# Important Noise Pollution Formulas PDF

**Formulas**
**Examples**
**with Units**

**List of 31**
**Important Noise Pollution Formulas**

## 1) Characteristics of Sound and its Measurements Formulas

### 1.1) Temperature in Kelvin given Speed of Sound Formula

Evaluate Formula

Formula

$$T = \left(\frac{C}{20.05}\right)^2$$

Example with Units

$$292.6574\,\text{K} = \left(\frac{343\,\text{m/s}}{20.05}\right)^2$$

### 1.2) Wavelength of Wave Formula

Evaluate Formula

Formula

$$\lambda = \frac{C}{f}$$

Example with Units

$$0.6\,\text{m} = \frac{343\,\text{m/s}}{571.67\,\text{Hz}}$$

### 1.3) Period and Frequency of Wave Formulas

#### 1.3.1) Frequency given Period of Wave Formula

Evaluate Formula

Formula

$$f = \frac{1}{T_p}$$

Example with Units

$$571.4286\,\text{Hz} = \frac{1}{0.00175\,\text{s}}$$

#### 1.3.2) Frequency given Wavelength of Wave Formula

Evaluate Formula

Formula

$$f = \frac{C}{\lambda}$$

Example with Units

$$571.6667\,\text{Hz} = \frac{343\,\text{m/s}}{0.6\,\text{m}}$$

#### 1.3.3) Period of Wave Formula

Evaluate Formula

Formula

$$T_p = \frac{1}{f}$$

Example with Units

$$0.0017\,\text{s} = \frac{1}{571.67\,\text{Hz}}$$

## 1.4) Root Mean Square Pressure Formulas

### 1.4.1) Root Mean Square Pressure given Sound Intensity Formula

Evaluate Formula

Formula

$$P_{rms} = \sqrt{I \cdot \rho \cdot C}$$

Example with Units

$$0.0002\,\mathrm{Pa} = \sqrt{1E\text{-}10\,\mathrm{W/m^2} \cdot 1.293\,\mathrm{kg/m^3} \cdot 343\,\mathrm{m/s}}$$

### 1.4.2) Root Mean Square Pressure when Sound Pressure Level Formula

Evaluate Formula

Formula

$$P_m = \left(20 \cdot 10^{-6}\right) \cdot 10^{\frac{L}{20}}$$

Example with Units

$$200\,\mu\mathrm{Pa} = \left(20 \cdot 10^{-6}\right) \cdot 10^{\frac{20\,\mathrm{dB}}{20}}$$

## 1.5) Sound Intensity Formulas

### 1.5.1) Density of Air given Sound Intensity Formula

Evaluate Formula

Formula

$$\rho = \frac{P_{rms}^{\;2}}{I \cdot C}$$

Example with Units

$$1.2857\,\mathrm{kg/m^3} = \frac{0.00021\,\mathrm{Pa}^{\;2}}{1E\text{-}10\,\mathrm{W/m^2} \cdot 343\,\mathrm{m/s}}$$

### 1.5.2) Power of Sound Wave given Sound Intensity Formula

Evaluate Formula

Formula

$$W = I \cdot A$$

Example with Units

$$1.4E\text{-}9\,\mathrm{W} = 1E\text{-}10\,\mathrm{W/m^2} \cdot 14\,\mathrm{m^2}$$

### 1.5.3) Sound Intensity Formula

Evaluate Formula

Formula

$$I = \frac{W}{A}$$

Example with Units

$$1E\text{-}10\,\mathrm{W/m^2} = \frac{1.4E\text{-}9\,\mathrm{W}}{14\,\mathrm{m^2}}$$

### 1.5.4) Sound Intensity Level Formula

Evaluate Formula

Formula

$$L = 10 \cdot \log10\left(\frac{I}{10^{-12}}\right)$$

Example with Units

$$20\,\mathrm{dB} = 10 \cdot \log10\left(\frac{1E\text{-}10\,\mathrm{W/m^2}}{10^{-12}}\right)$$

### 1.5.5) Sound Intensity using Sound Intensity Level Formula

Evaluate Formula

Formula

$$I = \left(10^{-12}\right) \cdot 10^{\frac{L}{10}}$$

Example with Units

$$1E\text{-}10\,\mathrm{W/m^2} = \left(10^{-12}\right) \cdot 10^{\frac{20\,\mathrm{dB}}{10}}$$

