A Clinician's Primer on How and Why to Perform the 'ANSI Test'

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We'd like to welcome you to today's course presented by Dr. Joshua Alexander. This course is in part of our annual summit, and we'd like to say thank you for all those partners who are participating in this year's innovation summit at this time. I'll hand the mic over to you, Dr. Alexander.

Great. Thank you so much. Ok, let's go ahead and get started. I'm very pleased at the attendance today, considering all the topics that we could be talking about, to be talking about something that probably most of you have not thought about or heard about since graduate school. So it's kind of an overview of where we'll be going today with this presentation.

We're going to kind of start about the high view and then kind of narrow into the very specifics and conclude today with about a 15 minutes tutorial of actually kind of going through the measurements that I'll be talking about first, kind of go over the what, the who and the why. We've all, hopefully, at this point, have encountered standards throughout our everyday professional practice. I'm not going to read you this long definition, but as we know, we use standards in our everyday practice in terms of our audiometers, specifications for audiometers, our test boosts, and so on and so forth. And this is no exception. Hearing aids are no exception.

And the whole point of standards, as you may know, is to simplify life in terms of trying to have minimum quality control, conformity assessment, where different manufacturers are agreeing to do things the same way, as well as increase the reliability and effectiveness of the goods and services we receive every day. The outset, it's important to note that these standards, for the most part, are voluntary. Compliance with them is not mandated, except for in certain circumstances by law. So compliance with the standards is a voluntary thing. But generally, it's agreed that when industry participates, that it's best for all players involved.

So with regard to standards, it's kind of important to think about where they come from, who decides these things. And the fact of the matter is, these standards are decided by voluntary committee members. This includes professionals like you and me who use the products. I am on member of the standards committee. I'm actually one of the voting representative for ASHA.

So if you're a member of ASHA, I am your representative when it comes time to approve some of these standards. Todd Ricketts is the voting representative for the AAA. So we have professionals who actually use the products. We have expert scientists who, whether it be consultants in terms of engineers, as well as representatives from the hearing aid industry, as well as a strong representation from those who produce the products that we're talking about, the hearing aid verification equipment. We're all to get together.

We generally talk about these things, whether it be for some of our professional meetings or over zoom. We discuss these things as well as engage back and forth through email to try to decide some of the nuances associated with the standard. So it's people that you've probably met at some of your professional conferences. We have three main committees, standing committees. The one that we'll be talking about is the ANSI American National Standards Institute.

And the ones that we're concerned most about are the ones that are under the purview of the Acoustical Society of America. There are international bodies as well. And that's the other thing too, is opposition of these committees do have a strong involvement from our international members, in particular, because a lot of the products are manufactured or manufactured overseas. But also to the extent that where we can, we like to have what we call harmonization, that is where we agree to do things the same

way. So perfect harmonization would be, is where the international standard and the american standard are exactly the same, and it could go one of each way.

The international committee adopts the american leniency standard as their own, or vice versa. But we have strong involvement on these committees from the international community. So everybody really does have a good say in how these things come about. So, with regard to ANSI, particularly the ones under, again, the purview of the Acoustic Society of America, you can see there are four main categories. Acoustics, which is, which fall under the s one standards, s two, which would be mechanical vibration and shock.

The ones that we'll be talking about, the ones that probably most that you use most often with regard to audiometry, your test booths fall under bioacoustics. And the one we're talking about today is the s 3.22 standard. It's coming up on its 50th anniversary. It's the specification of hearing aid characteristics, as well as there's a standard, s twelve, for noise. So the standards that I get to partake in are the latter two categories, s three.

And the s twelve standards are the ones that get some representation from our professional organization. That is ASHA, with regard to these standards. So what is the s three two standard? Well, it's like all standards of purposes, quality control, product certification, and conformity assessment. Well, that's a very nice definition.

However, the idea here is that really what it comes down to is it's an agreement by the hearing aid manufacturers as well as the equipment verification equipment manufacturers, in terms of the terms, what we call things, what sort of measures, procedures for obtaining the measures, as well as the performance parameters. And in this case, we're specifically talking about the electroacoustic characteristics of hearing aids. Use has evolved over the time. I mean, the first ANSI s three two two standard

was introduced in 1976. There we had much less certainty, I think we could agree, in terms of what was coming from what was being manufactured, and also in terms of what was being received, and also in terms of what it was that we actually were trying to do with these hearing aids back in 76 versus what we're doing with them now, fitting them in real ears with pro microphone measurements.

It's important to emphasize, though, that the purpose, the primary purpose or exclusive purpose of 322 standard is for quality control. It's not a performance standard, doesn't establish minimum requirements for hearing. It's just for only quality control purposes. And we'll kind of see how this plays out as we kind of present what some of these measures are. And really what it comes down to is to just check to see if the main components, in this case, the microphone, the receiver, and any sort of circuitry involved, are functional, just to see if they really are working the way that they are supposed to be working.

So, just a brief history, and then we'll take a deeper dive into what some of the nuances are with the standard. The S three t two standard is the labeling document for the US FDA for hearing aids. The one that is currently that was recognized or is mandatory by the FDA. That's in the Federal Register is the 2003 version, the most recent one, 2014. It's recognized, but it's not yet mandatory.

As you can see, there have been other versions along the way. 2020, we affirmed the 2014 standard. Okay, so that puts us into 2024, which is why we're having this discussion today. So we have been actively for the last couple of years, but mostly in the last year, discussing revision of the 322 standard for a couple of reasons that details I'm not going to necessarily get into. And that was kind of the whole purpose of having this presentation today.

So if you've had some familiarity with the ANSI test and the S 322 standard, maybe again from school or whatnot, the idea here is what's new, what is going to be changed in this new document? It will be a revision of the existing standard sometimes, like I said, 2020, we just reaffirmed the existing one. We are actually making some revisions within the standard. It's out for balloting ballots, are due at the end of March, so I don't anticipate any big challenges. I would expect that this ballot rule or this standard, this revision will pass, primarily because we've again had a lot of active discussion over the last year.

So I think everybody who's wanted to say something or contributes already offered their opinion. So I'm pretty sure that the standard will be approved and fully in use in the upcoming future. So what do you need to do? So if you have any familiar, you can go. What is different?

What is going to change with the standard? The reality is not a whole lot as far as what we do as audiologists, not a whole lot. The big things that I can see is in terms of the calibration of the sound source and sound field. And I'm just going to assume that we all have some working knowledge of test box measures. As we know, with test box measures, we equalize the sound field, we calibrate the sound field, we level the sound field, whatever term that you're familiar with.

And the idea there is that we know the sounds coming out of the loudspeaker vary as a function, the levels vary as a function of frequency. And one of the things that we want to do with our measurements, just the same as when we do our speech measurements, whether on ear in the test box, we want to have very fine control over what the DBsPl of the source is at the hearing aid microphone. So given that the source, the speaker itself, and any sort of the presence of the box itself could alter the acoustics that reach the hearing aid microphone. The point here is that's what sound field calibration is doing. It's a frequency by frequency adjustment at what we'll identify

as the reference test point, which is going to be pretty much where you put your hearing aid microphones in the reference microphone.

And again, I assume that you have some working knowledge of test box measures. That's not new. What is going to be new is this idea of the calibration being uncompensated or compensated. And this refers to whether or not during the calibration procedure, the hearing aid itself, and then the coupler. And this coupler assembly is referring to the actual microphone and the wiring, whether those are present during the time of calibration or whether they're not.

