ANSI S12.71
Performance criteria for systems intended to estimate the attenuation obtained by the individual users of passive HPDs

✔ Types of FAMS
✔ FAMS characteristics and reporting requirements
✔ Data collection and Statistical analysis
✔ Calculation of Personal Attenuation Rating (PAR)
Introduction to upcoming ANSI S12.71

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Yours could be here...
Personal Attenuation Rating (PAR)
equivalent to
Real-Ear Attenuation at Threshold (REAT)
PAR)

(REAT)

Not perfect:
- Overestimation of low-frequency attenuation
- Large intra-subject variability
High precision, but low accuracy

High accuracy, but low precision
Valid measurement system

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estimate the attenuation obtained by the individual users of passive HPDs

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Types of FAMS

FAMS characteristics
### Table 1 – Four types of FAMS

<table>
<thead>
<tr>
<th>FAMS type / HPD test device</th>
<th>Standard HPD</th>
<th>Surrogate HPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Psychophysical</td>
<td>III</td>
<td>IV</td>
</tr>
</tbody>
</table>

**NOTE:** At the time of this writing, Type IV systems do not exist.
Performance criteria for systems intended to estimate the attenuation obtained by the individual users of passive HPDs

- Types of FAMS
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Maximum permissible background noise → Same results at [SPL\text{max}] as at [SPL\text{max} - 20 \text{ dB}]

Dynamic range

Calibration → Daily Calibration Check
Annual Calibration

Maximum output level → 90 dB max SPL for time of measurement

Repeatability

Reproducibility
Maximum permissible background noise

Dynamic range

Calibration

Daily Calibration Check
Annual Calibration
Same results at [SPL_{max}] as at [SPL_{max} - 20 \, \text{dB}]
Dynamic range
Scattergram of Predicted (FAMS on x-axis) vs. Reported (REAT on y-axis) Attenuation (N=40)
Calibration
Daily Calibration Check
Annual Calibration
Repeatability

Maximum output level

Calibration

Daily Calibration

Annual Calibration
90 dB max SPL for time of measurement
Maximum permissible background noise → Same results at [SPL_{max}] as at [SPL_{max} - 20 dB]

Dynamic range →

Calibration → Daily Calibration Check
Annual Calibration

Maximum output level → 90 dB max SPL for time of measurement

Repeatability

Reproducibility
- Types of FAMS
- FAMS characteristics and reporting requirements
- Data collection and Statistical analysis
- Calculation of Personal Attenuation Rating
• 1\textsuperscript{st} set of REAT and FAMS pairs
• 2\textsuperscript{nd} set of REAT and FAMS pairs
• obtain 2 sets of pairs for the remaining subjects (9 or 19)

Reference value (REAT)

Probability density

Smallest range

Closest to zero
• 1\textsuperscript{st} set of REAT and FAMS pairs
• 2\textsuperscript{nd} set of REAT and FAMS pairs
• obtain 2 sets of pairs for the remaining subjects (9 or 19)

![](etc...)
Table 5 – Equivalence ranges and FAMS measurement class

<table>
<thead>
<tr>
<th>Equivalence range (in dB)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ +2</td>
<td>A</td>
</tr>
<tr>
<td>≤ +4</td>
<td>B</td>
</tr>
<tr>
<td>≤ +6</td>
<td>C</td>
</tr>
<tr>
<td>&gt; +6 dB</td>
<td>D</td>
</tr>
<tr>
<td>Unknown</td>
<td>Z</td>
</tr>
</tbody>
</table>
Individual users of passive HPDs

- Types of FAMS
- FAMS characteristics and reporting requirements
- Data collection and Statistical analysis
- Calculation of Personal Attenuation Rating (PAR)
\[ \text{PAR}_x(n_s) = \text{FAMS}_A(n_s) - \alpha \cdot \sqrt{S^2_{\text{measurement}} + S^2_{\text{fit}}(n_s) + S^2_{\text{spectrum}}} \]

**Measurement uncertainty**
- FAMS intrinsic variability
- REAT intrinsic variability

**Fit uncertainty**
- Fit/refit variability
- Assessed from:
  - user being tested
  - from tabulated data

**Spectrum uncertainty**
- Established per ANSI S12.68 standards
- Alternative calculation for FAMS not having 7 frequencies
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