Important Froude Scaling and Scale Factor Formulas PDF

Formulas
Examples
with Units

List of 21
Important Froude Scaling and Scale Factor Formulas

1) Froude Scaling Formulas

1.1) Froude Scaling Formula

Evaluate Formula

Formula

$$F_n = \sqrt{\frac{F_i}{F_g}}$$

Example with Units

$$0.6 = \sqrt{\frac{3.636\,\text{kN}}{10.1\,\text{kN}}}$$

1.2) Froude Scaling given Velocity and Length Formula

Evaluate Formula

Formula

$$F_n = \frac{V_f}{\sqrt{[g] \cdot L_f}}$$

Example with Units

$$0.5943 = \frac{20\,\text{m/s}}{\sqrt{9.8066\,\text{m/s}^2 \cdot 115.5\,\text{m}}}$$

1.3) Gravity Forces for Froude Scaling Formula

Evaluate Formula

Formula

$$F_g = \frac{F_i}{F_n^2}$$

Example with Units

$$10.1\,\text{kN} = \frac{3.636\,\text{kN}}{0.6^2}$$

1.4) Inertia or Pressure Forces given Froude Scaling Formula

Evaluate Formula

Formula

$$F_i = \left(F_n^2\right) \cdot F_g$$

Example with Units

$$3.636\,\text{kN} = \left(0.6^2\right) \cdot 10.1\,\text{kN}$$

1.5) Length for Froude Scaling Formula

Evaluate Formula

Formula

$$L_f = \frac{\left(\frac{V_f}{F_n}\right)^2}{[g]}$$

Example with Units

$$113.3018\,\text{m} = \frac{\left(\frac{20\,\text{m/s}}{0.6}\right)^2}{9.8066\,\text{m/s}^2}$$

1.6) Velocity for Froude Scaling Formula

Evaluate Formula

Formula

$$V_f = F_n \cdot \sqrt{[g] \cdot L_f}$$

Example with Units

$$20.1931\,\text{m/s} = 0.6 \cdot \sqrt{9.8066\,\text{m/s}^2 \cdot 115.5\,\text{m}}$$

2) Scale Factor Formulas

2.1) Scale Factor for Acceleration Formula

Evaluate Formula

Formula

$$\alpha A = \frac{\alpha V^2}{\alpha L}$$

Example

$$0.9997 = \frac{4.242^2}{18}$$

2.2) Scale Factor for Acceleration given Scale Factor for Time and Velocity Formula

Evaluate Formula

Formula

$$\alpha A = \frac{\alpha V}{\alpha T}$$

Example

$$0.9998 = \frac{4.242}{4.243}$$

2.3) Scale Factor for Density of Fluid given Scale Factor for Inertia Forces Formula

Evaluate Formula

Formula

$$\alpha \rho = \frac{\alpha F}{\alpha V^2 \cdot \alpha L^2}$$

Example

$$1.0004 = \frac{5832.571}{4.242^2 \cdot 18^2}$$

2.4) Scale Factor for Inertia Forces Formula

Evaluate Formula

Formula

$$\alpha F = \alpha \rho \cdot \alpha V^2 \cdot \alpha L^2$$

Example

$$5829.6557 = 0.9999 \cdot 4.242^2 \cdot 18^2$$

2.5) Scale Factor for Kinematic Viscosity given Scale Factor for Time and Length Formula

Evaluate Formula

Formula

$$\alpha \nu = \frac{\alpha L^2}{\alpha_{TR}}$$

Example

$$1 = \frac{18^2}{324.0001}$$

2.6) Scale Factor for Length given Scale Factor for Acceleration Formula

Evaluate Formula

Formula

$$\alpha L = \frac{\alpha V^2}{\alpha A}$$

Example

$$17.9874 = \frac{4.242^2}{1.0004}$$

2.7) Scale Factor for Length given Scale Factor for Inertia Forces Formula

Evaluate Formula

Formula

$$\alpha L = \sqrt{\frac{\alpha F}{\alpha \rho \cdot \alpha V^2}}$$

Example

$$18.0045 = \sqrt{\frac{5832.571}{0.9999 \cdot 4.242^2}}$$

2.8) Scale Factor for Length given Scale Factor for Time Formula

Evaluate Formula

Formula

$$\alpha L = \alpha T^2$$

Example

$$18.003 = 4.243^2$$

2.9) Scale Factor for Length given Scale Factor for Time and Kinematic Viscosity Formula

Evaluate Formula

Formula

$$\alpha L = \sqrt{\alpha_{TR} \cdot \alpha \nu}$$

Example

$$17.991 = \sqrt{324.0001 \cdot 0.999}$$

2.10) Scale Factor for Time Formula

Evaluate Formula

Formula

$$\alpha T = \sqrt{\alpha L}$$

Example

$$4.2426 = \sqrt{18}$$

2.11) Scale Factor for Time given Scale Factor for Acceleration Formula

Evaluate Formula

Formula

$$\alpha T = \left(\frac{\alpha V}{\alpha A}\right)$$

Example

$$4.2403 = \left(\frac{4.242}{1.0004}\right)$$

2.12) Scale Factor for Time given Scale Factor for Length and Kinematic Viscosity Formula

Evaluate Formula

Formula

$$\alpha_{TR} = \frac{\alpha L^2}{\alpha \nu}$$

Example

$$324.3243 = \frac{18^2}{0.999}$$

2.13) Scale Factor for Velocity given Scale Factor for Acceleration Formula

Evaluate Formula

Formula

$$\alpha V = \sqrt{\alpha A \cdot \alpha L}$$

Example

$$4.2435 = \sqrt{1.0004 \cdot 18}$$

2.14) Scale Factor for Velocity given Scale Factor for Inertia Forces Formula

Evaluate Formula

Formula

$$\alpha V = \sqrt{\frac{\alpha F}{\alpha \rho \cdot \alpha L^2}}$$

Example

$$4.2431 = \sqrt{\frac{5832.571}{0.9999 \cdot 18^2}}$$

2.15) Scale Factor for Velocity given Scale Factor for Time Formula

Evaluate Formula

Formula

$$\alpha V = \frac{\alpha L}{\alpha T}$$

Example

$$4.2423 = \frac{18}{4.243}$$

Variables used in list of Froude Scaling and Scale Factor Formulas above

- F_g Forces Due to Gravity *(Kilonewton)*
- F_i Inertia Forces *(Kilonewton)*
- F_n Froude Scaling
- L_f Length for Froude Scaling *(Meter)*
- V_f Velocity of Fluid *(Meter per Second)*
- α_{TR} Scale Factor for the Time of Reynolds Scaling
- **αA** Scale Factor for the Acceleration
- **αF** Scale Factor for Inertia Forces
- **αL** Scale Factor for Length
- **αT** Scale Factor for the Time
- **αV** Scale Factor for Velocity
- **αv** Scale Factor for Fluid Viscosity
- **αρ** Scale Factor for Density of Fluid

Constants, Functions, Measurements used in list of Froude Scaling and Scale Factor Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Force** in Kilonewton (kN)
  Force Unit Conversion

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