The other thing that would be new is, and if you've done this sort of measurements. So this is going to just simply apply to our measurements using the ANSI test, not during. If you were doing simulated realear measures, for example, in the test box with a broadband stimulus like speech. This is just simply for the ANSI test. One of the things that you do is you'll be removing that.

If there is a reference microphone, you'll be removing it from the test box. So if you use the verifit, it's the short one that's on the gooseneck. Technically, according to standard, you'd have to remove that from the test box during the measure, regardless if you're using a compensated or uncompensated measure. Let's just kind of quickly talk about the difference. Uncompensated is the calibrations performed without the hearing aid and the coupler microphone, so on and so forth in the box at the time of the calibration.

And at first, to me, it took a little bit of research and some thought you'll see here, this is actually going to be the preferred method. And one of the things is that to me at first is like, well, this, because it's kind of contrary to how we usually do these things, whether it be we were doing whatever our test system, if we've used the fry box, and I'll provide you with a video tutorial, doing it the way we usually do it, I've been doing it

historically, is you very carefully, you have one microphone with the fry system, and then you swap out and put a dummy microphone and you measure the characteristics of the sound source in the box with the hearing aid and the coupler in place. And the reason you would want to do that is to account for any sort of effects that the presence of that hearing aid and the coupler are making on the acoustics. In reality, they do have an effect, but they're going to be for those very short wavelengths because the objects in that box, after all, are very small. So it will have some subtle effects in those high frequencies, the short wavelengths.

The advantages, though, is if you only need one microphone, their systems are going to have one or two. So that's a gift. Here's the thing, is that when we do the calibration, we're going to put that reference microphone in the exact same spot that we're going to put our hearing aid microphones. Those two will actually be physically at the same point just at different times. It's argued that this is going to give the most readily reproducible condition.

The other advantages is that as long as the sound source remains stable, you can use the same calibration for multiple tests, different hearing aids, different form factors. If you have to get in there and change the program and the hearing aid and fiddle it or move it a little bit. As long as the microphones are in that reference point, you don't need a new calibration that's advantageous. Compensated here, you would actually calibrate the sound source and test box with the hearing aid that you will be using and in the place and the position you'll be using, as well as the coupler and the assembly in the position that they'll be used. So everything remains in place just as we'll be doing the testing.

The advantage there is we can compensate for the presence of the thing we're putting in the box, the hearing aid and the coupler. Disadvantages. This would actually require two microphones, each having its own calibration reference microphone and then the

coupler microphone. And again, even with both methods, though, the important thing is, actually when we run the test, we'd be removing that reference microphone because we're running the calibration at the same time that the hearing aid is in the box. We can't put them physically at the same point.

So the thing here is we're going to put them perpendicular to the sound source. That hasn't changed, but we'd have to put them symmetrical about the reference points. That's key there, as long as it's symmetry, relying on that symmetry to kind of keep everything constant as if they were similar acoustics. The other thing, too, is that if you go in and if you have to change the hearing aid or you reposition it to change the program, you have to technically require a new calibration. So you can see where the favorite is going to be is in the uncompensated calibration method.

That's kind of what kind of wrap up, what's new about the new standard. So the rest of this discussion is kind of, kind of explain what's in the standard, what hasn't changed, and then really kind of give, from a clinician's perspective, what is the best way of kind of going about doing this, and some of the tips and tools that have made available for you to be able to do this efficiently every time. So take kind of a few steps back. You have to ask, because the thing is why? You get a choice of topics.

I could have talked about a lot of different things, and this is one topic that, again, I kind of somewhat passionate about just with my participation on the committee. And also you have to think about why is it that we as clinicians don't do these tests anymore? One is that thought is that the ANSI tests are outdated, and this will kind of relate to the next point. I've already said that we're coming up on the 50th year anniversary of the S 322 standard. However, given that we're going to have a new revision out with.

It's been updated over the years. We have a new revision coming out this year, certainly not updated. I would venture to guess the second one is probably the most likely reason they were taught in school and then never used again. So it's very popular with university clinics to have the graduate students run the ANSI test and every hearing aid that comes in, and basically that's that. And then they don't necessarily use it when they go out to their externships in the first years in practice.

I mean, this is one of the things we did back when I was in graduate school 20 years ago and pull out the plotter paper and the rulers and do all of these measurements that are now done automatically. We'd have to do them by hand, including changing the volume control. So things have come a long way. But this mentality is that this is something that kind of lives in the academic domain. It's a textbook thing.

It doesn't really apply to the real world. The other option is that maybe it was never taught during school or ever used in training, so maybe never had any exposure to this. And I think hopefully with today's presentation, you'll get to a certain comfort level that hopefully this won't be a limitation for you any longer. The other very valid reason, one might think, is all that matters, how the hearing aid performs in the patient's ear. And I will certainly agree with that.

So I'm going to say there's a time and a place for these, and it maybe is not for every single hearing aid that you see every day, because once we've kind of moved along to doing pro microphone measures, speech mapping, I think we could all agree that as long as the hearing aid is meeting targets, the patient's happy. That is all that we need. And I'm not going to negate that, but I'm going to argue that there is a certain time and a place for these other reasons to get the document itself. They are fairly expensive. They anywhere from often one to $200.

And if you really aren't motivated to do it, you're probably not going to be motivated to buy the document. And if you do have the document, if you bought it or you have it from school, it's technical. It can be very confusing and intimidating. So one of the things we'll hopefully try to mitigate these two factors. I'm going to hopefully be presenting the necessary information that you need to know to be able to run these tests and interpret them without having to get the document, without having to actually read the document.

That in of itself, these tests that I'm talking about are covered usually pretty extensively in most introductory hearing aid textbooks. And there's lots of resources. I know audiology online for many years in written form and other presentations have talked about these tests in detail. So there's plenty of free information out there. You might think that they take too long.

Again, hopefully we'll kind of prove that these tests don't take very long. The longest part, I think, is actually getting into the programming software and actually figuring out how to get the hearing aid in the right test mode. And I provide some tips and tricks for that as well. And that kind of gets to the next point. The test settings in the software, if you haven't had any exposure and you know that they exist, they can be intimidating.

If you've worked with several manufacturers, they're not easy to find. And so if you're not really sure what to look for, that might be another reason to discourage you from running these. And again, I have in the handout section here, as well as in the slides, I will show you. I've went ahead with all of the seven major manufacturers that are out there today with their most updated software, took screenshots and will show you exactly how to get into the test mode for each of those manufacturers. The important thing here is there may be a tendency, just with this in mind is I'll just take the hearing aid as it is for the patient when it arrives new and just plop it in the box, get the ANSI test and your hearing aid analyzer and call it a day.

And I can't emphasize enough not to do that. Not to do that. That is not a valid way about doing this. You do have to put the hearing aid at the specific test settings and more. We'll get into more detail about what these spec sheets are, but the manufacturers run these tests on all the hearing aids outgoing and they have to report them in one way shape or another.

And they're not easy to find. I got to be honest, sometimes they're not easy to find. But I'll give you some tips and tricks on how to find these pretty efficiently as well. All right, so this kind of gets us into our first quiz question. If you notice the key one in the upper right, why perform the ANSI test?

Well, we can kind of take a quote here from our hearing aids experts, Todd Ricketts, Ruth Petmar, and Gus Mueller, current best practice guidelines from our professional organizations. As you see here, the AAA and ASHA recommend that all hearing aids new and repaired be assessed electroacoustically to provide a benchmark against which future quality control measures can be made. That's a fine definition, and I think this is where I've seen some tendency to this idea as a benchmark. So why would you take a hearing aid that's at user settings and run it through this antsy test mode? And I think the mentality is, well, it'll give me a benchmark, so it doesn't matter that I get what the manufacturer had on their end.

