

Deviation Request ETSO-C139a#1 for an ETSO approval for CS-ETSO applicable to Audio Systems and Equipment (ETSO-C139a)

Consultation Paper

1 Introductory Note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004 as amended by EASA Management Board [Decision No 12-2007](#) products certification procedure dated 11th September 2007, Article 3 (2.) of which states:

“2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.”

2 ETSO-C139a#1 Audio Systems and Equipment

2.1 Summary of Deviation

Deviates from RTCA DO-214A section 2.6.2.1 a. and b. by using a Sound Pressure Level of 104 dB SPL if the microphone is linear (within 1 dB from the linear approximation) and if the frequency responses curves in standard conditions are identical (within 1 dB) at both 104dB SPL and 94dB SPL levels.

2.2 Original Requirement

RTCA DO-214A section 2.6.2.1 : Near Field Sensitivity and Frequency Response - Microphones

a. Microphones (Except Oxygen Mask) – Sensitivity

*(1) Setup and calibrate the Artificial Voice and associated equipment, according to the manufacturer's instructions. Set the output frequency to 1000 Hz and the SPL to **94 dB SPL** (reference: 20 µPa) 6 mm from the opening.*

(2) ...

(3) ...

(4) ...

(5) Calculate the output in volts per Pascal (94 dB SPL equals 1 Pascal).

(6) Vary the dc excitation voltage from 8.0 V to 16.0 V while observing the ac output.

b. Frequency Response

- (1) *Set up and calibrate the Artificial Voice and associated equipment, according to the manufacturer's instructions. Set the output frequency at 1000 Hz and the SPL to 94 dB SPL (reference: 20µPa) 6 mm from the opening.*
- (2) ...
- (3) ...
- (4) *Operate a level recorder in tandem with the sine generator (automatic mode) and run a frequency response curve, or manually adjust the sine generator to frequencies of 350, (...) and 6000 Hz, reading the output in dB on an audio-frequency voltmeter for each frequency. From this data, plot a curve of the frequency response of the microphone.*

2.3 Industry

The measurements can be performed at 104 dB SPL instead of 94 dB SPL to improve the Signal/Noise (S/N) ratio and therefore the quality and accuracy of the measurement. Environmental laboratories are often subject to high acoustical noise levels (due to test devices). This can adversely affect the measurements microphone.

The 94 dB SPL results in a S/N ratio of 40 dB for measurements conducted in an ambient noise of 54 dB (*).

The same measurement at 104 dB SPL leads to a S/N ratio of 50 dB.

(*) average level

Therefore, it is better to use a 104 dB SPL to assess the microphone performance independently of any ambient noise.

These measurements are appropriate when the following conditions are met:

- The microphone is linear (within 1 dB from the linear approximation) on the tested frequency range between 94 dB SPL and 104 dB SPL; and
- The frequency response curves at 94 dB SPL and at 104 dB SPL are identical (within 1 dB) when measured in standard conditions (resulting in an environment with low noise).

Furthermore, it is noted that the tests developed in DO-214A section 2.6.2.1 a. and b. intend to demonstrate compliance with, respectively, DO-214A section 2.2.3.1 Sensitivity and 2.2.1.1 Frequency Response.

Whereas the test procedure in DO-214A section 2.6.2.1 use a reference to 94 dB SPL (reference 20 µPa) 6 mm from the opening, DO-214A requirement for sensitivity (2.2.3.1) is referenced to 114 dB SPL and no reference is defined for the frequency response (2.2.1.1).

Both 94 dB SPL and 114 dB SPL pertain to the range that the speech level can reach: DO-214A section 1.2.1.1.c. states 98 dBA level at 6 mm for the average level and 115 dBA for the normal maximum microphone input level for the average person speaking approximately one inch (25.4 mm) from the microphone under extreme conditions.

