

# The Ultimate Midrange Shootout

## 16 Pairs Of World Class Midranges Tested!

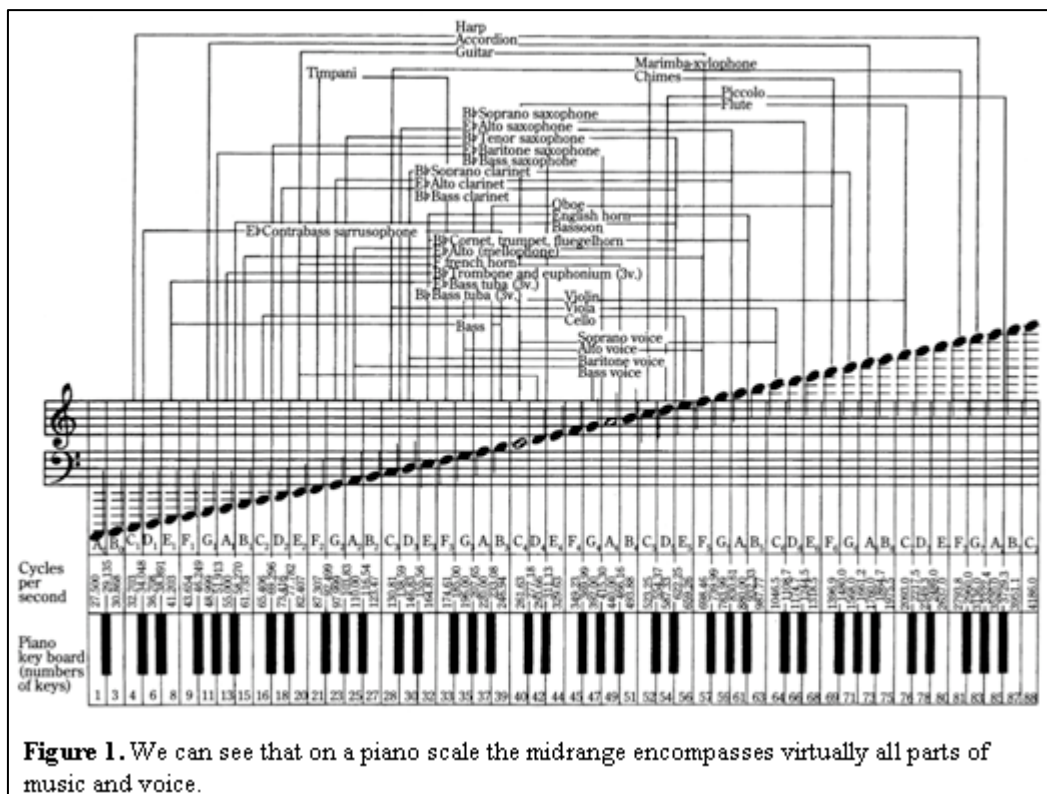
By Jerry Niebur

What is the best midrange? That is the question we set out to answer when starting this test, but some of you may be asking a more basic question, “Why would I need a dedicated midrange?” Midrange = body, soul, substance; meat & potatoes, ice cream in a sundae ... well, you get the idea. The midrange is hyper critical in the reproduction of music, and as for all intent and purposes we can conclude it is the heart and soul of the music (*Figure 1*).

Achieving a high-end, accurate and audiophile-worthy sound reproduction is possible in a two-way system set up, but a dedicated midrange in a three-way system can do wonders for precise sound replication. The dedicated midrange alleviates the midbass and tweeter from these strenuous frequencies allowing them to optimize the reproduction of the frequencies for which they are best suited, while allowing a much more focused and holographic presentation of the entire frequency reproduction of the system. A large

majority of the highest regarded home loudspeakers use a dedicated midrange to achieve their reference level performance. Choosing the right midrange, one that is free of coloration and other frequency response anomalies is critical in system design. If the midrange is not up to the task, it can impart a negative effect and cause a smeared image, phasing issues, also causing group delays, thereby making its integration into the system difficult. Couple this problem with our beloved in-car environment and it could be disastrous. In the world of high-end car audio, a diminutive 3 – 4” midrange can transform a system and graduate it to reference level. These small high-end drivers allow ease of installation with their flexibility to be mounted above the dashboard, the A pillar, kick panel, or even free-air in the door. Today’s high-end DSP (digital signal processing) devices allow a high-end mobile system to finally rival a high-end home audio system.

The technology and small size of these compact “super-drivers” allows customization and flexibility to tune for the perfect sound. We were lucky enough to test 16 pairs of these dedicated midrange speakers to find out just what the differences were. If you are considering one of these products you will note that the ultimate performance will be attained with proper installation, including an optimal sized enclosure (Please reference Side Bar “What is Qtc?” on the perfect Qtc to achieve the ultimate in sound quality). After all, the midrange is the heart and soul of the music!



## BACKGROUND & TESTING CRITERIA

The test was born from the DIYmobileaudio.com forum. This engaging and wonderful forum includes members who are some of the most helpful and knowledgeable experts in the world of mobile audio. Its membership is diverse and includes industry professionals, do-it-yourself hobbyists, and even high-end home and mobile audio dealers. The main questions that spawned this massive undertaking were: "Is price point really indicative of quality in sound reproduction?" and "What are the highest performance drivers?" We needed questions answered and I had to take the challenge. I am an avid believer of dedicated midrange drivers and have used them in numerous different systems. I remember adding my first pair of midranges and recall what a wonderful transformation they made to my system.

When we embarked on this journey to test 16 different pair of midrange drivers, we were given advice (too numerous and varied to mention) by helpful members of the audio community concerning the appropriate way to implement the testing. Some of it was logical and helpful - some of it simply pointed out the limitations of trying to do such a test. All of it helped us to focus in on the best test we could design. The best and most fitting comment was "ARE YOU GUYS NUTS? THIS CAN'T BE DONE!" Truth be told, this test caused many sleepless nights but with proper methodology and design to prevent errors in testing, we came up with an excellent method.

## FINAL TEST METHODOLOGY

(For all those who want to flip to the end and just view the results, WAIT, you cannot properly understand the results without understanding the parameters under which the speakers were tested.)

### Purpose:

The purpose of this test was to compare the sonic differences between various midrange speakers by utilization of the test methods as outlined below.

### Testers/Judges:

Jerry (Niebur3): Male - Age 34

Nichole: Female - Age 31

Alex (Remeolb): Male - Age 28

Janet: Female - Age 60

Gerald: Male - Age 60, did not participate in the speaker judging, because of possible high frequency hearing loss

None of the testers have any product affiliation or employment with an audio manufacturer.

- Jerry, competing in competition car audio off and on since 1994 and most recently placed 5<sup>th</sup> at the 2009 USACi World Finals in Consumer "Q".
- Nichole has competed with Jerry, and helps tune the sound system in the competition vehicle.
- Alex owns a high-end home audio store and is currently building a competition vehicle.
- Janet was an IASCA and USACi competition sound judge for two years.

### What is Qtc?

Q is defined as the ratio of reactance to resistance (series circuit) or resistance to reactance (parallel circuit). Qtc is defined as the total Q of the speaker system at the resonant frequency of the closed box system, including all system resistances. Certain values of Qtc provide specific response characteristics. For instance, a Qtc of 0.5 is considered "critically damped", while a Qtc of 0.707 is considered to provide optimum transient response (fastest rise response with minimal settling time), while a Qtc greater than 0.707 is considered under damped. Maximum power handling occurs at a Qtc of 1.1, and a Qtc greater than 1.2 is rarely used and generally considered undesirable. Vance Dickason proves insight regarding the effect of Qtc on the subjective sound quality, "High Q's in the vicinity of 1 tend to have a warm, if somewhat robust, quality that audio marketing people describe as "saleable". Lower values around 0.8 sound more detailed (due in part to improved transients) and, by comparison, somewhat shallow. Qtc equaling 0.5 is usually regarded as excessively taut and over damped." Some authorities, however, still consider this value (0.5 - 0.6) to be optimal. For the purposes of this test, we chose a consistent (and relatively non-controversial) Qtc of 0.707 for all the drivers tested.

References: Vance Dickason, The Loudspeaker Design Cookbook, 6<sup>th</sup> ed., Audio Amateur Press, Peterborough, NH, 2000.

### Testing Procedure:

The procedure involved blind listening sessions and technical measurements of all the drivers. The blind testing of all the drivers was implemented on two separate occasions - two weeks apart to ensure no outside factors, such as stress or fatigue, affected the results. The speakers were covered with acoustically transparent grill cloth so that none of the blind listeners could see the speakers and the testers had to leave the room for each speaker change. Gerald was responsible for changing the drivers for the testers. The drivers were assigned a random number and a control driver was also chosen at random and implemented throughout the testing session to validate the tester's ability to accurately rate each set of drivers. A different control driver was utilized during the two testing sessions and all testers consistently identified the control driver at random intervals during the testing, thereby validating the listeners accuracy and repeatability. The testers were given score sheets to judge the speakers based on various aspects with a section to write down thoughts and opinions. Each set of speakers was evaluated for approximately 25 minutes during the listening portion of the test. Jerry performed all technical measurements of the drivers using the WT3 Woofer Tester by Dayton Audio.

### Drivers:

*All drivers in this test were donated by DIYMA.com members with their DIYMA member names in parentheses with the exception of the Hybrid Audio Technologies L4, which was provided by Scott Buwalda, CEO Hybrid Audio Technologies, Inc. In statistical theory this would constitute a true random sample.*

### Drivers Tested: See Figure 2:

**Alpine** F#1 (Jimbn01)  
**Aura** NS4 (MiniVanMan)  
**Dayton** RS100 (MiniVanMan)  
**Dayton** RS125 (MiniVanMan)  
**Dynaudio** Esotar2 430 (Niebur3) - Tester  
**Hustler Audio** Trinity (MiniVanMan)  
**Hybrid Audio Technologies** L4 (Scott Buwalda)  
**Hertz** HL70 (Pork Soda)  
**Morel** CDM88 - (Remeolb) - Tester  
**Peerless** Exclusives (Jimbn01)  
**Pioneer** PRS (Jimbn01)  
**Rainbow** Profi (6spdcoupe)  
**Rainbow** Vanadium (6spdcoupe)  
**Scan Speak** 12M (Lycan)  
**TangBand** W4 (MiniVanMan)  
**Vifa** NE123 (Niebur3) - Tester

### Audio Delivery:

Amps – Tru Technology Billet B475-DS Stage 3  
Transport – Pioneer DEX-P9  
Processor – Pioneer DEQ-P9  
Interconnects – IXOS Ixotica  
Speaker Wire – IXOS Gamma  
RTA - AudioControl  
Power Supply – Cascade Audio



**Figure 2.** This picture shows all the test drivers as they arrived.



### Electronic Speaker Environment:

How did we choose this passband? We debated long and hard about the passband that would be fair, unbiased, and appropriate to obtain the most meaningful data and results. It was obvious that all of the midrange drivers must be evaluated over a consistent range of frequencies. If not, the results would likely be skewed in favor of those drivers capable of operating over the widest range of frequencies, potentially masking other important parameters such as timbre, transparency, and detail. Clearly, the basis for choosing a midrange driver does not depend solely upon its frequency bandwidth capabilities.

The high-pass crossover frequency was chosen using the following thought process. First, the resonant frequency of each of the 16 driver/box systems was calculated (using a  $Q_{tc}$  of 0.707 for reasons already explained). These frequencies ranged from 84 to 261Hz. Since conventional loudspeaker design utilizes drivers that operate at least one octave above their resonant frequency, the high-pass frequency was chosen to be 500Hz (one octave above 261 would be 522Hz). At first glance, one may question this choice. It would seem that this choice would unfairly negate the advantage of those drivers that play lower in frequency. On the other hand, why unnecessarily "punish" a driver designed to play a bit higher throughout the midrange by forcing it to operate too close to its resonant frequency? In actuality, this choice of high-pass crossover frequency would place fewer demands (lower excursion, lower inter-modular distortion, group delay, etc...) on those drivers capable of playing lower frequencies, therefore be expected to play more accurately above the high-pass frequency chosen. In simple terms, these midrange drivers would be "coasting", while those drivers operating closer to their resonant frequency would have greater demands placed upon them.

