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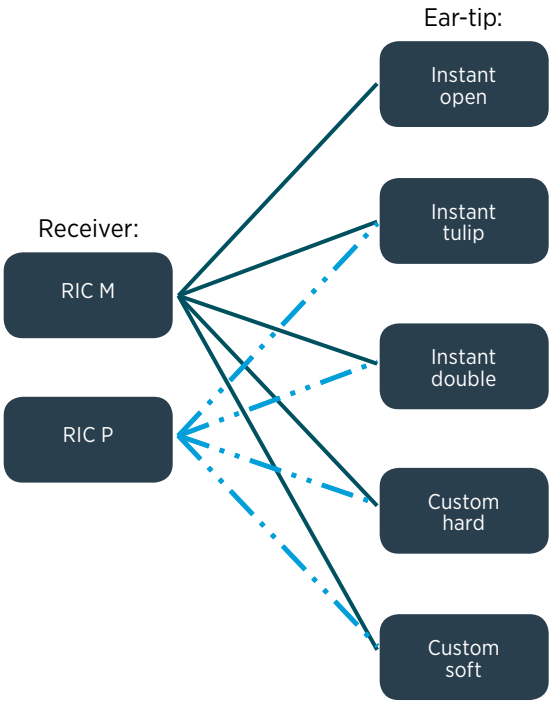
Acoustic performance of ear-tip solutions for M- and P-receivers – influences and the importance of the Feedback test in Compass

INTRODUCTION

This bulletin concerns the acoustic performance of the different ear-tip solutions available for RIC M- and P-receivers. In the first section, the acoustic performance of the ear-tip solutions is discussed by tabulating advantages and drawbacks. In the latter section, an example concerning a fitting procedure is given. In the example, the fitting professional changes the choice of ear-tip. As a consequence of this, the fitting professional must re-do the steps in the Compass Fitting section to allow the best basis for the estimation of the in-situ vent effect, and thereby for the best possible sound quality. The example refers to Compass V5.3.

The acoustic performance of different ear-tip and earmould solutions varies due to their physical structure – the design – as well as the actual fit of the specific ear-tip or earmould in the ear canal. In order to handle the differences caused by the design, Compass divides the different solutions into two acoustic identity categories: "Wire open" and "Wire flex". Based on the acoustic identity and the ear-tip or earmould chosen, the feedback test allows for an assessment of the in-situ vent effect and thereby the in-situ performance of the chosen solution.

Ear-tips and receivers can be combined in the following ways:



CONSIDERATIONS WHEN CHOOSING AN EAR-TIP SOLUTION

What determines the possible gain of a hearing aid in the ear? The most important factors are the receiver capacity and the degree of feedback of the hearing aid. The larger the capacity of the receiver, the more output it can provide. However, a limiting factor is the feedback risk. The vent in an earmould or ear-tip will allow some sound to travel back to the microphone. Even small leakages may have great consequences for the risk of feedback. Because of this, open fittings allow for less gain than closed fittings before feedback occurs. Compass offers a feedback test as an in-situ measure of the performance of the chosen solution. This is an important tool which provides information for the feedback cancelling system, and also gives the fitting professional an overview of the acoustic performance of the ear-tip or earmould in a specific ear.

