A Scientific Critique of SANS 10083:2023 Section 15.1.2.3 Note 1: Rectifying an Impediment to Advanced Hearing Conservation Practices

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Abstract

This white paper critiques Note 1 of Section 15.1.2.3 in the South African National Standard SANS 10083:2023, a standard for occupational noise and hearing conservation[1]. This recently added note implies that if the sound-blocking capability (attenuation) of an audiometric device cannot be easily field-measured by users with basic equipment, the device is unsuitable. We argue this note is scientifically flawed, misinterprets acoustic measurement principles, and effectively renders most, if not all, forms of earphone-based audiometry non-compliant, as the prescribed field measurement method is impractical for any type of headset. It also conflicts with related standards like SANS 10182[2] and ISO 8253-1[3], which already accommodate advanced audiometric technologies.

Note 1 wrongly confuses lab-validated device performance with impractical user field checks, ignores valid device attenuation data, and contradicts established best practices. Its inclusion in a previously respected standard raises concerns that it may unfairly target advanced technologies and has inadvertently created a situation where even conventional audiometry is difficult to justify under its narrow terms. This flawed note could limit access to hearing tests, increase costs, stifle innovation, and reduce test quality. We recommend removing Note 1 entirely or substantially rewriting it to align with scientific principles and support proven technologies, thereby restoring the standard's integrity and effectiveness.

1. Introduction: The need for sound standards in hearing conservation

Accurate hearing tests are vital for workplace hearing conservation programs. Modern technologies, such as validated boothless audiometry, make these tests more accessible and efficient[1]. However, the 2023 revision of South Africa's SANS 10083 standard ("The measurement and assessment of occupational noise for hearing conservation purposes"[1]) introduced a problematic clause: Note 1 in section 15.1.2.3.

This note has caused significant concern. SANS 10083 was a well-regarded standard, but the recent addition of Note 1 appears to create an arbitrary and scientifically questionable barrier. It

seems to misunderstand how audiometric device performance is validated and, by extension, could be interpreted to invalidate most forms of earphone-based audiometry. Some observers suggest this change is not an improvement but a step backward, potentially making the standard a point of ridicule rather than a benchmark of good practice. This paper argues that Note 1 is scientifically unsound, misapplies acoustic principles, and conflicts with other key South African (SANS 10182 [2]) and international (ISO 8253-1 [3]) standards.

2. The problematic clause: SANS 10083:2023 Section 15.1.2.3 and Note 1

Section 15.1.2.3 of SANS 10083:2023 addresses the "Test environment" for mobile audiometric units:

"In the event of mobile test facilities such as caravans, vans, trucks or booths, ensure that the external environmental noise does not exceed the insulation capabilities of the booth. After certification of the test facility, it should not be moved to an uncertified location. Once moved the testing environment should be reassessed to certify compliance." [1]

Note 1, controversially added to this section, states:

"Insert earphones, circumaural earcups (headphones) or a combination thereof or any similar device of which the actual attenuation cannot be measured physically with a type 1 or 2 sound level meter equipped with an octave filter should not satisfy this requirement of the testing environment (see SANS 10182)." [1]

Table 1: Exact wording of SANS 10083:2023, Section 15.1.2.3 and Note 1 [1]

Clause/Note	**Full Wording**
Section 15.1.2.3	In the event of mobile test facilities such as caravans, vans, trucks or booths, ensure that the external environmental noise does not exceed the insulation capabilities of the booth. After certification of the test facility, it should not be moved to an uncertified location. Once moved the testing environment should be reassessed to certify compliance.
Note 1	Insert earphones, circumaural earcups (headphones) or a combination thereof or any similar device of which the actual attenuation cannot be measured physically with a type 1 or 2 sound level meter equipped with an octave filter should not satisfy this requirement of the testing environment (see SANS 10182).

This note links to SANS 10182 [2], which covers acoustic environments for audiometric tests. The common interpretation of Note 1 is that if a user cannot personally measure a headset's

sound-blocking capability with basic field equipment, the headset is unsuitable. This wrongly implies that the headset cannot ensure external noise doesn't interfere with the test. This logic is flawed and also contradicts SANS 10182 [2] itself, as Section 4.1 of SANS 10182 [2] allows for various earphone types and refers to SANS 8253-1 [3] for their assessment.

3. The science of audiometric test environments

Valid hearing tests require quiet surroundings. Maximum Permissible Ambient Noise Levels (MPANLs) specify how loud background noise can be without affecting test accuracy. For devices that block sound (like specialized headsets), their specific MPANLs are found by:

1. Establishing a baseline MPANL for the "ears not covered" condition[4].
2. Adding the headset's scientifically measured sound-blocking capability (attenuation) to this baseline:

$$MPANL_{Device} = MPANL_{EarsNotCovered\_0dBHL} + a_{Device}$$

(where a_{Device} is the headset's attenuation)[5]. This is an internationally accepted method [4, 5].

SANS 10182 [2] (Section 4.1) and SANS 8253-1 [3] already provide a sound framework for this. Note 1 in SANS 10083:2023 [1] ignores this established science.

Table 2: Comparison of "Ears Not Covered" / Equivalent Unoccluded Baseline MPANLs (dB SPL for 0 dB HL Testing) from key standards

Frequency (Hz)	ANSI S3.1-1999 (Ears Not Covered) (dB SPL)[4]	ISO 8253-1:2010 (Bone Conduction as proxy for ENC) (dB SPL)[3]	SANS 10182:2006 (Sound Field) (dB SPL)[2]
125	29.0	20	19.0
250	21.0	13	11.5
500	16.0	8	7.5
1000	13.0	7	6.5
2000	14.0	8	6.0
4000	11.0	2	2.0
8000	14.0	15	11.5

Source: Data derived from[5], Appendix Tables A1.1, A1.2, A1.3.