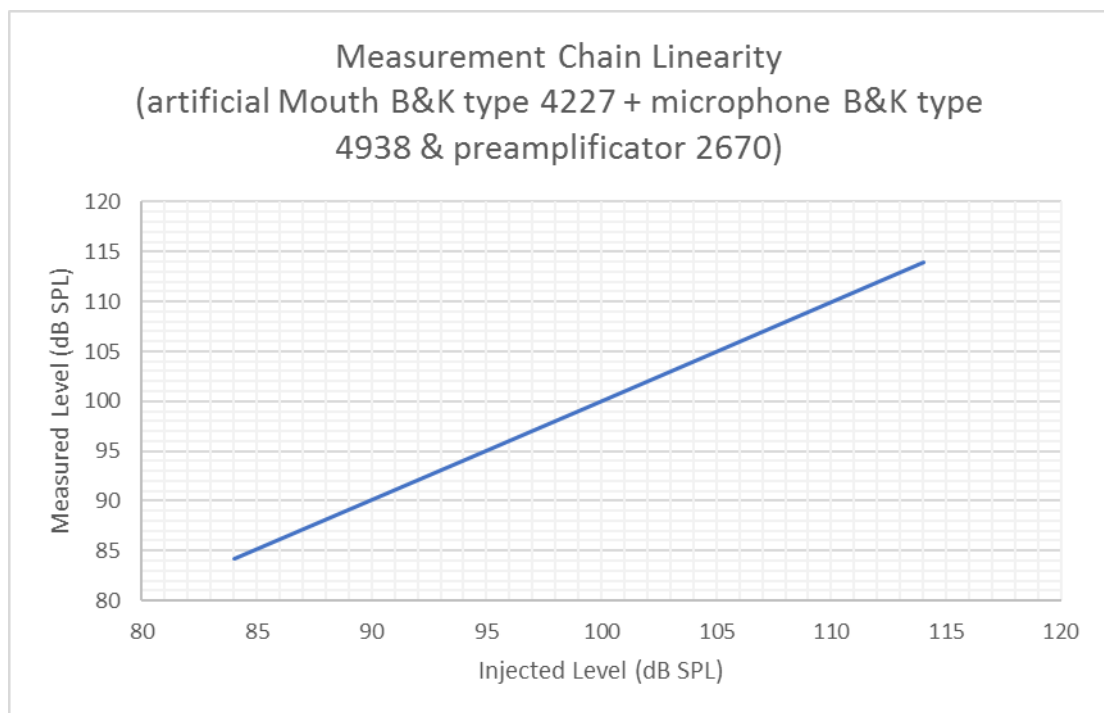
By using different levels when expressing the requirement and in the test procedure, DO-214A is therefore using, as the deviation proposes, the implicit assumption that the microphone is linear between 94 dB SPL and 114 dB SPL.

DO-214A extends this assumption, as the deviation does, to the environmental tests. Indeed, the environmental procedures in DO-214A section 2.5 are requesting that the microphone sensitivity (2.2.3.1) and frequency response (2.2.1.1) requirements are verified during some environmental tests (e.g. 2.5.1.4 Altitude Test) or after them (e.g. 2.5.1.3 Operating High Temperature Test or 2.5.5 Vibration Tests).

