TIPS FROM THE PROS

This section offers you tips from the pros in our industry; veteran competitors, dealers, installers, manufacturers, competitors and many others have taken the time to pass on some of their wisdom to you. There are many years of experience packed into these tips; they range from Sound Quality and Installation to RTA testing and SPL how to's.

The opinions expressed in this section deal directly with what you get judged on and are the thoughts of each individual; they may not necessarily reflect the thoughts of ***IASCA*** Worldwide Inc. or its rules. In Sound Quality, there are thoughts on system tuning, Tonal Accuracy and Spectral Balance, Imaging, Staging and RTA tuning. For Installation, you'll find ideas on how to properly route your wiring, amplifier and speaker installation, how to build a photo log, speaker positioning for the best sound quality and how to score those valuable points in Craftsmanship, Integrity and Upgrades. In SPL, you'll read about how the pros get every last dB out of their systems, current requirements and proper enclosure construction.

All competitors follow some basic standards that apply to car audio competition, but many have their own unique way of achieving the best sounding or loudest vehicle in their Class. These people have given of themselves to help educate you on how you can improve in what you love to do.

As we receive more thoughts and ideas from some of the most respected names in our industry, we will add their write ups to this section and send copies to you, so make sure you keep some space at the end of your book!

Read on and soak up as much knowledge as you can! Who knows, you may be the next ***IASCA*** World Champion just from learning some new "tricks"!

Tonal Accuracy (Sound Quality) by Scott Buwalda

Tonal accuracy is by far my favorite section on the score sheet, as it represents what truly embodies "faithful reproduction of the musical source."

One of the most important things to do before even beginning the installation and tuning process is to calibrate your ears, and get a reference for your future listening tests. As an example, to really know what a snare drum sounds like, you must go and listen to one in person.

Listen to the timbre of different types of drum heads; how does an oil-filled head sound differ from a coated head? What is the effect of using wooden sticks verses nylon-tipped sticks, or fiber brushes verses steel brushes? Listen to how the tone of the snare drum changes with its depth, or how a loose drum head compares in sound to a tight drum head. And, just when the music store manager thinks you're crazy for tapping on snare drums, go to a live concert, and do it often. Whether it's listening to a snare drum, or a 200-piece orchestra, there's no substitute for the visceral impact and emotion of live, non amplified music. The human ear can always distinguish between live and recorded music; nothing else in life can touch your soul the way live music does.

IASCA wants nothing more than to know there are great sounding audio systems around the world competing in organized competition. As a musician, long-time car audiophile and speaker designer, I have found that when tonality is very good in a car, the other more objective categories, such as imaging and staging, seem to fall into place, and the system is pleasing to listen to for long periods of time. Isn't that why we do this, for the sake of the music? Become a student of sound, and it will pay dividends in the competition lanes.

Imaging (Sound Quality) by Scott Buwalda

Stereo Imaging represents an important suite of scored categories in IASCA SQ judging, and with a little time and effort, can be a readily achievable sound quality system attribute, as good imaging is based predominantly on the physical properties of timing and intensity of sound waves.

Quite possibly the most important functional consideration that an installer or do-it-yourself (DIY) enthusiast should give to speaker placement is to optimize, as best as possible, pathlength differences (PLD's) in the vehicle. PLD's are defined mathematically as follows (assuming a right-hand driven vehicle; PLD's are always a positive number): $X - Y = Z$

Where:
X = distance of the center of the left speaker from your left ear.
Y = distance of the center of the right speaker from your right ear.
Z = pathlength difference.

Applying this formula, assume that the distance of the left speaker from your left ear is 140cm, and the distance of the right speaker from your right ear is 100cm, then the pathlength difference is 40cm.

Good stereo imaging is completely dependent on arrival times of the fundamental vocal frequencies (typically around 140 Hz and above).
Differences as little as 10 microseconds can be detected by the brain. A PLD of 30 centimeters equates to the sound from the nearest channel arriving about 9 milliseconds earlier than the furthest channel. It is generally accepted that PLD's be kept to less than 30 centimeters in a vehicle which is intended to have good image placement from both seated positions.

The best way to go about evaluating certain locations in your vehicle is, in general, to look for the potential locations as far forward and away from you as possible, but with still a "line of sight" to the speakers (if you can't see the speakers, this might not be an ideal location, and you might be relying more on reflected energy at that point). An easy way to test various potential locations is to have a friend help you hold a tape measure or other measurement device from the potential speaker mounting locations, and measure those locations with respect to your ears.

