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January 26, 2007

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
Office of the Secretary
445 12th Street, SW
Washington, DC 20554

Re: WT Docket No. 01-309
Amendment to HAC Status Report #6

Dear Ms. Dortch:

During its December 2006 meeting, the Alliance for Telecommunications Industry Solutions' ("ATIS") Incubator Solutions Program #4 - Hearing Aid Compatibility (AISP.4-HAC) received feedback from hearing aid consumer representatives regarding specific technical information included in the industry's Hearing Aid Compatibility Compliance Efforts Status Report #6 (Status Report), filed on November 17, 2006, in the above-referenced docket.

Based on this feedback and subsequent discussions, AISP.4-HAC has revised Section III.C and Appendix D of the Status Report to address the input received from consumer representatives. AISP.4-HAC believes that attached amendment provides accurate information regarding the testing undertaken by AISP.4-HAC Working Group #8 and clarifies potential misunderstandings related to the conclusions that may be drawn from this data.

If there are any questions regarding this matter, please do not hesitate to contact the undersigned.

Sincerely,

_____

Thomas Goode
General Counsel

Attachment

C. Articulation Weighting Factor and Modulation Effects (WG-8)

Experimental *in vivo* tests were performed to better understand the cause of inconsistencies observed in previous experiments of cell phone users wearing hearing aids. The intent was to obtain data on the performance of telecoil hearing aids relative to their user's experience in a live telephone call using WDs with a T3 or higher rating.

Three different *in vivo* experiments were conducted by a team from WG-8 with subjects attending the 2006 HLAA annual convention. Each experiment had a test plan ("TP") with a specific objective:

- TP3 – Measure telecoil user hearing aid acoustic and telecoil sensitivity using a Fonix 7000. Sixty two hearing aids were measured.
- TP4 – Measure telecoil user hearing aid near-field susceptibility (immunity) to 1000 Hz 80% AM modulation using a unique RF test table. Forty seven hearing aids were measured.
- TP5 – Assess telecoil hearing aid user experience with working handsets available from service providers and manufacturers (all phones were rated M3, T3 or better). 378 tests were conducted -- 86 with cochlear implant users and 292 with hearing aid users.

These experiments, and the results obtained, are described in more detail in **Attachment D**. Key observations that have been noted include:

(1) Observation of the collected test data indicated that HA immunity and WD emissions – the measurements required by the C63.19 Standard -- are not the only predictors of usability.
(2) As in past years over 90% of the participants were able to find WDs that worked for them.
(3) Unfortunately, some of the test subjects were consumers in TP 4 with highly immune t-coil hearing aids that were not able to find a usable T3 or T4 rated wireless device.

The experiments also demonstrate that hearing aid compatibility is a very complex problem. There are several elements that have an impact on compatibility, including the subject's hearing profile, the RF immunity of the HA, the HA audiologist adjustment, and the RF emissions from the WD. In addition, if the consumer uses the T-coil mode, the elements that effect usability include the HA's magnetic coupling strength, the audiologist T-coil sensitivity settings, the T-coil position within the HA, and the WD's magnetic signal strength.

A hearing aid wearer may use a hearing aid/cell phone combination that, based on the ANSI C63.19 system rating standard, should provide excellent performance, and even though the hearing aid wearer detects little to no interference, the performance of the two devices may be poor for other reasons, such as the audibility, perceived quality, or intelligibility of the speech that is heard.

AISP.4-HAC's test data and observations indicate that the majority of hearing aids made after 2004 are more RF immune than previous HAs on the market, but highly immune HAs were measured dating as far back as 1984. Those consumers who use these hearing aids have a greater degree of choice and compatibility with a wide range of wireless devices regardless of their rating. This data raises certain questions that will need to be addressed and that could be the subject of further AISP.4-HAC work including:

(1) Is the 50% regulatory requirement for HAC RF emissions necessary when over 90% of the testing participants in TP 5 testing at the 2006 HLAA conference, report that they currently have a usable WD? Some of these users are unable to use a WD in their preferred method (M or T).
(2) How can the consumer's message or test procedures on HAC be improved to not create false expectations when there are so many factors that impact HA compatibility?
(3) Does the HAC system rating system defined in C63.19 Table 7-6 for hearing aids "as made" make sense for "as used" conditions when consumers do not know the rating of their HA and so many other factors such as their audiologist's adjustments that contribute towards a consumer's usability?

Attachment D – WG-8 Experimental in vivo Tests

Test Plan 3

In a limited 2005 "as is" cellphone user experiment conducted at the SHHH 2005 convention, it was found that hearing aid (HA) users reported cellphones were more usable when microphone coupled than when telecoil coupled. It was suspected that a cause of this previously-observed inconsistency with expectations was due to the hearing aids not having balanced T-coil and microphone sensitivity. To determine if imbalance was occurring, a commercially available Fonix 7000 HA test system was used at the HLAA 2006 convention to measure "as is" the acoustic and telecoil sensitivity of the HAs removed from the user's ear. The microphone and telecoil were measured at the same volume control settings.

