The Decibel

Very often when people speak about how loud something is, they will specify a number, typically between 50 and 120, followed by the term 'decibel' or dB. Another example is often seen on graphic equalizers. The faders on the equalizer can be raised or cut typically up to 6 or 12 dB. Obviously, these are two very different applications of the term. One relates to an audible or acoustic level and the other relates to an electronic level.

The explanation to this lies in the fact that a decibel is simply a **ratio between two numbers**. For our application here, a ratio is defined as a relation between two similar things. We have the level that we want to express and we also have a reference level that we are going to relate it to.

Since loudness is the amount of sound pressure at a given point, we use the term Sound Pressure Level or SPL when describing audible levels. A good reference point for loudness measurements is complete (or nearly complete) silence. This level is defined as 0 dBSPL and equals .00002 Pascals.

Part of the confusion with the term decibel arises as a result of how it is used. Often, the description of the reference level is assumed and therefore left off. For example, if the loudness of a room is being measured and the result is 75dB SPL, the measurement may be documented as 75dB. It is assumed that since the measurement is an auditory one, the reference level is 0 dB SPL.

For electronic signals, we use the following reference points:

Voltages:	0 dBV = 1 volt
	0 dBu = .776 volts
Amp Level:	0 dBW = 1 watt
Non-coherent signals:	0 dBm = 1 milliwatt

* Notice there are 2 reference points for voltages. This came about through the evolution of the industry. Both are technically correct; however, dBu is more commonly used.

In our graphic equalizer example mentioned above, we know that our signal is a voltage; therefore, we want our reference to be a voltage as well. If we raise the 400Hz fader +3 dB (or more correctly +3 dBu), we are in effect boosting a .776 volt (0 dBu) signal at that frequency to 1.1 volts (+ 3 dBu).

Keep in mind that reference points greater than zero allow for negative decibel levels. A microphone is a good example of a very weak electronic signal that is well below .776 volts. A 50 millivolt microphone level is calculated to be –23.8dBu or –26dBV.

There are a couple nomenclature benefits to using the decibel. First, it allows us to represent large numbers in a relatively small way. Secondly, it scales acoustic and power levels into a fashion that better correlates with how humans hear.

