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Hypersonic Flow Parameters Formulas

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List of 20 Hypersonic Flow Parameters Formulas

Hypersonic Flow Parameters

1) Axial Force Coefficient

Open Calculator

fx $$\mu = \frac{F}{q \cdot A}$$

ex $$0.00502 = \frac{2.51\text{N}}{10\text{Pa} \cdot 50\text{m}^2}$$

2) Coefficient of Drag

Open Calculator

fx $$C_D = \frac{F_D}{q \cdot A}$$

ex $$0.16 = \frac{80\text{N}}{10\text{Pa} \cdot 50\text{m}^2}$$

3) Coefficient of Pressure with Similarity Parameters

Open Calculator

$$C_p = 2 \cdot \theta^2 \cdot \left(\frac{Y+1}{4} + \sqrt{\left(\frac{Y+1}{4} \right)^2 + \frac{1}{K^2}} \right)$$

ex $$0.82588 = 2 \cdot (0.53\text{rad})^2 \cdot \left(\frac{1.6+1}{4} + \sqrt{\left(\frac{1.6+1}{4} \right)^2 + \frac{1}{(2\text{rad})^2}} \right)$$

4) Deflection Angle

Open Calculator

$$\theta_d = \frac{2}{Y-1} \cdot \left(\frac{1}{M_1} - \frac{1}{M_2} \right)$$

ex $$-4.444444\text{rad} = \frac{2}{1.6-1} \cdot \left(\frac{1}{1.5} - \frac{1}{0.5} \right)$$

5) Drag Force

Open Calculator

$$F_D = C_D \cdot q \cdot A$$

ex $$80\text{N} = 0.16 \cdot 10\text{Pa} \cdot 50\text{m}^2$$

6) Dynamic Pressure

Open Calculator

fx $$q = \frac{F_D}{C_D \cdot A}$$

ex $$10\text{Pa} = \frac{80\text{N}}{0.16 \cdot 50\text{m}^2}$$

7) Dynamic Pressure given Coefficient of Lift

Open Calculator

fx $$q = \frac{F_L}{C_L \cdot A}$$

ex $$10\text{Pa} = \frac{10.5\text{N}}{0.021 \cdot 50\text{m}^2}$$

8) Fourier's Law of Heat Conduction

Open Calculator

fx $$q' = k \cdot \Delta T$$

ex $$407.2\text{W/m}^2 = 10.18\text{W/(m*K)} \cdot 40\text{K/m}$$

9) Hypersonic Similarity Parameter

Open Calculator

fx $$K = M \cdot \theta$$

ex $$2.0034\text{rad} = 3.78 \cdot 0.53\text{rad}$$

10) Lift Coefficient

Open Calculator

fx $$C_L = \frac{F_L}{q \cdot A}$$

ex $$0.021 = \frac{10.5\text{N}}{10\text{Pa} \cdot 50\text{m}^2}$$

11) Lift Force

Open Calculator

fx $$F_L = C_L \cdot q \cdot A$$

ex $$10.5\text{N} = 0.021 \cdot 10\text{Pa} \cdot 50\text{m}^2$$

12) Mach Number with Fluids

Open Calculator

fx $$M = \frac{u_f}{\sqrt{Y \cdot R \cdot T_f}}$$

ex $$3.7789 = \frac{256\text{m/s}}{\sqrt{1.6 \cdot 8.314 \cdot 345\text{K}}}$$

13) Mach Ratio at High Mach Number

Open Calculator

fx $$Ma = 1 - K \cdot \left(\frac{Y - 1}{2}\right)$$

ex $$0.4 = 1 - 2\text{rad} \cdot \left(\frac{1.6 - 1}{2}\right)$$

14) Moment Coefficient

Open Calculator

fx $$C_m = \frac{M_t}{q \cdot A \cdot L_c}$$

ex $$0.031053 = \frac{59\text{N*m}}{10\text{Pa} \cdot 50\text{m}^2 \cdot 3.8\text{m}}$$