The Fonix test system is a recognized HA industry tool that performs several automated tests. This test plan collected data with the Fonix 7000 system utilizing the test methods specified in the ANSI S3.22-1996 American National Standard Specification of Hearing Aid Characteristics (S.3.22) standard for HA manufacturing quality control. Since hearing aids are routinely adjusted by audiologists in the field, the user HA performance measured in the field cannot be expected to meet the manufacturing performance limits of the S3.22 standard. However, S3.22 testing methodology and the Fonix 7000 system's acoustically shielded enclosure serve to provide a consistent HA industry accepted method of measurement in a manner effective for a crowded noisy environment such as the HLAA 2006 convention floor.

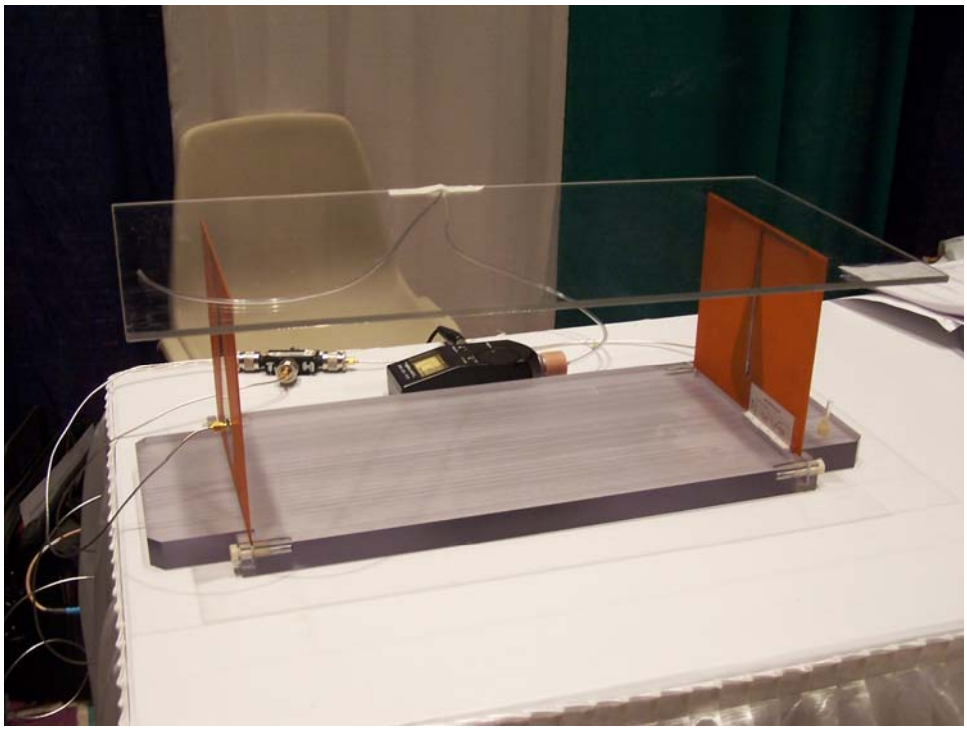
It was found that the difference between telecoil and microphone sensitivity in a HA varied substantially from one HA to another which tends to support the 2005 experimental observation and confirms that adjustments are routinely tailored for users. Further, it was found that many of the hearing aids tested showed a wide variation in the sensitivities between the microphone mode versus the telecoil mode. An implication of this "as is" result is that there clearly is a methodology difference between microphone coupling and telecoil coupling tailoring at a fixed volume control setting.

Test Plan 4

A unique, specially designed test table utilizing 2 planar dipoles for the legs and a clear plastic top was built to measure the near-field RF interference immunity of the same hearing aids measured in TP 3. The dipoles were sequentially excited with a 1000Hz, 80% AM signal at both 816.5 and 1880 MHz at a level close to the maximum acceptable level permitted for a HAC compliant cellphone. The SPL output from the HA was measured when the user's HA was positioned over a C63.19-type dipole antenna to produce the loudest output level with the HA volume control unadjusted for telecoil coupling. This enabled this test table to measure a hearing aid for near-field RF Interference on the convention floor much more practically and possible than using a GTEM.

This test plan also utilized a HA measurement methodology based on that specified in the ANSI C63.19 standard for assessing HA M-category rating. In summary, this "as used" testing methodology measures the induced audio interference power delivered by a HA to a HA/cellphone user when used in an environment with a RF field at a maximum

permissible threshold level established by the FCC for a cellphone to be certified as HAC.



Unfortunately, it is impossible to determine the HA M-category rating per C63.19 solely by measuring the output SPL “as used” measurements in the field because the determination of the input-referred interference level requires an input acoustic reference and a variable RF field strength. Another contributing factor, not addressed in the ANSI C 63.19 Standard, is that there is no input magnetic field reference level specified, so that the telecoil mode IRIL measurement depends on the matching of the telecoil mode and microphone mode sensitivities. As noted in the TP 3 discussion, one factor is the perturbation in gain settings by audiologist tailoring and user volume control setting relative to the particular C63.19 sensitivity specified gain setting. Thus, the C63.19 standard categorical assessment is limited to an “as made” environment not an “as used” environment with the consequence that a user’s usability experience in the field is expected to differ from the somewhat idealized expectations projected in the C63.19 standard. In fact, TP3 data showed there is a substantial variation in HA performance between these two environments whereas that variation does not occur with cellphones so this disparity will exist as long as there are HA units that deviate from the “as made” conditions. However, it appears that in several cases the telecoil settings in the “as used” measurements did not differ from the “as made” standard conditions. Evaluation of these devices is therefore also of special interest.