The following factors were given to the choice of low-pass crossover frequency. First, it is known that all drivers begin to narrow their dispersion of sound, or "beam", at higher frequencies. The frequencies at which they begin to beam is related to their cone diameter. This phenomenon is an inescapable fact in physics, and cannot be engineered out of speakers. The generally accepted rule-of-thumb for permissible levels of beaming, is a loss of 6 dB at 45 degrees off axis. *For midrange drivers approximately four inches in diameter, this equates to about 4238Hz. Vance Dickason states that this value can be exceeded by at least 10% without a substantial loss in degradation.* This results in a theoretical maximum use frequency of 4661Hz. However, in order to extract as much of the useful musical range from the drivers, a low-pass crossover frequency of 6300Hz was chosen. It was believed that this relatively high choice of frequency would test each of the drivers for cone breakup, which is important and extremely detrimental to midrange driver performance.

With regard to high and low-pass crossover slopes, the choice seemed easy. First-order slopes introduce the least amount of phase shift ( $\pm 45$  degrees at the crossover frequency). Higher order slopes introduce more phase shift at the crossover frequency ( $\pm 90$  degrees for second-order,  $\pm 135$  degrees for third-order, and  $\pm 180$  degrees for fourth-order). It is known that proper crossover design depends upon the proper use of complimentary pairs of crossovers. Because the proper execution of this test used high and low-pass crossovers, it was required by default to use a crossover slope. Therefore, the slope that implemented the fewest number of artifacts, first-order, was chosen. Of course, this choice resulted in greater demands on each of the drivers in their out-of-band operation, but this was viewed as an appropriate advantage for identifying anomalous and unwanted behavior.

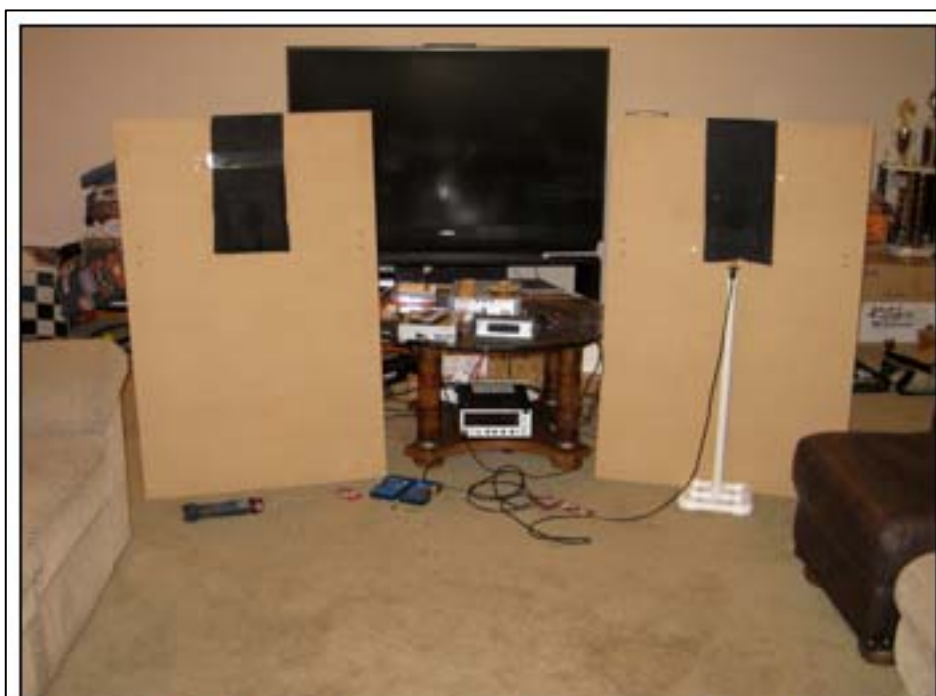
The speakers were tested in the pass band of 500Hz and 6.3 kHz with a 6dB/octave crossover slope. When performing subjective listening evaluations, proper level matching is vitally important. Industry experts generally agree that components under evaluation should be level matched to within 0.2 deciBels (dB). To ensure that all speakers were precisely level matched, an AudioControl real time analyzer (RTA) was used to verify the volume of the each speaker tested. The RTA's microphone was positioned eight inches in front of each speaker to measure the total sound pressure level (SPL) while pink noise (20 to 20k Hz, Focal JM Lab Tools CD, Track 2 – Pink Noise –Ref -14dB Fs) was played. The volume of each speaker was precisely adjusted until its total un-weighted SPL was  $105 \pm 0.2$  dB. While 105 dB may seem like a high sound pressure level, it is important to realize that this measurement was taken eight inches from the speaker. This volume, essentially at the speaker, was derived from considerable experimentation and evaluation before the test began.

The panel of testers unanimously agreed that the volume chosen for this shootout was ideal for evaluating the subjective sound quality of the speakers. The entire panel agreed that the volume at the listening position was sufficiently loud to discern differences between speakers but not too loud to cause listening fatigue. It is also important to note that no equalization was used and no other speakers (tweeters, woofers, or subwoofers) were used in conjunction with the midrange speakers tested. We did not add any equalization or implement any other speakers (i.e. tweeters, midbass or subwoofers).

*Reference: Vance Dickason, The Loudspeaker Design Cookbook, 6th ed., Audio Amateur Press, Peterborough, NH, 2000.*

### **Physical Speaker Environment (see Figure 3 – leather ottoman was removed during listening test):**

The speakers were tested in a controlled listening environment in a large carpeted 19x25 ft room with a 9 ft ceiling. Soft, absorbent materials were placed to both sides of the baffles at approximate points of early reflections, in an attempt to minimize their influence on the testing. We decided not to test the speakers inside a vehicle because a large room is the ideal setting and each car has its own unique issues and tuning difficulties. Conducting the test inside the car would not have produced a much larger variation in results and would have only revealed, at best, the ideal speaker for that particular vehicle. The speaker baffles were placed 7 feet away from the testers seating position. Each tester was seated in a



**Figure 3. This picture is of the physical testing environment.**

fixed position with Janet and Nichole on the ends and Alex and Jerry in the more ideal seating positions. However, the women judged each speaker from the same seating position so as not to bias their results. The speakers were placed 8 ft from the wall behind the baffles, 7 ft from the side walls, and 17 ft from the walls in front of them. Each of the speakers were mounted on  $\frac{3}{4}$ "-thick wood baffles, approximately 33" wide by 48" tall as shown in Figure 3. Each speaker was modeled in WinISD (a box modeling program) to determine the enclosure size required to achieve a speaker  $Q_{tc}$  of 0.707. After the results for each speaker were recorded, it was determined that two specific enclosures were needed. We constructed a large sealed enclosure (.33 ft<sup>3</sup>) to emulate an infinite baffle application and a small sealed enclosure (.053 ft<sup>3</sup>). The speaker boxes were constructed from  $\frac{3}{4}$  inch wood and mounted to the  $\frac{3}{4}$ " front baffle in an airtight manner using gasketing foam.

### **Test Music:**

A test disc was derived from music requested by each tester. The selections covered a large range of various types of music, including: "Don't Speak" by No Doubt, "Just To Get High" by Nickelback, "Uninvited" by Alanis Morissette, "Smooth (Feat. Rob Thomas)" by Santana, "The First Taste" by Fiona Apple, "I'm Yours" by Jason Mraz, "Spoon" by Dave Matthews Band, "Carnival" by Natalie Merchant, "9 Crimes" by Damien Rice, "Trains" by Porcupine Tree, and "Round Here" by Counting Crows. All music was transferred to a single test disc using Apple Lossless file encoding to ensure CD quality sound.

### Electrical Testing:

All speakers were individually tested in free air and a single driver was tested in the listening test enclosure using the WT3 Woofer Tester. During the free air test the drivers were tested basket side down on the kitchen table. The 1k Ohm reference resistor was provided with the tester and was used to calibrate the tester and the leads were calibrated as instructed by the WT3 manual before the test. The WT3 tests the speakers for the following Thiele/Small parameters:

**Re** – Measured in ohms ( $\Omega$ ), this is the DC resistance of the voice coil.

**Fs** - The frequency at which the combination of the moving mass and suspension compliance maximally reinforces cone motion, called the resonance frequency, measured in hertz (Hz)

**Qts** – Total Q factor. A unitless measurement characterizing the combined electric and mechanical damping of the driver.

**Qes** – Electrical Q factor. A unitless measurement describing the electrical damping of the loudspeaker.

**Qms** – Mechanical Q factor. A unitless measurement characterizing the mechanical damping of the driver, that is, the losses in the suspension (surround and spider.)

**Le** – Measured in millihenries (mH), this is the inductance of the voice coil.

**NOTE: The “% Difference” as noted in the chart of the measured Thiele/Small parameters is the percentage difference between “Measured Speaker 1” and “Measured Speaker 2” as tested in free air. This percent difference suggests consistency in the manufacturing process as the speakers were a random sample from the general population.**

### RESULTS

Ahhh, yes. On that note, I will dive right in to the 1-16 rankings of all the speakers tested. Wait, you didn't really think it would be that easy, did you? We decided long ago that we would NOT be ranking the drivers from 1-16. Why? The main reason is each tester had a slightly different final ranking of all the speakers with the *only exception* being the top 3 and bottom 2. With that being said, we came up with a 5-tier system for the final rankings.

**Tier 5** - The drivers in this tier came up very short of the expectations of this test.

**Tier 4** - The drivers in this tier performed below expectations.

**Tier 3** - The drivers in this tier performed fairly and would meet most audiophile expectations.

**Tier 2** - The drivers in this tier performed strongly and would exceed many audiophile expectations.

**Tier 1** - The drivers in this tier performed well above expectations and would satisfy the most discerning of audiophiles, REFERENCE LEVEL.

A few more notes regarding our scoring system. The scoring sheets were scrutinized after the test was over to make sure if two different speakers scored the same in a particular category, the comments backing up the score matched between the two different speakers. Also, as the testing went along, each tester comprised a ranking of the drivers based on overall impressions which was later analyzed and compared against the individual category scoring each tester gave for each speaker to ensure validity. The scores given to the speakers in the individual categories determined the final tier placement for each speaker. We will not divulge the actual scoring sheets used due to endless questioning of our testing criteria, but I can assure you we listened for the drivers that demonstrated the very best midrange qualities, including; tonal accuracy, detail, imaging, depth, etc.

The drivers appear in alphabetical order in the tier in which they were placed.

