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**Speech and multimedia Transmission Quality (STQ);
Frequency responses of different Mouth simulators and
Head And Torso Simulators (HATS)**

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

Introduction

One of the problems for measuring super wide band systems in send direction is the need to use an artificial mouth (discrete or part of a HATS) with a sound production extending from 50 Hz to at least 14 kHz. Of course it needs not to be flat, but only a reasonable amount of equalization is necessary.

In order to have precise information on existing devices, measurement has been conducted in Orange laboratory (Lannion, France), LES laboratory (Quimper, France) and HEAD acoustics laboratory (Herzogenrath, Germany).

1 Scope

The present document presents measurement results of various mouth simulators as well as Head And Torso Simulators (HATS). These measurements have been produced in the context of a study related to the extension of HATS use in super wide band (SWB).

These measurement results are presented for information purpose.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

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Not applicable.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

FFT	Fast Fourier Transform
HATS	Head And Torso Simulator
HMS	Head Measurement System
Hz	Hertz
kHz	kilohertz
LES	Lacroix Electronics Solutions
MRP	Mouth Reference Point
SPL	Sound Pressure Level
SWB	Super Wide Band

4 Measurement method

The measurement systems used to measure the response curve of mouth simulators and HATS mouths are illustrated by the schemes presented in figures 1a and 1b.

NOTE 1: Measurements were realized by 3 laboratories, so measurement chains are not exactly the same (different equipment was used) but the principle is identical for all characterizations.

NOTE 2: Measurements are realized in acoustically treated room.

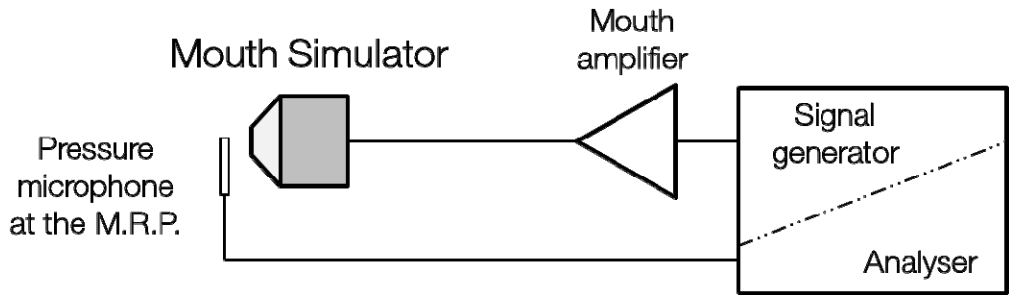

Figure 1a: Test system used for mouth simulators

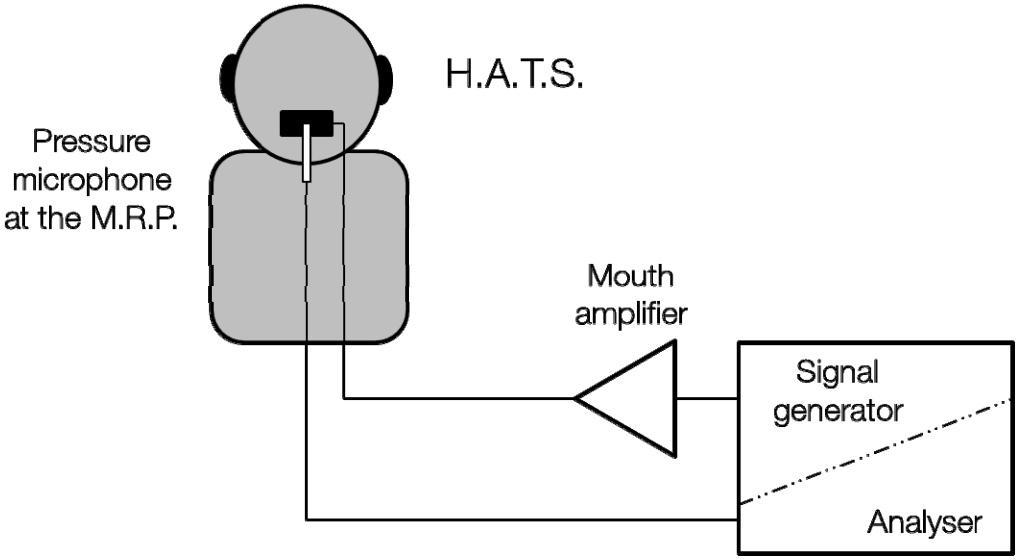

Figure 1b: Test system used for Head And Torso Simulators

A device able to generate the test signal is connected to the artificial mouth (from mouth simulator or HATS) under test via an amplifier. The test signal is pink noise and the amplifier gain is adjusted to get an acoustic level of about 90 dB SPL at the MRP.

Acoustic signal generated by mouth simulator or HATS is captured by a pressure microphone placed at the MRP. This microphone is connected to the input of an analyzer.

The analyser provides a 1/12th octave analysis by using FFT analysis. Each calculated response curve results of a difference between electrical input (pink noise signal produced by signal generator) corresponding to signal applied to mouth amplifier and output of microphone representative of acoustic level at the MRP of artificial mouth.

5 Frequency response curves

Various artificial mouths have been measured in LES laboratory (Quimper, France), Orange laboratory (Lannion, France) and HEAD acoustics (Herzogenrath, Germany).

LES and Orange laboratories have measured frequency response curves of mouth simulators and HATS. HEAD acoustics laboratory have measured frequency response curves of HATS.

In this section, measurement results (obtained in 1/12th octave) are presented separately for each laboratory. These 12th octave analysis is produced using a FFT calculated on 8 192 samples for audio files at 48 kHz frequency rate.

5.1 Measurement results obtained by LES laboratory

3 Bruel&Kjaer mouth simulators (type 4227) and 2 Bruel&Kjaer Head And Torso Simulator (type 4128-D) have been tested in LES laboratory (Quimper, France).