The only thing that matters is how that hearing aid is performing on this test when it comes in new. And now when I see it each and every time, whatever I got here will be my benchmark for whether or not it's functioning. And I'm going to show you why that's not the right approach to do that. Here's more practical reason, I said, and I'll agree with you, in a busy practice, probably outside of a student, a clinic, it doesn't maybe make sense to test every hearing aid when it comes in. We know we should,

but we can pretty feel, rest assured that, again, if we put it in the patient's ear, it's hitting targets, we get sufficient output, sufficient gain, patient's happy.

We could bet ten to one that that hearing aid is performing just fine. The practical reason, what I would say is to evaluate the electromechanical functioning of the microphone and receiver while minimizing contributions from the DSP, the circuit, the programming, basically everything that's provided by the chip inside the hearing to the greatest extent. We really want to test the two endpoints, the microphone and the receiver. Those are the two things that are most likely going to be affected over time or that get damaged and need repair. It's going to be those two things to a certain extent.

We really want to remove all of the processing that goes on that can interfere with our results. So, again, you could do this for all hearing aids coming in new. I venture to guess not very often will you see something that's going to surprise you. But considering, if you think of any sort of practice, a busy practice on a regular basis, you're going to get hearing aids that come in for repair, they get dropped off, or the patients there waiting for it. And I would say this would be the time to quickly pull up and do your ANSI test.

See really, how is that hearing aid performing at that moment? Is there a performance problem with the hearing aid, likely against socioeconomic microphones and receivers? You may do some repairs. You may put it in the drying system. Some of the drying systems are fairly sophisticated, or you send it in for repair.

Or probably a good liker thing, too, is you do something there in the office and you want to know, have I fixed the problem? You could do a listening check, but a better thing to do is put it and do a before and after ansi test to see if you've made any improvement. And after you've made that repair or you've dried the hearing aid, is it performing according to specifications as the manufacturer had sent it out day one?

The other thing would be, is to identify patients complaints that may be related to the programming or actually to the fit itself. They're complaining that it's too noisy or it's just not sounding right.

Maybe you set compression. You've adjusted the gain. You've adjusted compression so that the compression ratio is so high that the patient is reporting that speech is hard to understand. Point here is, as a troubleshooting measure, is there's something related to the fit, something related to the programming, something or maybe related to counseling. That's not a problem with the hearing aid itself.

So it's an objective way, again to say, hey, is there a need to even send this hearing aid in for repair, or should I be looking at something else?

Talk about test conditions and settings, terminology and concepts will probably spend a fair amount of our time. Brings us to our other quiz question point here is that again, the point here is reproducibility. We want to be able to reproduce on our end in the clinic what the manufacturer did on their side when that hearing aid was shipped out. And the point there is that in order to do so, we have to agree upon a common way of doing this set of test conditions. Those test conditions are specific to what signals we use.

Most importantly, you see here in bold, and the red is the hearing aid settings, any sort of hooks, tips, filters, wax guards, so on and so forth. These are not specified in the standard. But if the manufacturer says, this is the way we ran our test with this particular tone hook employed, whether it be an unfiltered tone hook, maybe it's a tone hook with a damper. In order to replicate it on your end, you have to do the same things that they did on theirs. And you know that because they do have to specify here's the thing too.

Test signals are always pure tone signals, and we know these aren't representative of everyday sounds. Why do we use pure tone signals? We know that when we program the hearing aid for patient, we care about speech. That's the most important thing that the patient wants to hear. They want to hear.

Well, when it comes down to these measures, again, we want to have an agreement, a common understanding from all parties involved how we're going to do this. Pure tone signals are nice because everybody knows what the signal is. We can agree upon what its input is, we can agree upon how it's going to be analyzed and get the same thing. That brings me now to the ANSI test setting. It goes by different names within the programming software, but it's, the idea is we're going to set the hearing aid in one of two ways while running these tests.

Either of these ways really doesn't reflect, particularly the first one, how the hearing aid is actually going to function in the user's ear or how it's going to perform under real world conditions. We're choosing very specific settings of the hearing aid that don't represent its everyday functioning. And these settings, we do them for one of two reasons, one of which is we can all agree where to set the volume control, the gain. The other of which is, again, as I said, is to a certain extent really what we want to do. We want to remove from the equation all of the signal processing involved, just so we can test those core components, the receiver and the microphone, and not have to worry about sort of any of the influence that the DSP is doing in between the other things.

So we can get the same thing each time, every time. This requires that we get into the programming software and find special test mode. Now, we have things easy nowadays, as I indicated, I was in graduate school, we had to do all these things by hand. We had to go ahead and get in there and adjust the volume of wheel so it's just at the right levels. Everything is now basically in the programming software.

The thing is that it's not easy to find unless you know what you're looking for. And it's different for every manufacturer and they use different terms. And again, I am going to help you out because I have a handout here as well as the slides screenshots from all of the manufacturers where to find these settings. It's just usually a few clicks in. Generally, however, that's recommended.

The manufacturers in their test settings, the microphones should be set to omnidirectional hearing it at its widest bandwidth, at the greatest output and gain. Here's the other thing here, is we want to remove from the equation any of the digital signal processing. So we put all of the advanced features, noise reduction, feedback suppression, all of those should be deactivated. We really just want to test the core components of the hearing aid, the microphone amplifier, the receiver.

It's important then, is not to run the ANSI test. And then when I say this ANSI test, it's usually a button or menu selection in your hearing aid analyzer, not to run it at user settings as it's programmed for the patients here, because lots of things could happen. These tests aren't designed for user settings, and the premise behind the standards is repeatability. Be able to get the same thing each time, every time. And as we know with our hearing aids today, they're constantly altering the sounds that are coming in to reduce noise, to reduce limited feedback, to selectively amplify depending upon the relative speech and noise levels, and that's going to affect the repeatability.

I said, one of the things that I've seen is there's this temptation to take the hearing aid at user settings. I said, plop it in the box. Run your curves. That's my benchmark. So now, every time I see that patient or hearing aid, or if I think there's a problem, that will be my reference point.

But I'm going to show you here why that's not a good idea. Even though that you think you're getting something that's going to be, again, a benchmark. It's going to be a benchmark. It needs to be repeatable, and I'm going to prove to you that that's not the case. So here's a hearing aid.

This is one of the hearing aids just manufactured, came in in this fall. These are the ones we use for my hearing aids class. So never pit in the patients. You're brand new if you're familiar with these tests, and we'll talk about what these curves are, but you don't really need to know even what these curves are to know. They look really wonky.

You expect a frequency response of the hearing aid to be fairly smooth and not have these big dips. And here it is, we see significant decreases at particular frequencies, and this is the contribution, the feedback ends. These are pure tone signals. The hearing aid sees that and identifies. This is feedback, and it does what it wants to do and it suppresses it.

That's a problem. This is why we can't run these tests. At user settings. Here's another thing. I said, okay, let's look at second hearing aid.

At the hearing aid, we get the same thing, slightly different place, but we still see evidence of the feedback canceller reducing these pure tone signals, these high intensity pure tone signals. Thinking that it's feedback, you go, well, all that matters is that it's a benchmark. I get the same thing each and every time with this particular hearing aid. What I did was I simply hit test again. I ran the test again immediately after I took the picture.

Hit run test. There it is again. Did it again. And this is what I get. I could not get the same thing even though nothing had changed.