## Tier 5 – The drivers in this tier came up very short of the expectations of this test.

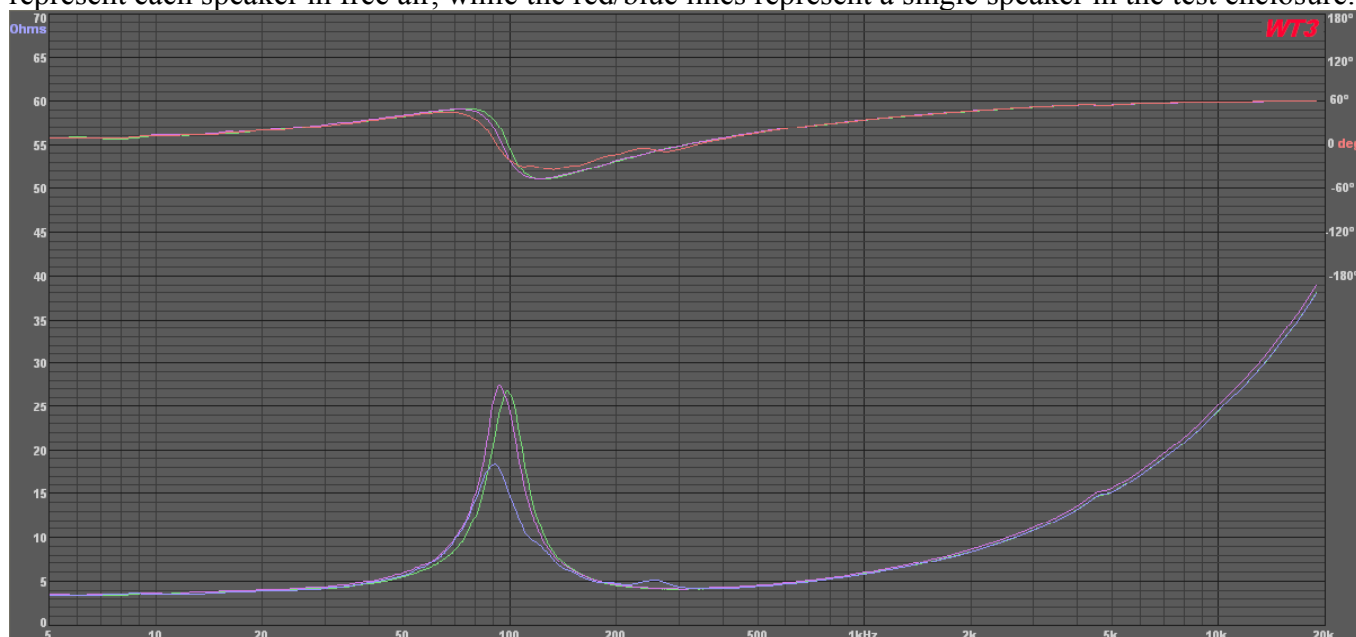
### Aura NS4 - \$62.40/pair MSRP – Tier 5

These speakers feature a silver aluminum cone with a black rubber surround and a NRT neodymium radial magnet system. The AuraNS4 is advertised as having very high excursion with very low distortion and is considered a wideband speaker.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Aura NS4	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size required for .707 Qtc	
Re	3.597	3.517	2.3%	3.6	3.631	Ft <sup>3</sup>	.055*
Fs	92.86	98.25	5.5%	66	90.17	Ltr	1.55
Qts	.6364	.6701	5.0%	.42	.6375	Fs (Hz)	113.68
Qes	.731	.7711	5.2%	.46	.7941		
Qms	4.919	5.118	3.9%	4.57	3.233		
Le	.3989	.3881	2.8%	n/a	.3881		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

My mom always said, “If you don’t have anything nice to say, don’t say anything at all”. If I took her advice, the review of this driver would stop right here. During our subjective listening test, we found the NS4’s to exhibit everything we don’t want in a high performance midrange driver. As a matter of fact, these were by far the worst drivers tested. The testers were in consensus that the NS4’s sounded muffled with very poor detail, making it virtually impossible to distinguish different instruments. These speakers sounded very heavy with no discernible depth in the sound stage. When listening to “Smooth” by Santana during the intro verse, Rob Thomas has an out of phase electronic quality which then changes back to his normal voice. With these speakers, it was hard to discern even this easily noticeable difference.

Final conclusion: This is one case in which we all would have chosen silence over having to listen to music on these drivers. All judges were unanimous.

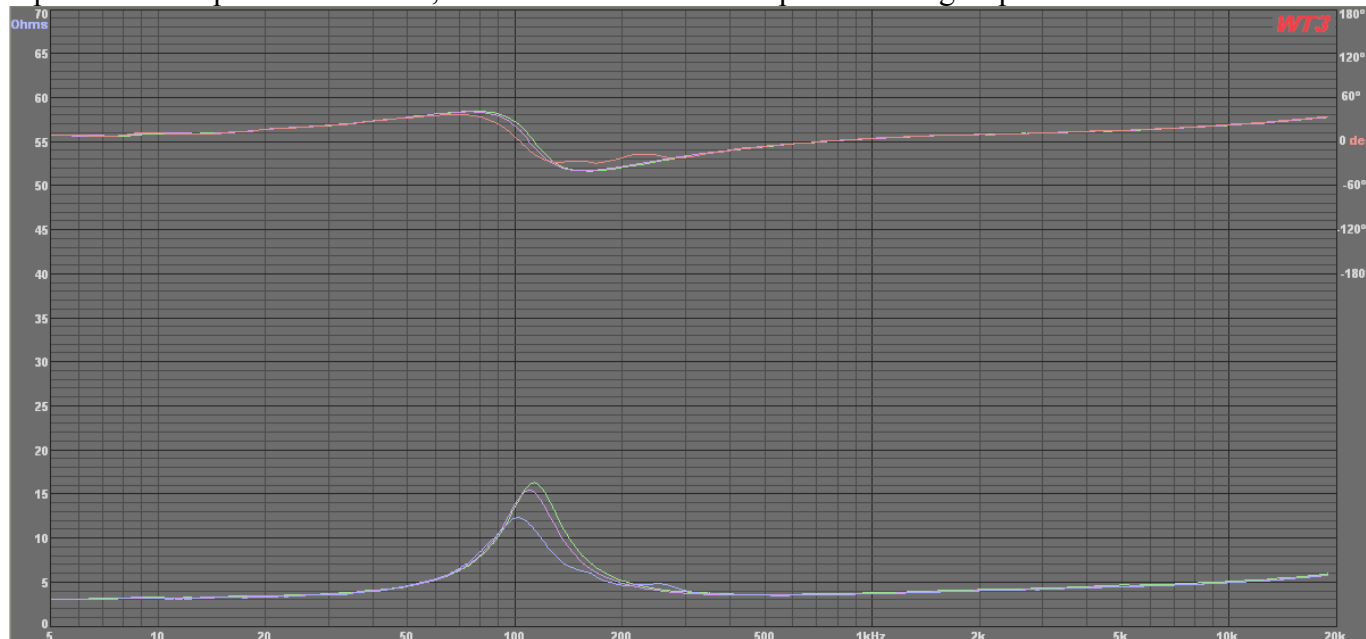
### H-Audio Trinity - \$229.00/pair MSRP – Tier 5

These speakers feature a titanium magnesium injected alloy cone with a die cast basket and a neodymium magnet. These are considered a wideband driver with a usable frequency range from 200Hz – 20kHz and one of the smallest diameter drivers we tested which aids in placement.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

H-Audio Trinity	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.188	3.042	4.8%	3.3	3.097	$Ft^3$	.038*
Fs	113	110.4	2.4%	95	101.6	Ltr	1.1
Qts	.5815	.5781	0.6%	.472	.5703	Fs (Hz)	145.5
Qes	.723	.7199	0.4%	.622	.7619		
Qms	2.97	2.935	1.2%	1.96	2.269		
Le	.0645	.0638	1.1%	n/a	.0628		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

It should be noted that the H-Audio Trinity are a 3-inch speaker in a 4-inch speaker test, which puts them at a huge disadvantage. During our subjective listening test, we found the Trinity's were lacking in detail and were unable to create an accurate listening soundstage. When listening, the testers noted that the music had a very flat musical quality despite being tonally accurate. Rob Thomas and Santana in "Smooth" sounded barely in front of the music, showing the speakers ability to create some marginal depth. Tonally, Gwen Stefani in "Don't Speak" sounded full and light and Alanis Morissette in "Uninvited" sounded tonally accurate. These speakers seem to have trouble when more musical information was present or during a crescendo.

Final conclusion: The Trinity speakers were tonally accurate but were unable to create any real feeling or emotion to the music, they were not overly detailed, and did not produce an accurate sound stage. An increase in the high pass crossover frequency or slope would seem to help.



#### Tier 4 - The drivers in this tier performed below expectations.

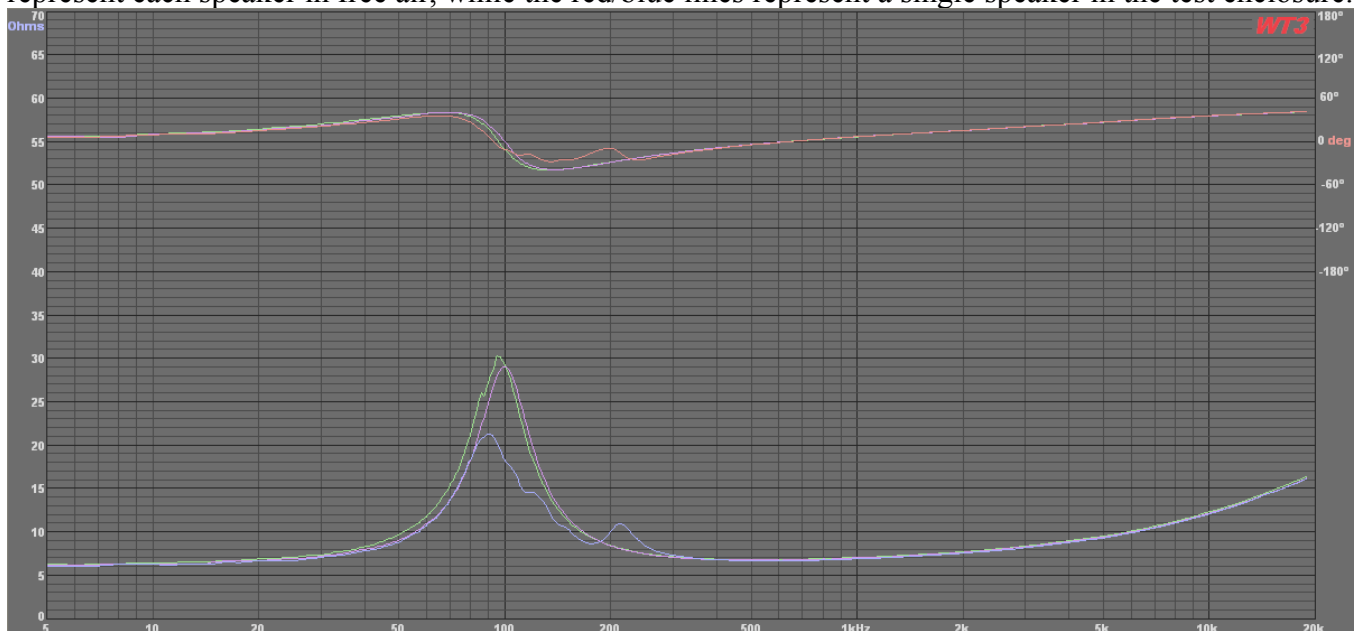
##### Dayton RS100 - \$69.98/pair MSRP – Tier 4

These speakers feature a lightweight black anodized aluminum cone, rubber surround, solid aluminum phase plug, and advanced low-distortion motor design. These are considered a wideband driver with a usable frequency range from 80Hz – 20 kHz. These are also one of the smallest diameter drivers in our test group.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Dayton RS100	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	6.154	6.105	0.8%	6.4	6.064	Ft^3	.09*
Fs	94.88	99.59	4.7%	82.5	89.5	Ltr	2.5
Qts	.6136	.6399	4.1%	.52	.6391	Fs (Hz)	115.5
Qes	.7702	.8101	4.9%	.65	.8937		
Qms	3.018	3.047	1.0%	2.75	2.244		
Le	.1719	.1687	1.9%	.73	.1676		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\* Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.

The Dayton RS100 is marketed as a 4-inch speaker, but seems smaller the most 4-inch speakers that were tested, which could have put them at a disadvantage. During our subjective listening test, we found the RS100's seemed more on the clinical side, as they were able to demonstrate a moderate level of detail but were unable to produce accurate depth and a musical soundstage. During "Smooth", Santana's guitar was thrown way to the background and sounded less like a duet between Rob Thomas and Santana. Some quotes from the testers score sheets include: "Sound very dead and lifeless" and "Music is very dead and flat". The higher midrange frequencies fared much better than the lower midrange frequencies, as those frequencies seemed very muted on most songs.

Final conclusion: The RS100's again seemed to suffer from size in this test. They were able to play with some detail but lacked richness and depth, sounding very dead and lifeless on most musical passages.

