tester is doing; this may actually be helpful. Cease testing immediately if the subject shows any sign of distress or flinching; then ask if the sound was uncomfortable and, if appropriate, reinstruct and retest.
2. Start testing at 60 dB HL or at the subject's hearing threshold level for that ear at that frequency, whichever is highest, unless otherwise indicated (e.g. see Section 2.2).

¹ It is recommended that this should be based on assuming (i) a safe maximum exposure equivalent to 76 dB(A) continuously for 8 hours per ear per 24 hours, (ii) that dB HL is approximately equivalent to dB(A) and (iii) that maximum sound dose increases by 3 dB with a halving of exposure time, although the latter assumption should be regarded with caution above 100 dB HL. This allows for testing up to 110 dB HL four times per ear per 24 hours given reasonable allowances for variation in stimulus duration. The 76 dB(A) is more cautious than 80 dB(A) used in The Control of Noise at Work Regulations (Health & Safety Executive, 2005).

² An exception is where there is clear evidence of a sufficient physical conductive hearing loss (e.g. arising from middle ear pathology; not 'cochlear conductive').

3. Present a 1-second-long tone, followed by at least a 1-second quiet period. Increase the stimulus by 5 dB and present the stimulus in the same manner. Repeat this process. Cease testing immediately if the subject responds, if the subject shows any sign of distress or flinching or if an appropriate maximum level has been reached (see Section 4.1).
4. It does not matter if the presentation of the tones is rhythmical; this may actually be helpful. Sufficient time shall be provided between presentations for the subject to respond, which may be greater for some subjects than others.
5. The level of the tone at which the subject responds is the ULL. If the test is terminated because the subject flinches before making a formal response, that level can also be taken as the ULL if the subject confirms that that tone, but not the previous tone, was uncomfortable.

A retest at one or more frequencies may be conducted if there is reason to doubt the reliability of the ULLs obtained or if enhanced precision is required.

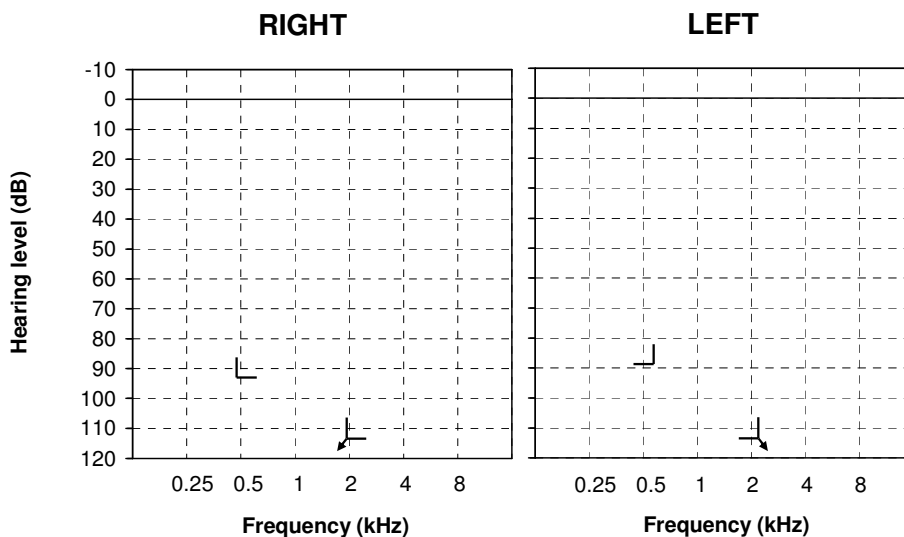


Figure 1

Illustration of the symbols used to record ULLs on the audiogram. ULL is at 90 and 85 dB HL at 500 Hz on the right and left, respectively, and greater than 110 dB HL at 2000 Hz on both sides.

4.3 Recording

See Figure 1 for the symbols used for ULL testing. When the maximum recommended level, or the maximum output of the audiometer, is reached without the subject responding, the ULL is recorded as “greater than” this value. Any modifications to the procedure, use of alternative stimuli or the change of behaviour taken to indicate the ULL should be noted with the audiogram.

5. References

Baguley DM, Andersson G (2007) Hyperacusis: mechanisms, diagnosis, and therapies. San Diego: Plural Publishing.

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Appendix A. Authors and acknowledgments

This revision was conducted by the BSA Professional Practice Committee between September 2008 and September 2011 in accordance with BSA (2003). The Committee thanks all involved with previous versions of this document and all who contributed to this review including those who contributed during two consultations (Spring 2009 and 21st May 2011 to 21st June 2011). An electronic copy of the anonymised comments (from seven individuals) received during the most recent consultation, and the responses to these by the authors, is available from BSA on request.