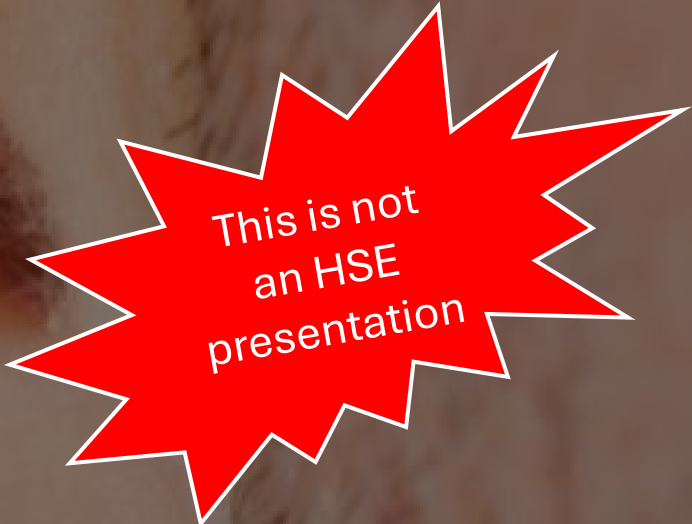


A Perfect Fit?

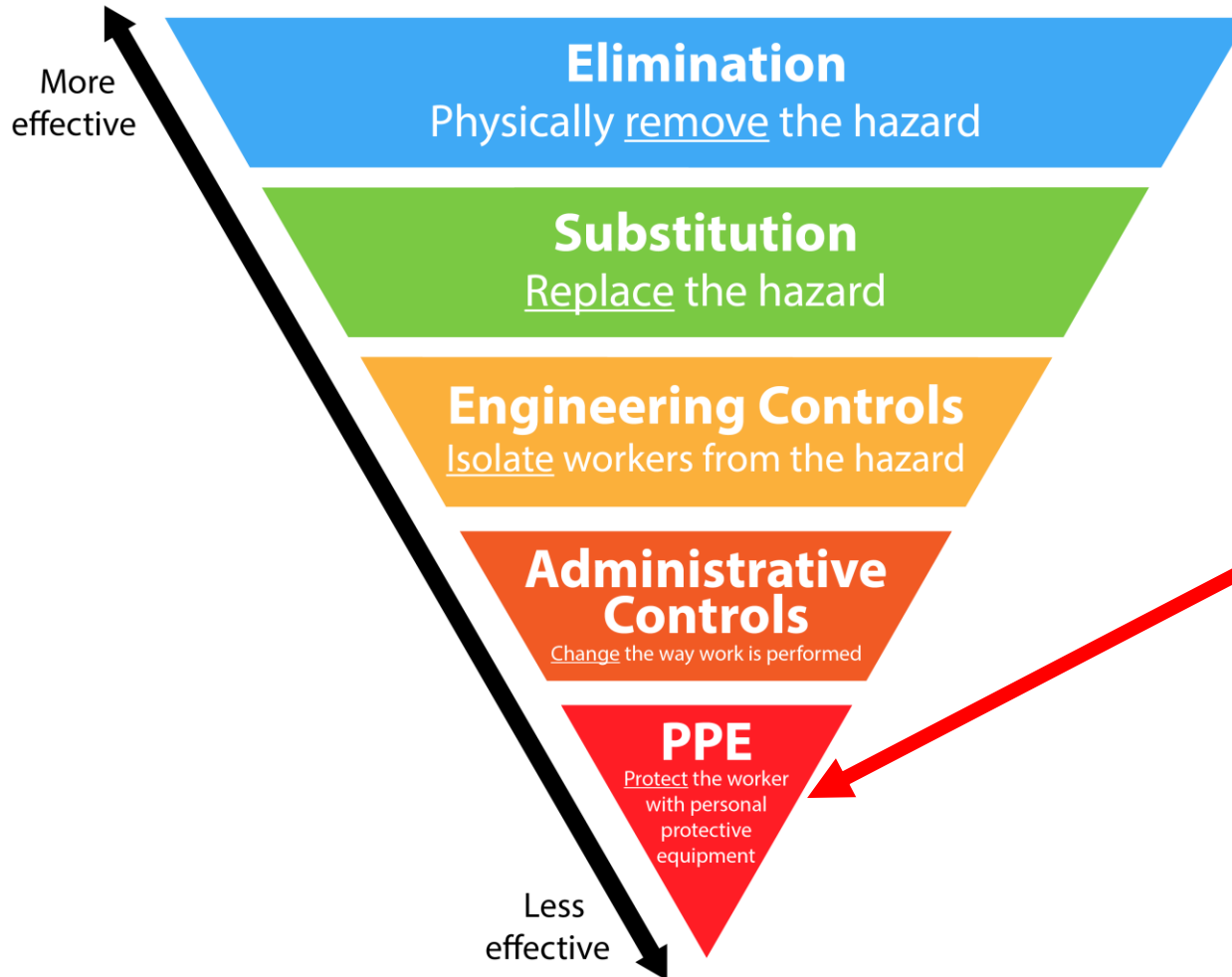
Methods for Fit Testing your Hearing Protection Device

Mary Cameron BSc LFOH CertOH COC – Control
HM Specialist Inspector – Occupational Hygiene, Health and Safety Executive
Board Member, British Occupational Hygiene Society

BOHS London and Southeast Regional Meeting
24th September 2025



This is not
an HSE
presentation



How can it go wrong?

- You've selected the wrong one for that wearer, task or environment
- You've selected the wrong one for that noise hazard
- The person isn't wearing it correctly (poor fit)
- The person isn't wearing it when they should be
- The person isn't taking care of it (dirty, degraded)

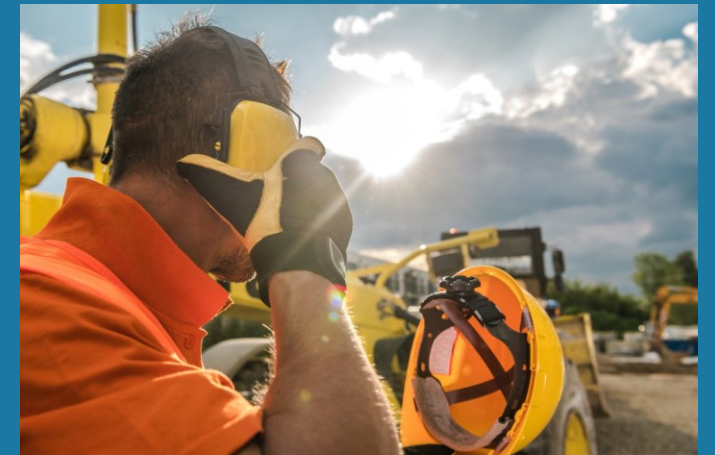
Adequate

It is right for the hazard and reduces exposure to the level required to protect the wearer's health.



Suitable

It is right for the wearer.
It is right for the task.
It is right for the environment.



Adequate

It is right for the hazard and reduces exposure to the level required to protect the wearer's health.