Since C63.19 M-category ratings cannot be ascertained alternative S-category value ranges were defined to make “as used” usability projections. Any difference between these categories can theoretically be reduced utilizing extensive HA gain measurements to determine the difference between the “as used” output-referred interference values and the C63.19 55 dB SPL reference IRIL. Among the many things to consider is that the S3.22 HA “as made” standard differs from the C63.19 standard as it is measured using a

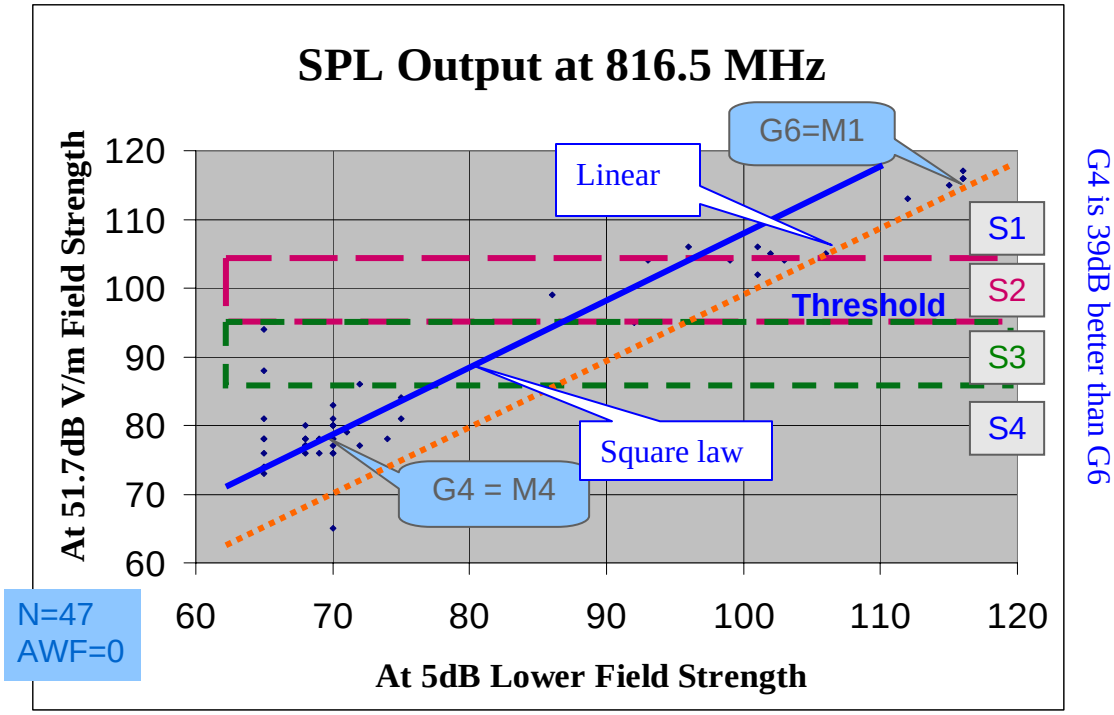
3-frequency audio average, while C63.19 uses only a single 1300 Hz frequency (which is not included in the 3 frequencies specified by S3.22). As a result, further data adjustment is still needed. Another factor in relating the S-category rating to the M-category rating is that specific HA gain compression also needs to be known.

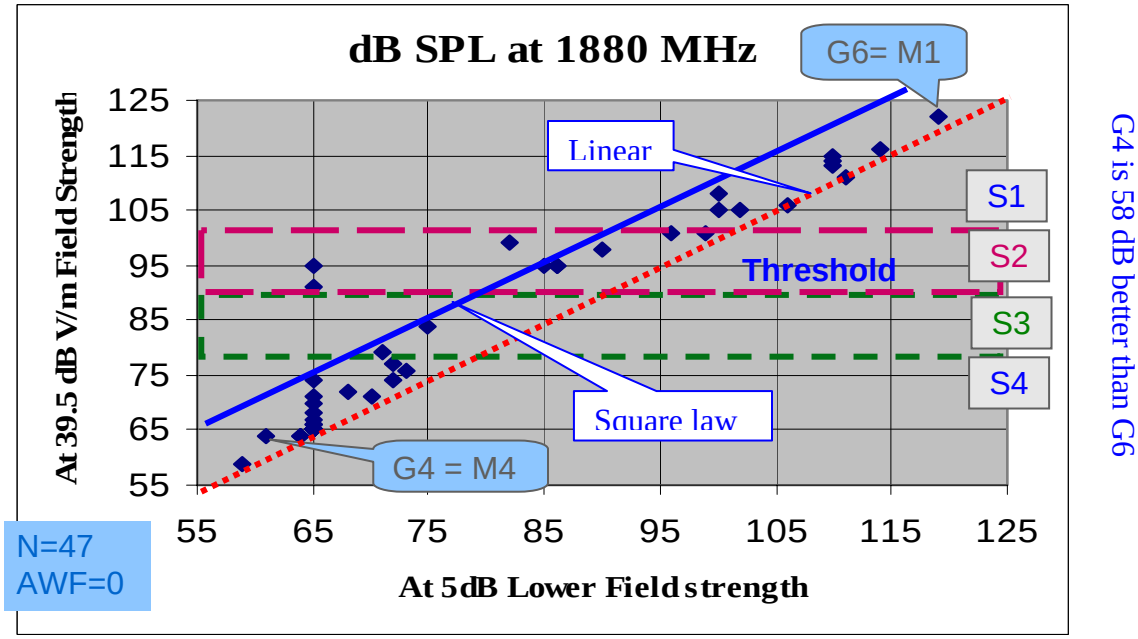
This measured interference audio power that is being delivered to the user by a HA "as used" was subsequently utilized to establish an S-category value attempting to relate to the system usability rating value (per C63.19) expectation of telecoil coupled users of a T3 rated cellphone.