4. Why Note 1 is scientifically flawed and problematic

Note 1's requirement - that devices are unsuitable if their attenuation cannot be field-measured by an end-user with basic equipment - is wrong because:

- **It confuses lab validation with impractical field checks:**
  A headset's sound attenuation is precisely determined in laboratories using standardized methods (e.g., REAT, acoustic test fixtures)[5, 8, 9]. Expecting users to replicate these with basic sound level meters (SLMs) in the field is scientifically inappropriate. An SLM measures ambient sound; it cannot measure a headset's attenuation on a person's head without a lab setup.

  Crucially, the method implied by Note 1 (measuring sound under an earcup with an SLM) is impractical for any type of earphone, including standard supra-aural headphones. Such a measurement would be contaminated by the earphone's own output or would fail to capture the true ambient noise attenuation. This effectively means Note 1 could be interpreted to disallow almost all current forms of earphone-based audiometry, pushing practitioners towards free-field testing, which is entirely unsuitable for routine occupational screening. SANS 10182 [2] itself, in its Annex A, details how to determine the sound insulation of an audiometric booth using sound level measurements inside and outside. [1] This shows SANS 10182 [2] accepts that attenuation can be quantified. If a procedure exists for booths, it's illogical for Note 1 to then imply that a headset's lab-verified attenuation is invalid simply because an end-user cannot perform an inappropriate and unworkable field measurement.

- **It ignores validated device data:**
  Note 1 dismisses robust, scientifically determined attenuation data for advanced systems like the Kuduwave audiometer, which has well-documented attenuation values[7], [5]. This data is the legitimate basis for calculating its MPANLs.

  Table 3: Kuduwave combined sound attenuation data with foam eartips (dB)[7]

Frequency (Hz)	Attenuation (dB)
125	31.0
250	37.7
500	43.8
1000	40.8
2000	38.1
4000	52.3
8000	45.8

The focus should be on the validity of the attenuation data, not on an end-user's ability to re-measure it with basic tools. SANS 10083 [1] itself refers to IEC 60645-1 [10] for audiometer standards, implying reliance on manufacturer specifications, not end-user field tests of attenuation.

- **It contradicts SANS 10182 and international best practice:** SANS 1018 [2] (Section 4.1) allows for "other types of earphone" and refers to SANS 8253-1 [3] for assessment. SANS 8253-1 [3] (Section 11.2) includes a "psychoacoustic check" – testing individuals with normal hearing to see if the environment affects their thresholds. This is an outcome-based check of the entire system (device + environment), which Note 1 undermines.

5. The negative impact of Note 1

This flawed note harms hearing conservation by:

1. **Reducing access to hearing tests:** It hinders portable boothless systems crucial for diverse settings [5, 7].
2. **Increasing costs:** Forcing reliance on traditional booths or flawed verification is inefficient.
3. **Stifling innovation:** It discourages development and adoption of better audiometric tools.
4. **Potentially lowering test quality:** It may sideline devices with superior real-time noise monitoring.
5. **Creating confusion:** Its ambiguity and conflict with SANS 10182 [2] and SANS 8253-1 [3] lead to inconsistent application of SANS 10083 [1].

6. Recommendations for a sounder standard

To rectify these issues:

1. **Best solution: Remove Note 1.** It is flawed, contradictory, and unnecessary.
2. **Alternative: Rewrite Note 1 scientifically.** If retained, it must guide users correctly. Example: *"For audiometric transducers providing sound attenuation (e.g., insert earphones, circumaural earcups, or combinations thereof), the suitability of the test environment shall be ensured by demonstrating that ambient noise levels do not exceed the Maximum Permissible Ambient Noise Levels (MPANLs) specific to that transducer. These device-specific MPANLs are determined by adding the transducer's empirically validated sound attenuation (as specified by the manufacturer and supported by research, established through standardized laboratory methods) to the appropriate 'ears not covered' or equivalent unoccluded baseline MPANLs (refer to SANS 10182 [2] and SANS 8253-1 [3] for principles of MPANL determination). The suitability of the test environment under these conditions can be verified by direct ambient noise measurement against these device-specific MPANLs or via psychoacoustic checks as outlined in SANS 8253-1, Section 11.2."* [3]
3. **Reinforce SANS 10182, Section 4.1:** This existing pathway is sufficient.
4. **Focus on valid outcomes:** Prioritize accurate hearing tests using devices with documented attenuation and accepted environmental checks.

5. **Promote psychoacoustic checks:** This practical method (from SANS 8253-1[3]) validates the entire test system.

7. Conclusion: Restoring integrity to hearing conservation standards

Note 1 in SANS 10083:2023 [1] is a scientifically flawed and detrimental addition. It wrongly demands impractical field measurements, potentially invalidating most forms of earphone audiometry and undermining the use of advanced technologies. This not only hinders effective hearing conservation but also damages the credibility of the standard itself.

Existing standards (SANS 10182 [2] and SANS 8253-1 [3]) already provide sound, flexible methods for ensuring appropriate test environments. South African standards authorities should urgently remove or fundamentally rewrite Note 1. This action is crucial to restore the integrity of SANS 10083 [1] and ensure it effectively supports the nation's hearing conservation goals.

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