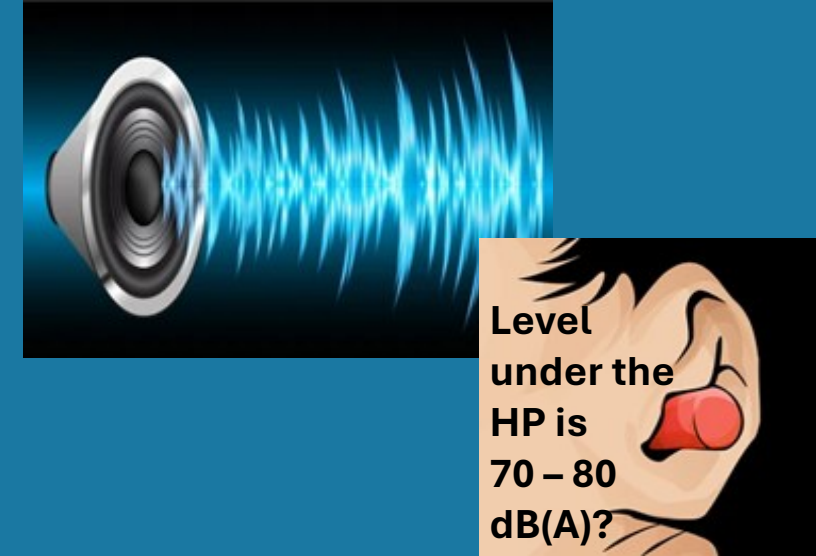


The hearing protection should attenuate noise levels to **70 - 80 dB(A)** at ear. Workers need to be able to hear warnings and alarms.



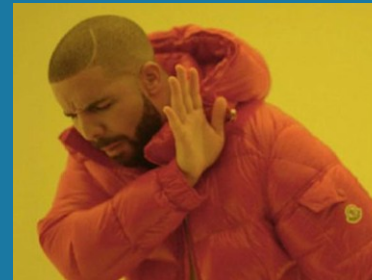
Adequate

It is right for the hazard and reduces exposure to the level required to protect the wearer's health.



Assess HP suitability to that noise source by-

- Octave band analysis
- SNR method
- HML method



Laboratory derived average attenuation figure... it **does not** correlate to real-world performance.



Suitable

It is right for the wearer.

It is right for the task.

It is right for the environment.

*What if the true real-life
attenuation is still unknown?*

*And what if the real-life
attenuation is significantly
more derated at ear due to poor
wear or poor fit?*

Fit Check Methods

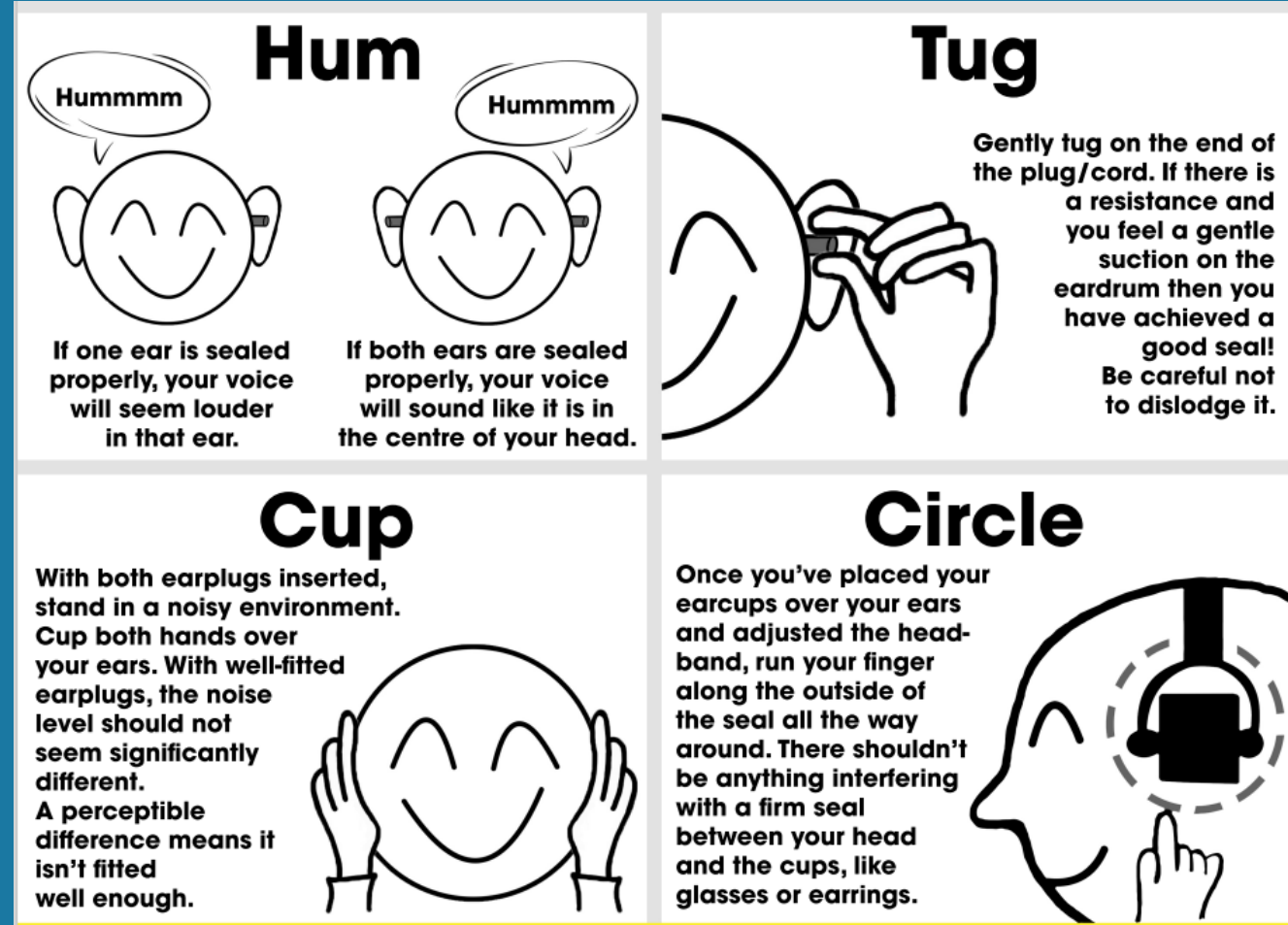


Suitable

It is right for the wearer.

It is right for the task.

It is right for the environment.



<https://hearingconservation.org.uk/wp-content/uploads/2024/02/CHECK-IT-OUT-Poster.pdf>

Hearing Protection Fit Testing



L108 – Selecting Suitable HP

Selecting suitable hearing protectors

222 Hearing protection falls into two broad categories: earmuffs and earplugs. Table 2 describes the main types within these categories and identifies some of the limitations that may affect their selection. Whichever type of protector is used, it will provide its best protection only if it is in good condition, is the correct size and is worn properly and at all times in noisy areas.

223 The following factors are likely to influence your selection of hearing protection:

- (a) types of protector and suitability for the work being carried out;
- (b) noise reduction (attenuation) offered by the protector;
- (c) compatibility with other safety equipment;
- (d) pattern of the noise exposure;
- (e) the need to communicate and hear warning sounds;
- (f) environmental factors such as heat, humidity, dust and dirt;
- (g) cost of maintenance or replacement;
- (h) comfort and user preference;
- (i) ease of use/ease of fitting;
- (j) ease of monitoring of their (correct) use;
- (k) any medical issues the wearer may have.

L108 – Provide the Required Protection

84 When consulting with employees or their representatives on the selection of hearing protection, you should include from the many different types and makes available, protectors that:

- (a) provide the required protection;
- (b) can be worn with comfort throughout the period of exposure to high noise;
- (c) are compatible with any required use of other personal protective equipment (PPE) (see Personal Protective Equipment at Work Regulations 1992 (as amended)⁷);
- (d) can be satisfactorily stored, cleaned and maintained (see regulation 8(1)(b)).

L108 – Use and Maintenance of HPs

Use and maintenance of hearing protectors

95 Hearing protection will not achieve manufacturers' reported attenuation characteristics unless the protection is easy to fit properly, is comfortable and is used all the times it is required. The protection achieved reduces significantly when hearing protection is removed in noisy areas – this reduction increases most rapidly in the first moments of non-wearing. You might encourage full and proper use of hearing protection in noisy areas by, for example, providing quiet areas where work can be discussed with hearing protection removed – see regulation 6(3)(c).