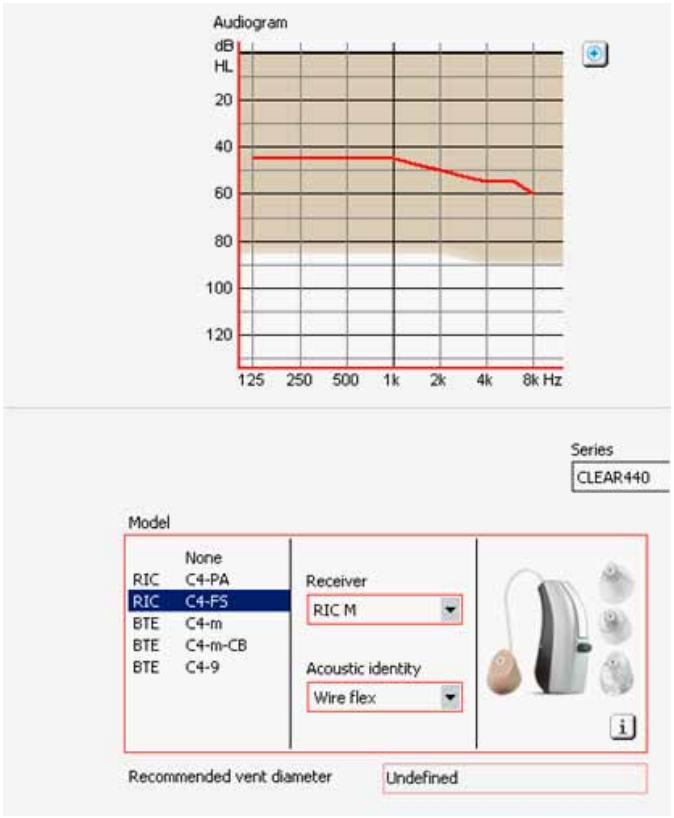
Let's take a look at the 5 different types of ear-tip: Instant open (the acoustic identity is named "Wire open"), Instant tulip, Instant double, Custom soft, and Custom hard (the acoustic identity for these is named "Wire flex"). There are different advantages and drawbacks to each type: they are suitable for different hearing loss types and all perform differently in relation to ease of insertion, physical fit to ear canal and comfort, as described in the scheme below.

	Acoustic identity	Insertion repeatability	Fit in ear	Comfort
Instant receiver open ear-tip 	Open. For hearing losses that do not require amplification in low frequencies.	Easy to insert. Good repeatability. The acoustic performance does not depend on how it is inserted, because it is an open fitting.	Good. The fact that there are two sizes makes it possible to find a good solution.	Very comfortable. Anchor normally needed.
Instant receiver tulip ear-tip 	Flex. For hearing losses that require amplification over the entire frequency range.	The placement of the ear-tip may vary from insertion to insertion.	In some ears, the fitting may not be sufficiently tight to ensure the adequate acoustic performance. The fact that only one size exists may mean that not all users will benefit from a tulip ear-tip.	Very comfortable. For an optimal fit, it is recommended to use an anchor.
Instant receiver double ear-tip 	Flex. For hearing losses that require amplification over the entire frequency range.	Easy to insert. Good repeatability.	Possibility of blocking the vent to make it acoustically closed. Due to the choice between three sizes it is possible to find a good physical fit for many different ear canals	Comfortable. Stays in the ear.
Custom receiver soft ear-tip 	Flex. For hearing losses that require amplification over the entire frequency range.	Easy to insert.	The custom solution ensures a good fit.	Comfortable. Stays in the ear.
Custom receiver hard ear-tip 	Flex. For hearing losses that require amplification over the entire frequency range.	Easy to insert.	The custom solution ensures a good fit.	Comfortable. Stays in the ear.

A FITTING EXAMPLE FROM REAL LIFE

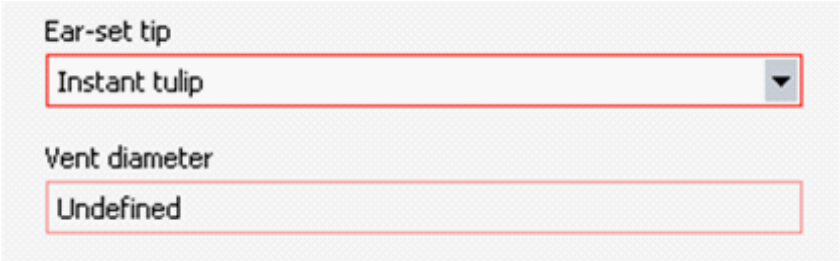
How is this knowledge used in real fittings? The following example concerns a person with a flat, moderate hearing loss and is supported by relevant screen views from Compass.

Example:
An audiogram of a user is measured as shown in the figure below.



Figur 1. For the hearing loss shown in the audiogram, a FUSION hearing aid with an M-receiver and a Wire flex acoustic identity is chosen.

