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Pelton Turbine Formulas

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List of 14 Pelton Turbine Formulas

Pelton Turbine

1) Absolute Velocity of Pelton Jet

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

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

$$ex \quad 28.27068\text{m/s} = 0.985 \cdot \sqrt{2 \cdot [g] \cdot 42\text{m}}$$

2) Bucket Velocity of Pelton Turbine

$$fx \quad U = V_1 - V_{r1}$$

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

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

3) Coefficient of Velocity for Pelton Wheel

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

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

$$ex \quad 0.975569 = \frac{28\text{m/s}}{\sqrt{2 \cdot [g] \cdot 42\text{m}}}$$


4) Energy per Unit Mass of Pelton

$$fx \quad E_m = (V_{w1} - V_{w2}) \cdot U$$

[Open Calculator !\[\]\(83bbbd261710c59db0214aa27b2edc0d_img.jpg\)](#)

$$ex \quad 391.35\text{m}^2/\text{s}^2 = (28.27\text{m/s} - 2.18\text{m/s}) \cdot 15\text{m/s}$$



5) Energy per Unit Mass of Pelton Turbine 

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

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

$$ex \quad 376.6519m^2/s^2 = (13.27m/s + 12.6m/s \cdot \cos(20^\circ)) \cdot 15m/s$$

6) Inlet Relative Velocity of Pelton 

$$fx \quad V_{r1} = V_1 - U$$

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

$$ex \quad 13m/s = 28m/s - 15m/s$$

7) Outlet Relative Velocity of Pelton 

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

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

$$ex \quad 12.6065m/s = 0.95 \cdot 13.27m/s$$

8) Pelton Head 

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

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


$$ex \quad 41.19959m = \frac{(28m/s)^2}{2 \cdot [g] \cdot (0.985)^2}$$

9) Power of Pelton Turbine 

$$fx \quad P = (1 + k \cdot \cos(\beta_2)) \cdot \rho \cdot Q \cdot U \cdot V_{r1}$$

[Open Calculator !\[\]\(aff7c69c44a5e015f18c35867ef3f5c3_img.jpg\)](#)

$$ex \quad 563.4199kW = (1 + 0.95 \cdot \cos(20^\circ)) \cdot 997kg/m^3 \cdot 1.5m^3/s \cdot 15m/s \cdot 13.27m/s$$

10) Power of Pelton Turbine given Velocity 


$$fx \quad P_v = (1 + k \cdot \cos(\beta_2)) \cdot \rho \cdot Q \cdot U \cdot (V_1 - U)$$

[Open Calculator !\[\]\(a25a22d88c5882f4a20f36103df86562_img.jpg\)](#)

$$ex$$

$$551.9562kW = (1 + 0.95 \cdot \cos(20^\circ)) \cdot 997kg/m^3 \cdot 1.5m^3/s \cdot 15m/s \cdot (28m/s - 15m/s)$$



11) Tangential Component of Inlet Velocity in Pelton Turbine 

$$fx \quad V_{w1} = V_{r1} + U$$

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


$$ex \quad 28.27\text{m/s} = 13.27\text{m/s} + 15\text{m/s}$$

12) Tangential Component of Outlet Velocity in Pelton Turbine 

$$fx \quad V_{w2} = U - V_{r2} \cdot \cos(\beta_2)$$

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

$$ex \quad 3.159873\text{m/s} = 15\text{m/s} - 12.6\text{m/s} \cdot \cos(20^\circ)$$

13) Wheel Efficiency of Pelton Turbine 

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

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

$$ex \quad 0.941526 = \frac{2 \cdot (1 + 0.95 \cdot \cos(20^\circ)) \cdot (28\text{m/s} - 15\text{m/s}) \cdot 15\text{m/s}}{(28\text{m/s})^2}$$

14) Wheel Efficiency of Pelton Turbine given Power 

$$fx \quad \eta_w = \frac{2 \cdot P}{\rho \cdot Q \cdot V_1^2}$$

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

$$ex \quad 0.667564 = \frac{2 \cdot 391.35\text{kW}}{997\text{kg/m}^3 \cdot 1.5\text{m}^3/\text{s} \cdot (28\text{m/s})^2}$$










Variables Used

- C_v Coefficient of Velocity for Pelton
- E_m Energy per Unit Mass of Pelton Turbine (*Square Meter per Square Second*)
- H Pelton Head (*Meter*)
- k K Factor for Pelton
- P Power of Pelton Turbine (*Kilowatt*)
- P_v Power of Pelton Turbine given Velocity (*Kilowatt*)
- Q Volume Flow Rate (*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_{w1} Tangential Inlet Velocity of Pelton (*Meter per Second*)
- V_{w2} 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

- **Constant:** **[g]**, 9.80665 Meter/Second²
Gravitational acceleration on Earth
- **Function:** **cos**, cos(Angle)
Trigonometric cosine function
- **Function:** **sqrt**, sqrt(Number)
Square root function
- **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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