### 1.5.6) Sound Intensity with respect to Sound Pressure Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $I = \left( \frac{P_{rms}}{\rho \cdot C} \right)^2$ | $9.9E\text{-}11\ W/m^2 = \left( \frac{0.00021\ Pa}{1.293\ kg/m^3 \cdot 343\ m/s} \right)^2$ |

### 1.5.7) Unit Area given Sound Intensity Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $A = \frac{W}{I}$ | $14\ m^2 = \frac{1.4E\text{-}9\ W}{1E\text{-}10\ W/m^2}$ |

## 1.6) Sound Pressure Formulas

### 1.6.1) Barometric Pressure given Sound Pressure Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $P_b = P_{atm} - P_s$ | $100525\ Pa = 101325\ Pa - 800\ Pa$ |

### 1.6.2) Sound Pressure Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $P_s = P_{atm} - P_b$ | $800\ Pa = 101325\ Pa - 100525\ Pa$ |

### 1.6.3) Sound Pressure Level in Decibels (Root Mean Square Pressure) Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $L = 20 \cdot \log 10 \left( \frac{P_m}{20 \cdot 10^{-6}} \right)$ | $20\ dB = 20 \cdot \log 10 \left( \frac{200\ \mu Pa}{20 \cdot 10^{-6}} \right)$ |

### 1.6.4) Total Atmospheric Pressure given Sound Pressure Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $P_{atm} = P_s + P_b$ | $101325\ Pa = 800\ Pa + 100525\ Pa$ |

## 1.7) Velocity of Sound Formulas

### 1.7.1) Speed of Sound Wave Formula

Evaluate Formula

| Formula | Example with Units |
|---|---|
| $C = 20.05 \cdot \sqrt{T}$ | $342.9957\ m/s = 20.05 \cdot \sqrt{292.65\ K}$ |

## 1.7.2) Velocity for Wavelength of Wave Formula

Evaluate Formula

Formula

$$C = \left(\lambda \cdot f\right)$$

Example with Units

$$343.002\,\text{m/s} = \left(0.6\,\text{m} \cdot 571.67\,\text{Hz}\right)$$

## 1.7.3) Velocity of Sound Wave given Sound Intensity Formula

Evaluate Formula

Formula

$$C = \frac{P_{rms}^{\ 2}}{I \cdot \rho}$$

Example with Units

$$341.0673\,\text{m/s} = \frac{0.00021\,\text{Pa}^{\ 2}}{1\text{E-}10\,\text{W/m}^2 \cdot 1.293\,\text{kg/m}^3}$$

# 2) Levels of Noise Formulas

## 2.1) Sound Intensity given Sound Level in Bels Formula

Evaluate Formula

Formula

$$I = I_o \cdot 10^{L_b}$$

Example with Units

$$1\text{E-}10\,\text{W/m}^2 = 1\text{E-}12\,\text{W/m}^2 \cdot 10^{0.2\,\text{B}}$$

## 2.2) Sound Intensity given Sound Level in Decibels Formula

Evaluate Formula

Formula

$$I = \left(I_o\right) \cdot 10^{\frac{L}{10}}$$

Example with Units

$$1\text{E-}10\,\text{W/m}^2 = \left(1\text{E-}12\,\text{W/m}^2\right) \cdot 10^{\frac{20\,\text{dB}}{10}}$$

## 2.3) Sound Level in Bels Formula

Evaluate Formula

Formula

$$L_b = \log 10\left(\frac{I}{I_o}\right)$$

Example with Units

$$0.2\,\text{B} = \log 10\left(\frac{1\text{E-}10\,\text{W/m}^2}{1\text{E-}12\,\text{W/m}^2}\right)$$

## 2.4) Sound Level in Decibels Formula

Evaluate Formula

Formula

$$L = 10 \cdot \log 10\left(\frac{I}{I_o}\right)$$

Example with Units

$$20\,\text{dB} = 10 \cdot \log 10\left(\frac{1\text{E-}10\,\text{W/m}^2}{1\text{E-}12\,\text{W/m}^2}\right)$$

## 2.5) Standard Sound Intensity given Sound Level in Bels Formula

Evaluate Formula

Formula

$$I_o = \frac{I}{10^{L_b}}$$

Example with Units

$$1\text{E-}12\,\text{W/m}^2 = \frac{1\text{E-}10\,\text{W/m}^2}{10^{0.2\,\text{B}}}$$

