Important Sound Propagation and Resonance Formulas PDF

Formulas
Examples
with Units

List of 12
Important Sound Propagation and Resonance Formulas

1) Resonance in Pipes Formulas

1.1) Frequency of 1st Harmonic Closed Organ Pipe Formula

Evaluate Formula

Formula

$$f_{1st} = \frac{1}{4} \cdot \frac{v_w}{L_{closed}}$$

Example with Units

$$32.5\,\text{Hz} = \frac{1}{4} \cdot \frac{65\,\text{m/s}}{0.5\,\text{m}}$$

1.2) Frequency of 2nd Harmonic Open Organ Pipe Formula

Evaluate Formula

Formula

$$f_{2nd} = \frac{v_w}{L_{open}}$$

Example with Units

$$90.2778\,\text{Hz} = \frac{65\,\text{m/s}}{0.72\,\text{m}}$$

1.3) Frequency of 3rd Harmonic Closed Organ Pipe Formula

Evaluate Formula

Formula

$$f_{3rd} = \frac{3}{4} \cdot \frac{v_w}{L_{closed}}$$

Example with Units

$$97.5\,\text{Hz} = \frac{3}{4} \cdot \frac{65\,\text{m/s}}{0.5\,\text{m}}$$

1.4) Frequency of 4th Harmonic Open Organ Pipe Formula

Evaluate Formula

Formula

$$f_{4th} = 2 \cdot \frac{v_w}{L_{open}}$$

Example with Units

$$180.5556\,\text{Hz} = 2 \cdot \frac{65\,\text{m/s}}{0.72\,\text{m}}$$

1.5) Frequency of Closed Organ Pipe Formula

Evaluate Formula

Formula

$$f_{closed\ pipe} = \frac{2 \cdot n + 1}{4} \cdot \frac{v_w}{L_{closed}}$$

Example with Units

$$162.5 = \frac{2 \cdot 2 + 1}{4} \cdot \frac{65\,\text{m/s}}{0.5\,\text{m}}$$

1.6) Frequency of Open Organ Pipe Formula

Evaluate Formula

Formula

$$f_{\text{open pipe}} = \frac{n}{2} \cdot \frac{v_w}{L_{\text{open}}}$$

Example with Units

$$90.2778 = \frac{2}{2} \cdot \frac{65\,\text{m/s}}{0.72\,\text{m}}$$

1.7) Frequency of Open Organ Pipe for Nth Overtone Formula

Evaluate Formula

Formula

$$f_{\text{open pipe,Nth}} = \frac{n - 1}{2} \cdot \frac{v_w}{L_{\text{open}}}$$

Example with Units

$$45.1389\,\text{Hz} = \frac{2 - 1}{2} \cdot \frac{65\,\text{m/s}}{0.72\,\text{m}}$$

1.8) Length of Closed Organ Pipe Formula

Evaluate Formula

Formula

$$L_{\text{closed}} = (2 \cdot n + 1) \cdot \frac{\lambda}{4}$$

Example with Units

$$0.5\,\text{m} = (2 \cdot 2 + 1) \cdot \frac{0.4\,\text{m}}{4}$$

1.9) Length of Open Organ Pipe Formula

Evaluate Formula

Formula

$$L_{\text{open}} = \frac{n}{2} \cdot \frac{v_w}{f}$$

Example with Units

$$0.7222\,\text{m} = \frac{2}{2} \cdot \frac{65\,\text{m/s}}{90\,\text{Hz}}$$

2) Sound Propagation Formulas

2.1) Intensity of Sound Formula

Evaluate Formula

Formula

$$I_s = \frac{P}{A}$$

Example with Units

$$20\,\text{W/m}^2 = \frac{900\,\text{W}}{45\,\text{m}^2}$$

2.2) Velocity of Sound in Liquid Formula

Evaluate Formula

Formula

$$v_{\text{speed}} = \sqrt{\frac{K}{\rho}}$$

Example with Units

$$1480.0004\,\text{m/s} = \sqrt{\frac{2183.83\,\text{MPa}}{997\,\text{kg/m}^3}}$$

2.3) Velocity of Sound in Solids Formula

Evaluate Formula

Formula

$$v_{\text{speed}} = \sqrt{\frac{E}{\rho}}$$

Example with Units

$$1480.9116\,\text{m/s} = \sqrt{\frac{2186.52\,\text{MPa}}{997\,\text{kg/m}^3}}$$

Variables used in list of Sound Propagation and Resonance Formulas above

- **A** Normal Area *(Square Meter)*
- **E** Elasticity *(Megapascal)*
- **f** Frequency *(Hertz)*
- f_{1st} Frequency of 1st Harmonic Closed Organ Pipe *(Hertz)*
- f_{2nd} Frequency of 2nd Harmonic Open Organ Pipe *(Hertz)*
- f_{3rd} Frequency of 3rd Harmonic Closed Organ Pipe *(Hertz)*
- f_{4th} Frequency of 4th Harmonic Open Organ Pipe *(Hertz)*
- $f_{closed\ pipe}$ Frequency of Closed Organ Pipe
- $f_{open\ pipe}$ Frequency of Open Organ Pipe
- $f_{open\ pipe,Nth}$ Frequency of Open Organ Pipe for Nth Overtone *(Hertz)*
- I_s Sound Intensity *(Watt per Square Meter)*
- **K** Bulk Modulus *(Megapascal)*
- L_{closed} Length of Closed Organ Pipe *(Meter)*
- L_{open} Length of Open Organ Pipe *(Meter)*
- **n** Number of Nodes
- **P** Power *(Watt)*
- v_{speed} Velocity of Sound *(Meter per Second)*
- v_w Velocity of Wave *(Meter per Second)*
- **λ** Wavelength *(Meter)*
- **ρ** Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Sound Propagation and Resonance Formulas above

- 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: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Megapascal (MPa)
  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: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Intensity** in Watt per Square Meter (W/m²)
  Intensity Unit Conversion

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