96 To ensure that the hearing protection provided is achieving the planned protection you should have a systematic programme to ensure it is used, taking into account the following:

- (a) the company's **safety policy**, which should include a clear commitment to using personal protection;
- (b) **signs and warning notices** to ensure awareness of where and when protectors should be used (see paragraphs 85–91);
- (c) **clear responsibilities**. You should identify who is responsible for the hearing protection programme and the distribution and maintenance of protectors;
- (d) **information, instruction and training** for all employees on the risks and the action they should take (see paragraphs 112–116);
- (e) **records** which should include details of the issue of hearing protectors, arrangements for ensuring users know where and how to use them, and any problems people encounter when using them;
- (f) **monitoring**, including spot checks to find out whether the hearing protectors are being used. You should keep a record and introduce a system to enable people to report deficiencies to a person with responsibility and authority for remedial action. Where an employee is not using hearing protection properly you should ask them why, and either resolve the difficulty or give and record a verbal warning. Where people persistently fail to use protectors properly you should follow normal disciplinary procedures.

HP Fit Testing – Around the World

Many countries recommend HP fit testing as **best practice** and give **guidance** on how to incorporate test methods into **hearing conservation programmes**.



HP Fit Test Methods

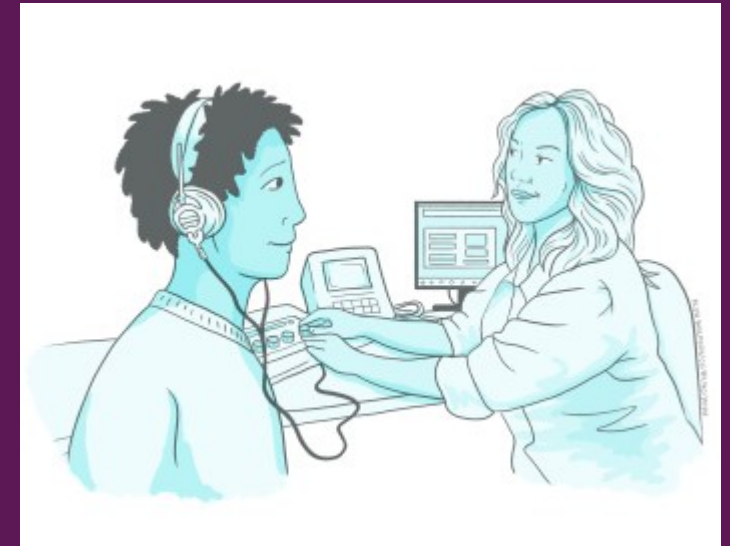
It's not mandatory though. Should I bother?

Sure!

Here are fit test methods:

- FMIRE (Field Microphone in Real Ear)
- Audiometric / audiometric based systems
- Web-based PAR systems
- Loudness balance test
- Acoustic seal tests by 'apps'
- Acoustic seal tests by pressure

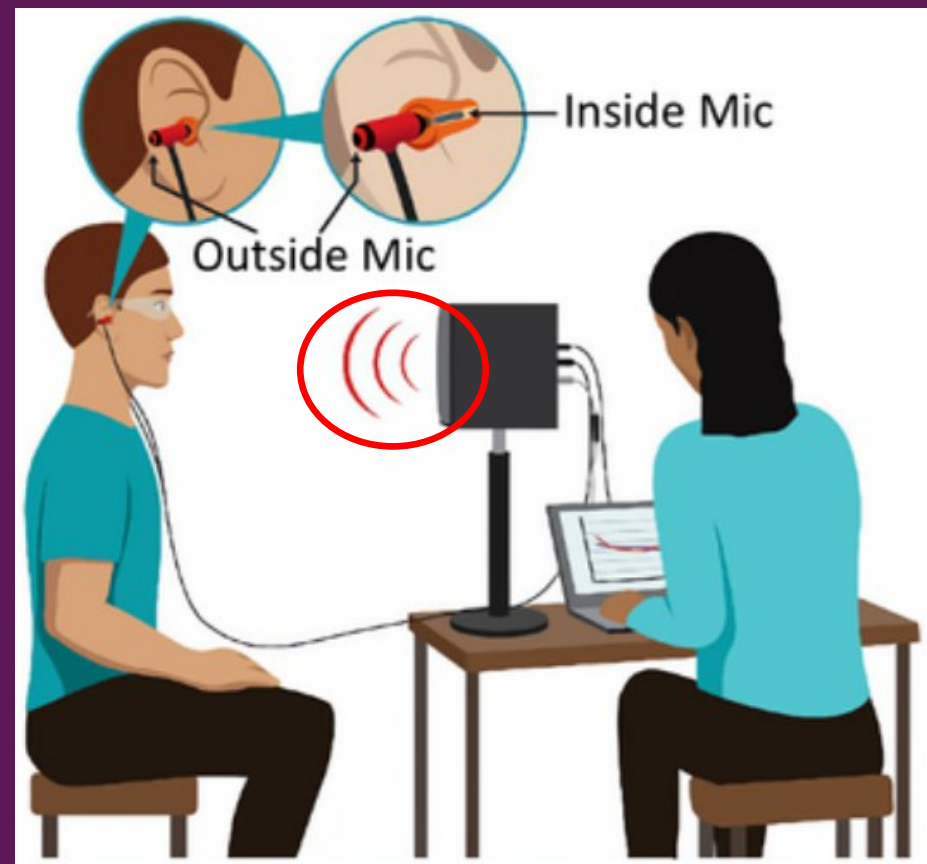
Either calculates a personal attenuation rating (PAR) or shows a simple pass/fail



HP Fit Test Methods

FMIRE

- Simultaneously measures the sound pressure level **outside and inside** a hearing protection device. The difference between the two is the PAR.



HP Fit Test Methods

FMIRE

- Simultaneously measures the sound pressure level **outside and inside** a hearing protection device. The difference between the two is the PAR.