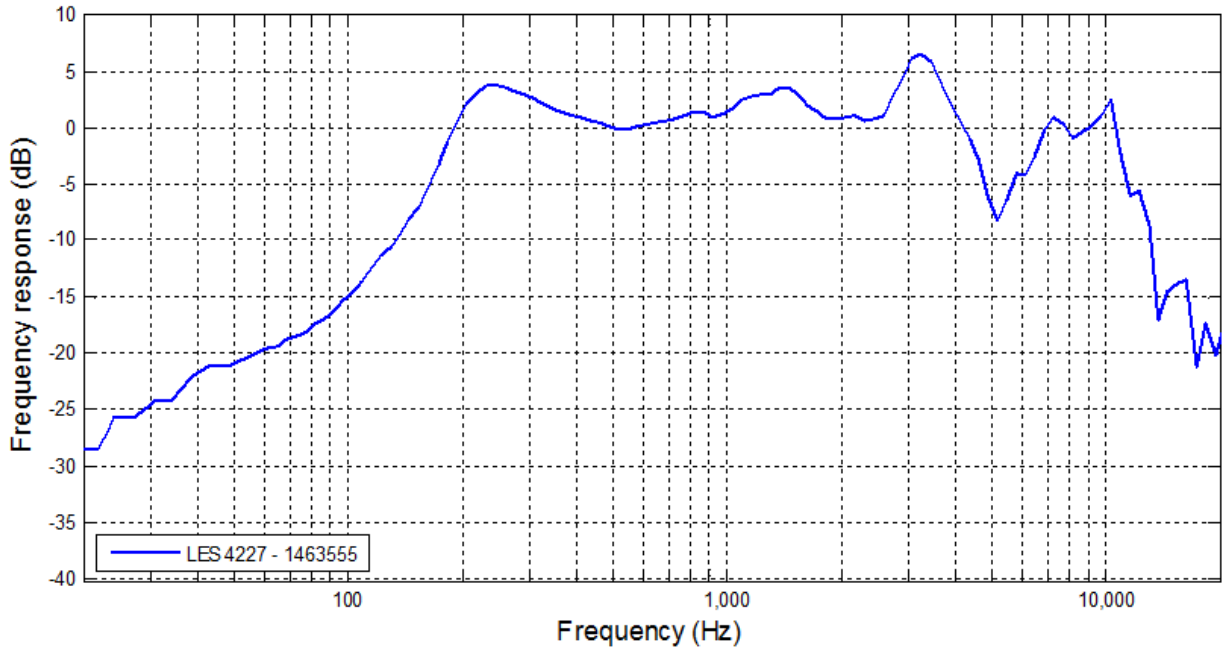

Figure 2: Frequency response curve of Bruel&Kjaer mouth simulator number 1463555 (type 4227)

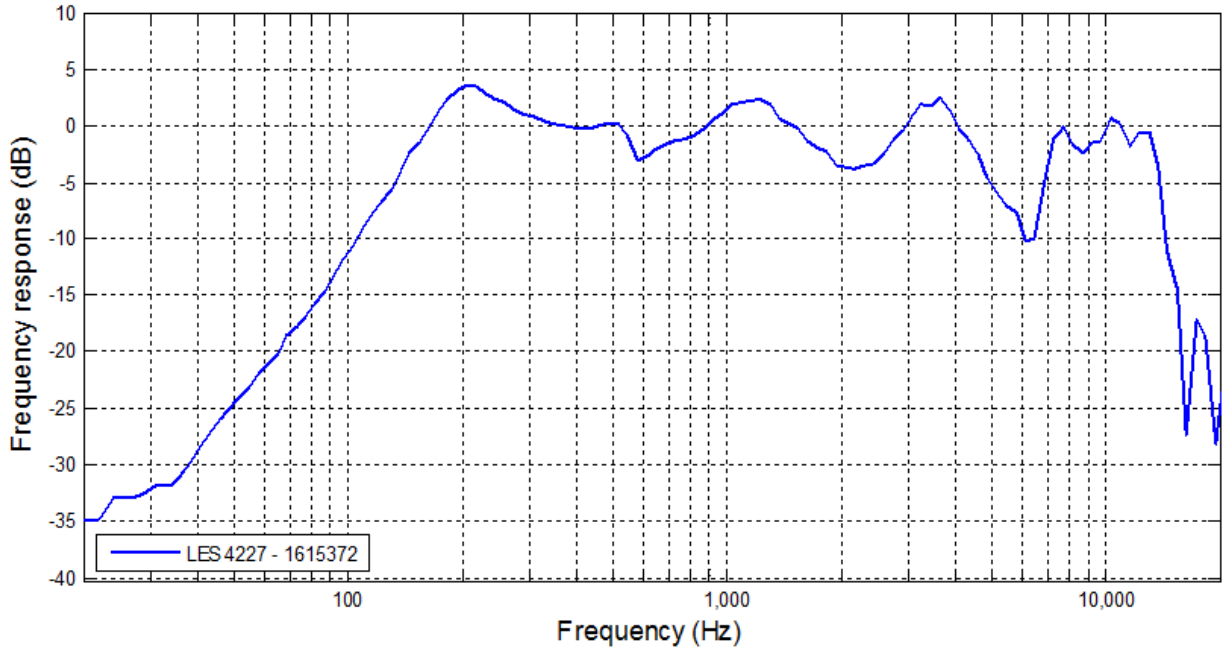

Figure 3: Frequency response curve of Bruel&Kjaer mouth simulator number 1615372 (type 4227)

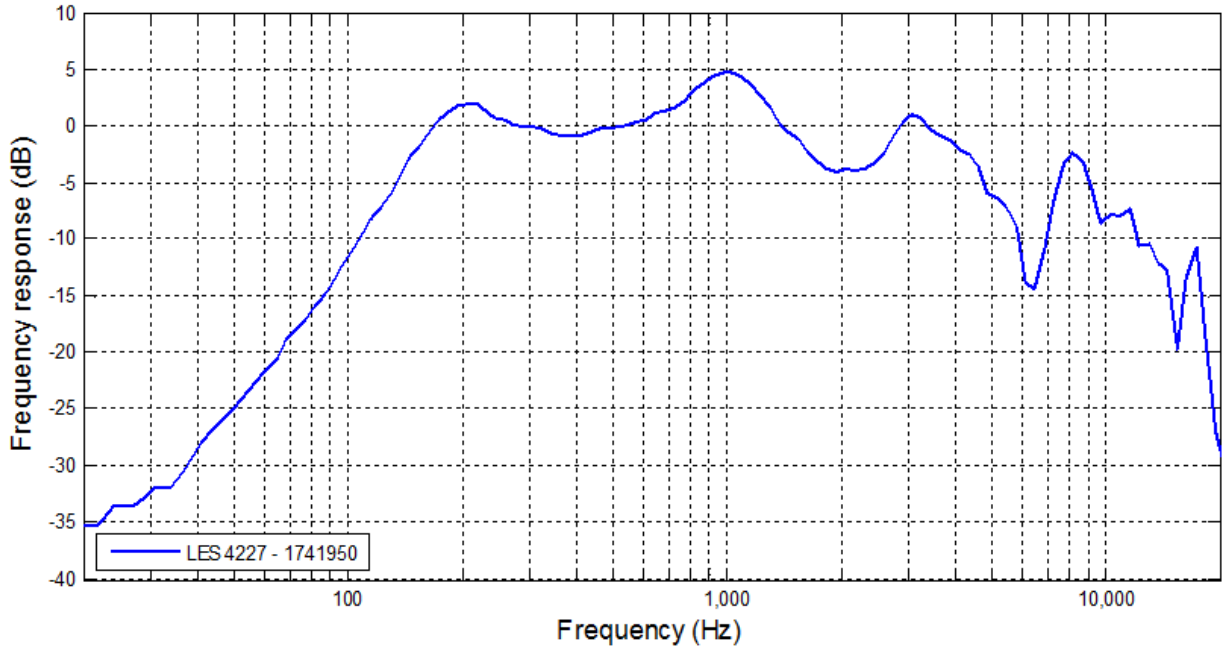

Figure 4: Frequency response curve of Bruel&Kjaer mouth simulator number 1741950 (type 4227)