The user has a moderate hearing loss with a flat configuration. As the hearing loss is moderate, a RIC M-receiver is chosen. Since this user needs some gain in the low frequencies, the open solution is not a possibility, so the Wire flex solution is chosen as Acoustic identity. As a result of this choice, the audiogram is now in the middle of the fitting range, as can be seen in figure 1. The client feels that the tulip ear-tip fits well and would like that, so the ear-set tip is set to Instant tulip in the Preconditions step under the Acoustic conditions:



The Sensogram and the feedback tests are performed and the results of the tests are shown below.

The Sensogram is as follows:

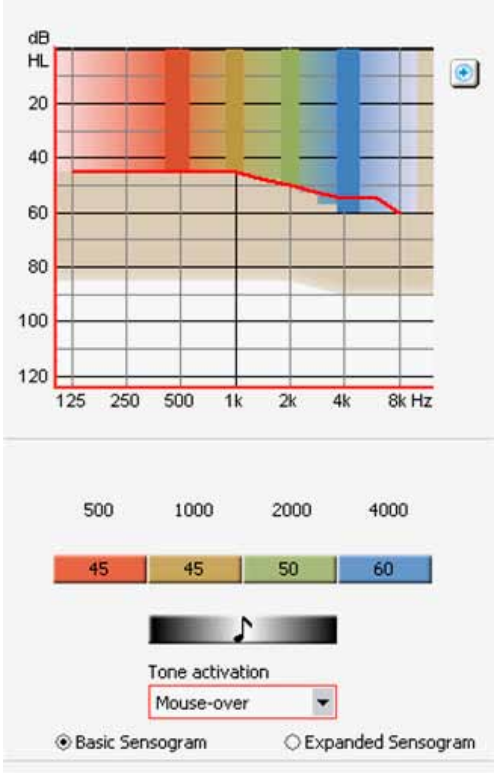


Figure 2. The Sensogram, using the Instant tulip ear-tip (vent: Undefined).

As can be seen, the Sensogram follows the audiogram quite well, apart from a small deviation in the high frequencies. The feedback test is as follows:

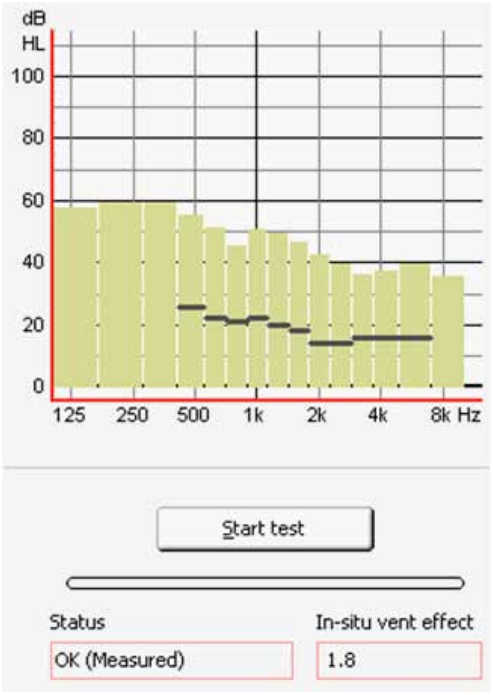


Figure 3. The feedback test, using the Instant tulip ear-tip (vent: Undefined).

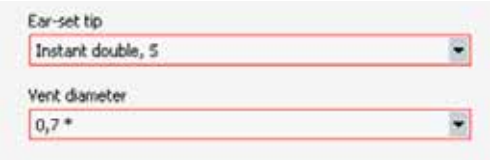
The graphic indicates that the feedback test is OK, and if the fitting is finalised with this feedback test result, the user would receive adequate amplification for normal speech inputs.

When those black bars are not on top of the green bars, the feedback test would state that the status is not OK.

INFORMATION:

The horizontal black bars in the feedback test graphic illustrate the minimal accepted gain for normal speech. A feedback test will only be displayed as OK if the available gain in the actual fitting (illustrated by the green bars) is sufficient. The feedback test is therefore also a measure of the in-situ acoustic performance of the chosen ear-tip or earmould solution.