It was just a mere minute later, right around the test, and every time got something different. So we lack repeatability. You do need to put these hearing aids at their designed settings. What are those settings? There's two of them.

One is full on gain fog, and I excuse the acronyms, I didn't create them, but I think we can work through them. Full on gain and reference test gain. There's two settings, and I'll just kind of briefly go through with the procedure. First, we put the hearing aid at full on gain setting. Going into the manufacturer software, we get into our hearing aid analyzers, you press run test run its curve curves, you'll pause, have you put the hearing aid at reference test gain and then proceed.

That'll be important for something I'm going to talk about just a little bit later. Full on gain, the volume control, the amplifier, everything's at its absolute max. Reference test gain. I'm going to talk more about later. Point here is that it's more representative of typical usage.

This concept will take a little bit more explain, so we're going to kind of hold off on that one. But the idea there, it said gains, supposed to be at a more typical user setting. So I've already identified that some of these manufacturers. It can be a little bit intimidating in terms of where do I find these test sets for full on gain and reference test gain. So here's some basically screenshots from each of the manufacturers.

Again, this is also in the handout, the most up to date version of their programming software. You can kind of go through this at your leisure. Point is usually it's just a few clicks in. One thing I will identify, these are the two Sonova products. The two Sonova products.

You don't need to actually have a client entered in. Actually, you don't need your client. This is just right upon you launch the software, you go right to the bottom, you click or

wherever, because it's different for each of the manufacturer, these two, but you don't enter in a client. And that makes sense because these tests don't rely on a particular audiogram. So it seems pretty convenient.

It seems pretty convenient because you don't have to go into a client, enter an audiogram. The only caveat I noticed with these is what they do is they dump the settings onto the hearing aid. So you go, I want full on gain, dumps it onto the hearing aid, and then when you're done with that, you have to revert back, and then you have to basically reestablish the connection. So if it's usually probably rechargeable hearing aid or if it's a battery hearing aid, zinc air, you just open the door and reestablish the connection. You get it back into pairing wood, and that's when you get into the box and you have to do some fiddling.

So you have to basically get it back into pairing mode because at that point it's done being paired. So you got to reestablish the connection with the programming software. So you get it open the box, you power it off, power it back on to get it into pairing mode, and then move to your next test. So there's some trade offs. I guess it's convenient because you don't need the client, but then you have to go ahead and take that extra step between the tests, the other manufacturers, you don't need to do that.

However, you do need to have a client. This doesn't necessarily need to be the client. You might not even have the user. It might be a new hearing aid, for example. If that's what you want to do, here's what I'd recommend.

Just go ahead and create a fictitious client called Ansl test. It doesn't matter the audiogram, because these are not audiogram specific tests. This way you don't have to worry about trying to fiddle for the particular whose hearing aid it is. Just go right in. AnSI test client.

And again, you're a few clicks in. And the other teaching point here is you notice the different terminologies that are used for these. We have technical measures, we have test mode test settings, test device, hearing aid, test quality assurance. They're all in different places within their fitting software. So it could be a little bit intimidating.

Hopefully, with these little tips, it won't be so scary to go ahead and find these within the software.

We do have to do a little bit of a discussion in terms of what it is, the things that we're going to measure. I'll try to try to keep this at the minimum level that we needed to know. Again, there's a lot more detail on the standards, but we actually do need to appreciate what it is that we are trying to measure. And I think we got to take one step back and figure out what it is, big picture that we're doing. So the idea here is that we're going to make a measurement on our side and we're going to compare it to what the manufacturer did on their side.

And that's the idea of why we want these test conditions to be replicable on both sides. We want to do what the manufacturer agreed, that we do these on our side, same test signals, same test settings, so on and so forth. And then we're going to compare the difference, what did we get versus what the manufacturer got? And we're going to check to see if that difference falls within the tolerance stated by the standards. The standard says, how close do you need to be in order for this to be still what we'd say in our nomenclature within specs?

So for each of these measures, there's going to be a tolerance. But the other thing too is we have to appreciate that to the tolerance, we need to add the accuracy of our measurement equipment. So the point here is that if our measurement equipment. So if our measurement equipment, for example, is only accurate within a decibel plus or minus, and if the tolerance in the standard says, well, you need to be within three of

what the manufacturer got, you have to increase your tolerance by that 1 db by the accuracy of the equipment. So in this case, if you're within four of what the manufacturer got, you'll be considered to meet specifications.

So one way to go ahead and find these tolerances, you go into the manufacturer's manuals and they're stated in there and not going to go through these details. But I want to reassure you there is a tool in the resources in this links, I guess under resources within here as I'll have a link as well as in the handouts in the PowerPoint here for the Excel spreadsheet where I went ahead and I've entered in the tolerances for each of the measures. So you don't need to get in there and do it yourself. You don't need to do this by hand, as well as the accuracy of the equipment for the two verifix as well as the fry system. And you can just copy and reduplicate it if you have other test systems and create your own spreadsheet for those other test systems that are out there.

So the point here is, while this might seem intimidating, I have an easy lookup table for you with all the spec tolerances as well as accuracies of this equipment. In fact, it's so easy that when you enter in the value, what the manufacturer's value will tell you what the acceptable range is, what the tolerance and the accuracy. Not only that, when you enter in your value, it will tell you whether or not it's in spec or not. All right, more terminology. Definitions.

We do need to, at some point, average our curves, our response curves at some point. This is called the HFA, high frequency average. I know these may not seem high frequency to you, but at the time they were developed, this was high frequencies for hearing aids, 1000, 602,500 hz. We average the SPL of those frequencies. So when we talk about some of our measures, we refer to the HFA.

That's the average of these three frequencies. Manufacturers could, they're not obligated to use these frequencies, but if they use other frequencies, and I haven't seen this in a long time, a very long time. But if they're called special purpose averages, they could have their own set of frequencies. Again, maybe if their hearing aid is designed with a very limited bandwidth, for example, for severe to profound hearing loss, they might decide that other frequencies are more representative of that hearing aid. There are specifications on what those frequencies are.

It's not arbitrary, our first measure that we're going to attain. So we put our hearing aid at full on gain. Again. Now, you don't need to get in there and find a volume wheel. This is within the programming software.

It'll put the hearing aid at full on gain, maximize the amplifier, run a curve, pure tones. These tones are all 90 decibels, dbspl at the input. So this is our OSPL 90 and that measurement. So, function of frequency is going to be our OSPL 90 curve. It's actually a curve.

And the point here is to approximate the maximum output that the hearing aid can produce. It may or may not produce a higher output with slightly higher inputs, but for all intents purposes, this is really going to represent the absolute max that the hearing aid can produce. These are not user settings. These are not MPL. MPO is the limits that we program into the hearing aid.

This is the absolute maximum that the hearing aid can produce. Again, it's a puritan sweep. It's a curve. What we want to do is come up with a description of that curve. So we use the high frequency average.

Again, I didn't come up with these acronyms, but HFA high frequency average, 1000 602,500 OSPL 90 curve. We average those three values. That's the HFA OSPL 90

tolerance of the standard says if we have to be within four of what the manufacturer has measured. And that's the other thing too, is these tolerances with the accuracy of the equipment, while we add the accuracy of the equipment back outgoing. When the manufacturer does this, they have to subtract the tolerance so they have a tighter window to me with these products going out.

But we account for the accuracy of the equipment as well as the tolerance. The other measurement point is the maximum loss pill 19. This could be anywhere along the curve between 205,000 hz. It doesn't have to be one of those high frequency averages, but whatever point on the curve produces the highest SPL, that SPL is the maximum SPL. This is a one sided measurement.