The field strength at the test table surface was subsequently measured on a Speag DASY 4.5 system just as done for a cellphone. To "calibrate" the test data two M-category, "extreme" reference HA units from Gallaudet University were also measured and the results mixed in the following figures with "as used" HA data. One reference unit had been measured in a GTEM by HA manufacturer Starkey[1] with an M4 rating while operating in telecoil mode, and the other with an M1 rating. It is noted that the output SPL of a test subject's HA of the same model as reference unit G6 measured within 1 dB of the reference unit output SPL. These units are respectively noted as G4 and G6 in the following data distribution graphs. The SPL output difference between these two reference units measured substantially greater at 1880 MHz than at 816.5 MHz.

These graphs were constructed to include an additional square law "validation" -- a fundamental assumption in the C63.19 standard. The method was to measure the "as used" SPL output at two RF levels 5 dB apart with the expectation that per the square law the SPL would be 10 dB different between the two RF level conditions. It can be seen that except for low output "good" units at 816.5 MHz, the slope at the output of the HA is less than square law and perhaps closer to first order. It is possible that the slope could be closer to square law if referred to the HA input.

[1] GSM tests of BTE and ITE hearing aids sent from Gallaudet University; Steve Hanke, Weili Lin; 27 Feb. 2006



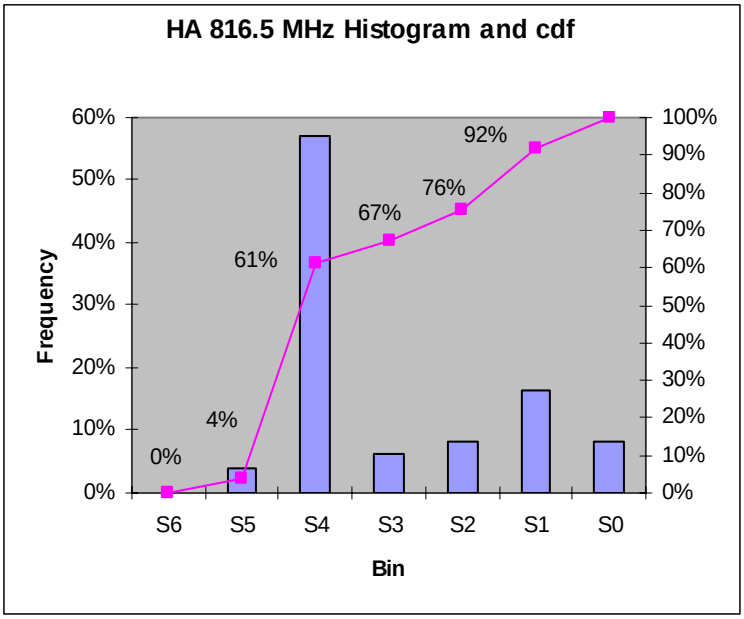


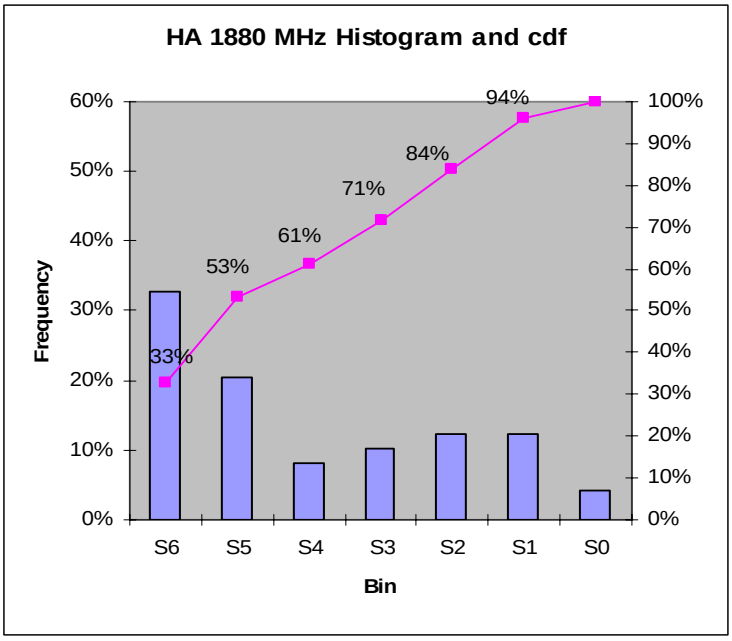
Based on the C63.19 square law assumption, two 10 dB wide SPL bands (marked S2 and S3) are incorporated in the preceding graphs that may correspond roughly to the two 5 dB wide RF level bands, based on the two HAs that were measured per C63.19, that establish rough endpoints to be positioned on the graphs for an estimate of the location of the FCC RF acceptance threshold defined as the boundary between M2 and M3.