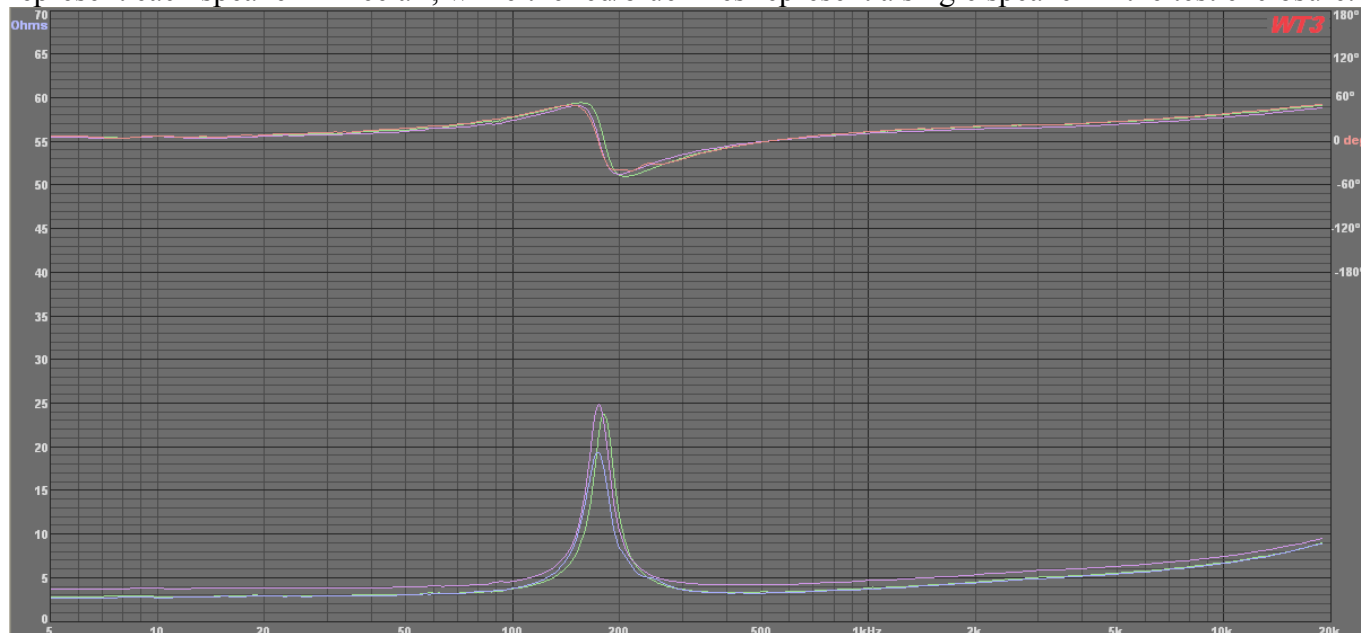
### Hertz HL70 - \$205.00/pair Internet Price – MSRP not found – Tier 4

The Hertz HL70 speakers feature a REN neodymium double magnet minimizing space requirements and insuring power and stability at high temperatures; its polypropylene cone and central phase plug provide smooth frequency response and tonal accuracy. They can be used as full range, central channel or excellent midrange in multi-way systems.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Hertz HL70	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	2.754	3.864	28.7%	3	2.685	$Ft^3$	.09*
Fs	181	174.3	3.8%	155	173.6	Ltr	2.55
Qts	1.05	1.348	22.1%	.95	.964	Fs (Hz)	165.47
Qes	1.187	1.594	25.5%	1	1.118		
Qms	9.04	8.725	3.6%	9.8	7.008		
Le	.0645	.0638	1.1%	n/a	.0628		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\* Based on the WinISD modeling, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.

The Hertz HL70 is another set of 3-inch speakers in a 4-inch speaker test, again potentially putting them at a disadvantage. During our subjective listening test, we found the HL70 to have a full and rich tonal quality that was very pleasing and enjoyable, however the speakers were lacking in detail, depth, and extension. These speakers seemed to do a better job recreating female voices than male voices for accuracy, again most likely due to the small size. Chad Kroeger's voice during "Just To Get High" normally has a very gruff quality that follows into the chorus, however, these speakers lost that quality and he sounded very light and poppy. The HL70 was unable to produce an accurate depth to the soundstage and testers noted that the instrumentation became overpowered, lost, and muddled.

Final conclusion: The HL70's also seemed to suffer from size in this test and they could potentially benefit from a pass band more within the speaker's intended range of operation. The lack of detail can be attributed to the pass band, but combined with the lack of extension and inability to create a natural soundstage, these would not be recommended as tested.

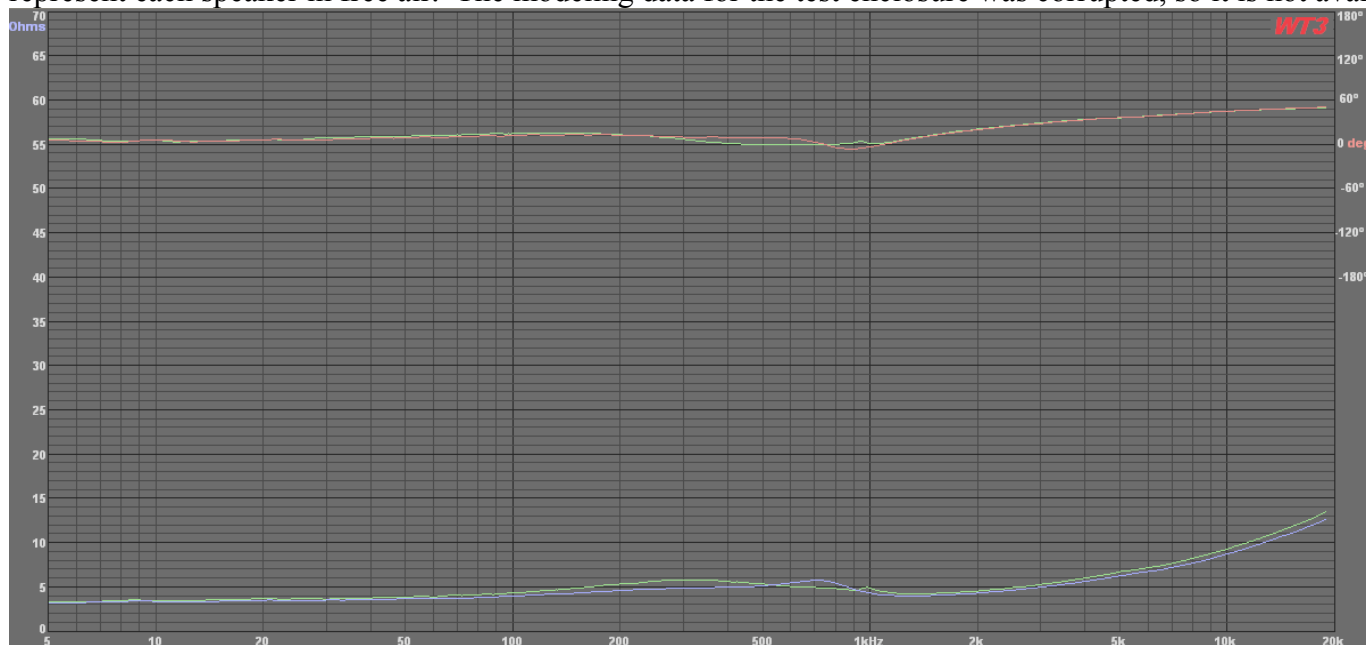
#### Morel CDM88 - \$399.99/pair MSRP – Tier 4

The CDM88 soft dome midrange features a large 54mm (2 1/8") diameter aluminum Hexatech voice coil that drives a soft dome membrane with a larger than normal sound radiating surface. According to the manufacturer, the CDM88 employs a C.A.R. Filter, providing an excellent acoustic loading while eliminating the need for a rear chamber. At only 3.5" in diameter, the CDM88 midrange was engineered to offer installers a small, high-quality midrange that can be easily installed in the dashboard or A-pillars for better sound stage and imaging.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Morel CDM88	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.921	3.448	13.7%	n/a	n/a	Ft^3	n/a*
Fs	293.4	391	25%	n/a	n/a	Ltr	n/a
Qts	.3634	.3558	2.1%	n/a	n/a	Fs (Hz)	n/a
Qes	.539	.5135	3.8%	n/a	n/a		
Qms	.539	.5135	5.0%	n/a	n/a		
Le	.1355	.1296	4.6%	n/a	n/a		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air. The modeling data for the test enclosure was corrupted, so it is not available.



**\*Based on manufacturer's specs, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.**

The Morel CDM88 should be noted as not only another 3-inch speaker but it is also the only soft dome midrange in the test. The CDM88's created a nasal quality to the voices while instrumentation sounded muted and muffled. The CDM88's struggled to create accurate soundstage depth and were lacking some in musical detail. In the intro to "First Taste" by Fiona Apple, you should be able to distinctly hear spit bubbles as she takes a breath and with these speakers, the spit bubbles sound very distorted and therefore makes it almost impossible to decipher what you are hearing. There were some high frequency detail aspects during songs, but the overall detail was poor due to the muted and muffled instrumentation. These speakers also had the overall

Final conclusion: In an application more suited for these speakers, you may achieve widely different results.

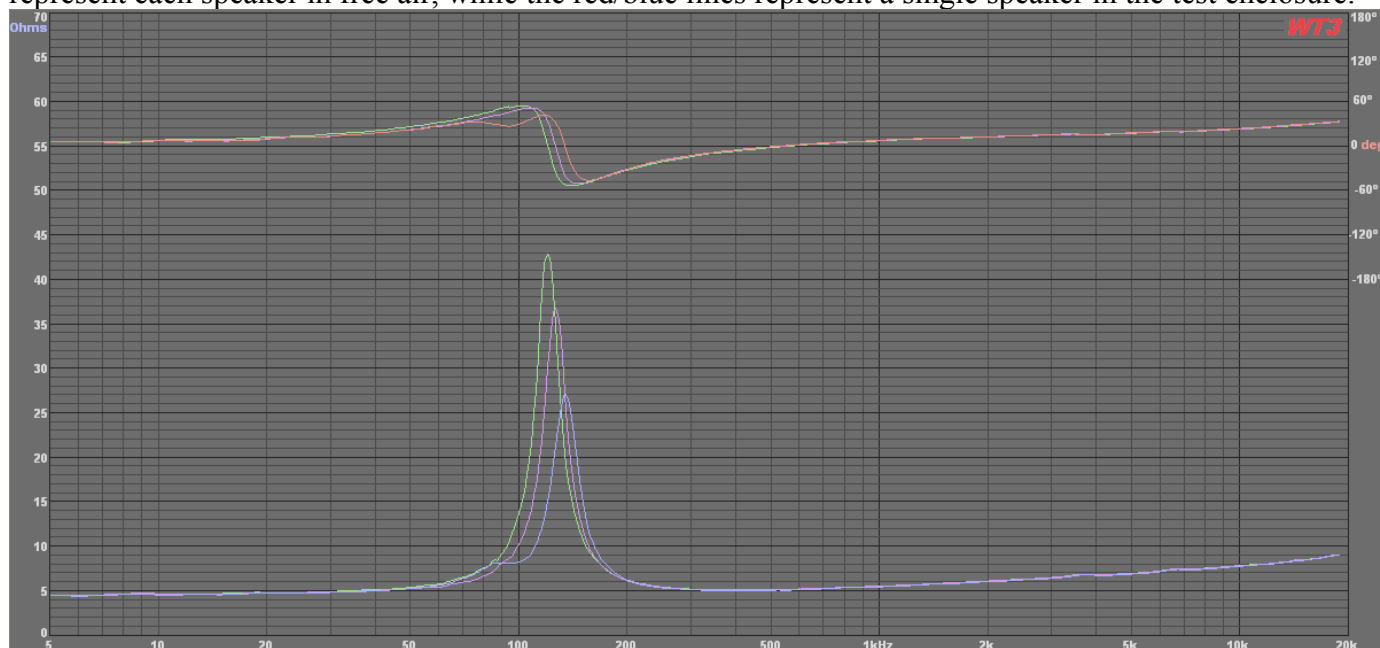
### Pioneer TS-S101PRS - \$n/a – Tier 4

This 10cm mid and high range Reference Series driver was designed to reproduce brilliant audio quality at high power input. It has a dual-layer composite cone made of Aramid Fiber and pulp, to make for a strong bend rigidity, whilst still being very light. This dual layer, which enables ideal sound reproduction in the mid and high range, also has a Micro Fiber Surround made of artificial suede – which is extremely light – so it also has a very low mechanical resistance.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Pioneer PRS	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	4.571	4.468	2.3%	4.6	4.538	Ft^3	.364*
Fs	120.5	126.5	4.7%	91	134.6	Ltr	10.3
Qts	.9443	1.053	10.3%	.7	1.243	Fs (Hz)	104.3
Qes	1.057	1.199	11.8%	.84	1.491		
Qms	8.842	8.683	1.8%	4.03	7.466		
Le	.1014	.1036	2.1%	.07	.1012		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\* Based on the WinISD modeling, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.