3M E-A-Rfit Dual-Ear Validation System

Sonomax – SonoPass

Michael & Associates – FitCheck for ear muffs

Svantek – SV102A+

Elcea International – Elacin SI-Meter

Phonak Communications – SafertMeter

Bachmaier – Machmaier Leak Test Instrument

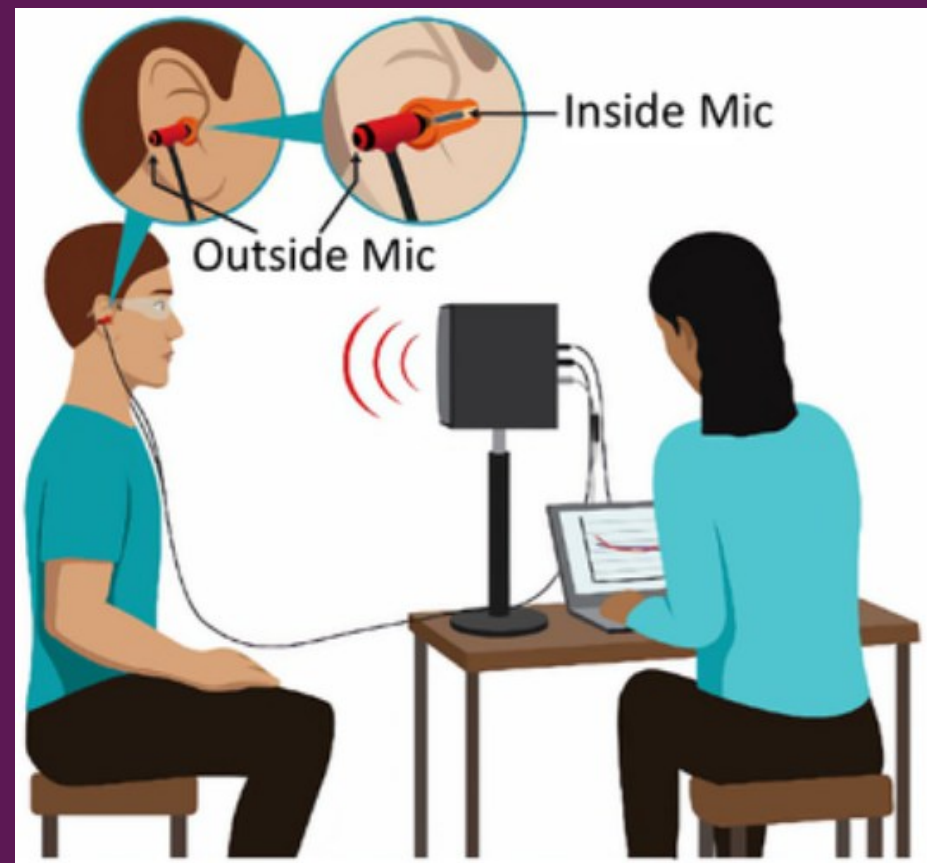


3M E-A-Rfit Dual-Ear
Validation System

HP Fit Test Methods

FMIRE

- Simultaneously measures the sound pressure level **outside and inside** a hearing protection device. The difference between the two is the PAR.
- It is **objective**.
- It gives you a **PAR value**.



Personal Attenuation Rating

Noise outside of the HP

minus

Noise inside of the HP

= PAR

Or

Hearing with HP

minus

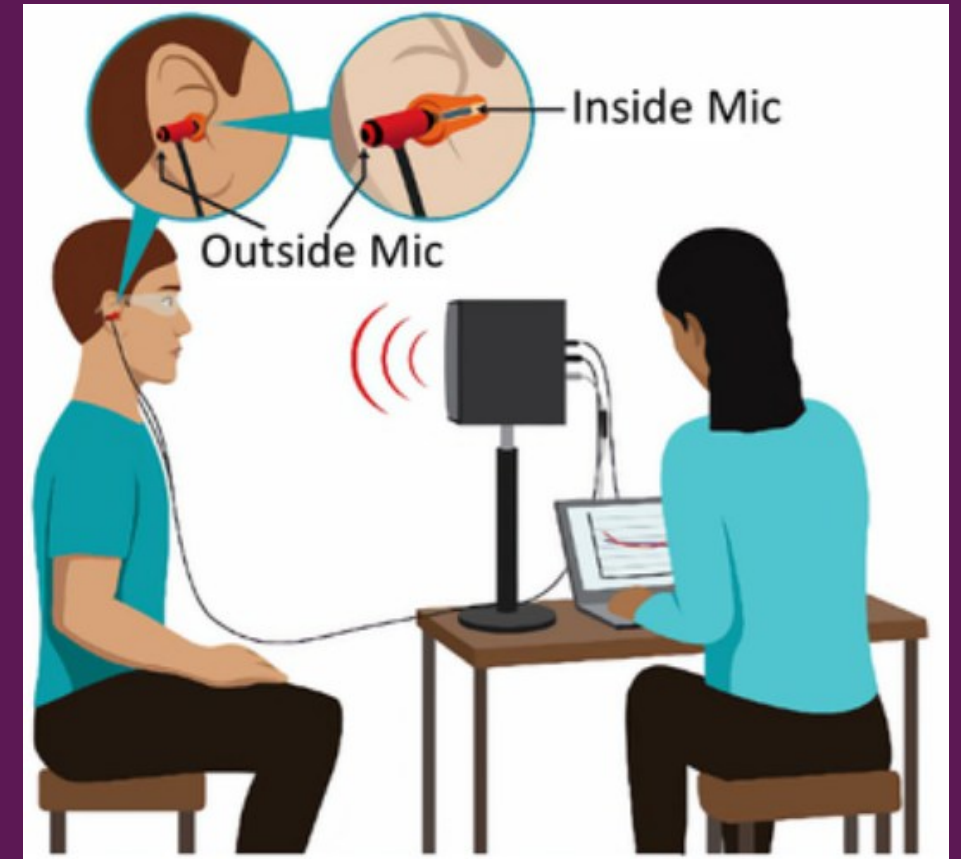
Hearing without HP

= PAR

HP Fit Test Methods

FMIRE

- Simultaneously measures the sound pressure level **outside and inside** a hearing protection device. The difference between the two is the PAR.
- It is **objective**.
- It gives you a **PAR value**.
- It is **quick and reliable**.
- Requires **specialist equipment**.
- May need a **trained operator**.
- It can be used for **plugs and muffs** but it may only be compatible with a **specific manufacturer or product**.



HP Fit Test Methods

Audiometric or Audiometric Based Systems

- Measures the change in a worker's **hearing threshold level** at various frequencies using headphones that deliver sound to the user's ear **with and without protection.**

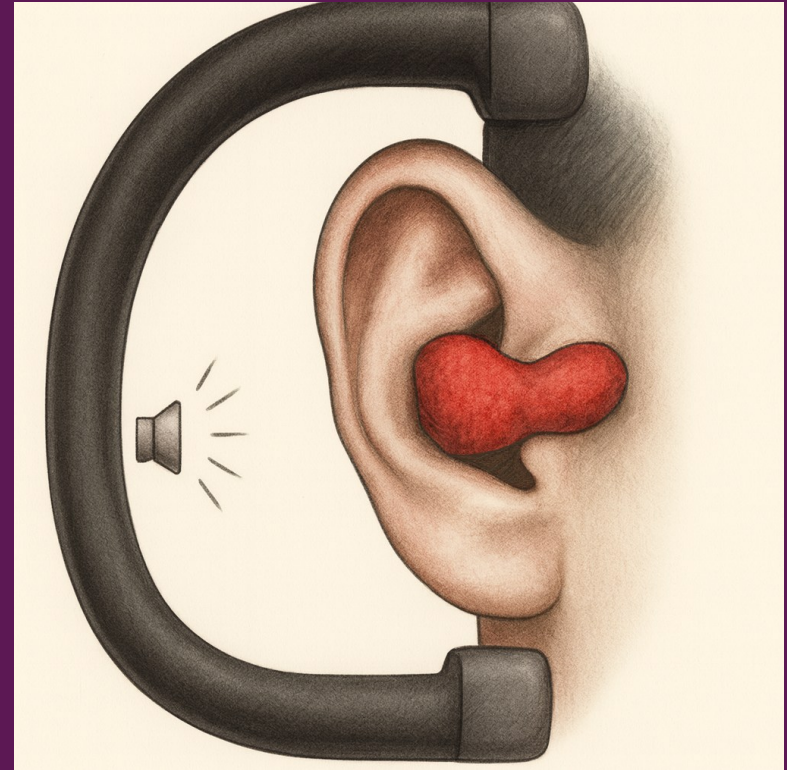


REAT (Real-Ear Attenuation at Threshold)

REAT



Unoccluded
(not wearing HP)



Occluded
(wearing HP)