There are three common mounting locations for front-stage speakers:
dashboard/A pillar, doors, and kick panels.

In the dashboard/A pillar scenario, a small midrange and tweeter can be installed. While there are obvious benefits to this style of component installation, in many vehicles, the PLD's between the left and right speakers are large, due to the proximity of the listener to the near-side speaker. This configuration will undoubtedly require both time and intensity domain equalization in most vehicles to ensure a good, focused center image, properly located in the center of the sound stage for one seated position. There are, however, some rare exceptions, and you may actually find that the dashboard locations provide the best equalized PLD of the available mounting locations. Conversely, should the PLD's not be ideal, you may still want to consider this scenario to net several benefits of this design, but only if you have the ability to digitally manipulate both time and intensity; you may find that mounting the front stage drivers in this way to be the best compromise for stable stage height, focused images, and excellent tonality, but with good image placement from only one seated position. Good image placement from one seated position may not necessarily be a problem, however, as some classes within IASCA's judging framework are evaluated

from only one seat, if you have the electronic means to equalize both time and intensity, this could very well be the way to go for a solid, focused center image for the driver's seat.

In the next scenario, the speakers can be mounted in the front doors; in certain vehicles, door locations represent a mild improvement in PLD's from the dashboard and a-pillar location identified above. However, door speaker systems will likely continue to require digital time and intensity manipulation for a stable, focused center image for one seated position (unless of course a center channel is used with even higher level of digital processing). And often times, tactile response of the speakers will give their location away, and stage height and position and depth to soundstage can suffer. This design is likely the least favorable of the three scenarios offered here for most vehicles.

The third and final potential mounting location is in the kick panels, or front floor area in most unibody vehicles. In this scenario, the midrange (and potentially treble speakers as well) are placed far forward in the A-frame cavity of the kick panels, or in the forward floor area. In many cases the kick panel location affords the best equalization of path length differences for most vehicles, and will likely require only a minimum of digital time and intensity manipulation, if any at all, to achieve a well-placed center image for both seated positions in most vehicles.

The lesson to be learned here is that by taking a few moments to evaluate the potential mounting locations in your vehicle, in a very short period of time, you will be able to find the best location for your front stage speakers by determining the location with the smallest PLD.

Cosmetic Integration in a Stealth Type Installation

By Jeremy Carlson

Integrating aftermarket car audio products in to an interior can be the most challenging part of the install. Anyone can mount equipment in the hatch of a car, or throw a head unit into the dash opening. To do this correctly and to follow the IASCA rule book is where the challenge comes in.

Often the factory uses materials that are hard to find or buy aftermarket or they're just too expensive; when laying out the system installation it's important to keep these materials in mind. You want to build a system that performs at its best and looks like it was a factory upgrade. An example would be if the stock oversized head unit was textured ABS plastic to match the rest of the dash, don't change the color of the piece being fabricated so it stands out.

Make sure to follow a color theme in lighting as well, if the cluster of gauges has orange lighting; don't throw an aftermarket head unit in with blue lights on it. If the car has factory grille cloth on the door panels, and you are building kick panels, make sure you match that grille cloth there and through out the entire car.

Basically what it comes down to is planning, sit down in the beginning and plan the car from front to back, pick the materials that best match, choose the equipment that best flows, and have a plan! It will save you a lot of time in the future from going back to change things after an IASCA judge points them out, and last, but not least, have fun!

Jeremy Carlson

TONAL ACCURACY BY Jason Gay

Tracks 6 and 7 on the ***IASCA*** Sound Quality Reference CD are excellent tracks to evaluate Tonal Accuracy; track 6 focuses on sub bass while track 7 focuses on midbass and the rest of the frequency range.

One of the unique features of track 6 is that in the CD liner, it tells you what will happen at specific times; for instance at the 1:09 time mark there is a very low bass note that you should notice with a proper system set up. The note is low enough that you may not necessarily "hear" it, but more so you should "feel" it resonate through the vehicle as it plays.