As long as we're within, not exceeding that by three decibels, it's still considered within specifications.

So this is our OSPL 90 curve in blue here. And then if we just go ahead and we average the SPL, the high frequency average frequencies, that would be our HFA OSPL 90. And then whatever point. And this one just happens in this example to line up with one of the test frequencies. But wherever between 205,000 hz, we get the highest SPL.

That is our max OSPL 90. Sorry.

Okay, so our other measurements. So the OSPL 90 curve is with a 90 decibel input, a high input max gain. What we have here now is the high frequency average, full on gain. And this time the input signal is 50 decibels. It's much lower.

And we're taking the average. And the whole principle here is that we want to really approximate the greatest gain. The hearing aid is capable of, not necessarily greatest output. How much gain is, and the principle there is, if there's any WDRC that's

involved, it's still present in the ANSI. In the test mode, as we know a WDRC, you get the greatest gain for the lowest inputs.

Higher inputs would gradually turn down the gain. So idea is that you lose a lower input to really drive the gain of the hearing aid at its highest. So the principle is different. We're looking at gain here. The other one, we're primarily looking at the maximum output.

And I did say, then we come back to reference test gain. What it is generally just in big picture what it is, is it's to get us at more typical user settings. And I'm going to have to break this down a little bit because this actually does come into play in terms of the curve that's generated and how we get these curves so we can better appreciate what it is we see when we run these tests. I'm just going to give the first part of this quote from the standard and you'll appreciate hopefully the breakdown of how we get here. So it's for 60 db input SPL, the setting of the gain control required to produce an HFA gain within plus or minus a decibel and a half of the HFA.

OSPL 90 -77 okay, that is a very tenuous definition. What's in the lighter color here? It's not arbitrary though. The point is, if this is less than, if the measurement, this reference test setting is less than the OSPL 90 -77 I'll explain how we get there then. The reference test gain is the same as the full on gain.

You go, well that's fine. But the important point here is because sometimes when we run our test curves, so we'll run our test at full on gain. So again, a programming software full on gain, the hearing aid analyzer, will run your curves, your full on WesTPL 90 curve and then your full on gain curve. And then most often it will pause. The software will pause and say okay, now go ahead, the test box.

The hearing aid analysts pause and say go ahead, and now put your hearing aid at reference test gain. Sometimes, however, for low gain hearing aids, the reference test gain is the same as full on gain and it will just continue to run. It won't even pause. So if you're wondering why did this test continue and I didn't get an opportunity to go into the programming software and change it, that's why it recognizes the hearing aids. At the full on gain is the reference test gain and just continue with the test.

That's why that's kind of down there. And the lighter color, it's not unimportant, but that's the take home there. So let's quickly, quickly try to get to where do we get this concept of -77 it takes a little bit of thought here. 77 is not arbitrary. The point is that the long term average speech spectrum at 1 meter away is about 65 decibels.

And if we consider the peaks of speech, the crest factor is about twelve db higher. That means the peaks of speech as an input signal are about 77 db sPl. That's where we get 77 what do you need to do for 60 dbspl test signal, which is where we run this curve. It is the gain needed to turn down the OSPL 90, the max by 17. Now you go, where is 17?

This kind of comes out of nowhere. Well, we have to kind of break this down a little bit. So reference test gain, we take our OSPL 90 curve, the high frequency average, subtract 77, the peaks of speech. We need to back up just a little bit. Kind of, just kind of take a few steps back.

Well, what is all of this? Input plus gain equals output. We know that. We'll do some rearranging here in just a moment. What is the input, the peaks of speech, which are 77.

What is the plus gain, typical gain, we'll identify as reference test gain and then maximum output. So we get 77 is our input signal, the peaks of speech, typical gain,

reference test gain, maximum output, high frequency average OSP 90. We arrange the terms, we get reference test gain equals the high frequency average. -77 okay, where does the 17 come in? Well, here's the thing is the peaks of speech at 77 are when the input signal is with speech is at 65, our input signal is 60.

For whatever reason, it's 60. So to get to 77, we have to add 17. So if our input signal 60, that's where the 17 comes in. So if you distribute the negative here, it becomes a -17 that's why we're subtracting 17 from this curve. And it's not arbitrary because the thing is, this is what generates our reference test curve, which is also going to then generate our frequency response.

So if we look at the output SPL, so we got our output SPL and the blue curve here, our OSPL 90 curve, we have our high frequency average. Whatever the average of those three frequencies gets subtracted by 17. And this is the nice things, this is what's happening underneath the hood of the software. When you get into the manufacturer's programming software and go, I go into reference testing. This is what it's doing.

We had to have to do this by hand adjusting the volume wheel. Sometimes it's a little off. And you can get into the manufacturer's software and adjust the level a little bit to get to reference test game. You'll see that in my tutorial here in a little bit. Okay, so that's where we get the reference test game.

I'll look on the axis on the right we have gain. That's where we get these numbers from average, those three frequencies. That's the reference test gain. And then finally we have the frequency response. Okay, so this is derived from the reference test gain curve.

In particular what we do is we draw a line 20 db down and look where it crosses. This would just be easier to show you a visually here. So we take our reference test gain

curve, that's the red. We take our reference test gain, which is the average of these three frequencies, and you drop down by 20. Again, this is what your hearing aid analyzer is.

So it's so easy nowadays because this does it automatically, but this is what it's doing underneath the hood, drops down by 20, draws a horizontal line wherever the reference test gain curve crosses those frequencies. That is your frequency range. With a few caveats, it can be technically no lower than 200 and technically the lower of no higher than 5000. So it's just really kind of trying to confine between 2000 5000 hz. That'll be important for the information on the next slide here.

So that would be the frequency response. There are tolerances in terms of how far off that needs to be. For the lower frequencies it's plus or minus four. The upper frequencies it's plus or minus six. But to be honest, sometimes the manufacturers produce these specifications, they don't have the curve.

So there's really nothing to compare against because technically what you could do is take what the manufacturer's curve is and make a template and see what you measures within that. But to be honest, most often we're not going to do that. This is the thing, technically it's a procedural definition first and foremost. Again, technically should be bounded between 2000 5000. Being said, it will report higher values.

Your equipment, it doesn't represent the actual usable range of the hearing aid. So if it says it goes up to 10,000 hz, well we got to actually consider it has to go in somebody's ear at some point who has high frequency hearing loss. And depending upon the shape of these curves that can be a gross misrepresentation of the actual frequency response. So point is that if you were to try to use this as a performance metric and say well this hearing aid is better than that hearing aid because there's a

wider frequency response using this test that is very misleading. We have two last measures, distortion and equivalent input noise.

Harmonic distortion. We measure at the three frequencies test. Input frequencies are half of the frequencies that we use during the other test. So 500, 800, 600, nice, sufficiently moderate input levels of 70 or 65. Point here is all we're doing is we're taking the amount of the powers of all of the energies that are present in the harmonics and comparing it to the input signal to derive a percentage point here.

If we're familiar with p clipping, this is a pure tone, 500 hz pure tone. These are actual examples generated within Matlab, so not contrived except for Matlab. But these are not cartoons by any means. So the idea here is if you have a 500 hz pure tone, no clipping. We know that if we turn it up to the point where we're saturating the output, for example, what we're going to get, those peaks of the pure tone will get clipped, they'll turn into square waves and we're going to get energy at every odd harmonic falling off at twelve db per Oct.

