# DECIBEL DYNAMICS
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The **Bel** is a logarithmic unit of intensity named for Alexander Graham Bell. Being a logarithmic unit, the Bel cannot have an absolute scale (i.e. a reference of 0). It always represents a power ratio of a given power level to a reference power level (10:1). One Bel represents a power ratio of 10. A factor of 10 is a bit coarse for most work, so the **decibel** (one-tenth of a Bel and is abbreviated as dB) is typically used instead.

In short, the **decibel** (dB) is a logarithmic unit used to describe a ratio between two numbers. It is not a unit of measure within itself (like an inch or a foot), but more like percentages.
- Other similar types of measurements include the Richter scale (for earthquakes) and pH scale (for hydrogen ion concentration in liquids).
- Decibels measure the *intensity* of sound via comparison

All logarithmic measurements compare the quantity of interest with a reference value, often the smallest likely value of the quantity.

**Sound pressure level** is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. Measured in decibels.
- decibels are the standard measure of sound loudness
- Each dB = 10% change in sound level
- 5 dB = 50% change in sound level; 10 dB = 100% change in sound level
- Our perception of loudness is not exactly the same as sound pressure level. Generally, an increase of 10dB is perceived to be 2x as loud.

When measuring the sound created by an object, it is important to measure the distance from the object as well, since the sound pressure decreases with distance

Popular music typically has a dynamic range of 6 to 10 dB

Depending on the instrument(s), classical music can have a range of 25+ dB

| Perceptions of Increases in Decibel Level ||
|---|---|
| Imperceptible Change | 1dB |
| Barely Perceptible Change | 3dB |
| Clearly Noticeable Change | 5dB |
| About 2x as Loud | 10dB |
| About 4x as Loud | 20dB |

| Sound Environment | Sound Pressure Level (dBA SPL) | Approx. loudness with regard to ordinary conversation (60 dB) |
|---|---|---|
| Threshold of hearing | 0 | Don't hear anything |
| Broadcast studio interior | 10 | 1/32 as loud |
| Quiet house interior | 20 | 1/16 as loud |
| Quiet office interior | 30 | 1/8 as loud |
| Quiet rural area | 40 | 1/4 as loud |
| Dishwasher in next room | 50 | 1/2 as loud |
| Ordinary conversation | 60 | Ordinary conversation |
| Vacuum cleaner at 10 ft. | 70 | 2x as loud |
| • Garbage disposal at 3 ft.<br>• Alarm clock | 80 | 4x as loud |
| Food blender at 3 ft. | 90 | 8x as loud |
| Lawn mower at 3 ft. | 100 | 16x as loud |
| • Night club with band<br>• Power saw at 3 ft. | 110 | 32x as loud |
| • Shotgun<br>• Vuvuzela at 3 ft. | 120 | 64x as loud (2x louder than night club) |
| • Jet plane taking off at 75 ft.<br>• Threshold of pain | 130 | 128x as loud |
| Rifle shot | 140 | 256x as loud |
| Instantaneous ear damage | 150 | 512x as loud |
| • Shockwave<br>• Saturn Rocket (loudest possible sound) | 194 | Just plain loud |

The longer you are exposed to higher decibel levels, the greater chance you have of hearing damage.