The client would like to try the Instant double ear-tip and he finds those ear-tips are more comfortable. Therefore, the fitting procedure must be re-done. The Instant double ear-tip is chosen instead, and this new selection must be indicated in the Preconditions step:



A new Sensogram must also be performed when the ear-tip is changed. The Sensogram with this new ear-tip is as follows:

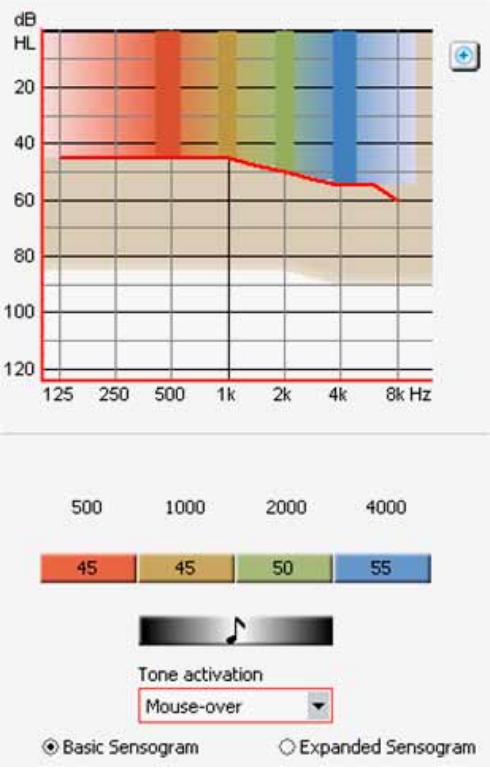
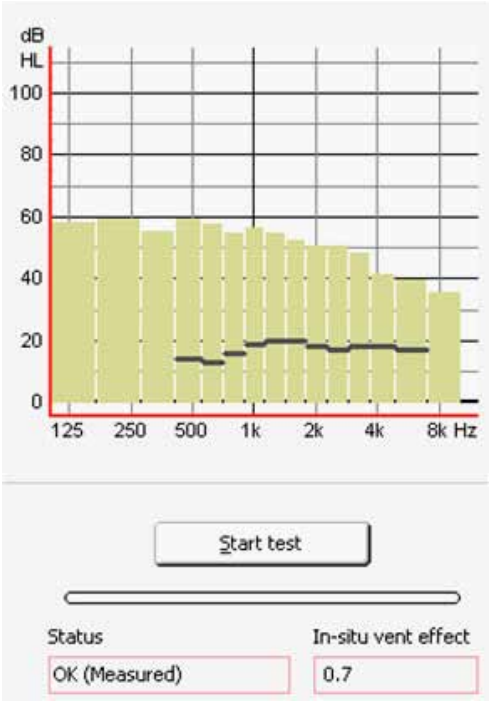


Figure 4. Sensogram, using the Instant double (vent: 0.7).

A new feedback test is also needed in order to obtain the most correct data concerning the in-situ acoustics of the actual fitting.



Figur 5. Feedback test using the Instant double (vent: 0.7).

This feedback test is slightly different from that of the Instant tulip ear-tip, and this is because the in-situ vent effect differs in the two solutions.

Those last steps are crucial: Always use the correct settings in Compass and always measure the Sensogram and the feedback test again when the physical setup has been changed! Because the acoustic performance changes when the ear-tip is changed, Compass has to know that this has happened in order to obtain the best basis for the estimation of the in-situ vent effect. The information given by the Sensogram and the feedback test is used to adjust the gain in the hearing aid and is also used by the feedback cancelling system, which prevents feedback occurring.

CONCLUSIONS

The acoustic performance varies from ear-tip solution to ear-tip solution, as can be seen when performing the feedback test in Compass. This performance depends on the in-situ vent effect, which is a measure of the intended vent effect of the ear-tip or earmould and the unintended vent effect occurring because of the actual physical fit in the ear canal. The feedback test is an important tool in securing the acoustic performance of a hearing aid fitting. It is highly recommended to perform the feedback test in Compass and, in case of a poor result, the ear-tip should be changed and a new Sensogram and feedback test should be measured.