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# Froude Scaling and Scale Factor Formulas

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# List of 21 Froude Scaling and Scale Factor Formulas

## Froude Scaling and Scale Factor

### Froude Scaling

#### 1) Froude Scaling

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

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

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

#### 2) Froude Scaling given Velocity and Length

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

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$\text{ex } 0.594263 = \frac{20\text{m/s}}{\sqrt{[g] \cdot 115.5\text{m}}}$$



### 3) Gravity Forces for Froude Scaling

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

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 10.1kN = \frac{3.636kN}{(0.6)^2}$$

### 4) Inertia or Pressure Forces given Froude Scaling

$$fx \quad F_i = (F_n^2) \cdot F_g$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 3.636kN = ((0.6)^2) \cdot 10.1kN$$

### 5) Length for Froude Scaling

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 113.3018m = \frac{\left(\frac{20m/s}{0.6}\right)^2}{[g]}$$

### 6) Velocity for Froude Scaling

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

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$ex \quad 20.19308m/s = 0.6 \cdot \sqrt{[g] \cdot 115.5m}$$



## Scale Factor

### 7) Scale Factor for Acceleration

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

[Open Calculator !\[\]\(23d9fc146e83b5c3013cfa32c784f8d5\_img.jpg\)](#)

$$\text{ex } 0.999698 = \frac{(4.242)^2}{18}$$

### 8) Scale Factor for Acceleration given Scale Factor for Time and Velocity

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

[Open Calculator !\[\]\(aa53ad6fea213b8b2226d3077e30533a\_img.jpg\)](#)

$$\text{ex } 0.999764 = \frac{4.242}{4.243}$$

### 9) Scale Factor for Density of Fluid given Scale Factor for Inertia Forces

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

[Open Calculator !\[\]\(626ce8ac21792b9405bfddfea8e0c96a\_img.jpg\)](#)

$$\text{ex } 1.0004 = \frac{5832.571}{(4.242)^2 \cdot (18)^2}$$



## 10) Scale Factor for Inertia Forces

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

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$\text{ex } 5829.656 = 0.9999 \cdot (4.242)^2 \cdot (18)^2$$

## 11) Scale Factor for Kinematic Viscosity given Scale Factor for Time and Length

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

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$\text{ex } 1 = \frac{(18)^2}{324.0001}$$


## 12) Scale Factor for Length given Scale Factor for Acceleration

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

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$\text{ex } 17.98737 = \frac{(4.242)^2}{1.0004}$$




13) Scale Factor for Length given Scale Factor for Inertia Forces 

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

Open Calculator 


$$ex \quad 18.0045 = \sqrt{\frac{5832.571}{0.9999 \cdot (4.242)^2}}$$

14) Scale Factor for Length given Scale Factor for Time 

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

Open Calculator 

$$ex \quad 18.00305 = (4.243)^2$$

15) Scale Factor for Length given Scale Factor for Time and Kinematic Viscosity 

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

Open Calculator 

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


16) Scale Factor for Time 

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

Open Calculator 

$$ex \quad 4.242641 = \sqrt{18}$$



17) Scale Factor for Time given Scale Factor for Acceleration 

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

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)


$$ex \quad 4.240304 = \left( \frac{4.242}{1.0004} \right)$$

18) Scale Factor for Time given Scale Factor for Length and Kinematic Viscosity 

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

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

$$ex \quad 324.3243 = \frac{(18)^2}{0.999}$$

19) Scale Factor for Velocity given Scale Factor for Acceleration 

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

[Open Calculator !\[\]\(c444627dab9fee9a1550c053ffaaaae2\_img.jpg\)](#)

$$ex \quad 4.243489 = \sqrt{1.0004 \cdot 18}$$



20) Scale Factor for Velocity given Scale Factor for Inertia Forces 


fx

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

Open Calculator 

ex

$$4.243061 = \sqrt{\frac{5832.571}{0.9999 \cdot (18)^2}}$$

21) Scale Factor for Velocity given Scale Factor for Time 

fx

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

Open Calculator 

ex

$$4.242281 = \frac{18}{4.243}$$








## Variables Used

- $F_g$  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)
- $\alpha_{TR}$  Scale Factor for the Time of Reynolds Scaling
- $\alpha_A$  Scale Factor for the Acceleration
- $\alpha_F$  Scale Factor for Inertia Forces
- $\alpha_L$  Scale Factor for Length
- $\alpha_T$  Scale Factor for the Time
- $\alpha_V$  Scale Factor for Velocity
- $\alpha_v$  Scale Factor for Fluid Viscosity
- $\alpha_p$  Scale Factor for Density of Fluid




## Constants, Functions, Measurements used

- **Constant:** **[g]**, 9.80665  
*Gravitational acceleration on Earth*
- **Function:** **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* 



## Check other formula lists

- [Froude Scaling and Scale Factor Formulas](#) 
- [Relation between Forces on the Prototype and Forces on the Model Formulas](#) 

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