Important Force Exerted by Fluid Jet on Moving Curved Vane Formulas PDF

Formulas
Examples
with Units

List of 21
Important Force Exerted by Fluid Jet on Moving Curved Vane Formulas

1) Jet Striking a Symmetrical Moving Curved Vane at Centre Formulas

1.1) Absolute Velocity for Force Exerted by Jet in Direction of Flow of Incoming Jet Formula

Evaluate Formula

Formula

$$V_{absolute} = \left(\frac{\sqrt{F \cdot G}}{\gamma_f \cdot A_{Jet} \cdot \left(1 + \cos\left(\theta \right) \right)} \right) + v$$

Example with Units

$$9.9176\,\text{m/s} = \left(\frac{\sqrt{2.5\,\text{N} \cdot 10}}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(1 + \cos\left(30^\circ \right) \right)} \right) + 9.69\,\text{m/s}$$

1.2) Absolute Velocity for Mass of Fluid Striking Vane per Second Formula

Evaluate Formula

Formula

$$V_{absolute} = \left(\frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}} \right) + v$$

Example with Units

$$10.4545\,\text{m/s} = \left(\frac{0.9\,\text{kg} \cdot 10}{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2} \right) + 9.69\,\text{m/s}$$

1.3) Efficiency of Jet Formula

Evaluate Formula

Formula

$$\eta = \left(\left(2 \cdot v \right) \cdot \left(V_{absolute} - v \right)^2 \cdot \left(1 + \cos\left(\theta \right) \right) \right) \cdot \frac{100}{V_{absolute}^3}$$

Example with Units

$$0.59 = \left(\left(2 \cdot 9.69\,\text{m/s} \right) \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s} \right)^2 \cdot \left(1 + \cos\left(30^\circ \right) \right) \right) \cdot \frac{100}{10.1\,\text{m/s}^3}$$

1.4) Kinetic Energy of Jet per Second Formula

Evaluate Formula

Formula

$$KE = \frac{A_{Jet} \cdot v_{jet}^{3}}{2}$$

Example with Units

$$1036.8\,J = \frac{1.2\,m^2 \cdot 12\,m/s^{3}}{2}$$

1.5) Mass of Fluid Striking Vane per Seconds Formula

Evaluate Formula

Formula

$$m_f = \frac{\gamma_f \cdot A_{Jet} \cdot \left(V_{absolute} - v \right)}{G}$$

Example with Units

$$0.4827\,kg = \frac{9.81\,kN/m^3 \cdot 1.2\,m^2 \cdot \left(10.1\,m/s - 9.69\,m/s \right)}{10}$$

1.6) Maximum Efficiency Formula

Evaluate Formula

Formula

$$\eta_{max} = \left(\frac{1}{2} \right) \cdot \left(1 + \cos\left(\theta \right) \right)$$

Example with Units

$$0.933 = \left(\frac{1}{2} \right) \cdot \left(1 + \cos\left(30° \right) \right)$$

1.7) Velocity of Vane for given Mass of Fluid Formula

Evaluate Formula

Formula

$$v = V_{absolute} - \left(\frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}} \right)$$

Example with Units

$$9.3355\,m/s = 10.1\,m/s - \left(\frac{0.9\,kg \cdot 10}{9.81\,kN/m^3 \cdot 1.2\,m^2} \right)$$

1.8) Velocity of Vane given Exerted Force by Jet Formula

Evaluate Formula

Formula

$$v = -\left(\sqrt{\frac{F \cdot G}{\gamma_f \cdot A_{Jet} \cdot \left(1 + \cos\left(\theta \right) \right)}} - V_{absolute} \right)$$

Example with Units

$$9.0332\,m/s = -\left(\sqrt{\frac{2.5\,N \cdot 10}{9.81\,kN/m^3 \cdot 1.2\,m^2 \cdot \left(1 + \cos\left(30° \right) \right)}} - 10.1\,m/s \right)$$

1.9) Work Done by Jet on Vane per Second Formula

Evaluate Formula

Formula

$$w = \left(\frac{\gamma_f \cdot A_{Jet} \cdot \left(V_{absolute} - v \right)^{2}}{G} \right) \cdot \left(1 + \cos\left(\theta \right) \right) \cdot v$$

Example with Units

$$3.5782\,KJ = \left(\frac{9.81\,kN/m^3 \cdot 1.2\,m^2 \cdot \left(10.1\,m/s - 9.69\,m/s \right)^{2}}{10} \right) \cdot \left(1 + \cos\left(30° \right) \right) \cdot 9.69\,m/s$$

1.10) Work Done per Second given Efficiency of Wheel Formula

Evaluate Formula

Formula

$$w = \eta \cdot KE$$

Example with Units

$$0.0096\,\text{KJ} = 0.80 \cdot 12.01\,\text{J}$$

1.11) Area of Cross Section Formulas

1.11.1) Area of Cross Section for Force Exerted by Jet in Direction of Flow Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F \cdot G}{\left(1 + \cos\left(\theta\right)\right) \cdot \gamma_f \cdot V_{absolute} \cdot \left(V_{absolute} - v\right)}$$

Example with Units

$$0.3298\,\text{m}^2 = \frac{2.5\,\text{N} \cdot 10}{\left(1 + \cos\left(30°\right)\right) \cdot 9.81\,\text{kN/m}^3 \cdot 10.1\,\text{m/s} \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s}\right)}$$

1.11.2) Area of Cross Section for Force Exerted by Jet with relative velocity Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{F \cdot G}{\left(1 + a \cdot \cos\left(\theta\right)\right) \cdot \gamma_f \cdot V_{absolute} \cdot \left(V_{absolute} - v\right)}$$

