Important Torque Exerted on a Wheel with Radial Curved Vanes Formulas PDF

Formulas
Examples
with Units

List of 50
Important Torque Exerted on a Wheel with Radial Curved Vanes Formulas

1) Angular Momentum at Inlet Formula

Evaluate Formula

Formula

$$L = \left(\frac{w_f \cdot v_f}{G}\right) \cdot r$$

Example with Units

$$148.32\,\text{kg*m}^2/\text{s} = \left(\frac{12.36\,\text{N} \cdot 40\,\text{m/s}}{10}\right) \cdot 3\,\text{m}$$

2) Angular Momentum at Outlet Formula

Evaluate Formula

Formula

$$L = \left(\frac{w_f \cdot v}{G}\right) \cdot r$$

Example with Units

$$35.9305\,\text{kg*m}^2/\text{s} = \left(\frac{12.36\,\text{N} \cdot 9.69\,\text{m/s}}{10}\right) \cdot 3\,\text{m}$$

3) Angular Velocity for Work Done on Wheel per Second Formula

Evaluate Formula

Formula

$$\omega = \frac{w \cdot G}{w_f \cdot \left(v_f \cdot r + v \cdot r_O\right)}$$

Example with Units

$$13.3542\,\text{rad/s} = \frac{3.9\,\text{KJ} \cdot 10}{12.36\,\text{N} \cdot \left(40\,\text{m/s} \cdot 3\,\text{m} + 9.69\,\text{m/s} \cdot 12\,\text{m}\right)}$$

4) Efficiency of System Formula

Evaluate Formula

Formula

$$\eta = \left(1 - \left(\frac{v}{v_f}\right)^2\right)$$

Example with Units

$$0.9413 = \left(1 - \left(\frac{9.69\,\text{m/s}}{40\,\text{m/s}}\right)^2\right)$$

5) Initial Velocity for Work Done if Jet leaves in Motion of Wheel Formula

Evaluate Formula

Formula

$$u = \frac{\left(\frac{P_{dc} \cdot G}{w_f}\right) + \left(v \cdot v_f\right)}{v_f}$$

Example with Units

$$54.3704\,\text{m/s} = \frac{\left(\frac{2209\,\text{W} \cdot 10}{12.36\,\text{N}}\right) + \left(9.69\,\text{m/s} \cdot 40\,\text{m/s}\right)}{40\,\text{m/s}}$$

6) Initial Velocity given Power Delivered to Wheel Formula

Evaluate Formula

Formula

$$u = \left(\left(\frac{P_{dc} \cdot G}{w_f \cdot v_f}\right) - (v)\right)$$

Example with Units

$$34.9904\,\text{m/s} = \left(\left(\frac{2209\,\text{W} \cdot 10}{12.36\,\text{N} \cdot 40\,\text{m/s}}\right) - (9.69\,\text{m/s})\right)$$

7) Initial Velocity when Work Done at Vane Angle is 90 and Velocity is Zero Formula

Evaluate Formula

Formula

$$u = \frac{w \cdot G}{w_f \cdot v_f}$$

Example with Units

$$78.8835\,\text{m/s} = \frac{3.9\,\text{KJ} \cdot 10}{12.36\,\text{N} \cdot 40\,\text{m/s}}$$

8) Mass of Fluid Striking Vane per Second Formula

Evaluate Formula

Formula

$$m_f = \frac{w_f}{G}$$

Example with Units

$$1.236\,\text{kg} = \frac{12.36\,\text{N}}{10}$$

9) Power Delivered to Wheel Formula

Evaluate Formula

Formula

$$P_{dc} = \left(\frac{w_f}{G}\right) \cdot (v_f \cdot u + v \cdot v_f)$$

Example with Units

$$2209.4736\,\text{W} = \left(\frac{12.36\,\text{N}}{10}\right) \cdot (40\,\text{m/s} \cdot 35\,\text{m/s} + 9.69\,\text{m/s} \cdot 40\,\text{m/s})$$

10) Radius at Inlet for Work Done on Wheel per Second Formula

Evaluate Formula

Formula

$$r = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega}\right) - (v \cdot r_O)}{v_f}$$

Example with Units

$$3.161\,\text{m} = \frac{\left(\frac{3.9\,\text{KJ} \cdot 10}{12.36\,\text{N} \cdot 13\,\text{rad/s}}\right) - (9.69\,\text{m/s} \cdot 12\,\text{m})}{40\,\text{m/s}}$$