The Pioneer PRS speakers looked very attractive but sounded very dry and clinical. The speakers seemed to reproduce the male vocal range better than the female vocal range. In “I’m Yours”, Jason Mraz sounded tonally accurate, but still the overall sound was very lifeless and dead. In the beginning of “Don’t Speak”, Gwen Stefani employs the use vibrato, which these speakers were unable to reproduce. These speakers were unable to produce any real feeling or emotion in the musical selections and also struggled to produce accurate depth to the sound stage. The Pioneers were able to produce a moderate level of detail to the music, which was this speakers’ best quality, aside from the looks.

Final conclusion: Detailed but dry with not much more to offer aside from great looks. These are great to show off as long as the speakers stay off.



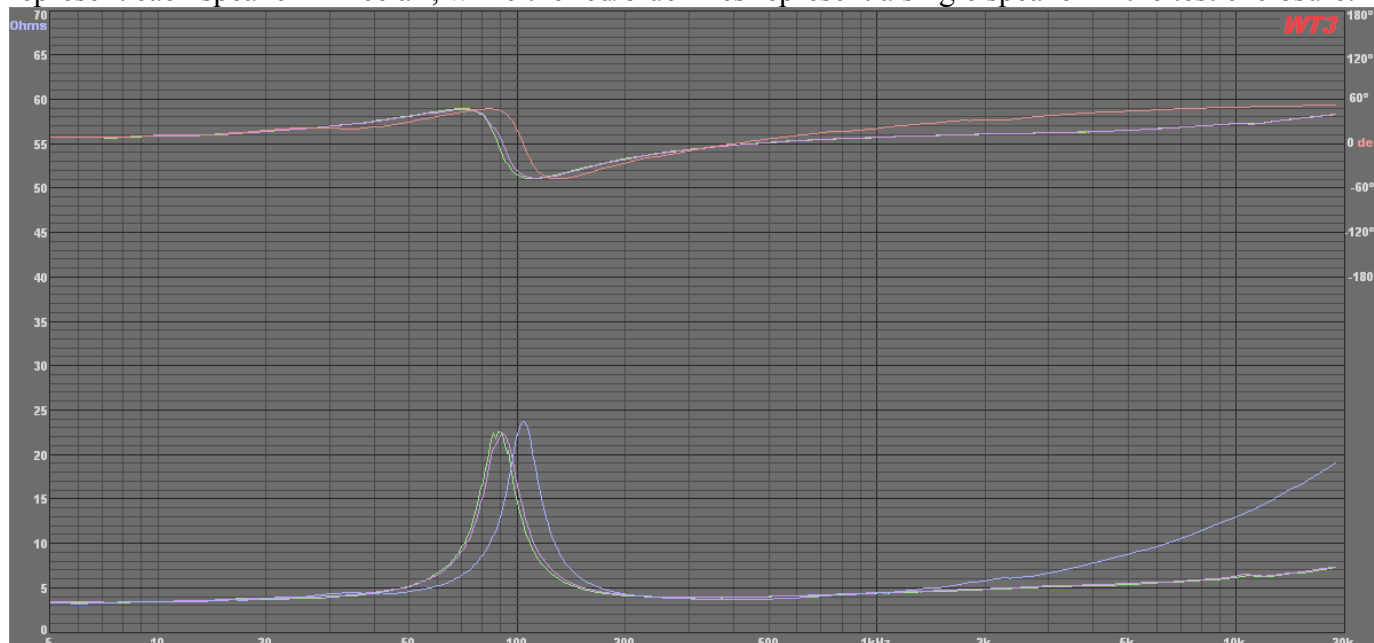
### Rainbow 100 Profi - \$314.99/pair MSRP – Tier 4

The Rainbow 100 Profi features special plastic compound basket with extreme stiffness for resonance-free operation, butyl rubber surround for controlled cone motion and low distortion, natural fiber cone for authentic and brilliant sound reproduction, innovative dust cap formed of reinforced natural fiber for optimal frequency response, and a vented magnet system for better magnet motor cooling, according to the manufacturer.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Rainbow Profi	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.353	3.211	1.0%	3.52	3.243	Ft <sup>3</sup>	.265*
Fs	92.86	90.84	1.5%	84	104.3	Ltr	7.5
Qts	.6924	.6471	3.5%	.61	.7609	Fs (Hz)	99.76
Qes	.7797	.7143	3.6%	.69	.8808		
Qms	6.181	6.872	3.3%	4.99	5.588		
Le	.2024	.2032	3.8%	n/a	.2027		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\* Based on the WinISD modeling, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.

Unfortunately, the Rainbow Profi sounded more like factory car speakers at times and less like quality replacements. These speakers seemed to have a very flat sound quality and were unable to produce much detail to the music. The testers commented that the speaker created an almost hollow quality to the music. The Profi struggled to produce an accurate soundstage with instrumentation overpowering the voices at inappropriate times. The only redeeming quality with these speakers was their ability to play male and female vocals with some sense of accuracy.

Final conclusion: As some mid frequency tones sounded good, there wasn't much to be desired.

### Tier 3 - The drivers in this tier performed fairly and would meet most audiophile expectations.

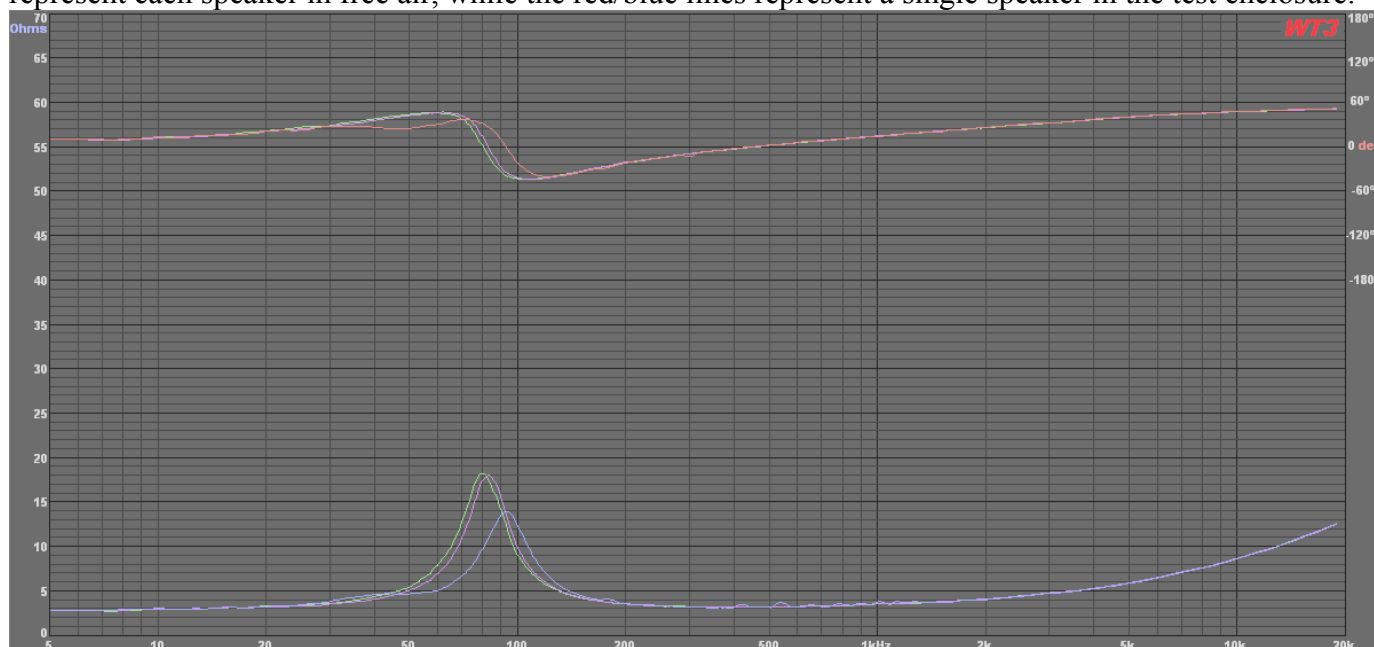
#### Dayton RS125 - \$75.98/pair MSRP – Tier 3

The Dayton RS125 features a low-distortion motor system with two short-circuit paths and a rigid aluminum cone. Their low-distortion characteristics and high excursion capabilities provide exceptional clarity, detail, and dynamics. This woofer features a black anodized cone, heavy-duty 6-hole cast frame, low-loss rubber surround, solid aluminum phase plug, rubber magnet boot, and gold terminals.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Dayton RS125	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.001	2.832	6.0%	3	2.737	Ft^3	.49*
Fs	78.73	83.44	5.6%	76	92.86	Ltr	14
Qts	.6506	.6633	1.9%	.63	.7185	Fs (Hz)	84.49
Qes	.7795	.7869	0.9%	.75	.8933		
Qms	3.935	4.223	6.8%	3.97	3.674		
Le	.1305	.1326	1.6%	.41	.1322		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\*Based on the WinISD modeling, the drivers were tested in our large sealed enclosure to emulate an infinite baffle.

The RS125 is a good speaker that is very musical with a full, lively sound. Alanis Morissette in “Uninvited” sounded light, open and airy and Gwen Stefani in “Don’t Speak” actually sounded a little pitchy, as she should. These speakers had a moderate level of detail but did struggle to create accurate soundstage depth. During “Smooth”, Santana’s guitar sounded as if it were background music and not a duet with Rob Thomas and although the Vibraphone in “The First Taste” was audible, it did fade into the background and was not as lively as it should be. Dave Matthews in “Spoon” sounded lifelike and rich and detailed, without getting pitchy, which can be a problem with his voice signature.

Final conclusion: Overall, the RS125 has a rich, enjoyable sound. These speakers were musical and full with good detail, and with their low cost, they could easily be regarded as “the best bang for the buck”.