So we have all of these harmonics that are present in the output that weren't present in the input. And we go ahead and quantify that, take these levels, convert them to powers, put them in the ratio. That's where we get our percent. You can see here, the whole point is to have this at a gross conceptual level. We don't need to know the big details.

Internal noise, this represents noise that's present in the not present, sorry, it's not present in the input. And reason for that is there is no input signal. This is something that's added by the hearing aid itself as an unintentional byproduct of its design or the signal processing. It's important because any internal noise is going to get added to the external signal and then amplified. So if you have a high gain or maybe a mild moderate hearing loss, once you add the gain to the hearing aid.

So tell my students, if you just go into the test booth, for example, there's no input noise. And you put on these hearing aids as normal hearing listeners, you're probably going to hear that noise because it's getting amplified above your audibility. Lots of studies and where this noise comes from, most often it's coming from the microphone. Our measurement, our technical measurement is the equivalent input noise level. So there is actually no input presented from the loudspeaker and the gain of the hearing aid is at the reference test gain.

So this is one of those measures that comes second after we get into the programming software. Just to kind of make this a little bit more clear. Just remember, input plus gain equals output. So our equivalent input noise is, we rearrange the terms is the output that we measure in the coupler, no input minus the gain that's being applied at the time reference test gain. That is our equivalent input noise level here.

Just frequency response. We shouldn't be using this as a performance metric to compare manufacturer a versus manufacturer b in terms of who is better. Part of it is because it depends upon their frequency responses. And if I showed you, if you remember before, the term that we're subtracting is the reference test gain. So if the reference test gain is determined by three frequencies, if one of those three frequencies happens to fall in the peak of the frequency response, the reference test gain will be higher, maybe not as representative of the entire curve.

So you're subtracting a higher number. The equivalent input noise will be a little bit lower and then vice versa. So the point is, it's repeatability. Can we get the same thing as the manufacturer when they did this test? It's not a performance metric.

The other kind of word of the wise here is that we have to be careful, particularly with the ha one coupler. So if you're using putty to put a rick in, or if you're using one of the

trick adapters, the verifit, or a custom device, if you don't have it completely sealed, you run the risk of feedback. I've seen this when my students turn in their assignments and it's like noisy, they all get out and it's like, what's happening? And you kind of look at the printout, you go, yeah, that hearing aid was in feedback at the time you ran the test. So just to be aware that you got to have a good seal because feedback will contribute to your noise levels and quite possibly to your harmonic distortion.

Okay, now we just kind of, kind of want to wrap everything up and say is the hearing aid inspects. So this is kind of take a quick screenshot of what we have in our manufacturers, the hearing aid analyzers software. So here's the verifit one, and not much different from verifit two, but here's our Max OSPL 90 reporting at 125. The green here is the OSPL 90 curve. The max is 125 and identifies it at 1120 5 HFA.

So you notice that they just use average. But this is what we identified as the HFA OSPL 90. We average this at least three frequencies down here. It's at 120 decibels. This is what identified before is our HFA high frequency average, full on gain.

So the hearing aid is still at its full on gain setting, but we have a lower input signal. The idea is we want to really see what's the maximum gain of this hearing aid. And then we have a reference test gain frequency response equipment. Input noise, battery drain. We're not going to talk anything about, really, because nowadays with rechargeable batteries, it's just something we're not going to measure.

Harmonic distortion, tack and release times. That's a carryover from one of the older versions. It's not actually in the main document of the S 322 standard price system. Still using one of these, or if you remember these from graduate school, same information OS, just slightly different way. Let me kind of just kind of go through this pretty quickly here, actually.

I won't pause right here. So this is the reference test game. So this is the idea, because we're going to see this in my tutorial here in just a minute. The idea is the software, the hearing aid analyzer, is going to compute. Where does that reference test gain need to be based on the OSPL 90?

And if everything works out, when you get. So that's the target here with the verifit, you'll see a visual display. The point here is that when you go into the manufacturer software and you say, now I'm going to go to a reference test game, this is the game that you should be getting. It should be fairly close. If it's off by more than a couple of decibels, you can go.

Some of the manufacturers, not all of them, just a few, allow you to go in. I think Starkey signia allows you to go in and make some adjustments to get that closer to the target when it's estimated based on the curve. But for all intents purposes, those two should be fairly similar specs. So what you want to do is you take the measurements that you obtain during your measurements and you want to compare them to what the manufacturer got. This is one, I think, another reason why some people might not.

They kind of shy away from this, particularly if you're not really convinced that this is something you should be doing. Where are these things? I actually show you in just a minute. But the point here is that wherever you find these, particularly if you get them off the Internet, you really have to make sure a few things. You want to make sure that the model hearing aid that you have is right.

Want to make sure the technology level is right. There might be, however, it's designated, one, two, three, so on and so forth. You have to make sure that the receiver that you're using is the right, you're using the specification for the receiver that you're using for the device. And we want to make sure that assuming we're doing all of our measurements in the two Cc coupler you're looking at the two Cc coupler

measures, not the ear simulator measures. So there's lots of kind of things you want to kind of pay attention to.

Once you're kind of used to it, though, it's pretty straightforward. And then here you can see all of the measures we talked about, what the manufacturer got, and we'll kind of put all this together and identify. This is what you put into my spreadsheet. This is what you want to compare your measurements against. Point here is they come in different forms.

This one here actually can show you the curves that we talked about. This one, next one, we just have a table of values. This particular spec sheet has the specifications for two different power receivers. You want to make sure you're in the right column, and you also want to make sure you're looking at the two Cc coupler.

Yet another one presented a slightly different way. The information is there, so you just kind of have to know where to look. It shows you the curves, breaks it down into what you get with full on gain and then a reference test gain. Where do you get these? So let's got question number five, the product packaging.

So when it comes in, sometimes it's kind of stuffed in there as a little half sheet or quarter sheet within the manuals. Not always. Very few of them, I'd say, that I've gotten the last couple of years will have that spec sheet actual in printed form. Well, now where to go? Well, sometimes in the programming software, you can find it.

It's not easy. Finding the test settings are hard. Finding the specs in the software is even more difficult. Well, where do we go for everything else in life? Allah, the Internet.

You could try the manufacturer's website. As a test case. I took all of the Hearing aids that we've gotten in the last, each of the manufacturers in the last couple of months

and went through this exercise. Manufacturer's website is kind of hit or miss. It's not straightforward, really.

It's a lot of searching. Pull down menus and sometimes even get into their search bar. They'll have a search bar. It's sometimes hard to find. You can Google.

You will google. So if you use Google, I would Google AnSI technical data sheet and then the make and the model of the hearing aid. Most often you'll find it. The problem there is, it's a lot of searching. You're going to want to actually search for the manufacturer's website, if you can, because you're going to get sources from different providers of hearing aids and ads.

And stuff. That's kind of a mess. If you haven't used perplexity AI, use a free version. I use a free version. It's an AI, it's a generative model.

It'll produce text. You don't care about the text. But for me, this was the best value, because actually, one thing that differs from this from, like, Chat GPT and copilot and Gemini that's out there is it actually provides you with links to the references and screenshots. And so this was my highest hit rate is going to perplexity, dumping the same term in ignore all the text but use the references most often. I find it's just right there.

You don't have the ads, you don't have to find all. There's other things up there.

Should have a high hit rate. And if you're paying attention, you're doing the question. Chat GPT is not the right answer. I tried Chat GPT, it's a generative model. It doesn't provide you with the links necessarily.

That's not going to help you out. All right, finally, let's go ahead and put this all together. So there's a lot of information, a lot to remember, and I think this would be another reason why. How do I consolidate this information? And again, if you're a little bit not convinced to use it, you're probably not going to.

