Sound Delay and Tempo

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Calculating the Speed of Sound and Time Delay

The Speed of Sound through air is ≈ 331.3 m/s at 0º Celsius, and each degree above this adds 0.61 m/s. (Note: this formula provides an accurate estimate for temperatures between 0º–100º Celsius.)

Speed of Sound (based on Temperature)

$$\text{Speed of sound (in m/s)} = 331.3 + (0.61 * \text{ºC})$$

If your starting point is ºF, you'll need to convert to ºC for the above formula to work.

Converting Fahrenheit to Celsius

$$\text{ºCelsius} = \frac{(\text{ºFahrenheit - 32}) * 5}{9}$$

At an "average room temperature" of 20º C (68 ºF) this comes out to **343.5 m/s**.

If your distances will be measured in feet, you'll need to convert to feet with the following:

Converting Meters to Feet

$$\text{Feet} = \frac{\text{Meters}}{0.3048}$$

So, using the Speed of Sound from above, we can find the Speed of Sound in ft/s and ft/min:

Converting m/s to ft/s: $343.5 \text{ m/s} \div 0.3048 = 1126.9685 \text{ ft/s} \approx$ **1127 ft/s**

Multiply this by 60 to get ft/min: $1126.9685 * 60 = 67618.11 \text{ ft/min} \approx$ **67618 ft/min**

Time Delay in Seconds and Minutes (with a Speed of Sound of 343.5 m/s)

$$\text{Delay (in seconds)} = \frac{\text{Distance (in feet)}}{\text{Speed of sound (in ft/s)}} \approx \frac{\text{Distance (in feet)}}{1127}$$

$$\text{Delay (in minutes)} = \frac{\text{Distance (in feet)}}{\text{Speed of sound (in ft/min)}} \approx \frac{\text{Distance (in feet)}}{67618}$$

Example: If you are 100 feet away from a sound source, the sound delay in seconds would be:

$$\frac{\text{Distance (in feet)}}{\text{Speed of sound (in ft/s)}} = \frac{100}{1127} \approx 0.0887 \text{ seconds } \approx 88.7 \text{ milliseconds}$$

Calculating Rhythmic Delay

We want to find the *delay in beats* based on a given distance and tempo:

$$\text{Delay (in beats)} = \text{Delay (in minutes)} * \text{Tempo (in beats per minute)} = \frac{\text{Distance (in feet)}}{67618} * BPM$$

Rhythmic Delay (with a Speed of Sound of 67618 ft/min)

$$\text{Delay (in beats)} = \frac{\text{Distance (in feet)} * \text{Tempo (in BPM)}}{67618}$$

Example: If you are 160 feet away (the width of a football field) and your tempo is 120 BPM:

$$\text{delay in beats} = \frac{160 * 120}{67618} = \frac{19200}{67618} \approx 0.284 \text{ beats} = \text{more than a 16th note!}$$

Rhythm Reference:

Beat Fraction	Rhythm
0.0625	64th Note
0.125	32nd Note
0.143	Septuplet
0.1666	Sextuplet
0.2	Quintuplet
0.25	16th Note
0.333	8th-note Triplet
0.5	8th Note

Here you can access an interactive "Rhythmic Delay" Calculator:
www.brianmuellercreations.com/sos/