REAT

BEEP

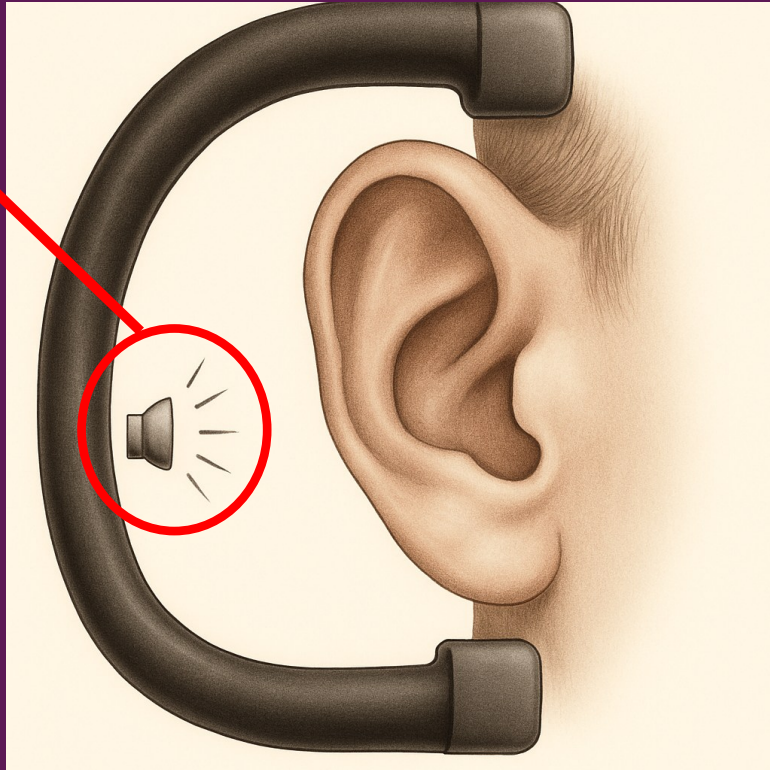
BEEP

BEEP



Unoccluded
threshold of
hearing

125 Hz
to
8k Hz



Unoccluded
(not wearing HP)

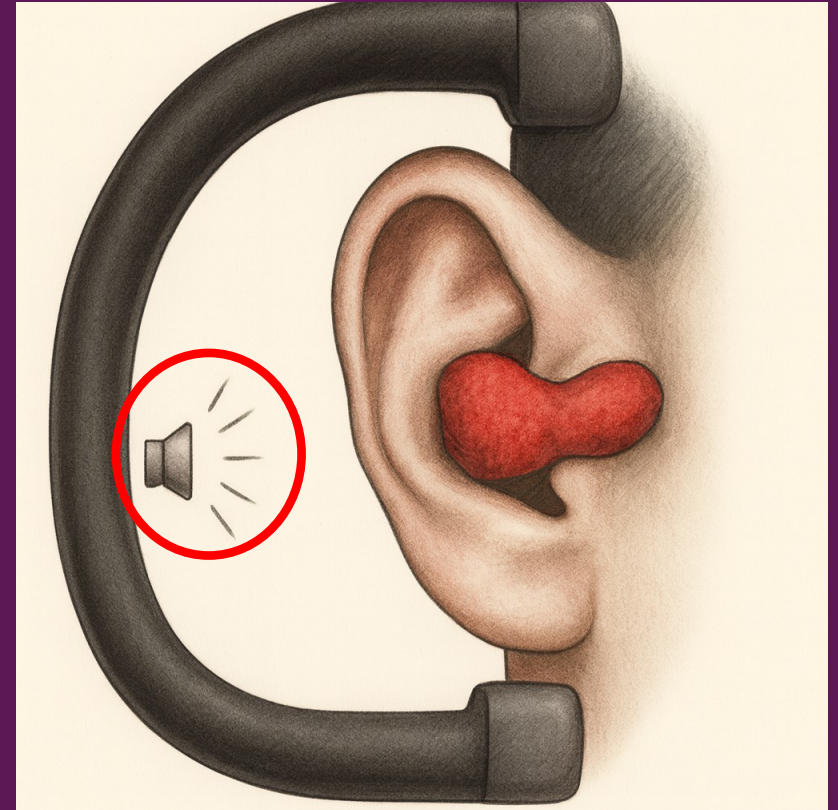
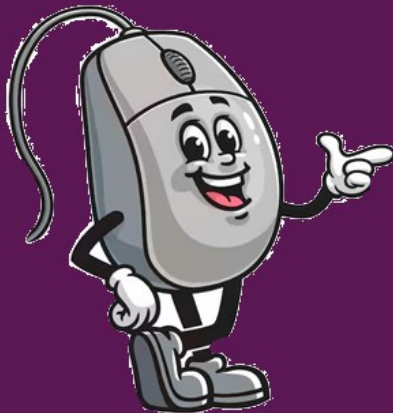
REAT

BEEP

BEEP

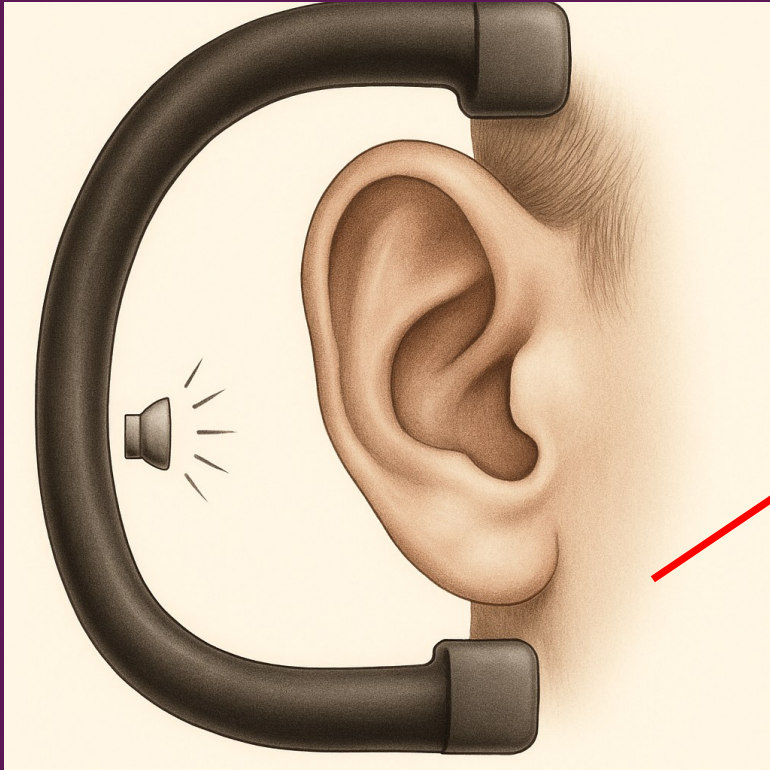
BEEP

Occluded
threshold of
hearing



Occluded
(wearing HP)

REAT



Unoccluded
(not wearing HP)

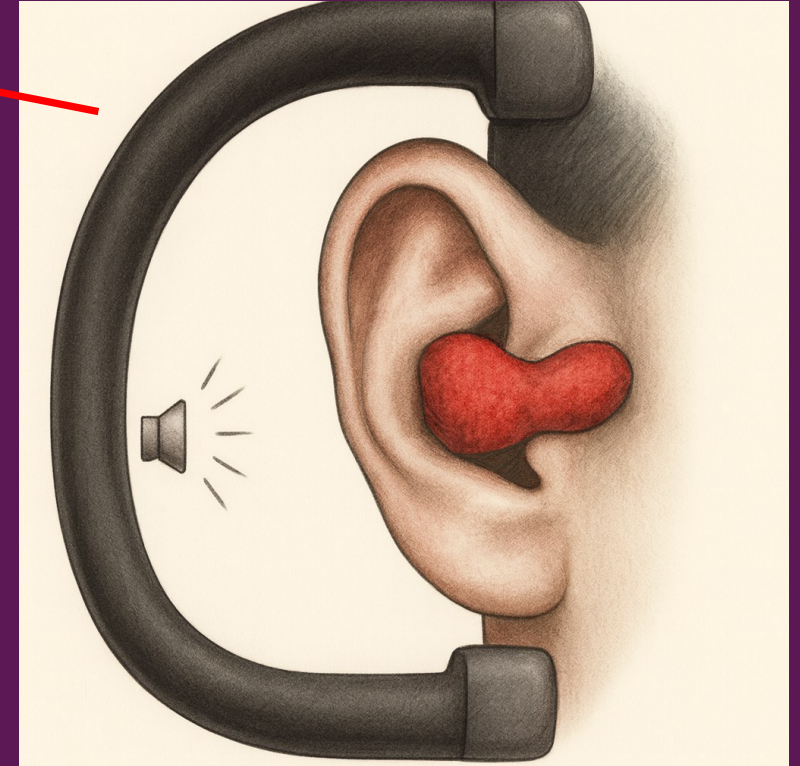
50dB(A)

