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F-MIRE: A New Approach to Field Evaluation of Hearing Protectors

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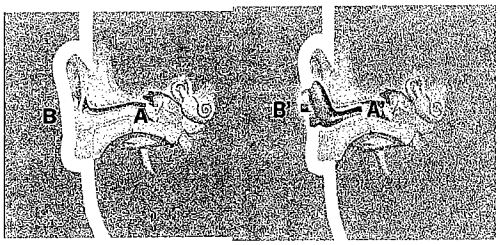
Defining Terms



Insertion loss is A-A′
Noise reduction is B′-A′
TFOE is B-A

REAT (attenuation) measures A-A′

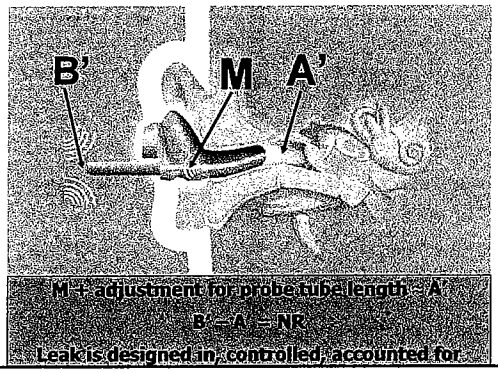
Existing Methodologies*

- Threshold testing
  - With & without HPD
- Difference yields attenuation
- Attributes
  - REAT Gold Standard
- Downside
  - Time consuming ($$)
  - Subjective
  - Reliable/Repeatable?
  - Resulting NRR not representative of field performance

- MIRE – Instrumented Ear
  - SPL measurement
    - Inside & Outside HPD
  - Difference yields:
    - Noise Reduction
    - Insertion Loss
- Attributes
  - Objective
  - May be faster
- Downside
  - Equipment portability and Leaks
  - Does not yield attenuation

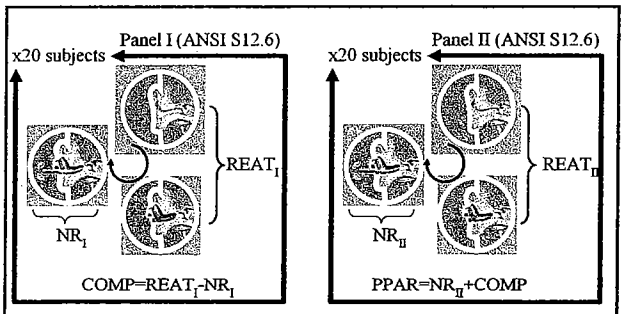
* Loudness balance

Field MIRE (F-MIRE)



Compensation

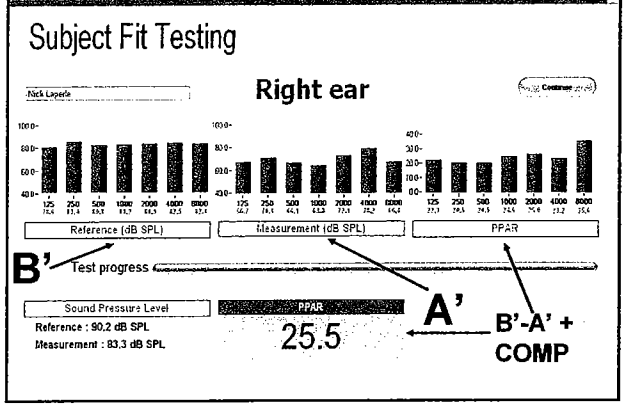
- ATT is the desired value
- NR is the measured value
- NR ≠ ATT
- ATT = NR + TFOE + PN
  - PN = physiological noise
- How to convert?



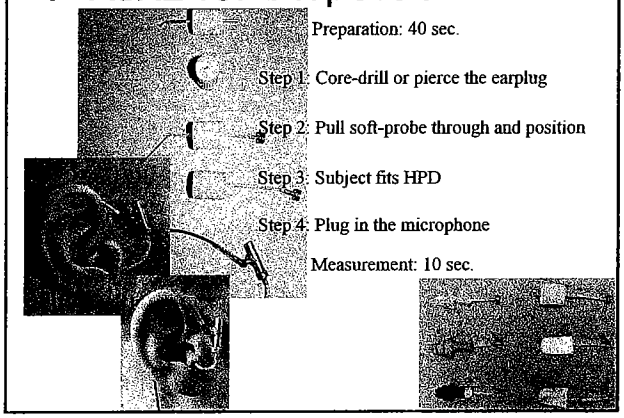
$\overline{ERROR} = \overline{PPAR - REAT_{II}}$ = 0.2 dB (with σ=3.6 dB)

- Compliance with *ISO Guide to the expression of uncertainty in measurement*
- Details of COMP computation available for review
- Submitted for publication
- All data (PPAR, REAT$_I$, REAT$_{II}$, etc.) 3rd Party Witnessed

P-PAR



F-MIRE for Disposable HPD



Current Issues

- Each disposable HPD will have unique compensation
  - May be able to classify by type
- Tube effect
  - Quantify
  - Add to compensation
- Consistent microphone position

Two Levels of Testing

- P-PAR
  - Predicted personal attenuation rating
  - Full RTA scan
  - B'-A' by octave band with full COMP
  - 125 to 8k
  - Surrogate for NRR
  - Currently SonoCustom only w/tested COMP
- Acoustic Seal
  - Free standing test
  - NR at low frequencies
  - Pass/fail

Conclusion

- Individual fit testing is viable
- Some obstacles remain
  - Regulatory
  - Technical
- But can be readily overcome though additional testing and quantification of variables