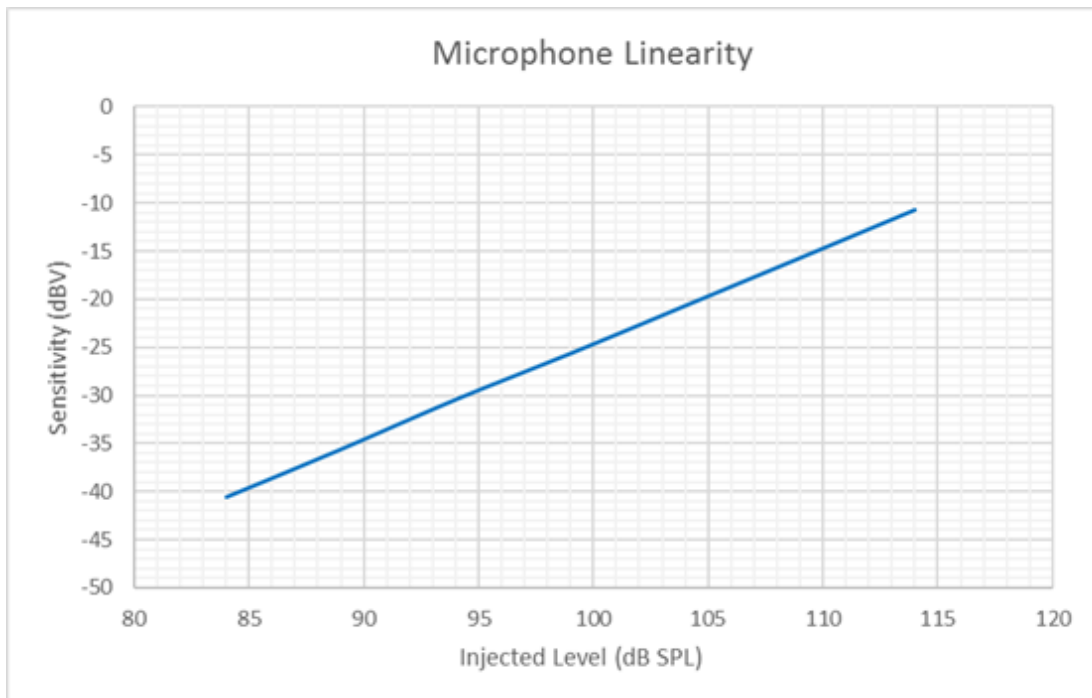
Because it is based on factual evidence of the linearity of the microphone rather than using an implicit assumption of the DO-214A, the deviation is providing assurance that the microphone characteristics are appropriate in the end user environment despite the use of a different reference.

For example, in the case of a specific project, the applicant shows that:

- The measuring chain (using a B & K type 4227 artificial mouth and a B & K type 4938 microphone and 2670 preamp) is linear up to 114 dB, as shown by the curve below:



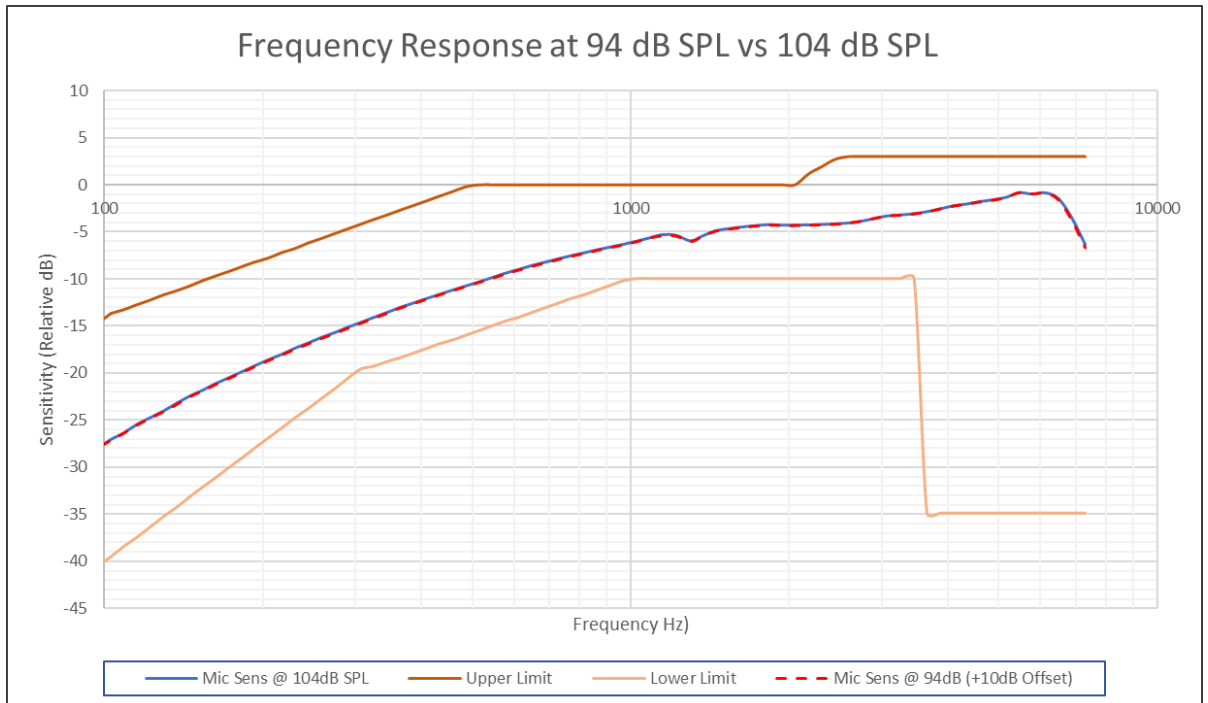
- The microphone is linear between 84 and 114 dB (within 1dB):