## 2.6) Standard Sound Intensity given Sound Level in Decibels Formula

Evaluate Formula

Formula

$$I_o = \frac{I}{10^{\frac{L}{10}}}$$

Example with Units

$$1E\text{-}12\,\text{W/m}^2 = \frac{1E\text{-}10\,\text{W/m}^2}{10^{\frac{20\,\text{dB}}{10}}}$$

# 3) Noise Abatement and Control Formulas

## 3.1) Distance between Source and Barrier given Noise Reduction in Decibels Formula

Evaluate Formula

Formula

$$R = \frac{20 \cdot h_w^{\,2}}{\lambda \cdot 10^{\frac{N}{10}}}$$

Example with Units

$$1.013\,\text{m} = \frac{20 \cdot 3.1\,\text{m}^{\,2}}{0.6\,\text{m} \cdot 10^{\frac{25\,\text{dB}}{10}}}$$

## 3.2) Height of Barrier Wall given Noise Reduction in Decibels Formula

Evaluate Formula

Formula

$$h_w = \sqrt{\left(\frac{\lambda \cdot R}{20}\right) \cdot 10^{\frac{N}{10}}}$$

Example with Units

$$3.0954\,\text{m} = \sqrt{\left(\frac{0.6\,\text{m} \cdot 1.01\,\text{m}}{20}\right) \cdot 10^{\frac{25\,\text{dB}}{10}}}$$

## 3.3) Noise Reduction in Decibels Formula

Evaluate Formula

Formula

$$N = 10 \cdot \log10\left(\frac{20 \cdot h_w^{\,2}}{\lambda \cdot R}\right)$$

Example with Units

$$25.0128\,\text{dB} = 10 \cdot \log10\left(\frac{20 \cdot 3.1\,\text{m}^{\,2}}{0.6\,\text{m} \cdot 1.01\,\text{m}}\right)$$

## 3.4) Wavelength of Sound given Noise Reduction in Decibels Formula

Evaluate Formula

Formula

$$\lambda = \frac{20 \cdot h_w^{\,2}}{R \cdot 10^{\frac{N}{10}}}$$

Example with Units

$$0.6018\,\text{m} = \frac{20 \cdot 3.1\,\text{m}^{\,2}}{1.01\,\text{m} \cdot 10^{\frac{25\,\text{dB}}{10}}}$$

## Variables used in list of Noise Pollution Formulas above

- **A** Area for Sound Intensity *(Square Meter)*
- **C** Velocity of Sound Wave *(Meter per Second)*
- **f** Frequency of Sound Wave *(Hertz)*
- $h_w$ Height of the Barrier Wall *(Meter)*
- **I** Sound Intensity Level *(Watt per Square Meter)*
- $I_o$ Standard Sound Intensity *(Watt per Square Meter)*
- **L** Sound Level in Decibels *(Decibel)*
- $L_b$ Sound Level in Bels *(Bel)*
- **N** Noise Reduction *(Decibel)*
- $P_{atm}$ Total Atmospheric Pressure *(Pascal)*
- $P_b$ Barometric Pressure *(Pascal)*
- $P_m$ Pressure RMS in Micropascal *(Micropascal)*
- $P_{rms}$ Pressure RMS *(Pascal)*
- $P_s$ Pressure *(Pascal)*
- **R** Horizontal Distance *(Meter)*
- **T** Temperature *(Kelvin)*
- $T_p$ Time Period of Sound Wave *(Second)*
- **W** Sound Power *(Watt)*
- **λ** Wavelength of Sound Wave *(Meter)*
- **ρ** Density of Air *(Kilogram per Cubic Meter)*

## Constants, Functions, Measurements used in list of Noise Pollution Formulas above

- Functions: **log10**, log10(Number)
  *The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.*
- Functions: **sqrt**, sqrt(Number)
  *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m)
  *Length Unit Conversion*
- Measurement: **Time** in Second (s)
  *Time Unit Conversion*
- Measurement: **Temperature** in Kelvin (K)
  *Temperature Unit Conversion*
- Measurement: **Area** in Square Meter (m²)
  *Area Unit Conversion*
- Measurement: **Pressure** in Pascal (Pa), Micropascal (μPa)
  *Pressure Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Power** in Watt (W)
  *Power Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz)
  *Frequency Unit Conversion*
- Measurement: **Wavelength** in Meter (m)
  *Wavelength Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  *Density Unit Conversion*
- Measurement: **Sound** in Decibel (dB), Bel (B)
  *Sound Unit Conversion*
- Measurement: **Intensity** in Watt per Square Meter (W/m²)
  *Intensity Unit Conversion*

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