Here's the link. There's also in the resources here in the live presentation, a link to this table as well. Well, you can type it in. This is a live document, meaning that I'll do some auto calculations for you. So I put in there.

So there's three tabs, one for barefoot, one, two, and then the fry phonics. So I have the tolerances. So you don't have to have the standard, you don't have to go back to my presentation, they're here in the document for you. I have the accuracies of the equipment and then what you do is you enter in the manufacturer's measurement from their spec sheets. It will auto calculate the range for you.

That's acceptable by adding the tolerance and the accuracy of the equipment. And then you enter in your measurements and this column here will tell you if it's yes or no inspects. It'll do that automatically. So this is fairly straightforward. You go in again, it's just a matter of finding the appropriate information, doing the test the right way, it could be very quick.

And that brings me to the very end. So this will conclude with a 15 minutes or so 14 minutes video tutorial of me going side by side with the verifit and the fry phonics system. And we'll take questions at that point. And I'll quick do a debriefing of how the new standard will alter what you see in the video when performing ansi test measurements on hearing aids. The setup and procedure is going to be a little bit different.

Depending upon whether or not you're using the fry system or the audio scan. Verifit one or verifit two for both of them. So in this case, we're testing a rick. And one of the important things when you test ricks is to make sure that the receiver is flush with the opening of the ha one coupler inside. All right.

It's not too far inside. It's just right at the opening there. And see how we have it sealed with putty. We're using an Ha one coupler with the fry verifit. We only have one measurement microphone.

So this microphone is going to serve as our reference for calibrating the box. Or what fry calls leveling. As well as making the ventral hearing aid measurements. So what we need, actually, is this dummy microphone. This microphone is what we call the substitution method.

What it's going to do is it's going to make a measurement with the measurement with the microphone. Near the.

Near where the hearing aid microphones are. Should be about one to 2 mm within the hearing aid microphones. And what this is doing is it's going to calibrate out of the measurement all of the local acoustic reflections associated with this particular setup. And this is something for pure measures. If you're doing this for ANSI test, you really should be doing this as be using that dummy microphone.

And then leveling every single time. For practical purposes, oftentimes you can level once and then save the settings. So what's going to happen is the setting is going to go ahead and be saved once you perform the measurement. That's what the substitution method is for our anti test. We're going to go ahead, we're going to use the dummy microphone again.

And what we're going to do is we're going to make the measurement. And we're going to switch the placement of the two microphones, close the lid. And remember, the thing is, the loudspeaker in the box is facing this way. So we want to face the hearing aid microphones that direction. We latch the lid and we go ahead and press the level button.

And it tells us that we are leveled to prepare ourselves for the ANSI measurements. What we need to do then is very carefully take out the dummy microphone and place it where the measurement microphone was. Hence the substitution method. What it's done at that point is it saved that measurement. It's going to take off all of the local, the resonances associated with the setup out of our feature references measurements, which is why we want to keep the setup exactly the same.

Now we are set for our ANSI test. Now we have the other hearing aid of this match in the verifit. And the verifit uses a method of modified pressure method, and it does it concurrently as the measurements being made. That's the purpose of this microphone here. It's the reference microphone, and what it's doing is it's measuring the output from the loudspeakers to ensure that the level at each frequency is where it needs to be at the point of the hearing aid microphones, which is why again, we put this microphone within about one to 2 hearing aid microphones.

The whole purpose of this, if we know precisely what the DBS pl of the input is, and we measure very carefully the DBS pl of the output, then we know exactly what the hearing aid is adding to the signal. Hearing aid does need to be within this box here, and the speakers are at two different angles. If you're doing a directional test, we ask if there's special directional test mode, in which case this is the front speaker. So you'd orientate the hearing aid microphones, the front and back, so they line up with this speaker. However, this test can be done in omnidirectional microphone, so we can face in the fact that this is a left hearing aid.

So it just naturally lies this way. I had a very difficult time facing it towards this left speaker. So I'm facing it towards the right speaker. The microphones are aligned that way.

Now to get our two systems into test mode. So within the verifit, or, sorry, the phonics, what we're looking at is ANSI 2003, not much different from the 2009 2014 reaffirmed. So we just go ahead and press the f three button. We are ready to go with the verifit. We're going to go to test our test box measures, and we are doing an ANSI test.

Okay, now, the only way to do this precisely is with these advanced digital hearing aids, is to get in the manufacturer's software and every manufacturer. It's a little bit tricky to find where the settings are to do the ANSI test within each manufacturer. I've gone ahead, I've done the work. I've created a little cheat sheet for every manufacturer on how to easily find those settings to get into ANSI test mode. For some of them, you can do this right up on the start screen.

You don't need to enter in a patient or their audiogram or start a fitting for most of them, however, and those are quite easy, it's just the splash screen goes up and you can go ahead and get into test mode right away. A lot of these you actually go ahead and have to actually load a client, get into the fitting mode, and then you have to know right where to click, which is where the cheat sheet comes into play. In this one, it's done at advanced tools. We're already in the fitting mode. And here we are, we're hearing aid test.

Hearing aid test. Now, here's our different settings. The first test we run is full on gain.

And the thing is, all of them really should give you this warning about, this is the loudest the hearing aid will go. And so definitely would not ever want to make sure that

you're running this in the patient's ears. Some of the manufacturers will create a temporary program, so if you lose the connection, you're back at how it was last programmed. For some of them, you actually have to go ahead and dump a temp. You save a program onto the hearing aid.

And then the thing is, you have to remember to put the, restore the patient's original settings back onto the hearing aid. Okay, so we have our warning. We're going to go ahead, click through that. Now we're going to start with the fry system. It's all ready to go.

Very easy. Just press the start button.

All right, remember, this is OSPL 90 outputs to DBS Pl for a 90 db input. So diagnostically, what you want to look for, it's 90 db in. What I sometimes see is when the hearing aid is disconnected or it's muted, you're going to see something at 90 db or a little bit less. Because remember, it has to come through this. The hearing aid is muted or it's off.

It's lost its connection. You got 90 db coming out here, and you're going to be picking up something around 90 or a little bit less. And it's just going to be coming through the measurement microphone without actually ever going through the hearing aid because the hearing aid is off at that point. So diagnostically, this line should be really above 100 or so, 110, 105, 115, depending upon the power of the hearing aid. So you want to make sure this is high enough that the other thing is, remember, there should be about a single resonant peak at about two to three khz.

So this is nice and smooth. And we get this roll off. Let's go ahead and do this for the barefoot nice and smooth. And I'll tell you what, this is in just a little bit. That was a smooth, single resonant peak and output dbspl.

Similar to the phonics. They are a little bit different. Sometimes that makes it a little bit tricky, because depending upon which system you're using, might be in specs in one and not on the other. All right, so what this is telling us, both of these are telling us in two different methods, is that we have to put the hearing aid at reference test gain. Remember, reference test gain is the amount of gain that's needed to bring this OSPL 90 curve at the high frequency average, the three frequency average down by 17 db.

And this is telling us where we need to be in order to achieve that. This is telling us the same thing with the visual display and what we want. If we're too low, this arrow is going to be down here and pointing up. Really what we wanted is zero there. In the old days, we'd have to do this by manipulating the volume wheel on the hearing aid.

With the manufacturers, it's pretty simple. They usually have a setting for reference test gain. They may call it user gain. We prefer reference test gain if it's available to us. And again, we're going to see a difference with the manufacturers because a lot of the manufacturers will just give you one setting, you press reference test gain and that's it.