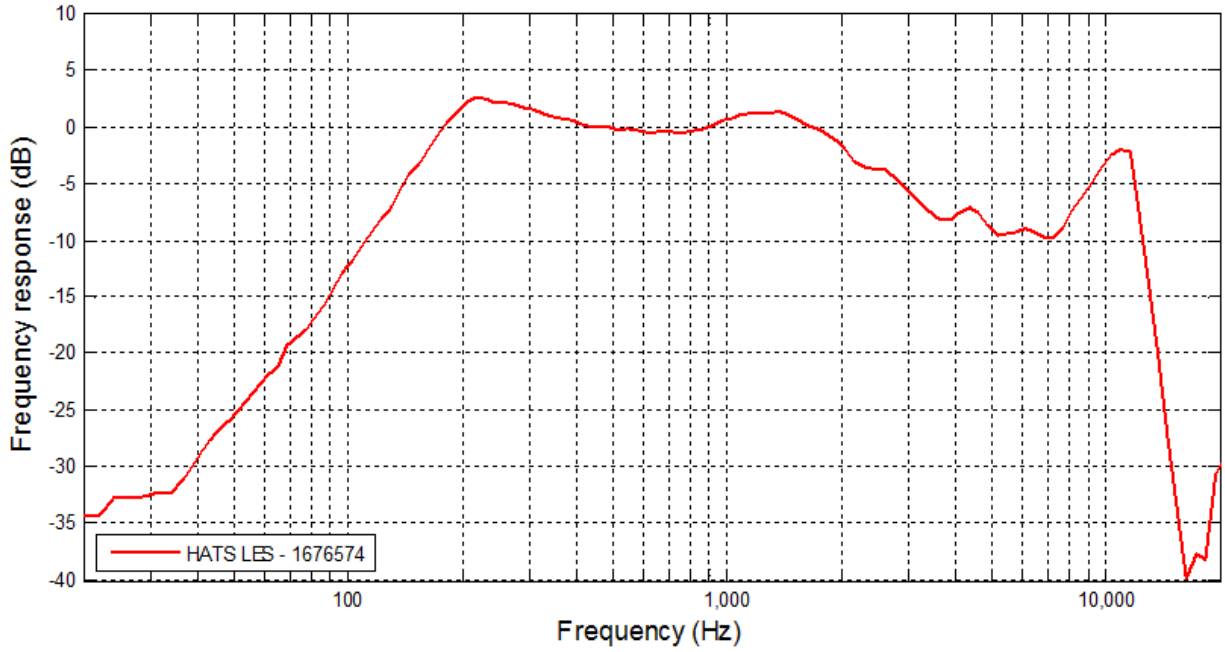

Figure 5: Frequency response curve of Bruel&Kjaer Head And Torso Simulator number 1676574 (type 4128-D)

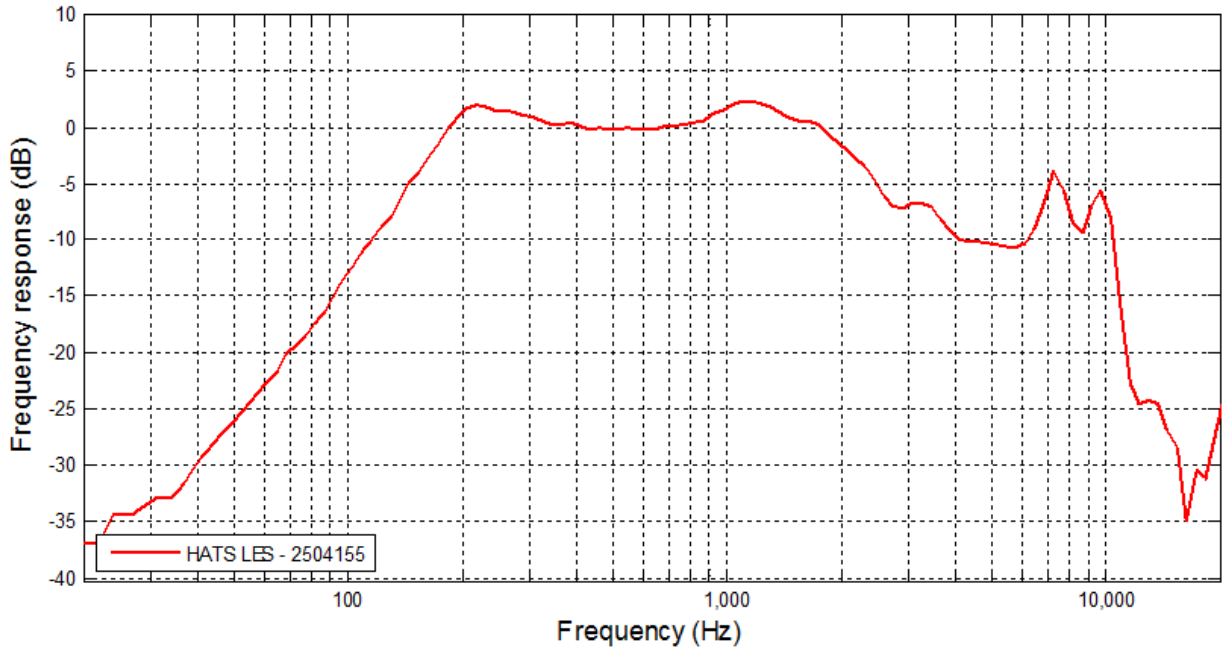

Figure 6: Frequency response curve of Bruel&Kjaer Head And Torso Simulator number 2504155 (type 4128-D)

5.2 Measurement results obtained by Orange laboratory

3 Bruel&Kjaer mouth simulator (type 4227) and 3 Bruel&Kjaer Head And Torso Simulator (type 4128-D) have been tested in Orange laboratory (Lannion, France).