For S-category calibration, these SPL bands are assumed to be positioned midway vertically between the two M-rated HA units as an "eyeball" estimate of the threshold audio SPL level corresponding to the FCC RF level thresholds. The unadjusted S-category output SPL threshold levels appear to be about 96 and 92 dB SPL respectively at 816.5 and 1880 MHz. An adjustment is appropriate to consider the difference in actual RF field strength and the FCC threshold. Based on the square law adjustment histograms were made. The histograms represent the "as used" interference output SPL distribution of the hearing aids measured in 10 dB bands using the S-categories, and the results are provided in the following graphs. Due to the wide variation in "as used" HA performance, the number of S-category bands exceeds the number of M-category bands.

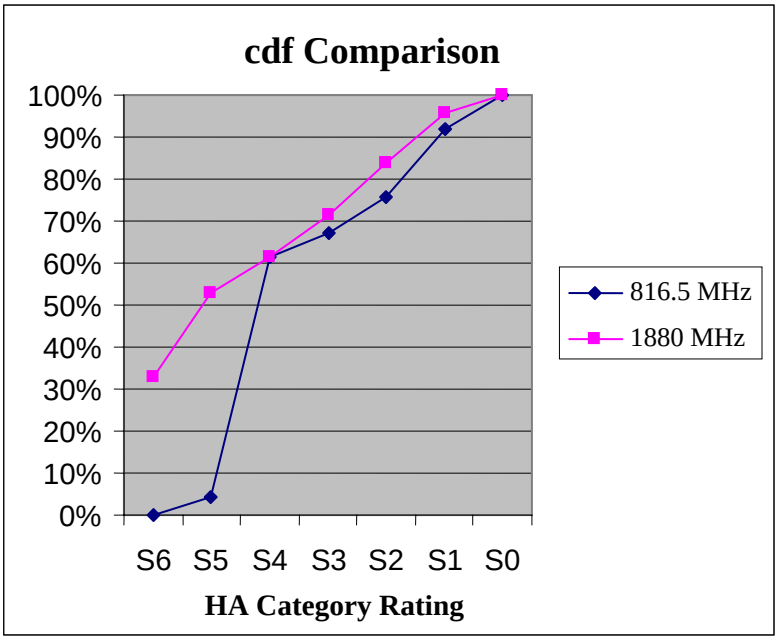
Associated cumulative distribution function (cdf) plots are provided also based on these S-category bands. Were the S-ratings and M-ratings equal, the data leads to the expectation that, due to the wide variation of hearing aid susceptibility to RF interference, only about 76% to 84% of users in the field would experience normal use or excellent performance with a T3 handset per the C63.19 HA/cellphone system performance categorization (depending upon the RF frequency band used for a phone call).

Further analyses on an HA-by-HA basis of HA gain is needed to more accurately align the S-Category and M-category bands. Longer term, a method is needed to quickly measure HA gain compression "as used" in the field, and correlate the C63.19 single frequency performance to the S3.22 multi-frequency gain. An additional analysis would be to relate results using the S3.22 standard to the IEC standard followed by hearing aid manufacturers.