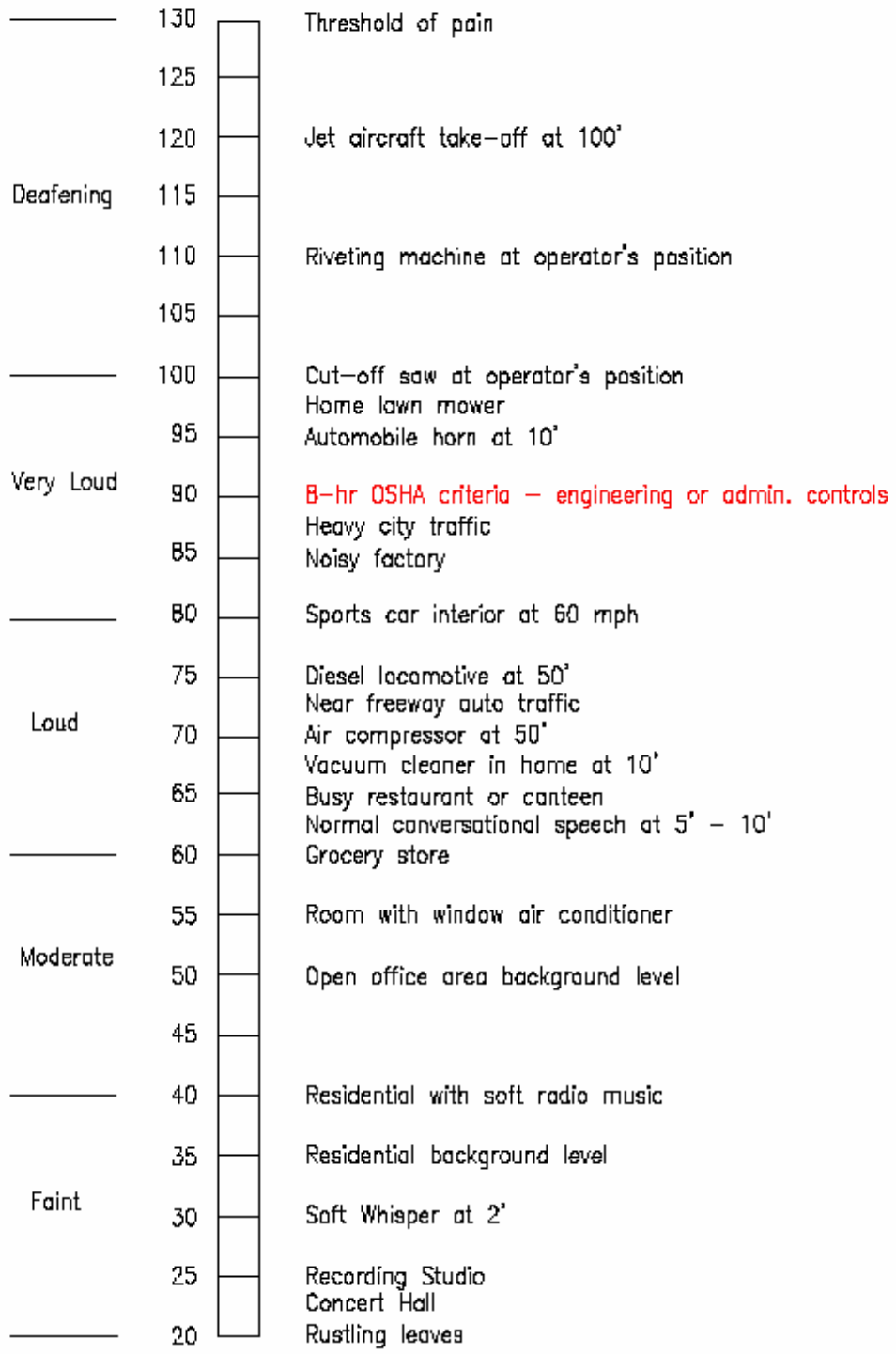
As seen in the chart below, a 1000 watt amplifier that is replaced with a 2000 watt amplifier will have a net gain of 3dB SPL on a sound system. This change would be noticeable, but not significant. The human ear would perceive the same 3 dB SPL level change between a 10 and 20 watt amplifier.

Some Useful dB Relationships

Subjective Change	Voltage, Distance, or Pressure Ratio	% of Original	Power Ratio	dB Change
Barely Perceptible	1.12 to 1	89	1.26 to 1	1 dB
	1.26 to 1	79	1.58 to 1	2 dB
Noticeable to most	1.41 to 1	71	2 to 1	3 dB
	1.58 to 1	63	2.51 to 1	4 dB
	1.78 to 1	56	3.16 to 1	5 dB
Goal for system changes	2 to 1	45	4 to 1	6 dB
	2.24 to 1	45	5 to 1	7 dB
	2.51 to 1	40	6.3 to 1	8 dB
	2.8 to 1	36	8 to 1	9 dB
Twice as loud or soft	3.16 to 1	32	10 to 1	10 dB
	10 to 1	10	100 to 1	20 dB
	31.6 to 1	3	1000 to 1	30 dB
Limits of Audibility	100 to 1	1	10000 to 1	40 dB
	316 to 1	0.3	100000 to 1	50dB
	1000 to 1	0.1	1000000 to 1	60 dB
	20log		10log	

Reprinted from Syn-Aud-Con

sight. sound. science.℠



A–Weighted Sound Pressure Level

	Volts	dBu	dBV
Mic Level	.010	-37.8	-40.0
	.020	-31.8	-34.0
	.050	-23.8	-26.0
	.100	-17.8	-20.0
Line Level	.400	-5.7	-8.0
	.500	-3.8	-6.0
	.775	0	-2.2
	1.0	2.2	0
	1.5	5.7	3.5
	2.0	8.2	6
	3.0	11.8	9.5
	5.0	16.2	14
	10.0	22.2	20
	70.7	39.2	37
High Voltage	120.0	43.8	41.6
	220.0	49.1	46.8
	480.0	55.8	53.6

Absolute dB levels for specified voltages