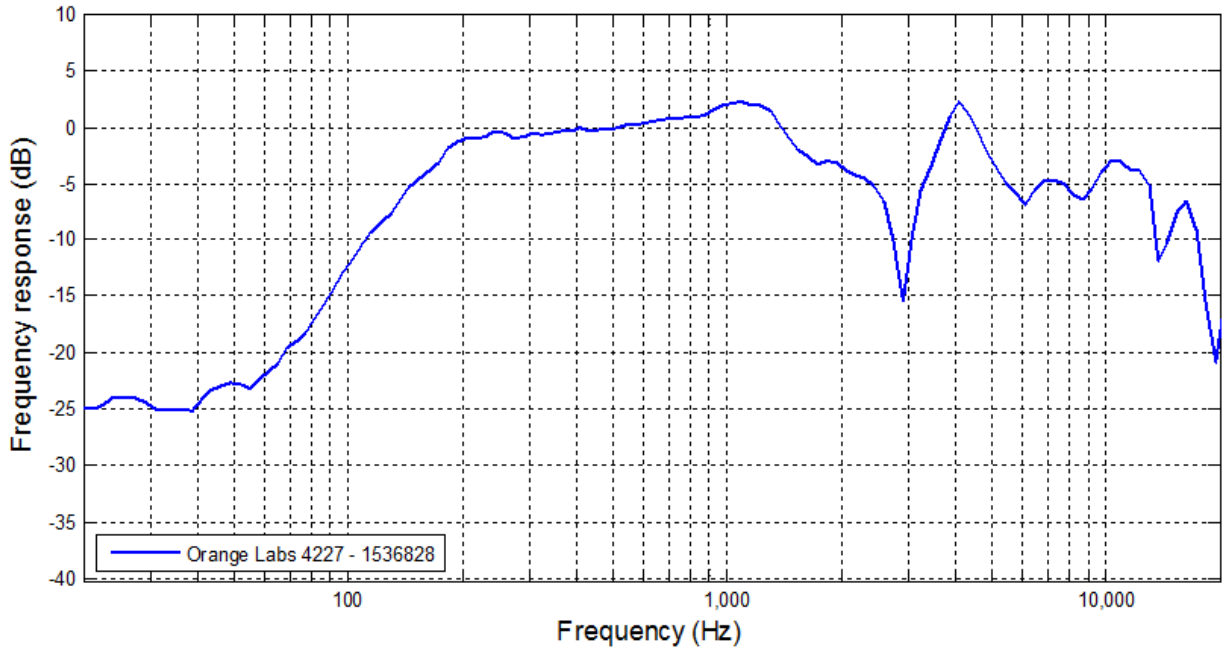

Figure 7: Frequency response curve of Bruel&Kjaer mouth simulator number 1536828 (type 4227)

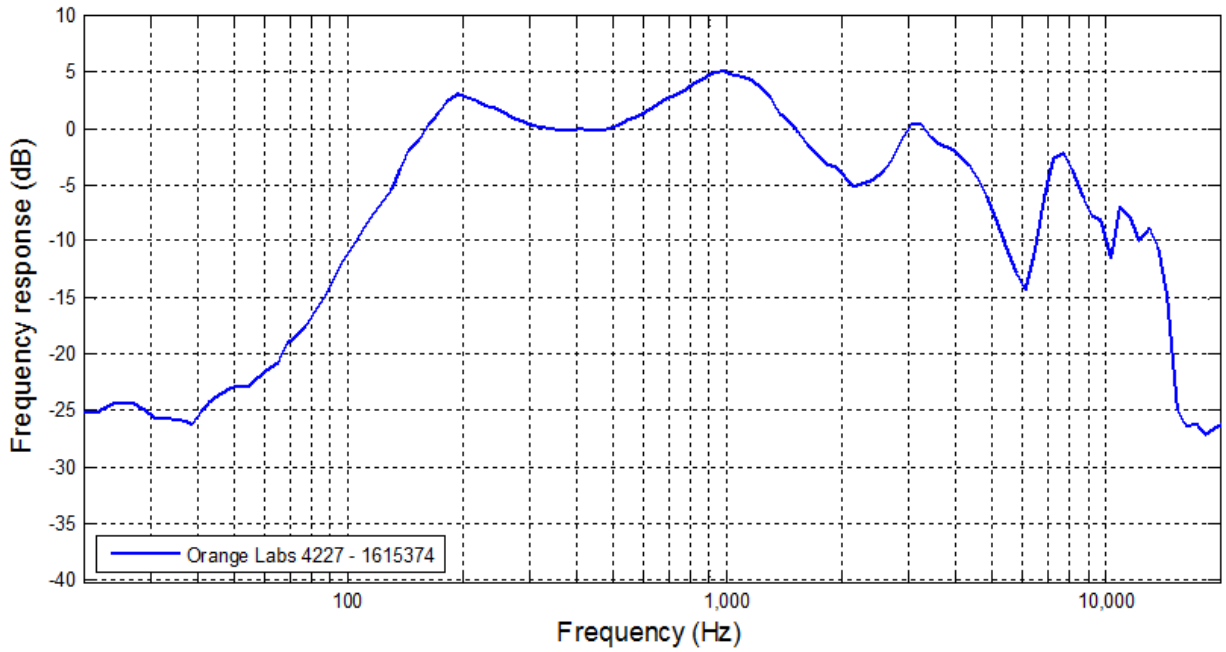

Figure 8: Frequency response curve of Bruel&Kjaer mouth simulator number 1615374 (type 4227)