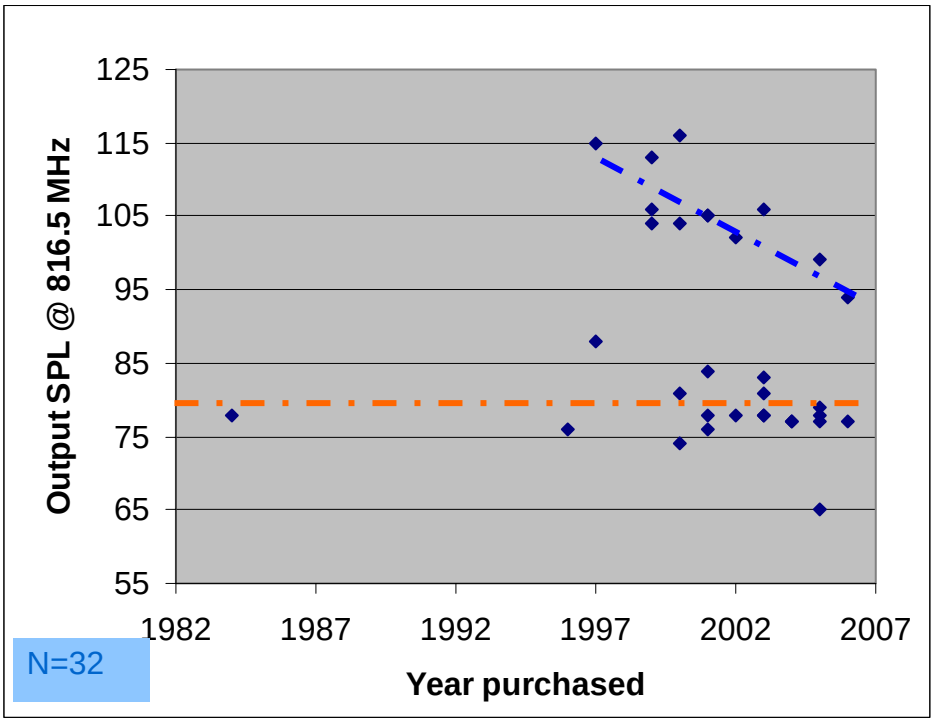


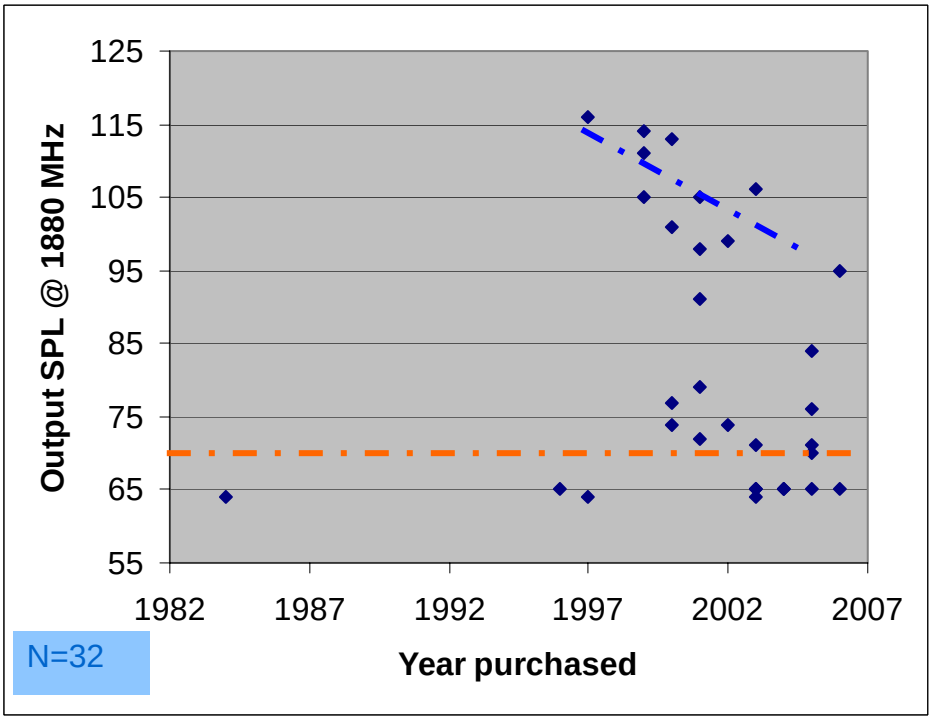


It is important to note that the RF exposure levels used to assess the hearing aids were those based on C63.19-2006, which permits handsets to have 10 dB greater field strength at 816.5 MHz than at 1880 MHz. To assess the effect of that change the user experience cdf curves were plotted for comparison in the same graph that follows. The similarity of those plots in the significant region of usability make it apparent that the 10 dB difference is justifiable as the expected user experience is very similar for the two bands under the conditions of this experiment. In fact, the user experience is somewhat more favorable even with the difference.



The year the user purchased his or her hearing aid was obtained and recorded for most subjects to determine how the output SPL distribution varied over hearing aid designs. It was found that most of the hearing aids in this experiment were purchased in the period from 1996 to 2006, but one was purchased in 1984. The output SPL measurements were then related to the year the HA used purchased the unit, and the results plotted in the following charts:





The data shows two distinct characteristics as portrayed by the dashed lines -- one showing a flat characteristic of high immunity over a period of 22 years and another showing low immunity improving about 42 dB in the last 10 years. The latter characteristic corresponds well with results reported by the European test lab Delta that has been measuring immunity of new HA designs over a period of several years. It is also noted that since 2002 the designs seem to meet a minimum S-category rating of S3.

Test Plan 5 User Experience

Consumers were assigned a unique ID number when getting their HA tested under TP 3. This ID number was then used in TP 4 and TP 5 to correlate the consumer's usability rating choices back to their test results in TP 3 and TP 4. The consumer usability ratings that participants selected for their experiences were all made using the set of usability terms of Excellent, Acceptable, Usable, and Not Usable ratings listed in the C63.19 standard. The C63.19 defines user rating terms as a sum of the HA and cellphone category rating values, which are based on a specific range of signal to interference ratio. The descriptions of these ranges and values were provided to the test subjects. The descriptions were the same as those used by Gallaudet University in concurrent testing at the HLAA convention.