11) Radius at Inlet with Known Torque by Fluid Formula

Evaluate Formula

Formula

$$r = \frac{\left(\frac{\tau \cdot G}{w_f}\right) + (v \cdot r_O)}{v_f}$$

Example with Units

$$8.8131\,\text{m} = \frac{\left(\frac{292\,\text{N*m} \cdot 10}{12.36\,\text{N}}\right) + (9.69\,\text{m/s} \cdot 12\,\text{m})}{40\,\text{m/s}}$$

12) Radius at Outlet for Torque Exerted by Fluid Formula

Evaluate Formula

Formula

$$r_O = \frac{\left(\frac{\tau \cdot G}{w_f}\right) - \left(v_f \cdot r\right)}{v}$$

Example with Units

$$11.9965\,\text{m} = \frac{\left(\frac{292\,\text{N*m} \cdot 10}{12.36\,\text{N}}\right) - \left(40\,\text{m/s} \cdot 3\,\text{m}\right)}{9.69\,\text{m/s}}$$

13) Radius at Outlet for Work Done on Wheel per Second Formula

Evaluate Formula

Formula

$$r_O = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega}\right) - \left(v_f \cdot r\right)}{v}$$

Example with Units

$$12.6644\,\text{m} = \frac{\left(\frac{3.9\,\text{KJ} \cdot 10}{12.36\,\text{N} \cdot 13\,\text{rad/s}}\right) - \left(40\,\text{m/s} \cdot 3\,\text{m}\right)}{9.69\,\text{m/s}}$$

14) Speed of Wheel given Tangential Velocity at Inlet Tip of Vane Formula

Evaluate Formula

Formula

$$\Omega = \frac{v_{tangential} \cdot 60}{2 \cdot \pi \cdot r}$$

Example with Units

$$3.1831\,\text{rev/s} = \frac{60\,\text{m/s} \cdot 60}{2 \cdot 3.1416 \cdot 3\,\text{m}}$$

15) Speed of Wheel given Tangential Velocity at Outlet Tip of Vane Formula

Evaluate Formula

Formula

$$\Omega = \frac{v_{tangential} \cdot 60}{2 \cdot \pi \cdot r_O}$$

Example with Units

$$0.7958\,\text{rev/s} = \frac{60\,\text{m/s} \cdot 60}{2 \cdot 3.1416 \cdot 12\,\text{m}}$$

16) Torque Exerted by Fluid Formula

Evaluate Formula

Formula

$$\tau = \left(\frac{w_f}{G}\right) \cdot \left(v_f \cdot r + v \cdot r_O\right)$$

Example with Units

$$292.0421\,\text{N*m} = \left(\frac{12.36\,\text{N}}{10}\right) \cdot \left(40\,\text{m/s} \cdot 3\,\text{m} + 9.69\,\text{m/s} \cdot 12\,\text{m}\right)$$

17) Velocity at Point given Efficiency of System Formula

Evaluate Formula

Formula

$$v = \sqrt{1 - \eta} \cdot v_f$$

Example with Units

$$17.8885\,\text{m/s} = \sqrt{1 - 0.80} \cdot 40\,\text{m/s}$$

18) Velocity for Work Done if there is no Loss of Energy Formula

Evaluate Formula

Formula

$$v_f = \sqrt{\left(\frac{w \cdot 2 \cdot G}{w_f}\right) + v^2}$$

Example with Units

$$80.0286\,\mathrm{m/s} = \sqrt{\left(\frac{3.9\,\mathrm{KJ} \cdot 2 \cdot 10}{12.36\,\mathrm{N}}\right) + 9.69\,\mathrm{m/s}^2}$$

19) Velocity given Angular Momentum at Inlet Formula

Evaluate Formula

Formula

$$v_f = \frac{L \cdot G}{w_f \cdot r}$$

Example with Units

$$67.4218\,\mathrm{m/s} = \frac{250\,\mathrm{kg{*}m^2/s} \cdot 10}{12.36\,\mathrm{N} \cdot 3\,\mathrm{m}}$$

20) Velocity given Angular Momentum at Outlet Formula

Evaluate Formula

Formula

$$v = \frac{T_m \cdot G}{w_f \cdot r}$$

Example with Units

$$10.383\,\mathrm{m/s} = \frac{38.5\,\mathrm{kg{*}m/s} \cdot 10}{12.36\,\mathrm{N} \cdot 3\,\mathrm{m}}$$