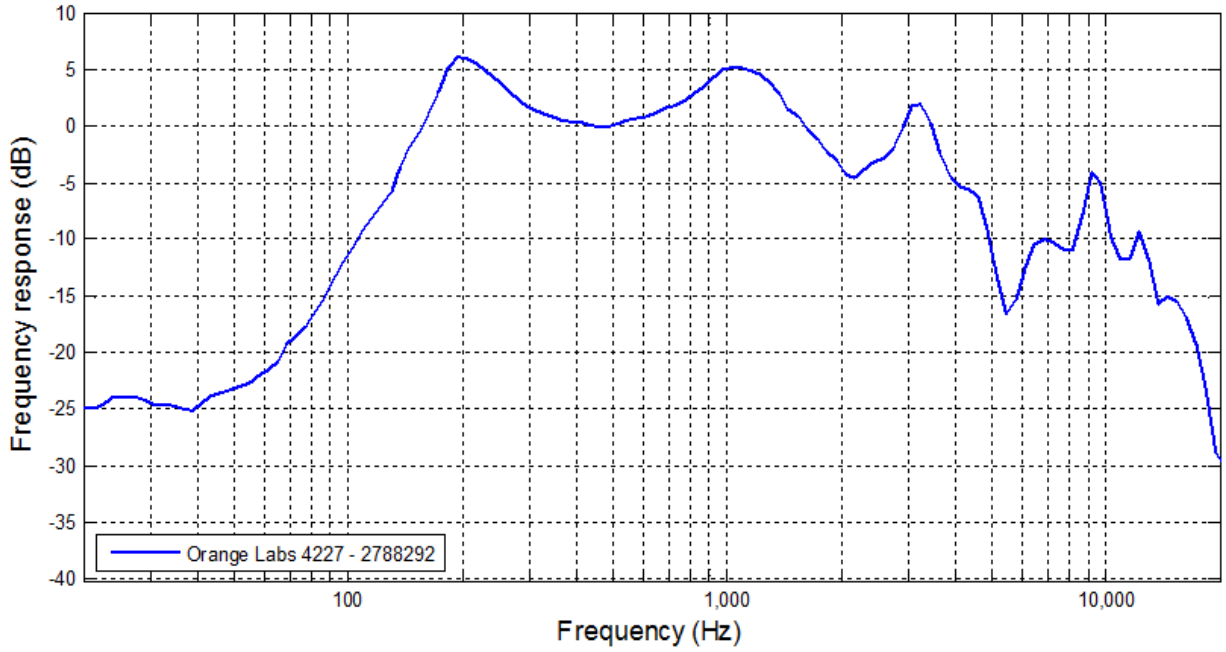

Figure 9: Frequency response curve of Bruel&Kjaer mouth simulator number 2788292 (type 4227)

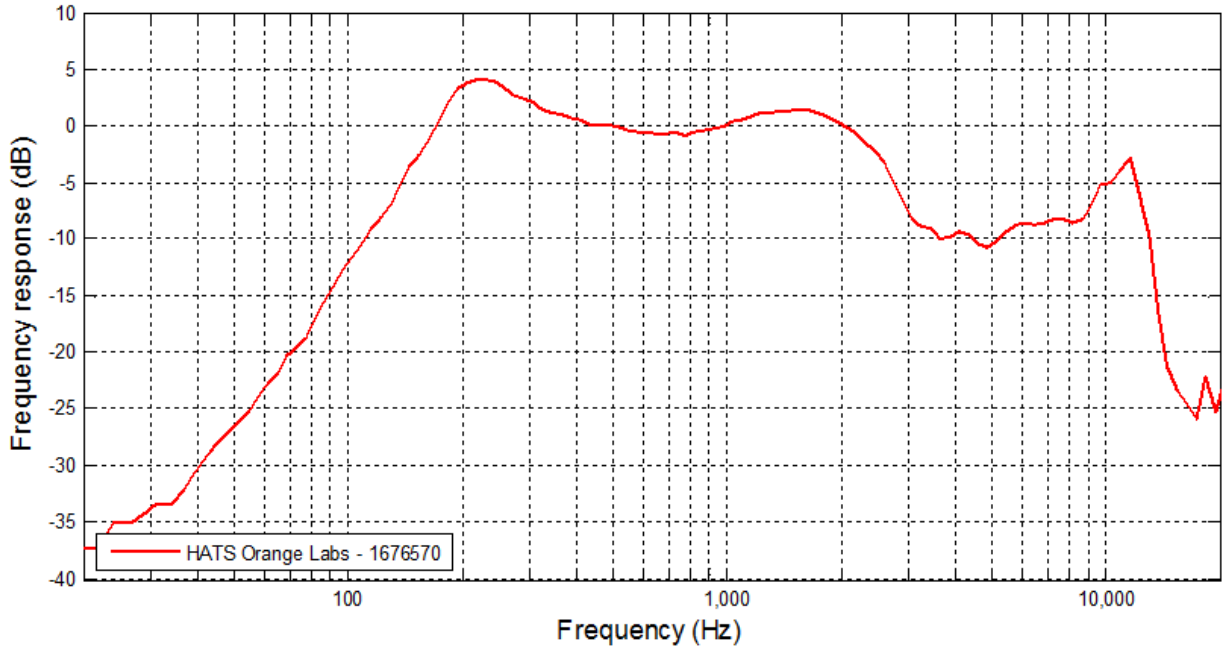

Figure 10: Frequency response curve of Bruel&Kjaer Head And Torso Simulator number 1676570 (type 4128-D)

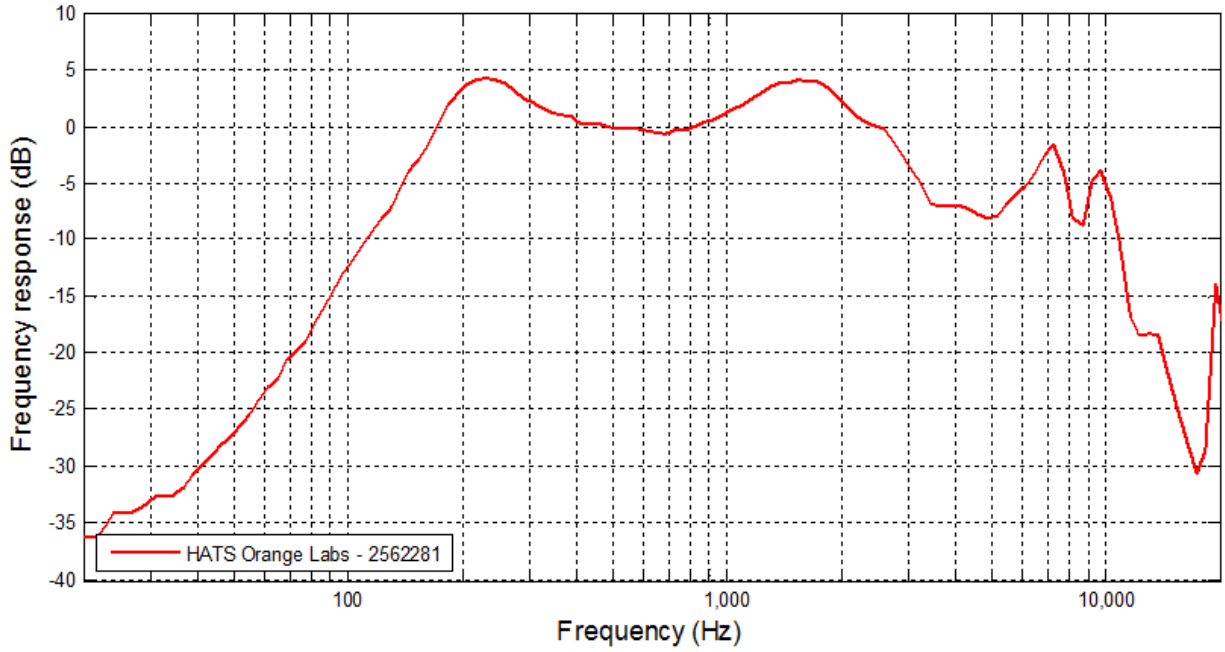

Figure 11: Frequency response curve of Bruel&Kjaer Head And Torso Simulator number 2562281 (type 4128-D)