-

20dB(A)

=

30dB(A)



Occluded
(wearing HP)

REAT



Michael & Associates – FitCheck Solo
Benson Medical Instruments – CCF-200
Egger Otoplastik + Labortechnik – ePRO Meter
Cotral Lab – CAPA
Inmedico – Oscilla
Maico – MA 33
Workplace INTEGRA – INTEGRAfit
CavCom REAT Fit Testing



HP Fit Test Methods

Audiometric or Audiometric Based Systems

- Measures the change in a worker's **hearing threshold level** at various frequencies using headphones that deliver sound to the user's ear **with and without protection**.
- It is **subjective**, relying on the individual to respond to the quietest sound they can hear.
- The data is used to calculate the **PAR**.
- It is slower than **FMIRE**.
- It needs a **quiet test environment** e.g. headphones or a sound booth.
- It can test **all types of earplugs**. Not muffs.
- Requires individuals with **normal hearing**.



REAT is the gold-standard technique of fit testing presented by ISO 4869-1

HP Fit Test Methods

Subjective Loudness Balance Test

- The person **balances the loudness** of sound sources provided between the ears with one or two earplugs and without any earplug in a subjective measurement.

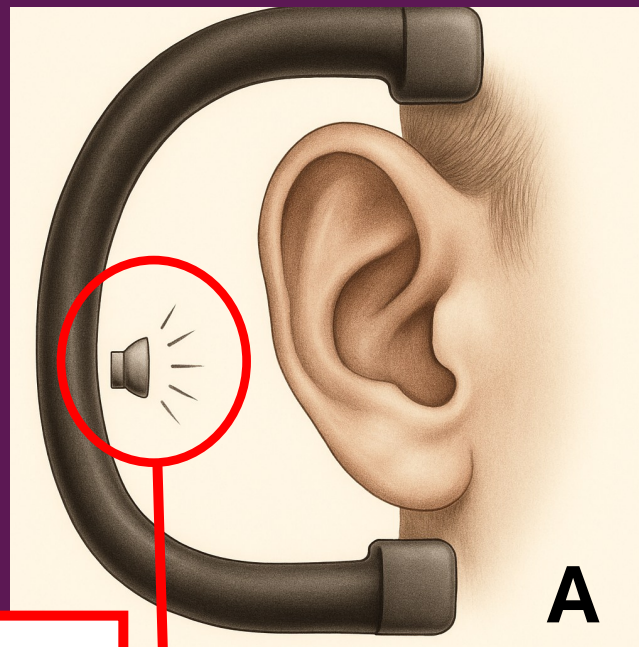
HP Fit Test Methods

Subjective Loudness Balance Test

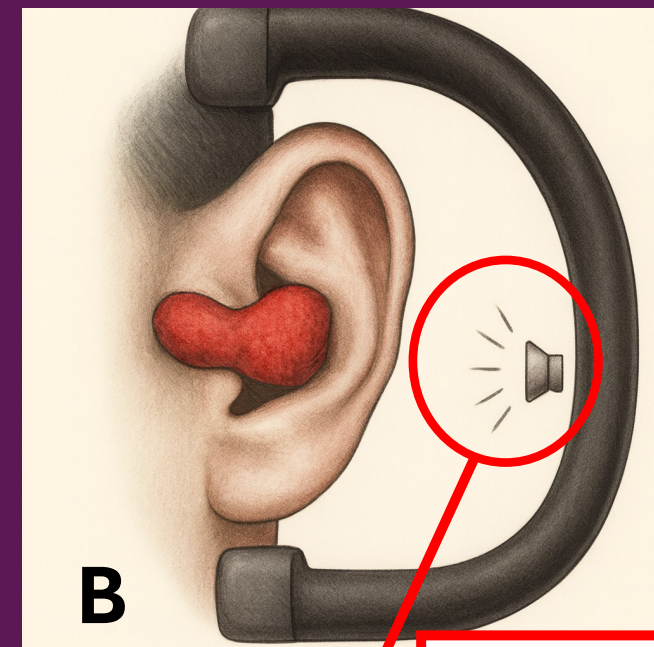
Step by step...

- The person wears headphones
- Sound is presented
- Person adjusts sound in one ear to equal sound in the other
- Repeat in one ear then the other
- The difference in volume to achieve the balance with and without HP is the reduction

$$B - A = \text{PAR}$$



Plays a
constant
sound



Plays a louder
sound which
can be
adjusted down

HP Fit Test Methods

Subjective Loudness Balance Test

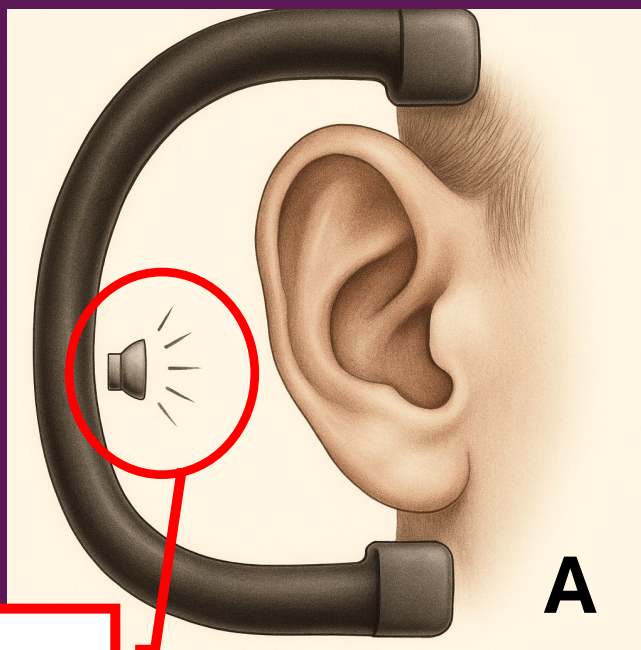
For example:

A (un-adjustable) = Plays at **40 dB(A)**

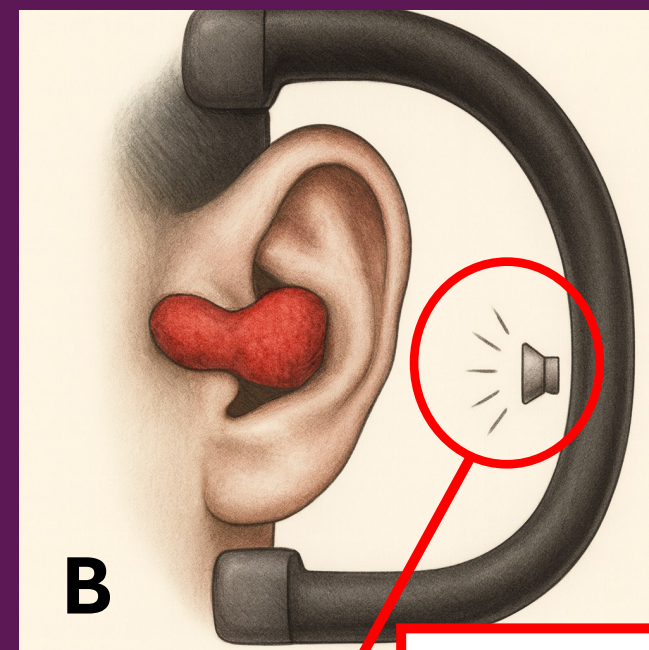
B (adjustable) = Starts playing at 80 dB(A) but the person adjusts down to **65 dB(A)** as this sound level is perceived as the same as in the other ear ("A").