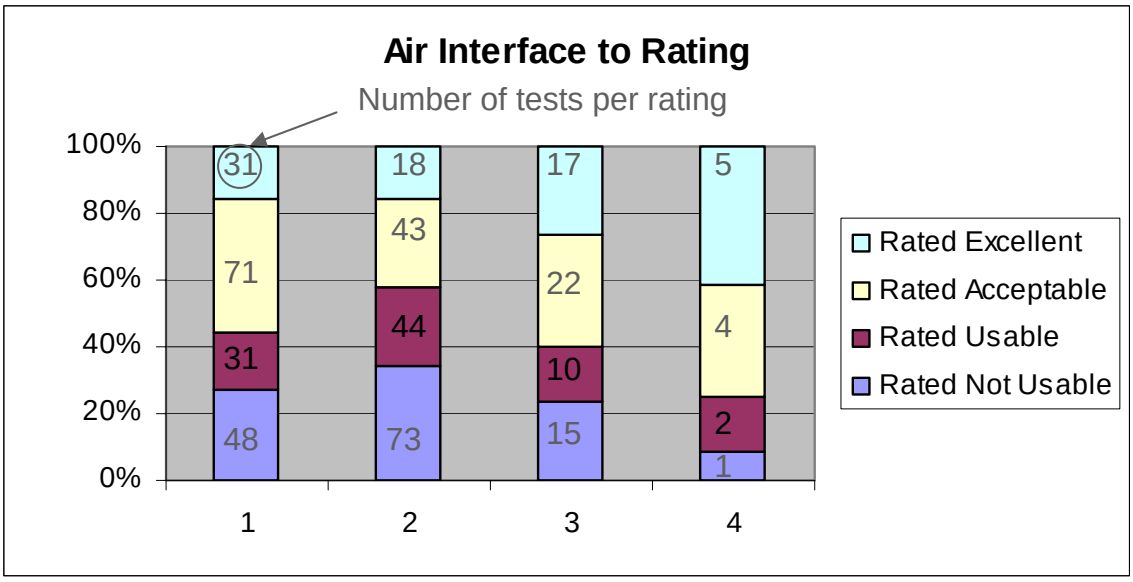
The consumers went to various cellphone manufacturer and service provider booths to try "on network" WDs rated M3 and T3 or better. All were to dial a number playing the "rainbow" phrase used in subjective studies by Gallaudet. Unfortunately, the dial-in number developed a problem and the test was changed to a playback of time and temperature.

The booth workers recorded the consumers' usability rating, unique ID number, and method of call – microphone or t-coil. These ratings were then related to various parameters as described in the following sections

A) Effect of Air Interface on Usability

GSM is penalized 5 dB in C63.19 for articulation weighting factor, as it was believed that air interface is a predictor of usability. It should be noted that all phones used in the testing were rated M3 and above. GSM phones were typically in the lower end of the M3 band while CDMA phones were typically rated M4. A limitation is noted for the UMTS terrestrial air interface that only one model was utilized for these measurements due to the fact that it is an emerging technology. It should also be noted that telecoil measurements were made to C63.19 2006 or earlier and were found to be a minimum of T3.

The data, as shown below, concludes that air interface is not the sole predictor of usability.



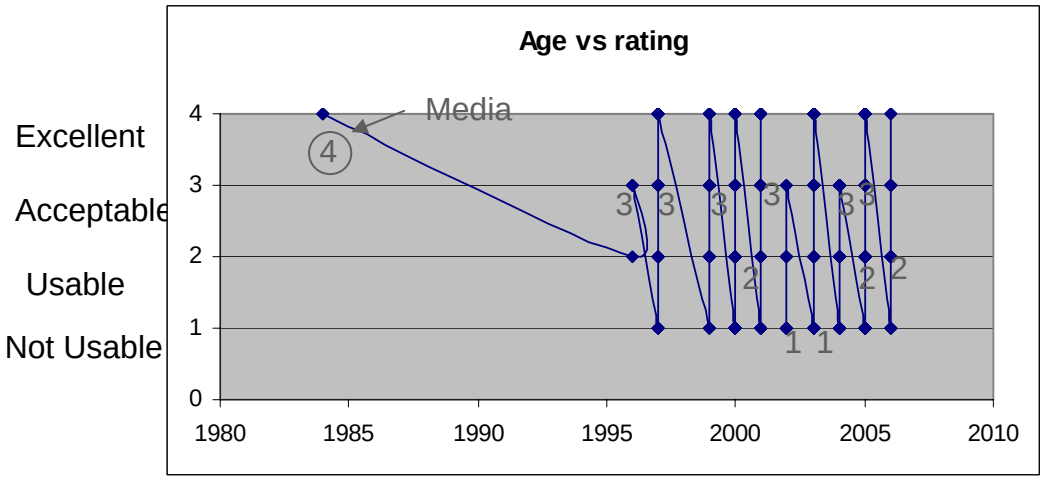
1 = CDMA 2 = GSM 3 = *i*DEN 4 = UMTS

B) Effect of Hearing Aid Age on Usability

It is assumed that newer hearing aids will perform better than older hearing aids. TP 4 confirmed newer HAs are more immune, having the TP 4 "S" rating of M4 or better.

The scattered usability with age shown below concludes that the age of an HA is not a sole predictor of usability as evident by comparison with the bi-modal data evident in the immunity vs. age graph shown in the TP4 report.

