Important Pelton Turbine Formulas PDF

Formulas
Examples
with Units

List of 14
Important Pelton Turbine Formulas

1) Absolute Velocity of Pelton Jet Formula

Evaluate Formula

Formula

$$V_1 = C_v \cdot \sqrt{2 \cdot [g] \cdot H}$$

Example with Units

$$27.9837\,\text{m/s} = 0.975 \cdot \sqrt{2 \cdot 9.8066\,\text{m/s}^2 \cdot 42\,\text{m}}$$

2) Bucket Velocity of Pelton Turbine Formula

Evaluate Formula

Formula

$$U = V_1 - V_{r1}$$

Example with Units

$$14.73\,\text{m/s} = 28\,\text{m/s} - 13.27\,\text{m/s}$$

3) Coefficient of Velocity for Pelton Wheel Formula

Evaluate Formula

Formula

$$C_v = \frac{V_1}{\sqrt{2 \cdot [g] \cdot H}}$$

Example with Units

$$0.9756 = \frac{28\,\text{m/s}}{\sqrt{2 \cdot 9.8066\,\text{m/s}^2 \cdot 42\,\text{m}}}$$

4) Energy per Unit Mass of Pelton Formula

Evaluate Formula

Formula

$$E_p = \left(V_{ti} - V_w\right) \cdot U$$

Example with Units

$$384.3057\,\text{m}^2/\text{s}^2 = \left(28.27\,\text{m/s} - 2.18\,\text{m/s}\right) \cdot 14.73\,\text{m/s}$$

5) Energy per Unit Mass of Pelton Turbine Formula

Evaluate Formula

Formula

$$E_m = \left(V_{r1} + V_{r2} \cdot \cos\left(\beta_2\right)\right) \cdot U$$

Example with Units

$$369.8722\,\text{m}^2/\text{s}^2 = \left(13.27\,\text{m/s} + 12.6\,\text{m/s} \cdot \cos\left(20^\circ\right)\right) \cdot 14.73\,\text{m/s}$$

6) Inlet Relative Velocity of Pelton Formula

Evaluate Formula

Formula

$$V_{r1} = V_1 - U$$

Example with Units

$$13.27\,\text{m/s} = 28\,\text{m/s} - 14.73\,\text{m/s}$$

7) Outlet Relative Velocity of Pelton Formula

Evaluate Formula

Formula

$$V_{r2} = k \cdot V_{r1}$$

Example with Units

$$12.6065\,\text{m/s} = 0.95 \cdot 13.27\,\text{m/s}$$

8) Pelton Head Formula

Evaluate Formula

Formula

$$H = \frac{V_1^2}{2 \cdot [g] \cdot C_v^2}$$

Example with Units

$$42.049\,\text{m} = \frac{28\,\text{m/s}^2}{2 \cdot 9.8066\,\text{m/s}^2 \cdot 0.975^2}$$

9) Power of Pelton Turbine Formula

Evaluate Formula

Formula

$$P_t = \left(1 + k \cdot \cos\left(\beta_2\right)\right) \cdot \rho \cdot Q_p \cdot U \cdot V_{r1}$$

Example with Units

$$553.2784\,\text{kW} = \left(1 + 0.95 \cdot \cos\left(20°\right)\right) \cdot 997\,\text{kg/m}^3 \cdot 1.5\,\text{m}^3\text{/s} \cdot 14.73\,\text{m/s} \cdot 13.27\,\text{m/s}$$

10) Power of Pelton Turbine given Velocity Formula

Evaluate Formula

Formula

$$P_t = \left(1 + k \cdot \cos\left(\beta_2\right)\right) \cdot \rho \cdot Q_p \cdot U \cdot \left(V_1 - U\right)$$

Example with Units

$$553.2784\,\text{kW} = \left(1 + 0.95 \cdot \cos\left(20°\right)\right) \cdot 997\,\text{kg/m}^3 \cdot 1.5\,\text{m}^3\text{/s} \cdot 14.73\,\text{m/s} \cdot \left(28\,\text{m/s} - 14.73\,\text{m/s}\right)$$

11) Tangential Component of Inlet Velocity in Pelton Turbine Formula

Evaluate Formula

Formula

$$V_{ti} = V_{r1} + U$$

Example with Units

$$28\,\text{m/s} = 13.27\,\text{m/s} + 14.73\,\text{m/s}$$

12) Tangential Component of Outlet Velocity in Pelton Turbine Formula

Evaluate Formula

Formula

$$V_w = U - V_{r2} \cdot \cos\left(\beta_2\right)$$

Example with Units

$$2.8899\,\text{m/s} = 14.73\,\text{m/s} - 12.6\,\text{m/s} \cdot \cos\left(20°\right)$$

13) Wheel Efficiency of Pelton Turbine Formula

Evaluate Formula

Formula

$$\eta_w = \frac{2 \cdot \left(1 + k \cdot \cos\left(\beta_2\right)\right) \cdot \left(V_1 - U\right) \cdot U}{V_1^2}$$

Example with Units

$$0.9438 = \frac{2 \cdot \left(1 + 0.95 \cdot \cos\left(20°\right)\right) \cdot \left(28\,\text{m/s} - 14.73\,\text{m/s}\right) \cdot 14.73\,\text{m/s}}{28\,\text{m/s}^2}$$

14) Wheel Efficiency of Pelton Turbine given Power Formula

Evaluate Formula

Formula

$$\eta_w = \frac{2 \cdot P_t}{\rho \cdot Q_p \cdot V_1^2}$$

Example with Units

$$0.9433 = \frac{2 \cdot 553\,\text{kW}}{997\,\text{kg/m}^3 \cdot 1.5\,\text{m}^3\text{/s} \cdot 28\,\text{m/s}^2}$$

Variables used in list of Pelton Turbine Formulas above

- C_v Coefficient of Velocity for Pelton
- E_m Energy Per Unit Mass of Pelton Turbine *(Square Meter per Square Second)*
- E_p Energy Per Unit Mass of Pelton *(Square Meter per Square Second)*
- H Pelton Head *(Meter)*
- k K Factor for Pelton
- P_t Power of Pelton Turbine *(Kilowatt)*
- Q_p Volume Flow Rate For Pelton Turbine *(Cubic Meter per Second)*
- U Bucket Velocity of Pelton Turbine *(Meter per Second)*
- V_1 Velocity of Pelton Jet *(Meter per Second)*
- V_{r1} Inlet Relative Velocity of Pelton Turbine *(Meter per Second)*
- V_{r2} Outlet Relative Velocity of Pelton *(Meter per Second)*
- V_{ti} Tangential Inlet Velocity of Pelton *(Meter per Second)*
- V_w Tangential Outlet Velocity of Pelton *(Meter per Second)*
- β_2 Outlet Bucket Angle of Pelton *(Degree)*
- η_w Wheel Efficiency of Pelton Turbine
- ρ Mass Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Pelton Turbine Formulas above

- constant(s): **[g]**, 9.80665
  Gravitational acceleration on Earth
- 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: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m³)
  Mass Concentration Unit Conversion
- Measurement: **Specific Energy** in Square Meter per Square Second (m²/s²)
  Specific Energy Unit Conversion

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