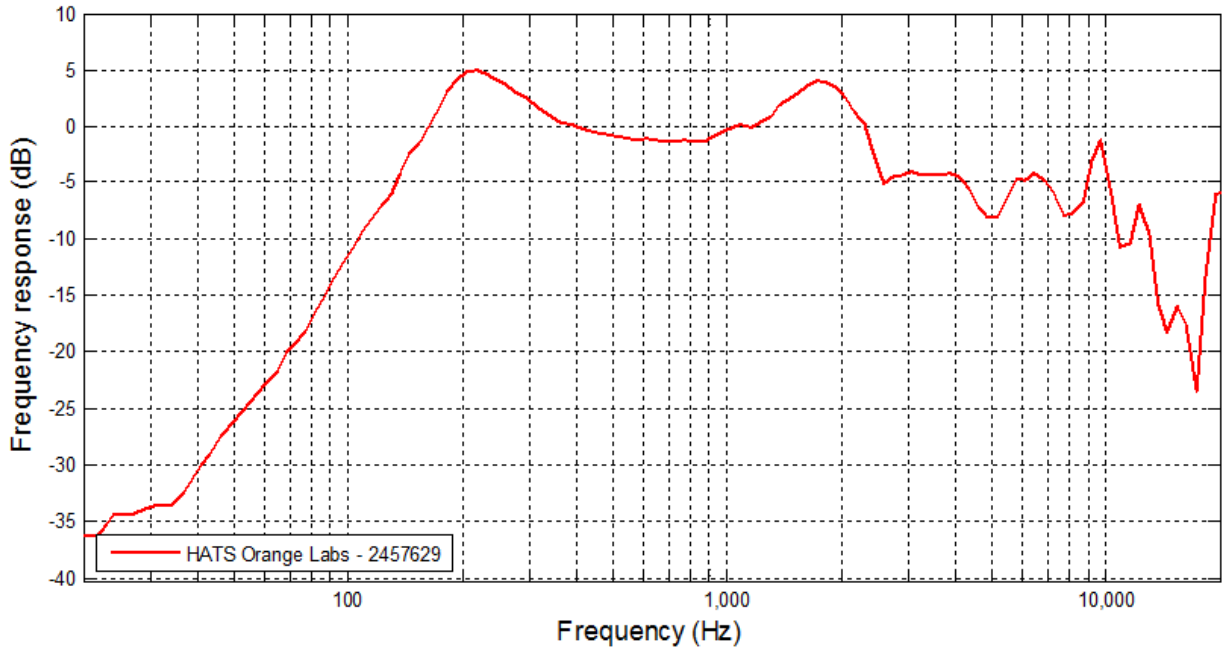

Figure 12: Frequency response curve of Bruel&Kjaer Head And Torso Simulator number 2457629 (type 4128-D)

5.3 Measurement results obtained by HEAD acoustics laboratory

2 HEAD acoustics Head And Torso Simulator (type HMS II.3) have been characterized in HEAD acoustics laboratory (Herzogenrath, Germany).

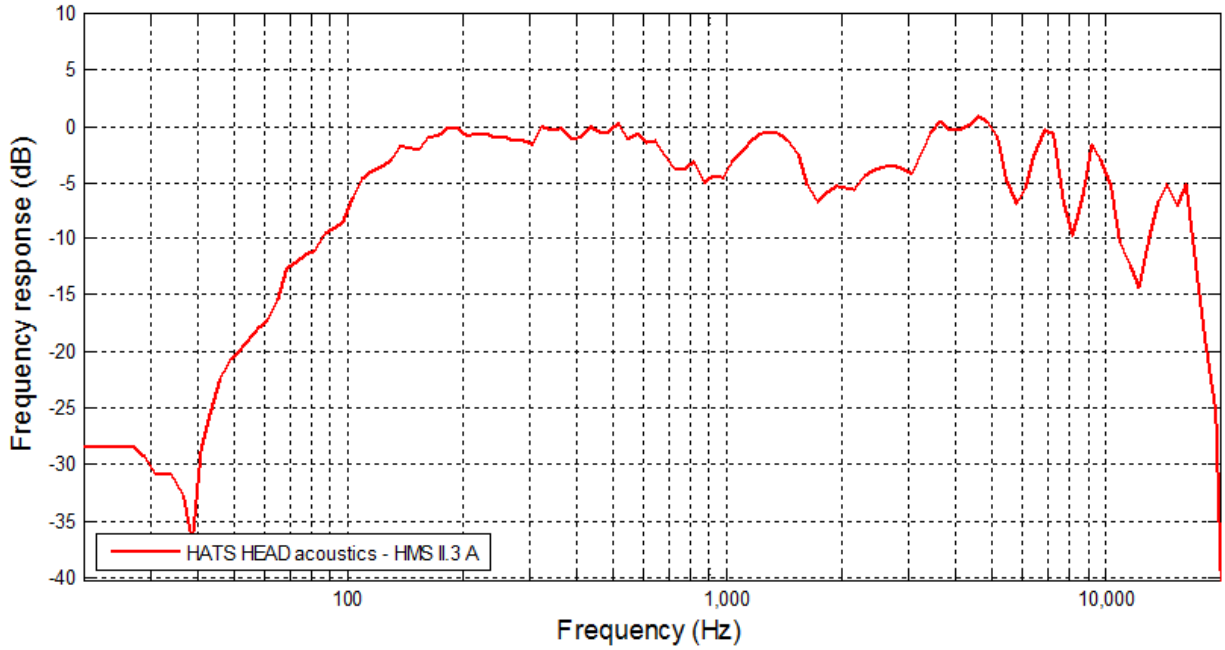

Figure 13: Frequency response curve of HEAD acoustics Head And Torso Simulator A (type HMS II.3)