HA Age and Rating



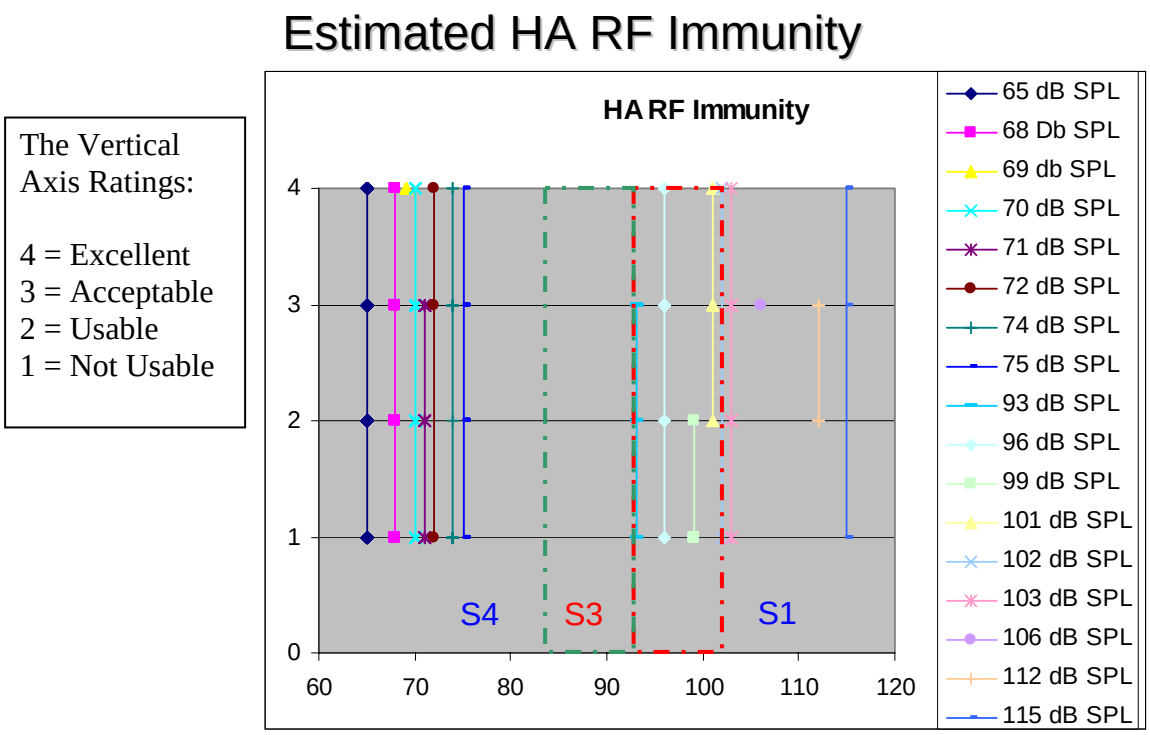
Median/**# of tests**

1984 = 4/**3**	1996 = 3/**3**	1997 = 3/**33**	1999 = 3/**24**
2000 = 2/**43**	2001 = 3/**31**	2002 = 1/**14**	2003 = 3/**47**
2004 = 2/**37**	2005 = 3/**67**		

C) Effect of HA Immunity on Usability

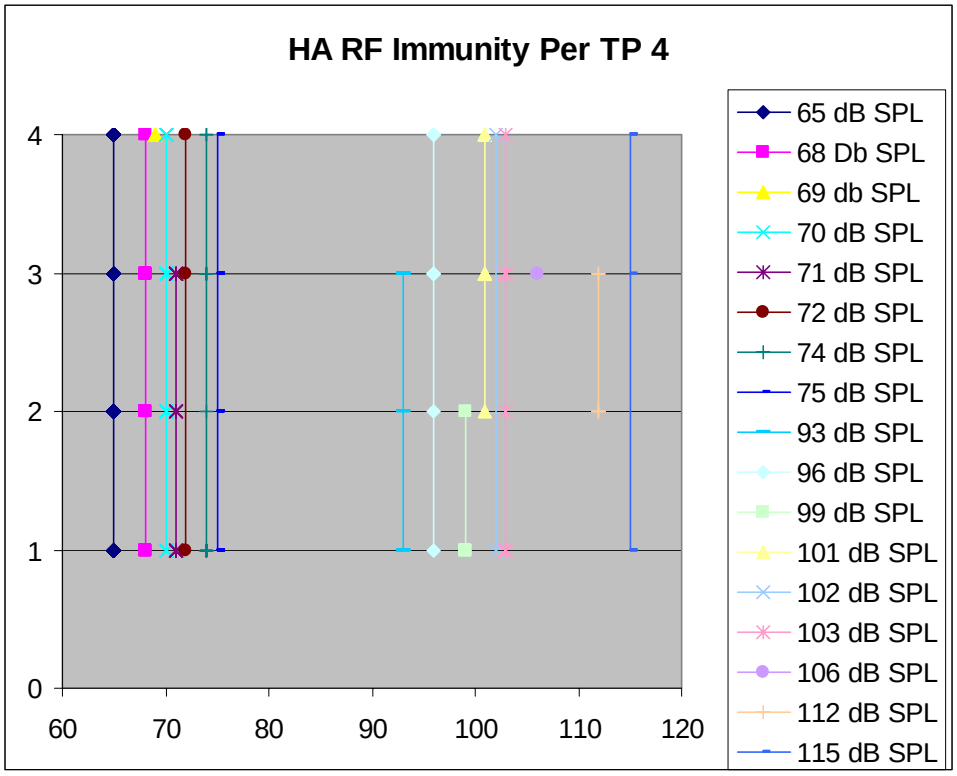
It has been assumed in C63.19 that an immune HA would result in good performance. Lowering the RF emissions from the WD and increasing HA immunity to RF are important but only two of many components that make up usability.

The data below concludes that RF immunity of an HA is not a sole predictor of usability as evident by noting the large number of "Not Usable" judgments for high S-rated hearing aids, and the "Excellent" and "Usable" judgments rendered for low S-rated hearing aids.



The Vertical Axis Ratings:

4 = Excellent
3 = Acceptable
2 = Usable
1 = Not Usable



The Horizontal Axis Values are in dB SPL