You can't do anything. Whereas with some of these, like Starkey here, in this example, Signia, a few others, you have the ability to go ahead and adjust the gain. So let's go have a look here. This actually puts us really close here within about a db of where we need to be. Sometimes you're off a little bit and you need to go in the software and you need to bump this up or down a little bit if it's available.

Sometimes it's not. Look at this. Here we are with the verifier. So both systems are ready to go. Reference test game.

Okay, we're going to go back to our phonics. Press start. It's ready to go.

Okay. And it's done. What you're going to do is you'll be comparing these measurements, then comparing them against the specs the manufacturer did in their factory. And add the tolerance of the equipment. You have to add the equipment.

If those two are within the range, then the hearing aid is within spec. So it's the measurement that you measure plus the accuracy, if you will, of the equipment and the tolerance of the standard. Go ahead. And we do it on the verifit in shape, but they have still have that same high frequency roll off. And again, the thing is, what the reference test gain is, is the amount of gain that's needed to bring this line 17 db down from the high frequency average of the OSPL 90 curve.

The other interesting measurements you look at here, we got our equivalent input noise, 24 db. We have our harmonic distortion over here, measuring maybe just slightly more harmonic distortion. But it's certainly, once you add the tolerance and the measurement accuracy of the equipment, it's going to be within specs and very close measurements. Sometimes you get different measurements depending upon the equipment. I tend to find that you tend to get higher noise measurements with the verifit, probably due to the difference in the latching system.

Because if there's any sort of impulse noise or vibration that can be picked up within the box and be picked up and recorded as equivalent input noise measure or noise. So just any sort of outside noise, even low frequency vibration that you might not think of can go ahead and contaminate the measurement. Sometimes you get really relatively, these equivalent input noise measurements will be out of specs. And sometimes it's due to the fact that even when the hearing aid, you tell the hearing aid to put it at fancy test settings, there's still some adaptive features that might be left on, including an expansion, which has been argued be one reason why some of these hearing aids may fail by a few DB on their equipment input noise measure. All right, so now we are done.

Thing is, you got to remember, you want to put it at the user settings.

And that completes the ANSI test.

Okay, this point I'll go ahead and open up for questions. I'll actually do just a brief, quick debriefing. So what we might expect with the new standard house, procedurally, that initial calibration would be different. Actually, with the fry box, it'd be very similar to how I showed you that second time. We just have that one measurement microphone in place.

You hit level. The key thing there is you want to make sure that those hearing aid microphones would then still be in place or at the exact position with the reference test position as the measurement microphone. With the verifit system that has the two microphones thing, there is you have to remember one. Well the idea here is we'd have to remove that reference microphone after we calibrate again. The uncompensated calibration method is probably going to be the preferred method where you just have the one microphone in the box at the time you calibrating the sound source as well as the acoustics of the test box at that reference test point.

And then again you would unplug the reference microphone and then proceed accordingly. Okay, so I do see a few questions in the Q-A-I use a Medrex hitbox. I have problems with the wireless hearing aids. Loose. Oh yes.

Losing connections with the No link wireless and programming software. The test and test box. Any suggestions?

Yeah, so this is, I guess I'm assuming so the NoA link, is that not the lower link wireless because we're using Bluetooth. The NoA link wireless, it's still Bluetooth, but it's a Bluetooth low energy. I would expect that to have a better connection than the NoA link

per can't. And I know because the isolation, the acoustic isolation of some of these boxes is enough to really block the wireless signal. And I know that was a big problem with some of these wireless programmers that we'd have with the neck loops and stuff and then you could never adequately close the box.

Yeah, I'm not sure I have solid suggestions with regard to that one.

Is there a place to find the tolerances for reference testing? I would assume.

I would assume that the tolerance for reference testing should have been within. Oh yeah, I'd have to check them within the specification. I will have to get back to you on that. How close does it actually need to be? That did cross my mind as I was doing a hand wavy explanation of it.

I'm not sure if it actually my understanding. I think it's informative. Meaning I don't think you're going to find tolerances around it, to be honest with you. I'll just say as a rule of thumb, be within a couple of DB, to be honest. But I think it's an informative measure that there is no tolerance associated with you.

That's an excellent question by the way, because it did cross my mind as it was playing access to the videos. I can probably post it, maybe up on YouTube or something. The go to place would be somewhere off my lab website, which should be hard to find. Also the videos from this presentation will be available. An excel sheet for Callisto.

I'll have to look into that. I'm not familiar with Callisto. So maybe Google Docs. There's some online versions that I'm sure that if you don't have, but you can probably import it into Google Docs. There's some free online converters for that.

But I appreciate if you don't have the office, Microsoft office, maybe I can quickly put a link to put it into a Google Drive document.

We do these tests daily and cannot find. Let's see. Can I get more of the response there?

What are some of the differences in the 96 three? Yeah, I tried to skip all of the historical stuff about the evolution of the standards because it did kind of go back in terms of the 96. And three were, I think, more hyper vigilant with digital technology, with measuring attack and release times and the compression circuits, about putting the hearing aid at what particular settings that the hearing aid needed to be put at, as well as the directionality.

The 14 version is the one that I was speaking to, but we don't run, like I said, they're in the annexes, if you will. They're optional tests one could use for compression and stuff. But I think the movement there at the time was just to try to get something that's getting more towards performance and really how these things might be working in the real world with, at the time, WDRC circuits. And right now, like I said, it's quality control. If we could just eliminate all of the signal processing in the middle, focus on what's happening with the transducers, the most sensitive parts, I think, to the environment that would be most susceptible to damage.

Can we get a better idea of the frequency response range? Really represents the frequency range that might actually be heard by the client. Well, I'd say your real ear measures would do that, to be honest. Now, the thing is, you go, well, if you don't have the real ear, and I want to have a better idea before maybe I order the hearing aid, I would actually have to say then that'd be trial and error. Using real ear measures, kind of get the best idea because every audiogram is going to be a little bit different.

Right. As well as the ear acoustics in terms, especially if we're thinking about those high frequencies, that's where you can get a lot of individual ear variability. So even if we had a standard model, a chemo or something, I think that would be difficult to really give a solid number for a particular patient in mind. Suggestions for the T coil test? The T coil is in the ANSI standard.

I don't have any specific suggestions. I don't see any real strong modifications coming out of this new standard from what we did? The only real difference there is the input signal. The input signal coming from the telephone simulator. Place the hearing aid horizontal, do the measurement.

And then the other one is, if you'd simulate is for induction loop, in which case the measurement is made vertical. There's not a lot in the standard, the gross details we had discussed. So that would be something that could be readily shared if need be.

Wow, that's like perfect timing. So I thank you today for your attention. I know, I'm very pleased at the response I've had today. I know, again, this topic could be a little bit thought to be maybe not relevant to today's practice, to today's hearing aids, but hopefully I convinced you the value of doing this. I'll just kind of give a quick summary.

Even if you're not doing this on every hearing aid coming in, certainly when you get a hearing aid that you think is going to go in for repair, whether you repair it yourself or you put it through a drying system, what is the status of that? And then I think the big thing for me would be, is if I'm going to send this hearing aid in for repair or I'm going to give it back to the patient, have I actually really fixed the problem? Doing your anSi test and comparing them to what the manufacturer did on day one will give you a really good idea if you really have a real problem with this hearing aid, if it needs to go in for repair. Okay, well, thank you so much. And again, I'll try to post some of the extra information, make it available on my website.

If not, shoot me an email. I'm not hard to find, and that's it.