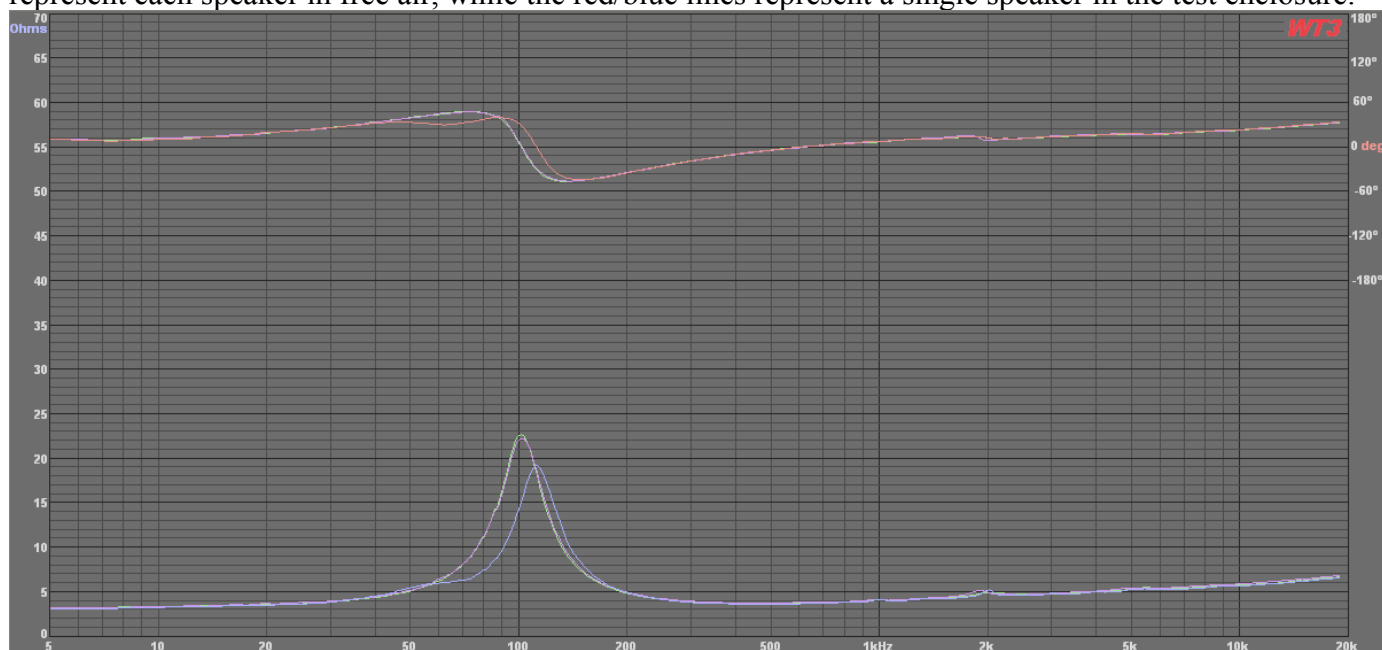
### Hybrid Audio Technologies (HAT) L4 - \$299.99/pair online – Tier 3

The Legatia L4 is a wide-bandwidth midrange, which features an untreated pressed paper cone, a phase plug pole piece extension to improve the performance and clarity, high-loss inverted rubber surround, and a motor that utilizes copper Faraday shorting rings. This speaker also features a 1-inch voice coil, ferrite magnet, a unique T-yoke to improve the speaker's power handling as well as a high quality cast aluminum basket.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

HAT L4	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.296	3.426	3.8%	3.4	4.237	Ft^3	.096*
Fs	101.6	102.3	0.7%	90	112.4	Ltr	2.7
Qts	.5823	.5968	2.4%	.50	.9415	Fs (Hz)	129.39
Qes	.6816	.7055	3.4%	.61	1.209		
Qms	3.997	3.874	3.2%	2.61	4.256		
Le	.0762	.0771	1.2%	n/a	.0605		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.**

The L4 is a very nice speaker with a lot of upper end detail. The vibraphone in “The First Taste” was very detailed and easy to decipher. The L4 was also able to recreate a fairly accurate soundstage and some depth. These speakers seemed to play the upper midrange frequencies (upper female voices and percussion) much better than the mid to lower midrange frequencies (male voices, organ, lower piano notes, etc.). These mid to lower midrange frequencies seemed to lack the richness of other offerings and actually felt a little boring. Comments from the testers described these speakers as being “flat” and “technically good” with no major problems, but also “no life”. While the upper end initially mesmerizes us, we soon came to wonder where the energy was in the mid to lower midrange registers.

Final conclusion: Overall the L4 is a very pleasing and detailed speaker that is technically strong, extending higher than any other speaker tested, but lacks life and sounds clinical and flat.

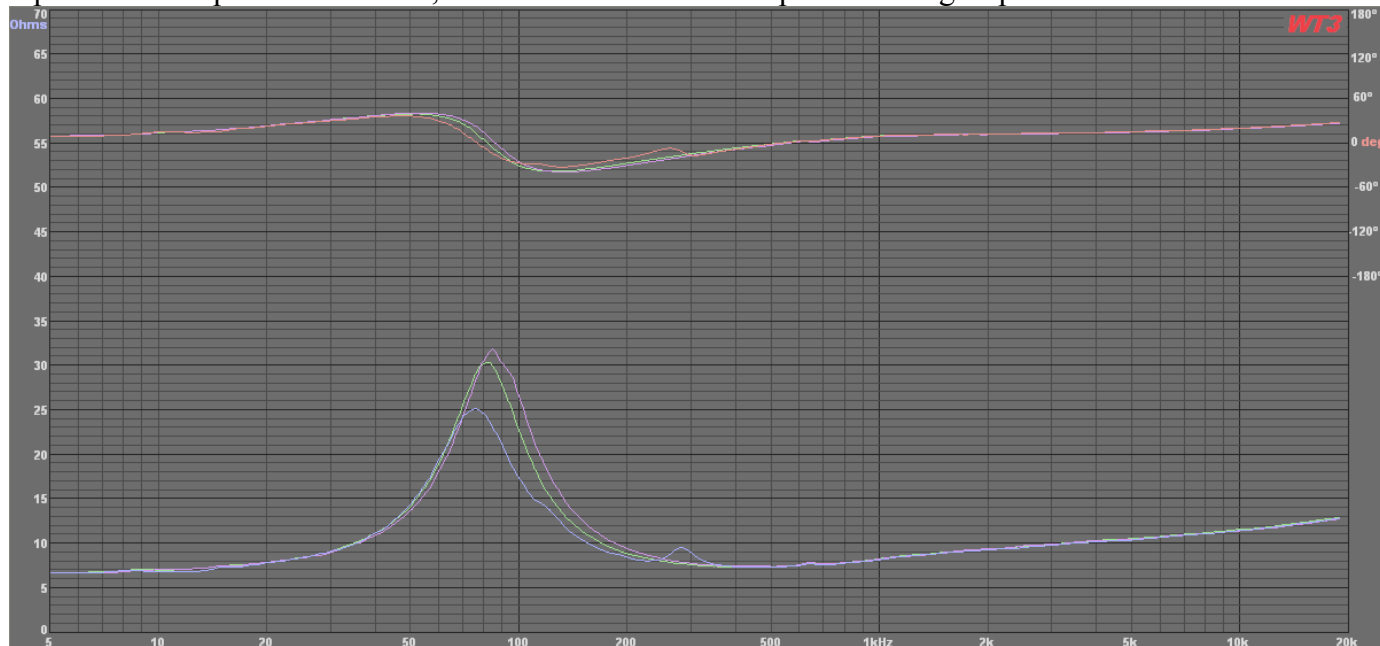
### Tang Band W4-1320SJ - \$125.98/pair MSRP – Tier 3

The Tang Band W4 speakers feature bamboo fiber cones and a neodymium motor with a copper ring to reduce distortion.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

TB W4	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	6.682	6.682	0%	6.8	6.514	Ft <sup>3</sup>	.074*
Fs	82.1	84.79	3.2%	75	75.37	Ltr	2.12
Qts	.50	.4711	6.1%	.35	.4697	Fs (Hz)	158.23
Qes	.6412	.5964	7.5%	.49	.6344		
Qms	2.271	2.244	1.2%	1.29	1.809		
Le	.1516	.1479	2.5%	.013	.1506		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

During our subjective listening test the testers commented that the W4 is a pleasant sounding speaker. The speakers are detailed, but struggled with depth and accurate placement of the sound stage. The W4 excelled in the female vocal range in tonal quality and detail, but in the male vocal range they tended to get muddy sounding and lost the crisp detail. Dave Matthews in “Spoon” sounded too laid back, while the background music tended to overpower the male singer. On the other hand, Gwen Stefani in “Don’t Speak” and Fiona Apple in “The First Taste” were very full sounding with good dimension. Throughout the overall midrange register they did not display a very rich quality and sounded tonally flat, while also lacking dimension.

**Final Conclusion:** Overall the Tang Band W4 is a good speaker, which is able to produce a very rich musical sound.



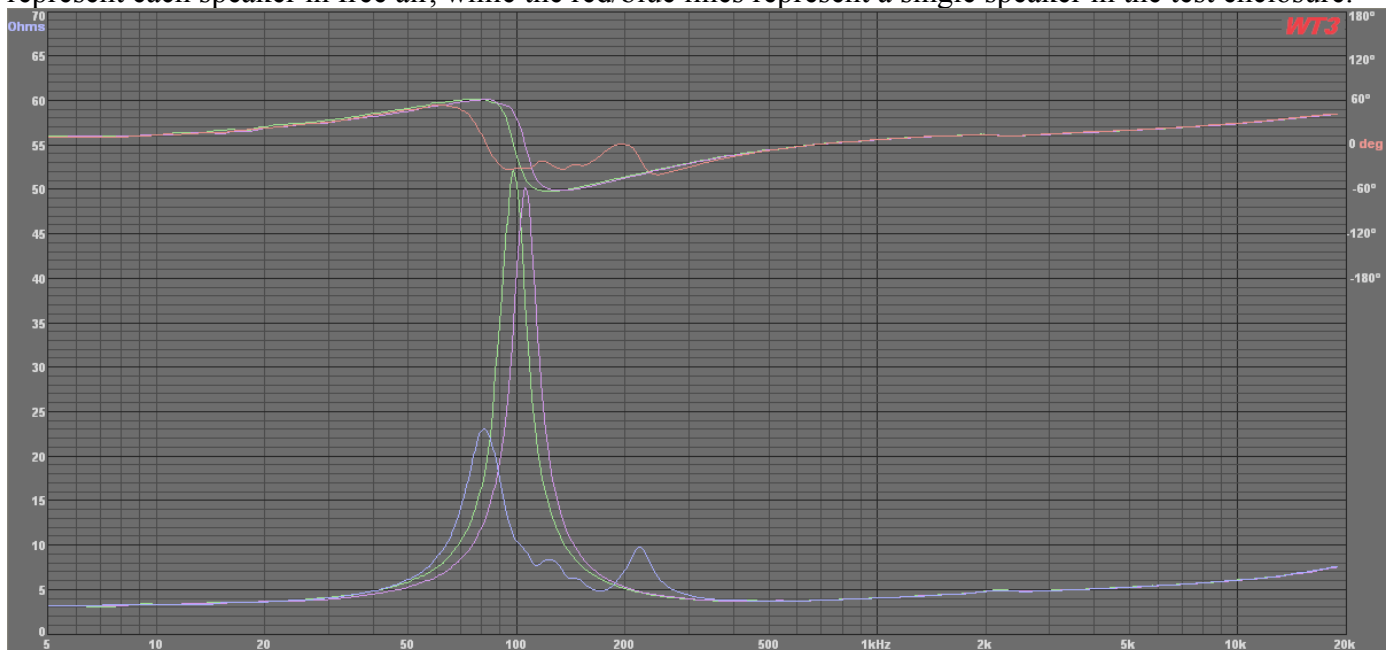
### Vifa NE123 - \$163.98/pair MSRP – Tier 3

The Vifa NE123 speakers features a cast aluminum frame that acts as a heat sink, a high-strength compact neodymium motor, coated natural wood fiber cone with half-roll rubber surround, pentacone cone technology for improved frequency response, a long-throw voice coil on titanium former, and a copper pole piece cap for extended HF response.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Vifa NE123	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.146	3.213	2.1%	3.3	3.213	$Ft^3$	.067*
Fs	98.25	106.3	7.6%	66	81.42	Ltr	1.9
Qts	.4682	.5089	8.0%	.41	.6266	Fs (Hz)	119.75
Qes	.4981	.5437	8.4%	.44	.7278		
Qms	7.786	7.959	2.2%	6.7	4.506		
Le	.0846	.0827	2.3%	.04	.0837		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

The Vifa NE123 was considered by many as the dark horse of this test due to their technical achievements and low price point. These speakers scored well in detail, with the vibraphone in “The First Taste”, apparent and separated from the other instruments. The sound stage seemed well placed with just a fair amount of depth. Male and Female vocals sounded good with a full, pleasant quality, although a little too gruff and flat sounding on lower vocals and music. There was nothing these seemed to do bad, but nothing really great either as the music was not real lively and lacked emotion. One tester noted, “nothing really wrong, but they put me to sleep.”

**Final Conclusion:** Not exactly the dark horse, but they did perform well finishing in the middle tier with some very redeeming qualities.

