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Turbulent Flow Formulas

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List of 18 Turbulent Flow Formulas

Turbulent Flow

1) Average Height of Irregularities for Turbulent Flow in Pipes

$$\text{fx } k = \frac{v' \cdot \text{Re}}{V,}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b_img.jpg\)](#)

$$\text{ex } 0.001208\text{m} = \frac{7.25\text{St} \cdot 10}{6\text{m/s}}$$

2) Blasius Equation

$$\text{fx } f = \frac{0.316}{\text{Re}^{\frac{1}{4}}}$$

[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d_img.jpg\)](#)

$$\text{ex } 0.1777 = \frac{0.316}{(10)^{\frac{1}{4}}}$$

3) Boundary Layer Thickness of Laminar Sublayer

$$\text{fx } \delta = \frac{11.6 \cdot v'}{V,}$$

[Open Calculator !\[\]\(f60b7a900783ac3fd531bfd9c111be6d_img.jpg\)](#)

$$\text{ex } 0.001402\text{m} = \frac{11.6 \cdot 7.25\text{St}}{6\text{m/s}}$$



4) Centreline Velocity

$$\text{fx } U_{\max} = 1.43 \cdot V \cdot \sqrt{1 + f}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$\text{ex } 3.080314\text{m/s} = 1.43 \cdot 2\text{m/s} \cdot \sqrt{1 + 0.16}$$

5) Centreline Velocity given Shear and Mean Velocity

$$\text{fx } U_{\max} = 3.75 \cdot V, + V$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$\text{ex } 24.5\text{m/s} = 3.75 \cdot 6\text{m/s} + 2\text{m/s}$$

6) Discharge through Pipe given Head Loss in Turbulent Flow

$$\text{fx } Q = \frac{P}{\rho_f \cdot [g] \cdot h_f}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$\text{ex } 3.004493\text{m}^3/\text{s} = \frac{170\text{W}}{1.225\text{kg}/\text{m}^3 \cdot [g] \cdot 4.71\text{m}}$$

7) Frictional Factor given Reynolds Number

$$\text{fx } f = 0.0032 + \frac{0.221}{\text{Re}^{0.237}}$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$\text{ex } 0.131254 = 0.0032 + \frac{0.221}{(10)^{0.237}}$$



8) Head Loss due to Friction given Power Required in Turbulent Flow

$$\text{fx } h_f = \frac{P}{\rho_f \cdot [g] \cdot Q}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$\text{ex } 4.717055\text{m} = \frac{170\text{W}}{1.225\text{kg/m}^3 \cdot [g] \cdot 3\text{m}^3/\text{s}}$$

9) Mean Velocity given Centreline Velocity

$$\text{fx } V = \frac{U_{\max}}{1.43 \cdot \sqrt{1 + f}}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$\text{ex } 1.869939\text{m/s} = \frac{2.88\text{m/s}}{1.43 \cdot \sqrt{1 + 0.16}}$$

10) Mean Velocity given Shear Velocity

$$\text{fx } V = 3.75 \cdot V' - U_{\max}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$\text{ex } 19.62\text{m/s} = 3.75 \cdot 6\text{m/s} - 2.88\text{m/s}$$

11) Power Required to Maintain Turbulent Flow

$$\text{fx } P = \rho_f \cdot [g] \cdot Q \cdot h_f$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$\text{ex } 169.7458\text{W} = 1.225\text{kg/m}^3 \cdot [g] \cdot 3\text{m}^3/\text{s} \cdot 4.71\text{m}$$



12) Roughness Reynold Number for Turbulent Flow in Pipes

$$\text{fx } \text{Re} = \frac{k \cdot V}{\nu}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$\text{ex } 6 = \frac{0.000725\text{m} \cdot 6\text{m/s}}{7.25\text{St}}$$

13) Shear Stress Developed for Turbulent Flow in Pipes

$$\text{fx } \tau = \rho_f \cdot V^2$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$\text{ex } 44.1\text{Pa} = 1.225\text{kg/m}^3 \cdot (6\text{m/s})^2$$

14) Shear Stress due to Viscosity

$$\text{fx } \tau = \mu \cdot d_v$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$\text{ex } 44\text{Pa} = 22\text{P} \cdot 20\text{m/s}$$

15) Shear Stress in Turbulent Flow

$$\text{fx } \tau = \frac{\rho_f \cdot f \cdot v^2}{2}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80_img.jpg\)](#)

$$\text{ex } 44.46162\text{Pa} = \frac{1.225\text{kg/m}^3 \cdot 0.16 \cdot (21.3\text{m/s})^2}{2}$$



16) Shear Velocity for Turbulent Flow in Pipes

[Open Calculator !\[\]\(eafc244b53721dd1ec133f0772f70fc7_img.jpg\)](#)

$$\text{fx } V_s = \sqrt{\frac{\tau}{\rho_f}}$$

$$\text{ex } 5.993193\text{m/s} = \sqrt{\frac{44\text{Pa}}{1.225\text{kg/m}^3}}$$

17) Shear Velocity given Centreline Velocity

[Open Calculator !\[\]\(10f8862fc183b400327470ea85afe9ae_img.jpg\)](#)

$$\text{fx } V_s = \frac{U_{\max} - V}{3.75}$$

$$\text{ex } 0.234667\text{m/s} = \frac{2.88\text{m/s} - 2\text{m/s}}{3.75}$$

18) Shear Velocity given Mean Velocity

[Open Calculator !\[\]\(35dc653d59570f8f891c312eeece91a2_img.jpg\)](#)

$$\text{fx } V_s = V \cdot \sqrt{\frac{f}{8}}$$

$$\text{ex } 0.282843\text{m/s} = 2\text{m/s} \cdot \sqrt{\frac{0.16}{8}}$$



Variables Used

- d_v Change in Velocity (Meter per Second)
- f Friction Factor
- h_f Head Loss Due to Friction (Meter)
- k Average Height Irregularities (Meter)
- P Power (Watt)
- Q Discharge (Cubic Meter per Second)
- Re Roughness Reynold Number
- U_{max} Centreline Velocity (Meter per Second)
- v Velocity (Meter per Second)
- ν Kinematic Viscosity (Stokes)
- V Mean Velocity (Meter per Second)
- V_s Shear Velocity (Meter per Second)
- V_s Shear Velocity 1 (Meter per Second)
- δ Boundary Layer Thickness (Meter)
- μ Viscosity (Poise)
- ρ_f Density of Fluid (Kilogram per Cubic Meter)
- τ Shear Stress (Pascal)



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:** **Power** in Watt (W)
Power Unit Conversion 
- **Measurement:** **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
Volumetric Flow Rate Unit Conversion 
- **Measurement:** **Dynamic Viscosity** in Poise (P)
Dynamic Viscosity Unit Conversion 
- **Measurement:** **Kinematic Viscosity** in Stokes (St)
Kinematic Viscosity Unit Conversion 
- **Measurement:** **Density** in Kilogram per Cubic Meter (kg/m³)
Density Unit Conversion 
- **Measurement:** **Stress** in Pascal (Pa)
Stress Unit Conversion 



Check other formula lists

- **Turbulent Flow Formulas** 

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