15) Newtonian Sine Squared Law for Pressure Coefficient

Open Calculator

fx $$C_p = 2 \cdot \sin(\theta_d)^2$$

ex $$1.859815 = 2 \cdot \sin(-4.444444\text{rad})^2$$

16) Normal Force Coefficient

Open Calculator

fx $$\mu = \frac{F_n}{q \cdot A}$$

ex $$0.005 = \frac{2.5\text{N}}{10\text{Pa} \cdot 50\text{m}^2}$$

17) Pressure Ratio for High Mach Number

Open Calculator

fx $$r_p = \left(\frac{M_1}{M_2}\right)^{2 \cdot \frac{Y}{Y-1}}$$

ex $$350.4666 = \left(\frac{1.5}{0.5}\right)^{2 \cdot \frac{1.6}{1.6-1}}$$

18) Pressure Ratio having High Mach Number with Similarity Constant

Open Calculator

fx $$r_p = \left(1 - \left(\frac{Y - 1}{2}\right) \cdot K\right)^{2 \cdot \frac{Y}{Y-1}}$$

ex $$0.007545 = \left(1 - \left(\frac{1.6 - 1}{2}\right) \cdot 2\text{rad}\right)^{2 \cdot \frac{1.6}{1.6-1}}$$

19) Shear-Stress Distribution

Open Calculator

fx $$\tau = \eta \cdot V_g$$

ex $$0.02\text{Pa} = 0.001\text{Pa*s} \cdot 20\text{m/s}$$

20) Supersonic Expression for Pressure Coefficient on Surface with Local Deflection Angle

Open Calculator

fx $$C_p = \frac{2 \cdot \theta}{\sqrt{M^2 - 1}}$$

ex $$0.290783 = \frac{2 \cdot 0.53\text{rad}}{\sqrt{(3.78)^2 - 1}}$$

Variables Used

- **A** Area For Flow *(Square Meter)*
- **C_D** Drag Coefficient
- **C_L** Lift Coefficient
- **C_m** Moment Coefficient
- **C_p** Pressure Coefficient
- **F** Force *(Newton)*
- **F_D** Drag Force *(Newton)*
- **F_L** Lift Force *(Newton)*
- **F_n** Normal Force *(Newton)*
- **k** Thermal Conductivity *(Watt per Meter per K)*
- **K** Hypersonic Similarity Parameter *(Radian)*
- **L_c** Chord Length *(Meter)*
- **M** Mach Number
- **M_1** Mach Number ahead of Shock
- **M_2** Mach Number Behind Shock
- **M_t** Moment *(Newton Meter)*
- **Ma** Mach Ratio
- **q** Dynamic Pressure *(Pascal)*
- **q'** Heat Flux *(Watt per Square Meter)*
- **R** Universal Gas Constant
- **r_p** Pressure Ratio
- **T_f** Final Temperature *(Kelvin)*

- u_f Fluid Velocity *(Meter per Second)*
- V_g Velocity Gradient *(Meter per Second)*
- Y Specific Heat Ratio
- ΔT Temperature Gradient *(Kelvin Per Meter)*
- η Viscosity Coefficient *(Pascal Second)*
- θ Flow Deflection angle *(Radian)*
- θ_d Deflection Angle *(Radian)*
- μ Coefficient of Force
- τ Shear Stress *(Pascal)*

Constants, Functions, Measurements used

- Function: **sin**, sin(Angle)
  Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- 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: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Newton Meter (N*m)
  Energy Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Thermal Conductivity** in Watt per Meter per K (W/(m*K))
  Thermal Conductivity Unit Conversion
- Measurement: **Heat Flux Density** in Watt per Square Meter (W/m²)
  Heat Flux Density Unit Conversion

- Measurement: **Dynamic Viscosity** in Pascal Second (Pa*s)
  Dynamic Viscosity Unit Conversion
- Measurement: **Temperature Gradient** in Kelvin Per Meter (K/m)
  Temperature Gradient Unit Conversion
- Measurement: **Stress** in Pascal (Pa)
  Stress Unit Conversion

Check other formula lists

- Approximate Methods of Hypersonic Inviscid Flowfields Formulas
- Boundary Layer Equations for Hypersonic Flow Formulas
- Computational Fluid Dynamic Solutions Formulas
- Elements of Kinetic Theory Formulas
- Hypersonic Equivalence Principle and Blast Wave Theory Formulas
- Hypersonic Flight Paths Velocity of Altitude Map Formulas
- Hypersonic Flow and Disturbances Formulas
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