SPL CALCULATIONS

SPL is one of the most misused and maligned driver parameters out there today. Because most know that SPL has something to do with the loudness of a driver, they think bigger is better. And in general, it is...

But recently, some manufacturers have taken to using unusual steps to "rate" the SPL of a driver. These can range from using non-standard drive levels, to measuring at 0.5 meters, to using in-room calculations. And unless they tell you what they used, you're out of luck!

Or are you... Actually, no! There is a way to actually CALCULATE the efficiency of a driver. That is, you can run some simple equations, and come up with measure of just how efficient a driver is at converting electrical power to acoustic power. And from that, you can easily get to SPL. So now, you can actually "level the playing field" by removing any bias from the manufacturer's numbers...

To start with, we'll need some of the basic Thiele-Small (T/S) parameters. I assume you can at least get these. If not, then take EVERYTHING that manufacturer says with a HUGE block of salt! If they aren't going to give you the absolute basic parameters about your driver, well...

Anyway, what you'll need is: Qes, Vas, and Fs. Yes, with these three little parameters, you can calculate the effective efficiency, and subsequently the SPL, of a driver. Here's how you do it:

Efficiency = 9.64 * 10^(-10) * Fs^3 * Vas / Qes

where

10^(-10) is ten to the minus ten power (0.0000000001)
Fs is the resonant frequency of the driver, in Hz
Vas is the equivalent compliance of the driver, in liters
Qes is the Q of the electrical system of the driver

This will give you a number, usually called n_0, or eta naught. And, it's usually expressed as a percent, so multiply by 100.

Now, n_0 is a measure of the efficiency of power conversion of the driver. That is, it tells you what percent of input electrical power is converted to acoustic power. Thus, you can calculate the output acoustic power by multiplying the input power by n_0.

Now, don't be scared of a number down below 1% (0.01)! Rather, this is VERY typical of most subwoofers. Yes, drivers are inefficient, but that's what we've got to work with...

So, how do we calculate the SPL of a driver from n_0? Use the following equation:

$$SPL = 112 + 10 * \log(n_0)$$

Where

n_0 is the efficiency calculated above
log is the base-10 logarithm

So, let's run an example. Say, our Shiva subwoofer driver. For starters, we have: Fs=21.6 Hz, Vas=136.6 liters, Qes=0.3996. So, the n0 would be:

n_0 = 9.64*10^(-10) * Fs^3 * Vas / Qes
n_0 = 9.64*10^(-10) * 21.6^3 * 136.6 / 0.3996
n_0 = 0.0033 or 0.33%

Now, let's put that into SPL:

SPL = 112 + 10 * log($n_0$0)
SPL = 112 + 10 * log(0.0033)
SPL = 87.21 dB SPL @ 1W, 1m

That's the 1 Watt, 1 meter sensitivity of Shiva. Go ahead and run your own favorite driver, and see if the manufacturer's being straight-up with you!