Important Computational Fluid Dynamic Solutions Formulas PDF

Formulas
Examples
with Units

List of 11
Important Computational Fluid Dynamic Solutions Formulas

1) Emissivity Formula

Evaluate Formula

Formula

$$\varepsilon = \sqrt{\frac{\mu_{viscosity}}{\rho_{\infty} \cdot V_{\infty} \cdot r_{nose}}}$$

Example with Units

$$0.9304 = \sqrt{\frac{375\,\text{P}}{1.225\,\text{kg/m}^3 \cdot 68\,\text{m/s} \cdot 0.52\,\text{m}}}$$

2) Emissivity given Reference Temperature Formula

Evaluate Formula

Formula

$$\varepsilon = \sqrt{\frac{\mu_{viscosity}}{\rho_{\infty} \cdot \sqrt{T_{ref}} \cdot r_{nose}}}$$

Example with Units

$$0.929 = \sqrt{\frac{375\,\text{P}}{1.225\,\text{kg/m}^3 \cdot \sqrt{4652\,\text{K}} \cdot 0.52\,\text{m}}}$$

3) Freestream Density Formula

Evaluate Formula

Formula

$$\rho_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot V_{\infty} \cdot r_{nose}}$$

Example with Units

$$1.1751\,\text{kg/m}^3 = \frac{375\,\text{P}}{0.95^2 \cdot 68\,\text{m/s} \cdot 0.52\,\text{m}}$$

4) Freestream Density given Reference Temperature Formula

Evaluate Formula

Formula

$$\rho_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \sqrt{T_{ref}} \cdot r_{nose}}$$

Example with Units

$$1.1716\,\text{kg/m}^3 = \frac{375\,\text{P}}{0.95^2 \cdot \sqrt{4652\,\text{K}} \cdot 0.52\,\text{m}}$$

5) Freestream Velocity Formula

Evaluate Formula

Formula

$$V_{\infty} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_{\infty} \cdot r_{nose}}$$

Example with Units

$$65.2296\,\text{m/s} = \frac{375\,\text{P}}{0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot 0.52\,\text{m}}$$

6) Nose Radius of Coordinate System Formula

Evaluate Formula

Formula

$$r_{nose} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot V_\infty}$$

Example with Units

$$0.4988\,\text{m} = \frac{375\,\text{P}}{0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot 68\,\text{m/s}}$$

7) Nose Radius of Coordinate System given Reference Temperature Formula

Evaluate Formula

Formula

$$r_{nose} = \frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot \sqrt{T_{ref}}}$$

Example with Units

$$0.4973\,\text{m} = \frac{375\,\text{P}}{0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot \sqrt{4652\,\text{K}}}$$

8) Reference Temperature given Emissivity Formula

Evaluate Formula

Formula

$$T_{ref} = \sqrt{\frac{\mu_{viscosity}}{\varepsilon^2 \cdot \rho_\infty \cdot r_{nose}}}$$

Example with Units

$$8.0765\,\text{K} = \sqrt{\frac{375\,\text{P}}{0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot 0.52\,\text{m}}}$$

9) Reference Temperature given Freestream Velocity Formula

Evaluate Formula

Formula

$$T_{ref} = V_\infty^2$$

Example with Units

$$4624\,\text{K} = 68\,\text{m/s}^2$$

10) Reference Viscosity Formula

Evaluate Formula

Formula

$$\mu_{viscosity} = \varepsilon^2 \cdot \rho_\infty \cdot V_\infty \cdot r_{nose}$$

Example with Units

$$390.9269\,\text{P} = 0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot 68\,\text{m/s} \cdot 0.52\,\text{m}$$

11) Reference Viscosity Given Reference Temperature Formula

Evaluate Formula

Formula

$$\mu_{viscosity} = \varepsilon^2 \cdot \rho_\infty \cdot \sqrt{T_{ref}} \cdot r_{nose}$$

Example with Units

$$392.1087\,\text{P} = 0.95^2 \cdot 1.225\,\text{kg/m}^3 \cdot \sqrt{4652\,\text{K}} \cdot 0.52\,\text{m}$$

Variables used in list of Computational Fluid Dynamic Solutions Formulas above

- r_{nose} Radius of Nose *(Meter)*
- T_{ref} Reference Temperature *(Kelvin)*
- V_{∞} Freestream Velocity *(Meter per Second)*
- ε Emissivity
- $\mu_{viscosity}$ Dynamic Viscosity *(Poise)*
- ρ_{∞} Freestream Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Computational Fluid Dynamic Solutions 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: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3)
  Density Unit Conversion

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