21) Velocity given Efficiency of System Formula

Evaluate Formula

Formula

$$v_f = \frac{v}{\sqrt{1 - \eta}}$$

Example with Units

$$21.6675\,\mathrm{m/s} = \frac{9.69\,\mathrm{m/s}}{\sqrt{1 - 0.80}}$$

22) Radius of the Wheel Formulas

22.1) Radius of Wheel for Tangential Velocity at Inlet Tip of Vane Formula

Evaluate Formula

Formula

$$r = \frac{v}{\frac{2 \cdot \pi \cdot \Omega}{60}}$$

Example with Units

$$7.0129\,\mathrm{m} = \frac{9.69\,\mathrm{m/s}}{\frac{2 \cdot 3.1416 \cdot 2.1\,\mathrm{rev/s}}{60}}$$

22.2) Radius of Wheel for Tangential Velocity at Outlet Tip of Vane Formula

Evaluate Formula

Formula

$$r = \frac{v_{tangential}}{\frac{2 \cdot \pi \cdot \Omega}{60}}$$

Example with Units

$$4.5473\,\mathrm{m} = \frac{60\,\mathrm{m/s}}{\frac{2 \cdot 3.1416 \cdot 2.1\,\mathrm{rev/s}}{60}}$$

22.3) Radius of Wheel given Angular Momentum at Inlet Formula

Evaluate Formula

Formula

$$r = \frac{L}{\frac{w_f \cdot v_f}{G}}$$

Example with Units

$$5.0566\,\mathrm{m} = \frac{250\,\mathrm{kg{*}m^2/s}}{\frac{12.36\,\mathrm{N} \cdot 40\,\mathrm{m/s}}{10}}$$

23) Tangential momentum and Tangential velocity Formulas

23.1) Tangential Momentum of Fluid Striking Vanes at Inlet Formula

Evaluate Formula

Formula

$$T_m = \frac{w_f \cdot v_f}{G}$$

Example with Units

$$49.44\,\text{kg*m/s} = \frac{12.36\,\text{N} \cdot 40\,\text{m/s}}{10}$$

23.2) Tangential Momentum of Fluid Striking Vanes at Outlet Formula

Evaluate Formula

Formula

$$T_m = \frac{w_f \cdot v}{G}$$

Example with Units

$$11.9768\,\text{kg*m/s} = \frac{12.36\,\text{N} \cdot 9.69\,\text{m/s}}{10}$$

23.3) Tangential Velocity at Inlet Tip of Vane Formula

Evaluate Formula

Formula

$$v_{tangential} = \left(\frac{2 \cdot \pi \cdot \Omega}{60}\right) \cdot r$$

Example with Units

$$39.5841\,\text{m/s} = \left(\frac{2 \cdot 3.1416 \cdot 2.1\,\text{rev/s}}{60}\right) \cdot 3\,\text{m}$$

23.4) Tangential Velocity at Outlet Tip of Vane Formula

Evaluate Formula

Formula

$$v_{tangential} = \left(\frac{2 \cdot \pi \cdot \Omega}{60}\right) \cdot r$$

Example with Units

$$39.5841\,\text{m/s} = \left(\frac{2 \cdot 3.1416 \cdot 2.1\,\text{rev/s}}{60}\right) \cdot 3\,\text{m}$$

23.5) Velocity given Tangential Momentum of Fluid Striking Vanes at Inlet Formula

Evaluate Formula

Formula

$$u = \frac{T_m \cdot G}{w_f}$$

Example with Units

$$31.1489\,\text{m/s} = \frac{38.5\,\text{kg*m/s} \cdot 10}{12.36\,\text{N}}$$

23.6) Velocity given Tangential Momentum of Fluid Striking Vanes at Outlet Formula

Evaluate Formula

Formula

$$u = \frac{T_m \cdot G}{w_f}$$

Example with Units

$$31.1489\,\text{m/s} = \frac{38.5\,\text{kg*m/s} \cdot 10}{12.36\,\text{N}}$$

24) Velocity at Inlet Formulas

24.1) Velocity at Inlet given Torque by Fluid Formula

Evaluate Formula

Formula

$$v_f = \frac{\left(\frac{\tau \cdot G}{w_f}\right) + (v \cdot r)}{r_O}$$

Example with Units

$$22.1097\,\text{m/s} = \frac{\left(\frac{292\,\text{N*m} \cdot 10}{12.36\,\text{N}}\right) + (9.69\,\text{m/s} \cdot 3\,\text{m})}{12\,\text{m}}$$

24.2) Velocity at Inlet given Work Done on Wheel Formula

Evaluate Formula

Formula

$$v_f = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega}\right) - v \cdot r_O}{r}$$

Example with Units

$$42.1461\,\mathrm{m/s} = \frac{\left(\frac{3.9\,\mathrm{KJ} \cdot 10}{12.36\,\mathrm{N} \cdot 13\,\mathrm{rad/s}}\right) - 9.69\,\mathrm{m/s} \cdot 12\,\mathrm{m}}{3\,\mathrm{m}}$$