PAR = 25 dB(A)

$$B - A = \text{PAR}$$



Plays a
constant
sound

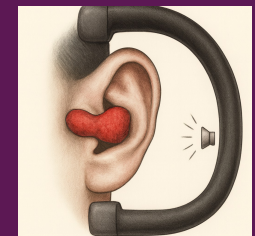


Plays a louder
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HP Fit Test Methods

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- The person **balances the loudness** of sound sources provided between the ears with one or two earplugs and without any earplug in a subjective measurement.
- The data is used to calculate the **PAR**.
- It is slower than **FMIRE**.
- It needs an **accurate response** from the listener.
- Any significant asymmetry in **hearing loss** and/or any hearing loss greater than 40-50dB makes the loudness balance test **impossible**.
- It can be used on **all types of earplugs**. But it isn't suitable for muffs.
- It needs a **quiet room** to perform.



HP Fit Test Methods

Subjective Loudness Balance Test



Honeywell VeriPRO Fit Testing System

HP Fit Test Methods

Web-based PAR Systems

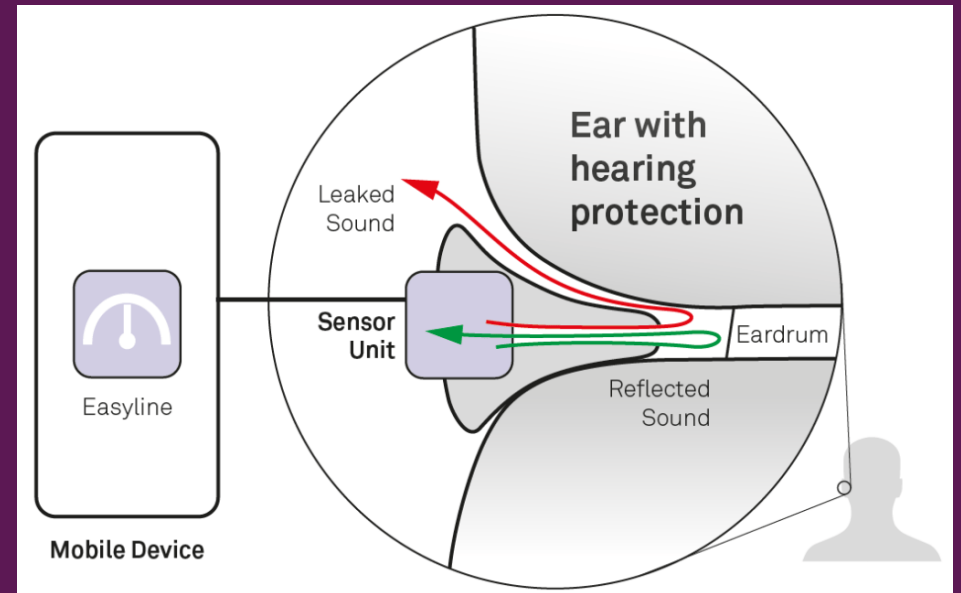
- Measure the **difference in sound level** between sound outside and inside the hearing protection, using headphones that deliver sound to the user's ear with and without protection.
- It is **subjective**, relying on the individual to respond to the quietest sound they can hear.
- The data is used to calculate the **PAR**.
- It is slower than **FMIRE**.
- Does not require **specialist equipment**.
- It does not need a **trained operator**.
- It can test **all types of earplugs**.



HP Fit Test Methods

Acoustic Seal Tests by 'Apps'

- Look at the **acoustic seal** of the HP by means of an “**app**” (mobile device application).
- **No response is required** from the person.
- The data can issue a **pass/fail result** or a **PAR**.
- The test is **quick**.
- It requires **specialist equipment**, some of which can store records.



HP Fit Test Methods

Acoustic Seal Tests by 'Apps'



Dynamic Ear

ACS Custom
(Advanced Communication Solutions Ltd)

Phonak

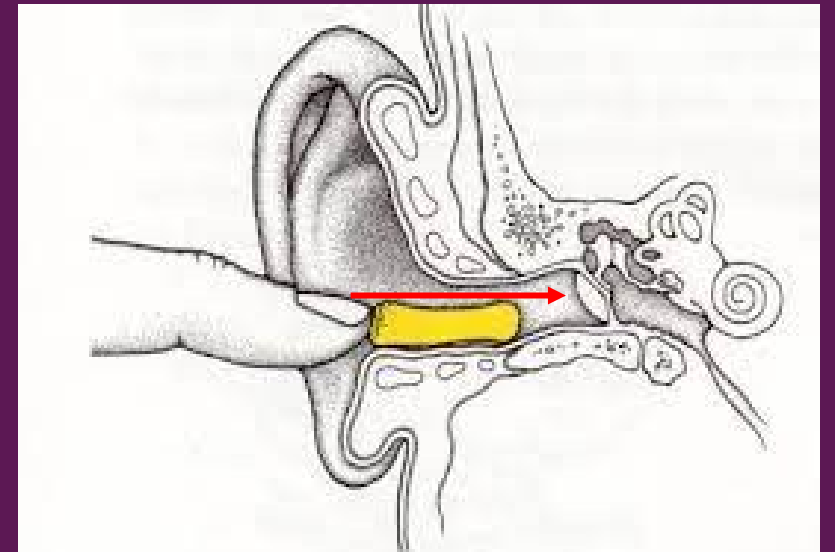


HP Fit Test Methods

Acoustic Seal Tests by Pressure

- Checks the **integrity of the acoustic seal** of the HP based on **air pressure decay over time**.
- Commonly used for checking **custom-moulded** earplugs.
- **No response is required** from the person.
- The data can issue a **pass/fail result**.
- It requires **specialist equipment**, it **cannot store records**.
- The test is **quick**.
- **No correlation** between pressure decay and HP attenuation characteristics.

If air can get through then noise can get through!



Stable pressure = good seal
Rapid pressure drop = leak

HP Fit Test Methods

In a nutshell....

- **FMIRE**
 - Uses a microphone to measure sound in the ear canal with and without HP.
- **REAT**
 - Uses the person to judge the loudness of sounds (with and without wearing HP) to determine attenuation.
- **Loudness balance**
 - Compares the loudness of sounds with and without HP.



HP Fit Testing – The Benefits

Not convinced yet? Here are some of the benefits:

- Helps to show if the HP can provide **adequate** and **suitable** protection from noise. Fit testing verifies the **actual** noise reduction provided.



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- Shows if **alternative HP** is needed.



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- It can help identify issues of **over-protection**.