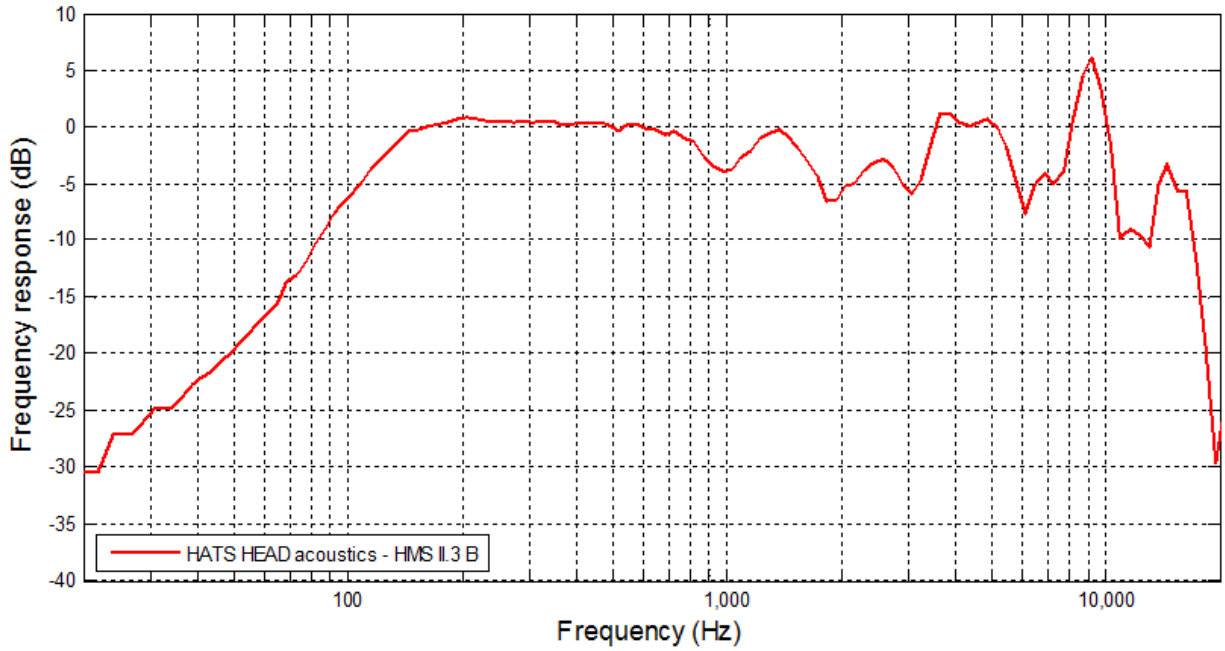

Figure 14: Frequency response curve of HEAD acoustics Head And Torso Simulator B (type HMS II.3)

5.4 Results comparison

The two figures below show the comparison of results for discrete artificial mouths (figure 15) and for HATS (figure 16).

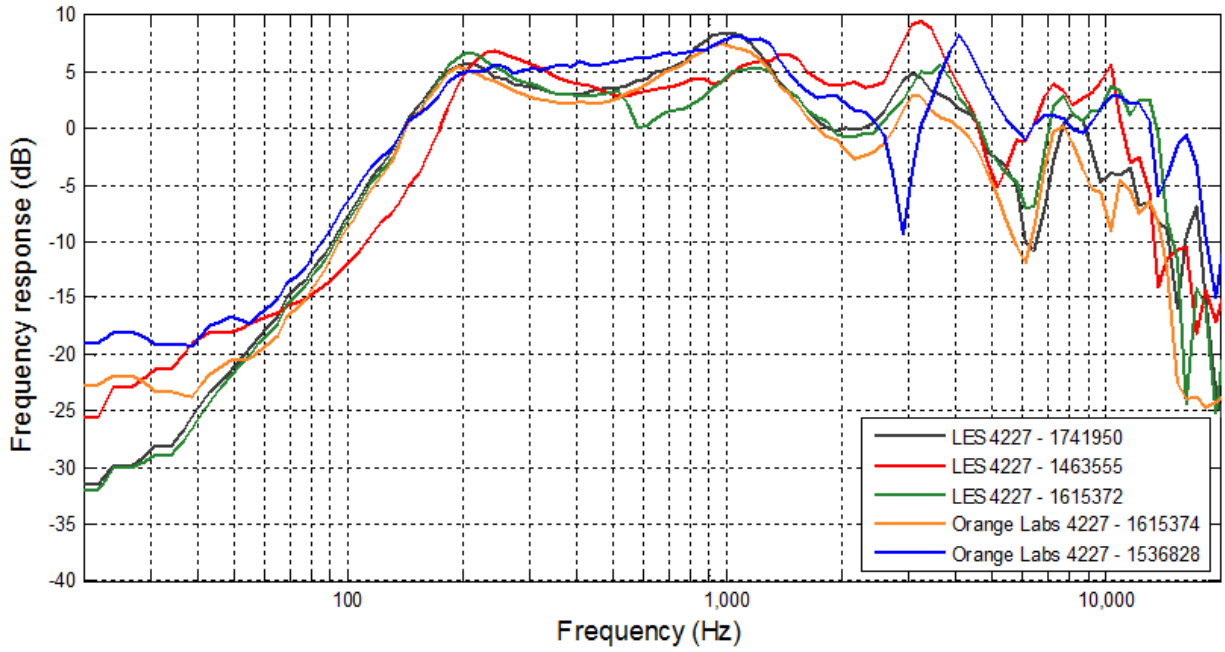

Figure 15: Results comparison of frequency response curves associated to various mouth simulators (Bruel & Kjaer type 4227)

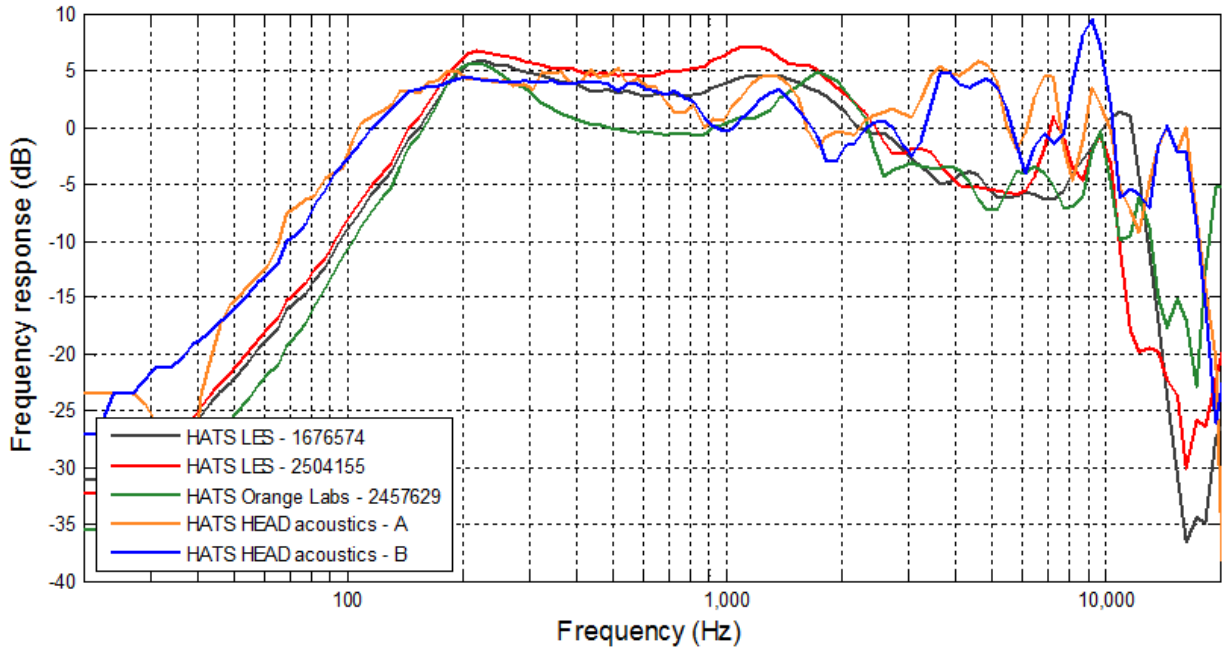

Figure 16: Results comparison of frequency response curves associated to various Head And Torso Simulators

5.5 Equalized response curves

Figure 16 shows that the artificial mouth of HATS can be equalized on frequency band from 80 Hz to 14 kHz (SWB).