Example with Units

$$0.3283\,\text{m}^2 = \frac{2.5\,\text{N} \cdot 10}{\left(1 + 1.01 \cdot \cos\left(30°\right)\right) \cdot 9.81\,\text{kN/m}^3 \cdot 10.1\,\text{m/s} \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s}\right)}$$

1.11.3) Area of Cross Section for Mass of Fluid Striking moving Vane per Second Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{m_f \cdot G}{\gamma_f \cdot \left(V_{absolute} - v\right)}$$

Example with Units

$$2.2376\,\text{m}^2 = \frac{0.9\,\text{kg} \cdot 10}{9.81\,\text{kN/m}^3 \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s}\right)}$$

1.11.4) Area of Cross Section for work done by Jet on vane per second Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{w \cdot G}{\gamma_f \cdot \left(V_{absolute} - v\right)^2 \cdot \left(1 + \cos\left(\theta\right)\right) \cdot v}$$

Example with Units

$$1.3079\,\text{m}^2 = \frac{3.9\,\text{KJ} \cdot 10}{9.81\,\text{kN/m}^3 \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s}\right)^2 \cdot \left(1 + \cos\left(30°\right)\right) \cdot 9.69\,\text{m/s}}$$

1.12) Force Exerted by Jet Formulas

1.12.1) Force Exerted by Jet in Direction of Flow of Incoming Jet with angle at 90 Formula

Evaluate Formula

Formula

$$Ft = \left(\frac{\gamma_f \cdot A_{Jet} \cdot \left(V_{absolute} - v \right)^2}{G} \right)$$

Example with Units

$$0.1979\,\text{kN} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s} \right)^2}{10} \right)$$

1.12.2) Force Exerted by Jet in Direction of Flow of Incoming Jet with angle zero Formula

Evaluate Formula

Formula

$$Ft = \left(\frac{\gamma_f \cdot A_{Jet} \cdot \left(V_{absolute} - v \right)^2}{G} \right)$$

Example with Units

$$0.1979\,\text{kN} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s} \right)^2}{10} \right)$$

1.12.3) Force Exerted by Jet in direction of Flow of Jet Formula

Evaluate Formula

Formula

$$F_s = \left(\frac{\gamma_f \cdot A_{Jet} \cdot V_{absolute} \cdot \left(V_{absolute} - v \right)}{G} \right) \cdot \left(1 + \cos\left(\theta \right) \right)$$

Example with Units

$$9.0965\,\text{N} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 10.1\,\text{m/s} \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s} \right)}{10} \right) \cdot \left(1 + \cos\left(30° \right) \right)$$

1.12.4) Force Exerted by jet with relative velocity Formula

Evaluate Formula

Formula

$$F_s = \left(\frac{\gamma_f \cdot A_{Jet} \cdot V_{absolute} \cdot \left(V_{absolute} - v \right)}{G} \right) \cdot \left(1 + a \cdot \cos\left(\theta \right) \right)$$

Example with Units

$$9.1387\,\text{N} = \left(\frac{9.81\,\text{kN/m}^3 \cdot 1.2\,\text{m}^2 \cdot 10.1\,\text{m/s} \cdot \left(10.1\,\text{m/s} - 9.69\,\text{m/s} \right)}{10} \right) \cdot \left(1 + 1.01 \cdot \cos\left(30° \right) \right)$$

2) Jet Striking an Unsymmetrical Moving Curved Vane Tangentially at one of the Tips Formulas

2.1) Area of Cross Section for Mass of Fluid Striking Vane per Second Formula

Evaluate Formula

Formula

$$A_{Jet} = \frac{m_f \cdot G}{\gamma_f \cdot v}$$

Example with Units

$$0.0947\,m^2 = \frac{0.9\,kg \cdot 10}{9.81\,kN/m^3 \cdot 9.69\,m/s}$$

2.2) Mass of Fluid Striking Vanes per Second Formula

Evaluate Formula

Formula

$$m_f = \frac{\gamma_f \cdot A_{Jet} \cdot v}{G}$$

Example with Units

$$11.4071\,kg = \frac{9.81\,kN/m^3 \cdot 1.2\,m^2 \cdot 9.69\,m/s}{10}$$

2.3) Velocity at Inlet for Mass of Fluid Striking Vane per Second Formula

Evaluate Formula

Formula

$$v = \frac{m_f \cdot G}{\gamma_f \cdot A_{Jet}}$$

Example with Units

$$0.7645\,m/s = \frac{0.9\,kg \cdot 10}{9.81\,kN/m^3 \cdot 1.2\,m^2}$$

Variables used in list of Force Exerted by Fluid Jet on Moving Curved Vane Formulas above

- **a** Numerical Coefficient a
- **A_{Jet}** Cross Sectional Area of Jet *(Square Meter)*
- **F** Force exerted by Jet *(Newton)*
- **F_s** Force by Stationary Plate *(Newton)*
- **Ft** Thrust Force *(Kilonewton)*
- **G** Specific Gravity of Fluid
- **KE** Kinetic Energy *(Joule)*
- **m_f** Fluid Mass *(Kilogram)*
- **v** Velocity of Jet *(Meter per Second)*
- **$V_{absolute}$** Absolute Velocity of Issuing Jet *(Meter per Second)*
- **v_{jet}** Fluid Jet Velocity *(Meter per Second)*
- **w** Work Done *(Kilojoule)*
- **γ_f** Specific Weight of Liquid *(Kilonewton per Cubic Meter)*
- **η** Efficiency of Jet
- **η_{max}** Maximum Efficiency
- **θ** Theta *(Degree)*

Constants, Functions, Measurements used in list of Force Exerted by Fluid Jet on Moving Curved Vane Formulas above

- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- 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: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J), Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Force** in Newton (N), Kilonewton (kN)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m^3)
  Specific Weight Unit Conversion

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