24.3) Velocity at Inlet when Work Done at Vane Angle is 90 and Velocity is Zero Formula

Evaluate Formula

Formula

$$v_f = \frac{w \cdot G}{w_f \cdot u}$$

Example with Units

$$90.1526\,\mathrm{m/s} = \frac{3.9\,\mathrm{KJ} \cdot 10}{12.36\,\mathrm{N} \cdot 35\,\mathrm{m/s}}$$

25) Velocity at Outlet Formulas

25.1) Velocity at Outlet given Power Delivered to Wheel Formula

Evaluate Formula

Formula

$$v = \frac{\left(\frac{P_{dc} \cdot G}{w_f}\right) - \left(v_f \cdot u\right)}{v_f}$$

Example with Units

$$9.6804\,\mathrm{m/s} = \frac{\left(\frac{2209\,\mathrm{W} \cdot 10}{12.36\,\mathrm{N}}\right) - \left(40\,\mathrm{m/s} \cdot 35\,\mathrm{m/s}\right)}{40\,\mathrm{m/s}}$$

25.2) Velocity at Outlet given Torque by Fluid Formula

Evaluate Formula

Formula

$$v = \frac{\left(\frac{\tau \cdot G}{w_f}\right) - \left(v_f \cdot r\right)}{r_O}$$

Example with Units

$$9.6872\,\mathrm{m/s} = \frac{\left(\frac{292\,\mathrm{N^*m} \cdot 10}{12.36\,\mathrm{N}}\right) - \left(40\,\mathrm{m/s} \cdot 3\,\mathrm{m}\right)}{12\,\mathrm{m}}$$

25.3) Velocity at Outlet given Work Done if Jet leaves in Motion of Wheel Formula

Evaluate Formula

Formula

$$v = \frac{\left(\frac{w \cdot G}{w_f}\right) - \left(v_f \cdot u\right)}{v_f}$$

Example with Units

$$43.8835\,\mathrm{m/s} = \frac{\left(\frac{3.9\,\mathrm{KJ} \cdot 10}{12.36\,\mathrm{N}}\right) - \left(40\,\mathrm{m/s} \cdot 35\,\mathrm{m/s}\right)}{40\,\mathrm{m/s}}$$

25.4) Velocity at Outlet given Work Done on Wheel Formula

Evaluate Formula

Formula

$$v = \frac{\left(\frac{w \cdot G}{w_f \cdot \omega}\right) - \left(v_f \cdot r\right)}{r_O}$$

Example with Units

$$10.2265\,\mathrm{m/s} = \frac{\left(\frac{3.9\,\mathrm{KJ} \cdot 10}{12.36\,\mathrm{N} \cdot 13\,\mathrm{rad/s}}\right) - \left(40\,\mathrm{m/s} \cdot 3\,\mathrm{m}\right)}{12\,\mathrm{m}}$$

26) Weight of the Fluid Formulas

26.1) Weight of Fluid for Work Done if there is no loss of Energy Formula

Evaluate Formula

Formula

$$w_f = \frac{w \cdot 2 \cdot G}{v_f^2 - v^2}$$

Example with Units

$$51.7893\,\text{N} = \frac{3.9\,\text{KJ} \cdot 2 \cdot 10}{40\,\text{m/s}^2 - 9.69\,\text{m/s}^2}$$

26.2) Weight of Fluid for Work Done on Wheel per Second Formula

Evaluate Formula

Formula

$$w_f = \frac{w \cdot G}{\left(v_f \cdot r + v \cdot r_O\right) \cdot \omega}$$

Example with Units

$$12.6968\,\text{N} = \frac{3.9\,\text{KJ} \cdot 10}{\left(40\,\text{m/s} \cdot 3\,\text{m} + 9.69\,\text{m/s} \cdot 12\,\text{m}\right) \cdot 13\,\text{rad/s}}$$

26.3) Weight of Fluid given Angular Momentum at Inlet Formula

Evaluate Formula

Formula

$$w_f = \frac{L \cdot G}{v_f \cdot r}$$

Example with Units

$$20.8333\,\text{N} = \frac{250\,\text{kg*m}^2\text{/s} \cdot 10}{40\,\text{m/s} \cdot 3\,\text{m}}$$

26.4) Weight of Fluid given Angular Momentum at Outlet Formula

Evaluate Formula

Formula

$$w_f = \frac{T_m \cdot G}{v \cdot r_O}$$

Example with Units

$$91.9788\,\text{N} = \frac{38.5\,\text{kg*m/s} \cdot 10}{9.69\,\text{m/s} \cdot 12\,\text{m}}$$