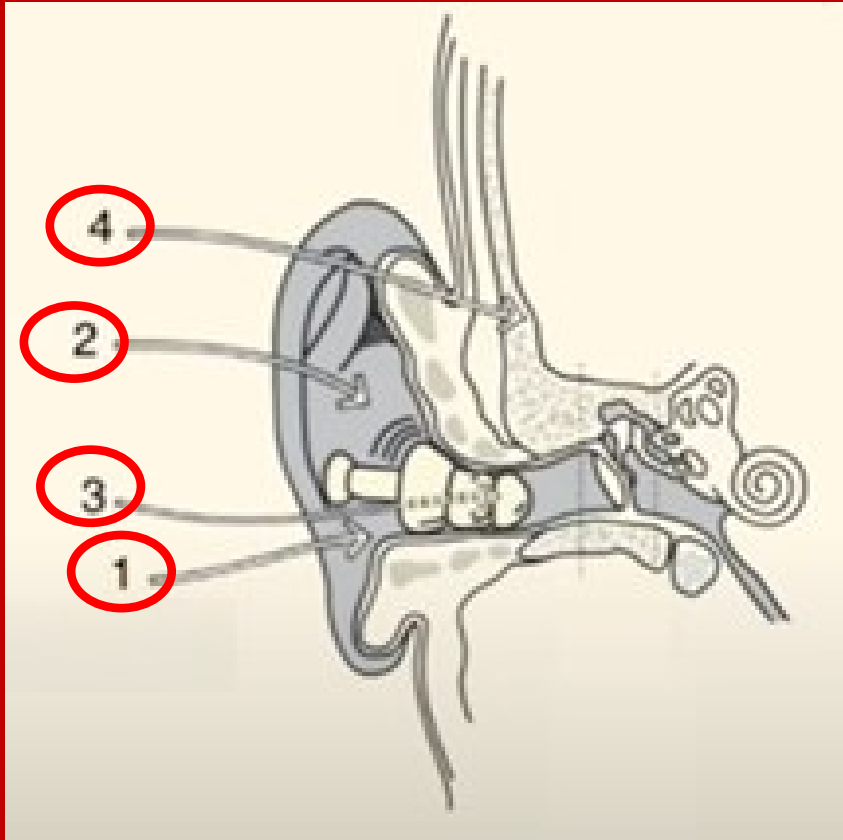
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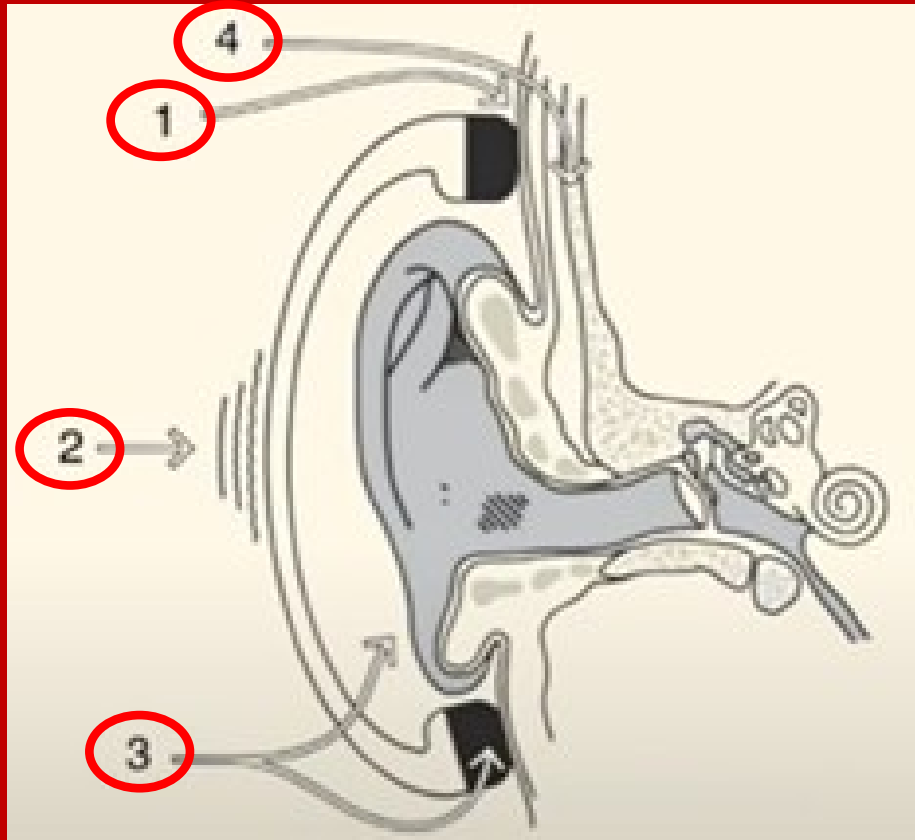
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- Can help **reinforce the message** during audiometric surveillance.
- Shows if **alternative HP** is needed.
- It can help identify issues of **over-protection**.
- **Documentation** of good training and selection.



The 4 Ways Noise Can Get in Your Ear



Plugs



Muffs

1. Air leaks
2. The HP resonates
3. Structural transmission
4. Through the bone and tissue

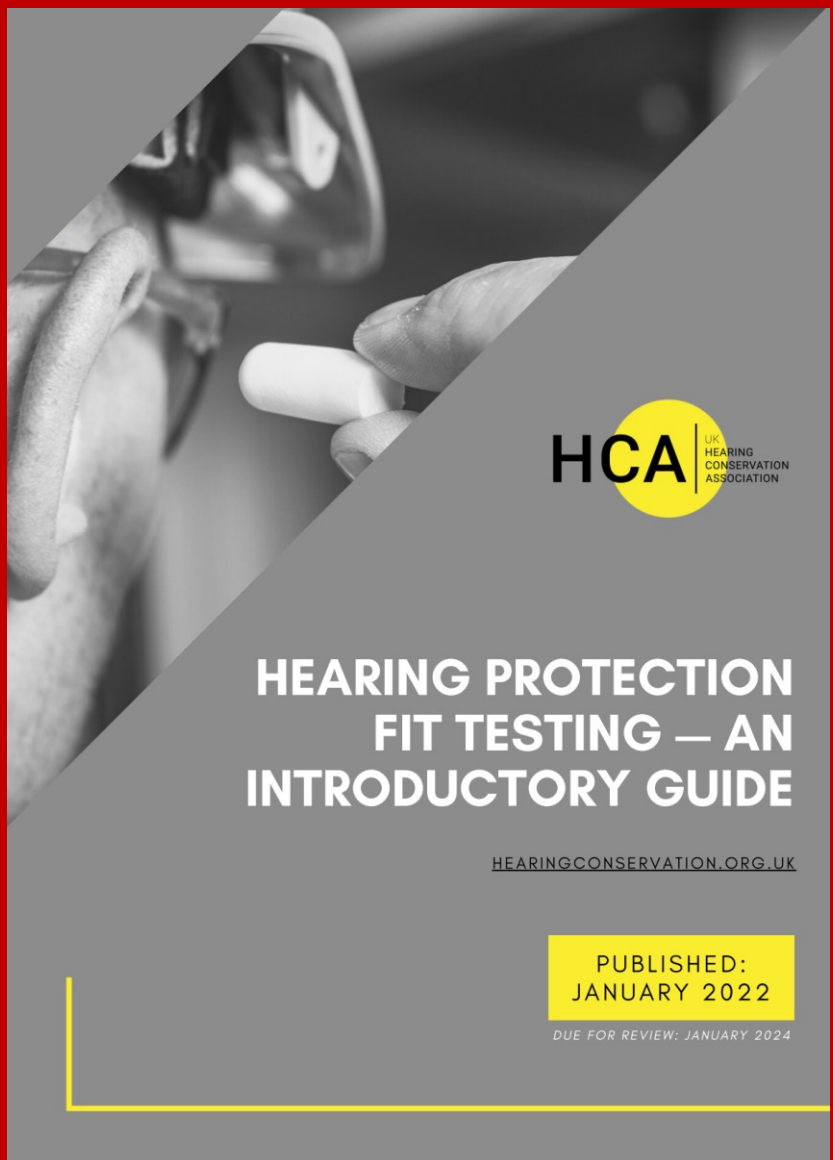
Conclusion



Just issuing out HP and expecting it to work isn't good enough. It needs follow through!



The employer must ensure that the HP provided is **achieving the planned protection**. HP fit testing is a great way to strengthen your **hearing health conservation programme!**



UK Hearing Conservation Association

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Company

**Choose News
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- ☐ UKHCA Mailing List
- ☐ Please tick to give us permission to process your personal data by adding you onto our mailing list

Sign Up

www.hearingconservation.org.uk

UK Hearing Conservation Association

A new era in hearing conservation

LISTEN UP CONFERENCE 2025



6th November 2025 at the Holiday Inn Manchester City Centre



THANKS FOR YOUR ATTENTION