Track 7 is a great track to check for any flaws in the system installation. Its strength in the midbass range, when played at higher volume levels will amplify any panel resonance in the vehicle; this will help you to determine problem areas with sound dampening (where it may be necessary) as well as installation weaknesses in the speaker mounting areas. The piano play in the track covers much of the sound spectrum; it should sound real and natural, not "electronically" generated. Track 10 is also a good track to use for this purpose.

STAGING by Jason Gay

Track 10 is also very useful for determining the sound stage in a vehicle; right from the beginning of the track there is an accurate representation of all frequencies through the sound spectrum. What you need to listen for with this track is stage height stability; good sounding cars that score well will reproduce midbass at an equal height on the sound stage as the mids and highs. Weaker systems are usually frequency dependent when it comes to staging; lower notes have a tendency to sound like they're coming from the floor, while mids and highs seem to emanate above the dash. Speaker placement is critical for staging and, to create a strong, high sound stage, a competitor needs to focus in this area.

IMAGING by Jason Gay

I find tracks 15 and 16 are good tuning tools to determine proper imaging and its size. Track 16 has a female voice positioned center stage and track 16 has a male voice center stage; both, when played back through the system , should sound detailed and focused. Most systems however, will likely reproduce only one of the voices well (likely the female voice due to its higher frequency range). Typically, the male voice will sound very wide and unfocused due to the lower frequency ranges it utilizes. I like to call systems like this "frequency dependent"; when reproducing the male vocal on the center stage, it sounds like the voice is moving or wandering across the soundstage. Working with crossover points between the midbass, midrange and tweeters and adjusting speaker location can usually correct this.

WIRING by Jason Gay

The best piece of advice I can offer when it comes to wiring a vehicle for ***IASCA*** competition is **"Pictures, pictures and more pictures!!"** Receiving maximum points in the installation scoring of this section is giving yourself the ability to show the judges every detail of your system wiring, even the wiring that is hidden from view. Take pictures of everything that's connected to the system, including the fusing and wiring installation of every component in the vehicle; that means all the equipment (head unit, amplifier/s, processors, speakers, etc.) as well as the "little things" like relays, fans, lighting, storage devices (capacitors/batteries) and switches.

One of the most overlooked items in an installation is the fusing; yes, we make sure we have fuses on all components, but we don't always make certain the fuse ratings match the current requirement of the equipment. Making certain that the fuse ratings match and that the system's main fuse rating equals the total current demand requirements is something that should always be done and documented in the installation log using photos and possibly a chart showing the values of each fuse.

One component that seems to be forgotten when it comes to fusing is the source (or head) unit of the system; they all have a fuse attached to their harness, but because it's already done we ignore the fact that we may have to access it if the fuse blows. Always make sure you can access any fuse within 30 seconds and have a photo log

indicating where they are located (if not visible); this will help you gain points in install judging and make your system the safest it can be!

FUSING IN IASCA COMPETITION by Mark Eldridge

HOW DOES A FUSE WORK?

A fuse is required to carry its rated load continuously, 135% of rated load for 1 hour, and double its rated load for 30 seconds. So, if a 500 amp fuse is used and the cable shorts to ground, it must generate 1,000 amps of current through the short to blow the fuse quickly, which isn't likely. Using too large a fuse is potentially very dangerous!

THE CREST FACTOR

Now that we know the basics of a fuse, how does it apply to use with audio equipment? To understand how it applies, we need to know about the Crest Factor. The Crest factor is simply *the ratio of the **peak** signal level to the **average** signal level*. An un-clipped sine wave has a crest factor of 3 dB (i.e. the peak level is double the power of the average level). Pink noise has a crest factor of 6 dB (the peak level is 4 times the power of the average level). For every 3 dB increase in the crest factor, the power level is divided by 2.

A crest factor of 10 dB means the peak power is 10 times the average power. 20 dB yields a peak power of 100 times the average. And a 30 dB crest factor yields a peak power 1,000 times the average!

Most music has a crest factor between 10 and 20 dB. Some of the newer popular recordings unfortunately have very low crest factors, often less than 10 dB. Music with a very low crest factor is not dynamic, has little impact, and typically sounds loud all the time.

Music that is very well recorded will have crest factors above 15 dB, and sometimes well into the 20+ dB range. (The James Newton Howard and Friends recording from Sheffield Labs has a 30 dB crest factor).