## Tier 2 - The drivers in this tier performed strongly and would exceed many audiophile expectations.

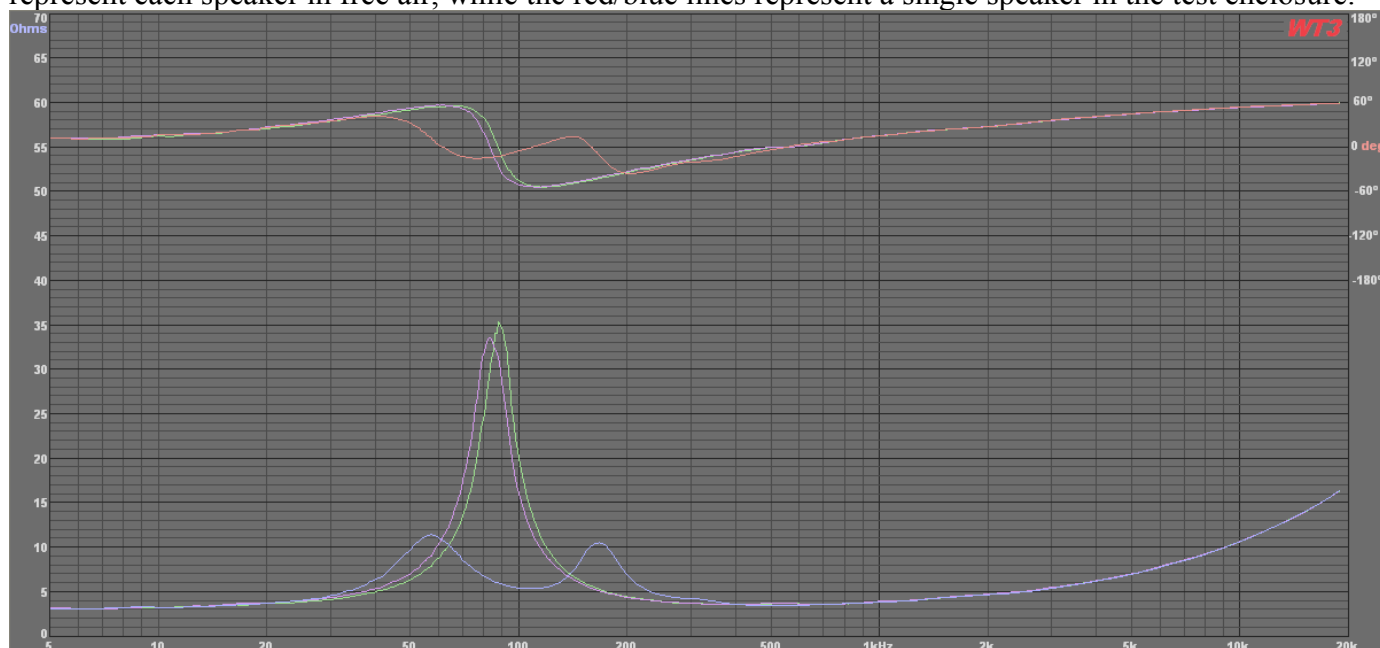
### Alpine F#1 - \$n/a – Tier 2

The Alpine F#1 midrange speaker features a crosscut wood fiber cone made from a blend of five different kinds of wood fiber. The cone has crosscut grooves to attempt to reduce the effects of cone breakup modes.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Alpine F#1	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.101	3.086	0.5%	3.2	3.008	$Ft^3$	.033*
Fs	87.48	83.44	4.8%	72	57.2	Ltr	0.95
Qts	.492	.4682	5.1%	.35	.5779	Fs (Hz)	149.25
Qes	.5393	.5154	4.6%	.37	.7855		
Qms	5.608	5.114	9.7%	.23	2.186		
Le	.1638	.1640	0.1%	n/a	.1642		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.

The Alpine F#1 speaker is Alpine's tweak of the Scan-Speak 12m. The detail of this speaker was a strong suit, ranked very high by all the testers with the vibrato in "Don't Speak" and the vibraphone in "The First Taste" very defined. They were noted as having a rich, three-dimensional texture with good soundstage placement. The main complaint with these was that they seemed to be a bit laid back and muted. The female vocals scored well with Gwen Stefani and Fiona Apple sounding full and rich, but not as well as the male voices, which sounded great with Jason Mraz and Dave Matthews sounding rich and tonally accurate with lots of texture.

Final Conclusion: Great sounding speakers, even though Alpine version of the Scan did not live up to the real thing.

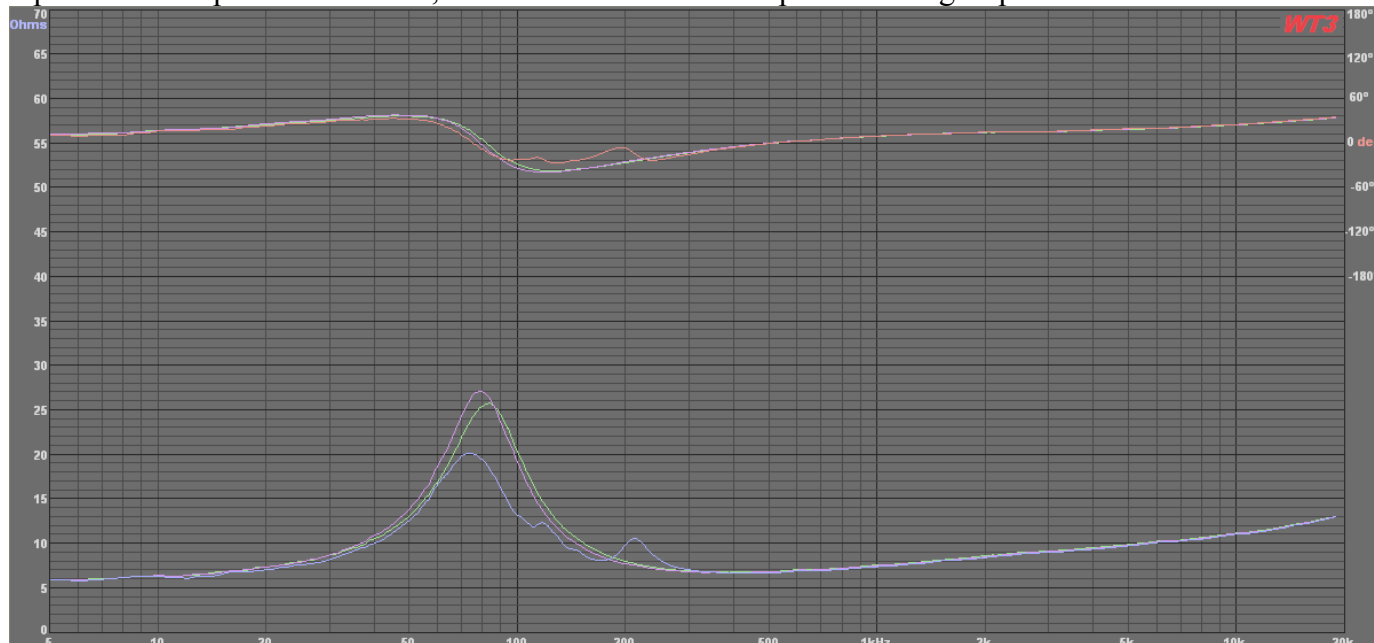
### Peerless Exclusive HDS - \$n/a – Tier 2

The Peerless Exclusive HDS speaker features an aluminum phase plug, long voice coil, distortion reduced motor, rubber surround, progressive spider and a rigid cast aluminum basket.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Peerless	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	5.735	5.739	0.1%	5.9	5.594	$Ft^3$	.049*
Fs	84.11	77.38	8.7%	81.2	74.69	Ltr	1.4
Qts	.4703	.457	2.9%	.45	.4539	Fs (Hz)	131.71
Qes	.6051	.5799	4.3%	.55	.6287		
Qms	2.11	2.155	2.1%	2.31	1.632		
Le	.1534	.1529	0.3%	1	.1524		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

To be honest the Peerless baffled most of our testers. We didn't love them at first but the more we listened the more they grew on us, and when all was said and done they ended up being our favorite drivers (before we heard the Tier 1 speakers). We originally thought we were hearing some distortion and inaccuracies in the songs that were flaws of the speaker, but later realized that it was just small details we had never heard before that were that pronounced. They had a level of detail that was amazing, but actually seemed overly detailed. Small background details were not only audible but would overpower the music and throughout numerous song selections were too pronounced. The speakers had a full rich sound but at times they would get a light, hollow, and airy sound that seemed a bit unnatural.

Final Conclusion: A great overall speaker with detail, depth, and a rich pleasing sound.

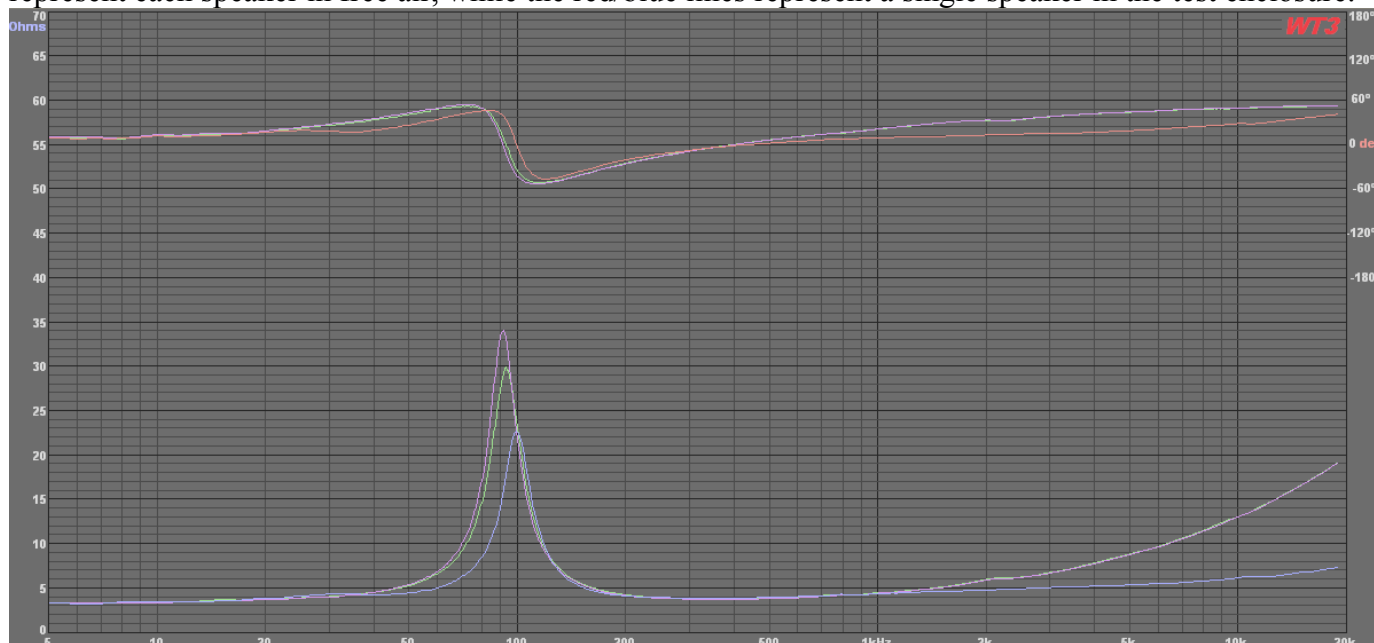
### Rainbow 100 Vanadium - \$349.99/pair MSRP – Tier 2

The Rainbow 100 Vanadium features, according to the manufacturer, special plastic compound basket with extreme stiffness for resonance-free operation, butyl rubber surround for controlled cone motion and low distortion, natural fiber cone for authentic and brilliant sound reproduction, innovative dust cap formed of reinforced natural fiber for optimal frequency response, and a vented magnet system for better magnet motor cooling.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Rainbow Vanadium	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.458	3.425	4.4%	3.373	2.685	Ft <sup>3</sup>	.196*
Fs	89.5	90.84	2.2%	99.59	173.6	Ltr	5.6
Qts	.8001	.7727	7.0%	.9287	.964	Fs (Hz)	102.93
Qes	.945	.9123	9.2%	1.091	1.118		
Qms	5.217	5.05	10.1%	6.237	7.008		
Le	.0832	.0865	0.4%	.083	.0628		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our large sealed enclosure to emulate an infinite baffle.**

The Rainbow Vanadium is a very strong driver. Numerous testers commented that possibly these speakers were able to handle the test frequency range better than the most other drivers, helping to raise their overall scores. The level of detail in the Vanadium was acceptable, but not amazing. The vibraphone in “The First Taste” was audible but would get drowned out at times. The Vanadium speakers were able to create an accurate soundstage, with good depth. The music was rich and full with a pleasing enjoyable sound quality. Jason Mraz in “I’m Yours” was very lifelike and rich sounding, whereas Alanis Morissette in “Uninvited” had a nice airy quality and was pleasing to listen to. These speakers provided some texture and dimension, but were not outstanding in this area and lacked some depth in the soundstage.