This possibility to equalize HATS artifical mouths is illustrated in figure 17 with the equalized curves for the same HATS as in figure 16. The 12th octave analysis is produced using a FFT calculated on 8 192 samples for audio files at 48 kHz frequency rate.

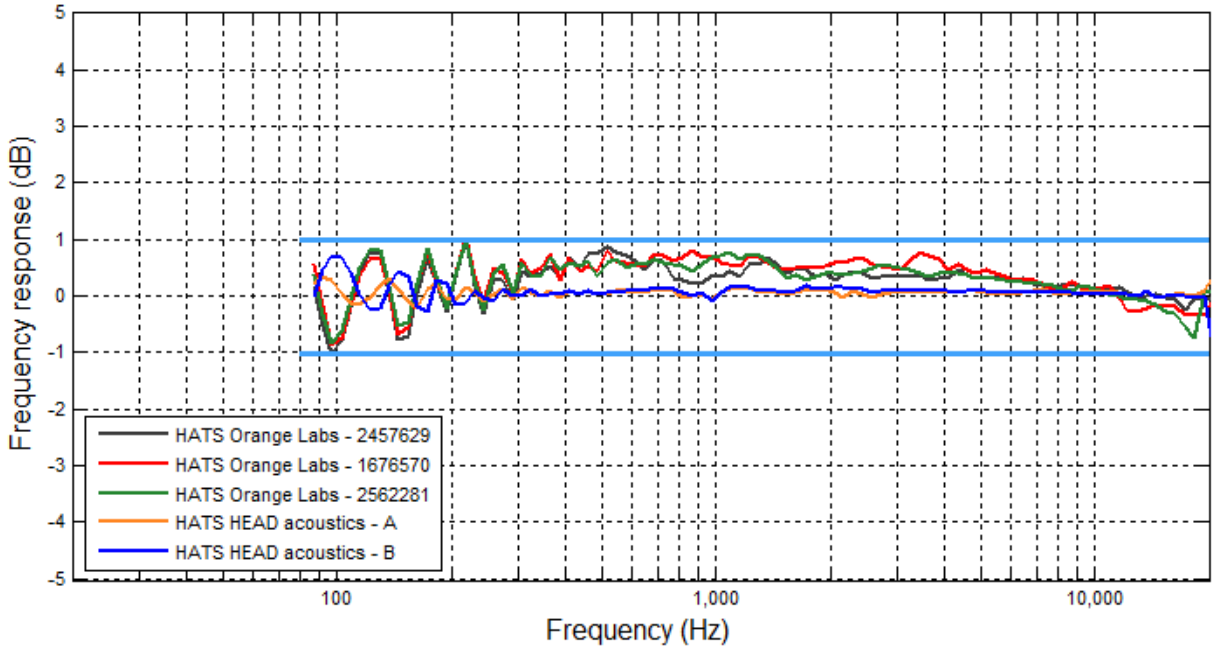

Figure 17: Results comparison of frequency response curves after mouth equalization These results concern different Head And Torso Simulators

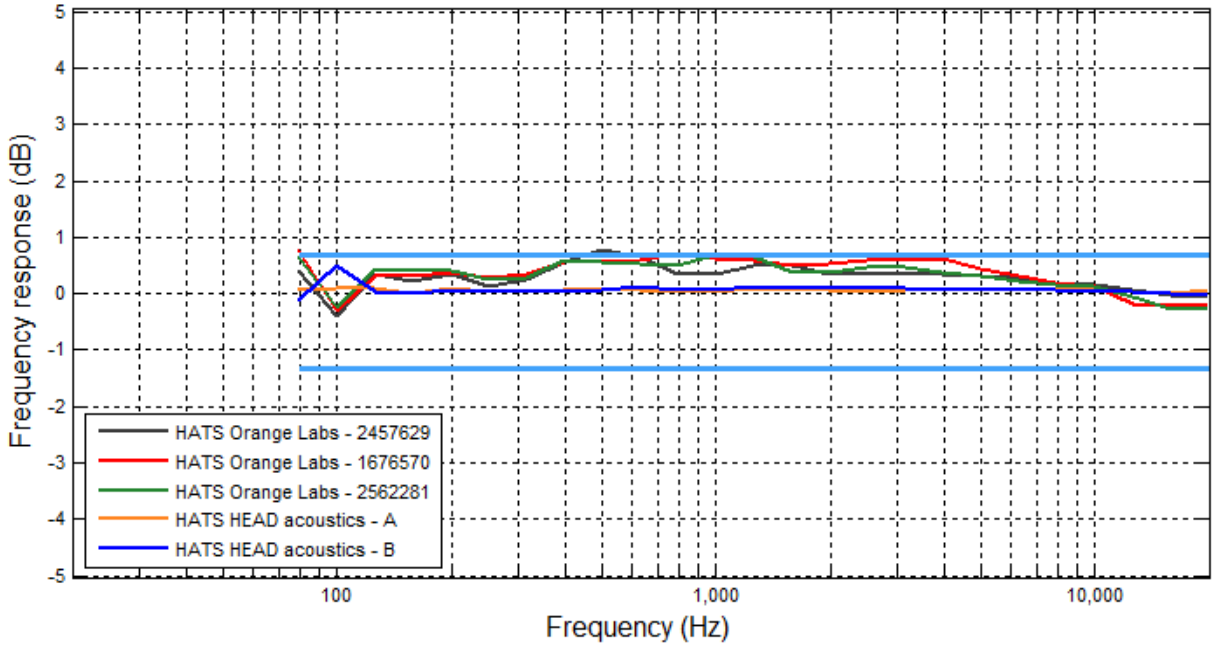

Figure 18: Same results as figure 17 but presented in 3th octave analysis

Annex A: Bibliography

- Recommendation ITU-T P.57: "Artificial ears".
- Recommendation ITU-T P.58: "Head and torso simulator for telephonometry".

History

Document history		
V1.1.1	July 2013	Publication