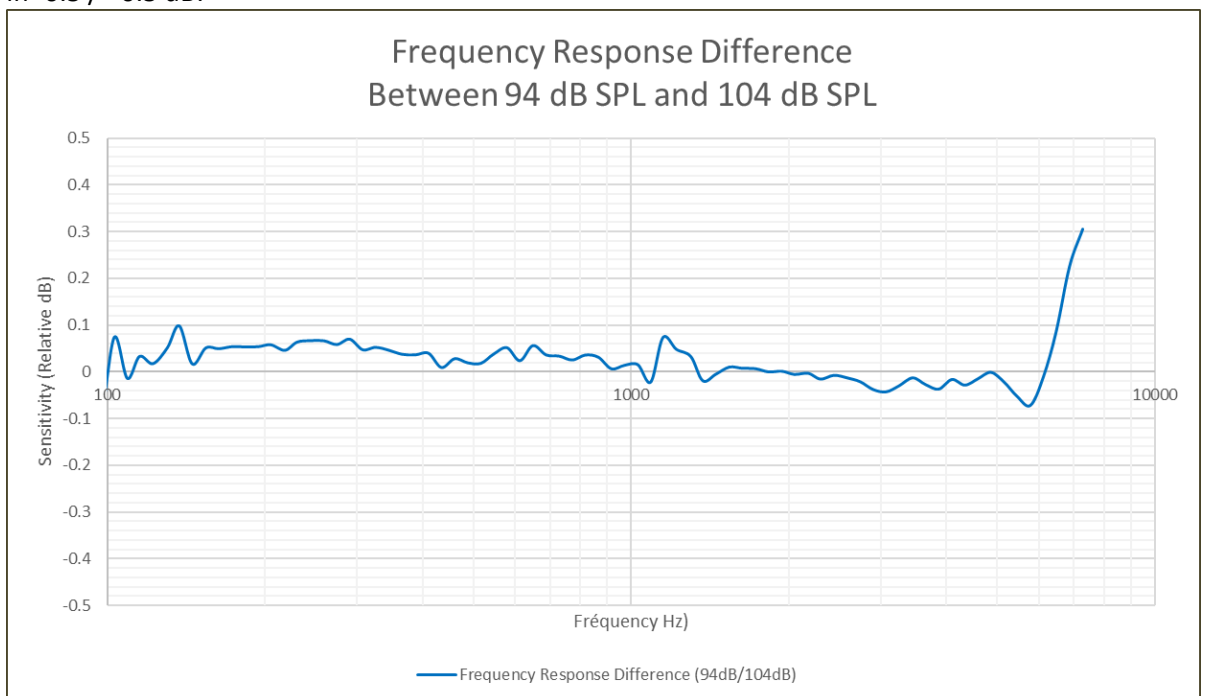
Between 84 dB SPL and 114 dB SPL (by 5 dB steps), the difference between the microphone sensitivity to the linear approximation is less than 1dB:

Injected Level (dB SPL)	Difference between Mic. Sens. & Linear approx. (dBV)
84	0,006
89	0,028
94	0,004
99	-0,006
104	-0,185
109	0,039
114	0,063

- The frequency response curves measured at 94 dB SPL and at 104 dB SPL in standard conditions are identical (within 1dB):



The Frequency difference between the response curves at 94 dB SPL and 104 dB SPL is included in -0.5 / +0.5 dB:



2.4 Equivalent Level of Safety

The measured performance of the microphone is the same regardless of whether the measurement is 94 dB SPL or 104 dB SPL, as shown by the linearity of the microphone over the frequency range and by the additional measurements at 94 dB in quiet conditions.

2.5 EASA position

We accept the deviation.