**Final Conclusion:** Overall a great speaker, with a full pleasing sound but lacking some on detail.



**Tier 1 - The drivers in this tier performed well above expectations and would satisfy the most discerning of audiophiles.**

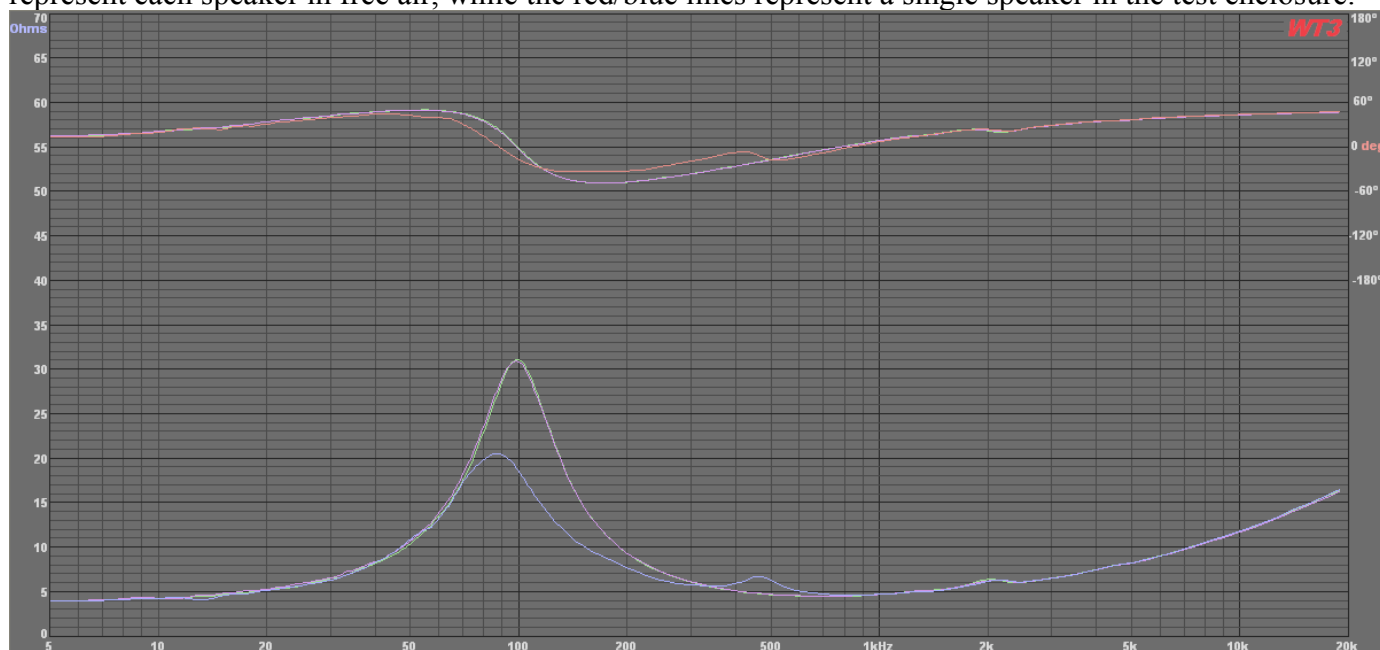
Dynaudio Esotar2 430 - \$1400/pair MSRP – Tier 1

The Dynaudio Esotar2 430 speaker features a diaphragm and dust cap molded as one piece, an internal double magnet system with a neodymium magnet and vented pole piece, aluminum voice coil wire, and a rigid die-cast chassis with aerodynamically shaped ribs.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Esotar2 430	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.874	3.85	0.6%	4	3.944	Ft^3	.009*
Fs	98.25	98.25	0.0%	64	87.48	Ltr	.255
Qts	.2737	.2695	1.6%	.18	.3034	Fs (Hz)	261.3
Qes	.3126	.3079	1.5%	.21	.3756		
Qms	2.195	2.163	1.5%	1.5	1.58		
Le	.1789	.1780	0.5%	.19	.1793		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

The Dynaudio Esotar2 430 speakers were, well, how do we say it? In a word, AMAZING! These speakers received the highest ranking, in every category, by every tester. The level of detail was amazing, during “9 Crimes” by Damien Rice, we were able to hear her chair move 4 separate times. The 2<sup>nd</sup> place speaker could only reproduce the chair moving once. The Male and Female Vocals were spot on tonally with rich texture. Another amazing quality about these speakers was the exceptionally deep soundstage they presented. Rob Thomas and Santana were both well in front of the other instruments in “Smooth” and Fiona Apple and her piano in “The First Taste” sounded well in front of the background music. “Carnival” sounded as you were hearing it for the first time, with amazing detail and clarity. We would love to go on and on about these, but unfortunately, you would definitely need to hear to believe. Plus, if I stop typing now, I can go listen to them more.

**Final Conclusion: The King of Midranges – Best Sound and Smallest Enclosure!**

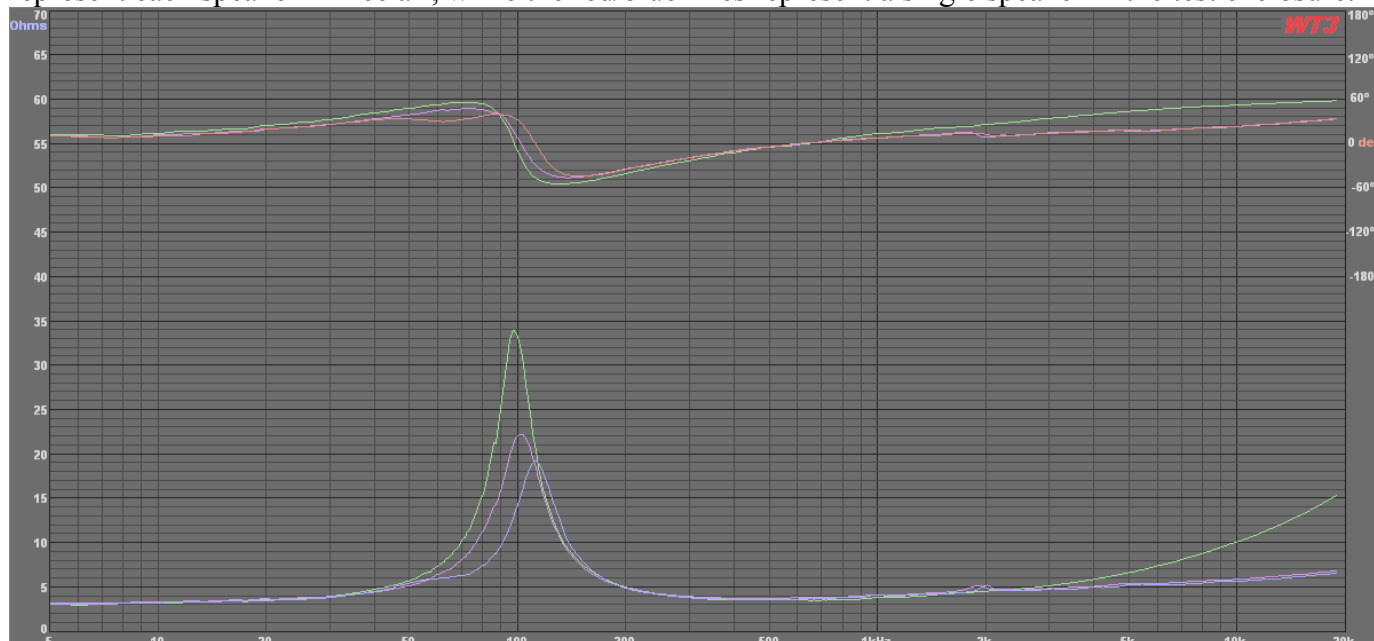
### Scan-Speak 12M - \$570/pair online – Tier 1

The Scan-Speak 12M is a Revelator driver using the “slit cone” technology. Some of the slits are used to control cone resonance and the other set of slits add rigidity. This speaker also has the new dynamic linear suspension for lower compression and higher linearity. A neodymium magnet has been chosen to reduce the depth, yet increase the magnetic energy.

Below is a chart of the measured Thiele/Small parameters using WT3 along with the recommended enclosure size per WinISD modeled using the manufacturer specs provided.

Scan 12M	Measured Speaker 1	Measured Speaker 2	% Difference	Manufacturer Specs	Measured in Test Enclosure	Enclosure size for .707 Qtc	
Re	3.004	3.193	5.9%	3	3.2	Ft^3	.023*
Fs	97.57	96.9	0.7%	155	75	Ltr	.66
Qts	.4538	.4701	3.5%	.95	.33	Fs (Hz)	170.18
Qes	.4978	.5207	4.4%	1	.35		
Qms	5.137	4.837	6.2%	9.8	5.57		
Le	.1553	.1550	0.2%	n/a	.22		

Below is the graph provided by WT3 showing the impedance measurement. The green and purple lines represent each speaker in free air, while the red/blue lines represent a single speaker in the test enclosure.



**\*Based on the WinISD modeling, these drivers were tested in our small sealed enclosure.**

The Scan-Speak 12M speakers deserve to share the top tier with the Esotar2 430's. While the level of detail and depth was not equal to the Dynaudio, they were still easily above every other speaker in every category, as rated unanimously by each tester. The Scan's were the first speakers that we were able to hear the chair move on "9 Crimes" by Damien Rice demonstrating the amazing level of detail to this speaker. The Scan's did a good job producing an accurate, deep soundstage and had a very rich full sound. One tester stated "the music is full and robust, but doesn't push it so it's forced, our first great speaker". In the blind testing order, the Scan's came before the 430's and after listening to these speakers, every tester unanimously agreed that we had just found the first Tier-1 speaker.

Final Conclusion: Easily the second best!

To the right is a visual representation of the drivers as they placed in the 5 Tier Ranking System.

## TEST CONCLUSION

As difficult & exhausting as this test was in its set-up and implementation it allowed for some valuable conclusions. Price is not always indicative of quality but when you factor in a reputable brand name, you get what you pay for. However, if we are judging on the lowest price to performance ratio there are great values in tier 2 & 3. I note that the differences from tier 1 (Dynaudio & Scan Speak) to the rest of the group were large and easily discernable to **all** the judges on both random testing days. We went to great lengths to prevent any errors or bias and we believe we succeeded evident in the results. Even if you cannot afford the drivers in Tier 1 you can easily put together a reference grade system

from the other tiers. Adding a quality tweeter and midbass to some of these great midrange drivers will help in augmenting presentation, depth, and detail. Some of the midranges were described as flat and lifeless, but as part of a three or four-way system this should be a non -issue. We set out to define which products had the best performance in midrange accuracy and in the end the winners were clear. It should also be noted that certain systems may require products with larger bandwidths and optimum performance in certain rather than others. There are a lot of great products to choose from at all price points and if you don't already have a dedicated midrange consider one, it makes a great difference in improving your system. Obviously, there is a science to properly implementing a dedicated midrange and utilizing proper crossover points and slopes. And even properly build enclosures, optimum placement, and aiming will help you reach reference level performance.

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## ONE FINAL NOTE:

*"The late, great J. Gordon Holt once said, "Midrange accuracy should be the STARTING POINT of loudspeaker design, onto which our other prized audiophile attributes should then be appended in order to convert that musical midrange into a semblance of literal accuracy."*