Now, amplifiers are rated at an RMS power output, which is simply the average output when reproducing an un-distorted sine wave. Since a sine wave has a crest factor of 3 dB, a 1,000 watt RMS rated amplifier will reproduce 2,000 watt peaks cleanly.

Now, let's take this 1,000 watt amplifier being driven to its maximum un-distorted output level of 2,000 watts with a music track having a crest factor of 20 dB. 2,000 watts divided by 100 = 20 watts average power output. If the crest factor is dropped to 10 dB, then the average power output will be 200 watts. And if really poorly recorded music is used with a crest factor of only 6 dB, the average power output would be 500 watts. So as you can see, the *actual* power output of an amplifier reproducing music is nowhere near the *theoretical* maximum output. It may be as high as 1/2 the rated output with really poor recordings, but will likely be much less than this.

NOTE: This does not apply to SPL competition, where amplifiers are typically driven to their maximum output with sine waves, and are often driven into substantial clipping as well.

With the crest factor considerations in mind, I would suggest the following:

First, a *maximum* allowable fuse value can be calculated based simply on adding up the recommended fuse values for all the amplifiers, any larger than this would be grounds for points deductions or disqualification. And quite honestly, this would be severe overkill on the main system fuse anyway.

A more precise fuse rating can be calculated using the following method:

Determine the maximum peak power output of each amplifier by multiplying the rated RMS power by a factor of two.

Allow for the efficiency of each amplifier. For class-A/B amplifiers, assume 60% efficient, and for switching or class-D amplifiers, assume 80%.

Assume supply voltage is 12 volts (This can be argued to be higher or lower, depending on the system, but 12 volts is a good average)

Assume a worst case music crest factor of 6 dB, which means the average output power is 1/4 of the peak output.

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Calculation Example:

A system has (3) 1,000 watt Class-D amps, (2) 500 watt class-A/B amps, and (2) 150 watt class-A/B amps.

The recommended fuse values for the amplifiers are as follows:

1,000 watt amplifiers - 100 amps each
500 watt amplifiers - 70 amps each
150 watt amplifiers - 25 amps each

The maximum allowable main system fuse size would be:
(100 amp X 3) + (75 amp X 2) + (25 amp X 2) = 500 amp

Now calculate the fuse value with peak outputs utilizing Crest factors:
The maximum peak outputs will be the RMS outputs multiplied by 2 to get the peak output for each amplifier:

1,000 watts X 2 = 2,000 watts
500 watts X 2 = 1,000 watts
150 watts X 2 = 300 watts

Taking efficiency into account:

2,000 / 0.8 = 2,500 watts
1,000 / 0.6 = 1,667 watts
300 / 0.6 = 500 watts

So the total power draw for the amplifiers would be:

2,500 X 3 amplifiers = 7,500 watts
1,667 X 2 amplifiers = 3,334 watts
500 X 2 amplifiers = 1,000 watts

The total power required for all the amplifiers to be driven to maximum peak output simultaneously would be 11,834 watts.

Now, take the 6 dB crest factor into account by simply dividing the above peak output by 4:

11,834 / 4 = 2959 watts
Now divide this by 12 volts: 2959 / 12 = 247 amps

A 250 amp fuse would be a much more realistic value than the 500 amp fuse that would be required by adding the recommended fuse values for all the amplifiers.
Notice that for a crest factor of 6 dB, the fuse value would be approximately 1/2 that of the fuse calculated by adding the recommended fuses together. If the crest factor is 9 dB, the fuse value would be 1/4, and for a crest factor of 15 dB, the fuse value would be 1/16th.

I have tested this technique, and have never had a problem burning a main fuse calculated simply by adding the ratings of all the amplifiers and dividing by two. This is the same as going through the entire calculation for a crest factor of 6 dB.

I know going through the entire calculation is somewhat confusing, and may be difficult to fully explain in the rule book, but this is how it works. And, using a fuse as large as that calculated by simply adding up the recommended fuses values for each amplifier will be overkill, and could even be dangerous.

Mark Eldridge
meldridge@mblsound.com
Mobile Phone (918) 810-2535

Mobile Soundstage Engineering
11110-J South 82nd East Place
Bixby, OK 74008
www.mblsound.com

YOUR TIPS

We'd like to give you the chance to have your tips and ideas printed! Write them down here and submit to us either by mail, fax, or electronically; we'll review them and if they meet all criteria to go into the IASCA rule book, they're in!