26.5) Weight of Fluid given Mass of Fluid Striking Vane per Second Formula

Evaluate Formula

Formula

$$w_f = m_f \cdot G$$

Example with Units

$$9\,\text{N} = 0.9\,\text{kg} \cdot 10$$

26.6) Weight of Fluid given Power Delivered to Wheel Formula

Evaluate Formula

Formula

$$w_f = \frac{P_{dc} \cdot G}{v_f \cdot u + v \cdot v_f}$$

Example with Units

$$12.3574\,\text{N} = \frac{2209\,\text{W} \cdot 10}{40\,\text{m/s} \cdot 35\,\text{m/s} + 9.69\,\text{m/s} \cdot 40\,\text{m/s}}$$

26.7) Weight of Fluid given Tangential Momentum of Fluid Striking Vanes at Inlet Formula

Evaluate Formula

Formula

$$w_f = \frac{T_m \cdot G}{v_f}$$

Example with Units

$$9.625\,\text{N} = \frac{38.5\,\text{kg*m/s} \cdot 10}{40\,\text{m/s}}$$

26.8) Weight of Fluid given Work Done if Jet leaves in Motion of Wheel Formula

Evaluate Formula

Formula

$$w_f = \frac{w \cdot G}{v_f \cdot u - v \cdot v_f}$$

Example with Units

$$38.5223\,\text{N} = \frac{3.9\,\text{KJ} \cdot 10}{40\,\text{m/s} \cdot 35\,\text{m/s} - 9.69\,\text{m/s} \cdot 40\,\text{m/s}}$$

26.9) Weight of Fluid when Work Done at Vane Angle is 90 and Velocity is Zero Formula

Evaluate Formula

Formula

$$w_f = \frac{w \cdot G}{v_f \cdot u}$$

Example with Units

$$27.8571\,\text{N} = \frac{3.9\,\text{KJ} \cdot 10}{40\,\text{m/s} \cdot 35\,\text{m/s}}$$

27) Work Done Formulas

27.1) Work Done for Radial Discharge at Vane Angle is 90 and Velocity is Zero Formula

Evaluate Formula

Formula

$$w = \left(\frac{w_f}{G}\right) \cdot \left(v_f \cdot u\right)$$

Example with Units

$$1.7304\,\text{KJ} = \left(\frac{12.36\,\text{N}}{10}\right) \cdot \left(40\,\text{m/s} \cdot 35\,\text{m/s}\right)$$

27.2) Work Done if Jet leaves in Direction as that of Motion of Wheel Formula

Evaluate Formula

Formula

$$w = \left(\frac{w_f}{G}\right) \cdot \left(v_f \cdot u - v \cdot v_f\right)$$

Example with Units

$$1.2513\,\text{KJ} = \left(\frac{12.36\,\text{N}}{10}\right) \cdot \left(40\,\text{m/s} \cdot 35\,\text{m/s} - 9.69\,\text{m/s} \cdot 40\,\text{m/s}\right)$$

27.3) Work Done if there is no Loss of Energy Formula

Evaluate Formula

Formula

$$w = \left(\frac{w_f}{2} \cdot G\right) \cdot \left(v_f^2 - v^2\right)$$

Example with Units

$$0.0931\,\text{KJ} = \left(\frac{12.36\,\text{N}}{2} \cdot 10\right) \cdot \left(40\,\text{m/s}^2 - 9.69\,\text{m/s}^2\right)$$

27.4) Work Done on Wheel per Second Formula

Evaluate Formula

Formula

$$w = \left(\frac{w_f}{G}\right) \cdot \left(v_f \cdot r + v \cdot r_O\right) \cdot \omega$$

Example with Units

$$3.7965\,\text{KJ} = \left(\frac{12.36\,\text{N}}{10}\right) \cdot \left(40\,\text{m/s} \cdot 3\,\text{m} + 9.69\,\text{m/s} \cdot 12\,\text{m}\right) \cdot 13\,\text{rad/s}$$

Variables used in list of Torque Exerted on a Wheel with Radial Curved Vanes Formulas above

- **G** Specific Gravity of Fluid
- **L** Angular Momentum *(Kilogram Square Meter per Second)*
- **m_f** Fluid Mass *(Kilogram)*
- **P_{dc}** Power Delivered *(Watt)*
- **r** Radius of wheel *(Meter)*
- **r_O** Radius of Outlet *(Meter)*
- **T_m** Tangential Momentum *(Kilogram Meter per Second)*
- **u** Initial Velocity *(Meter per Second)*
- **v** Velocity of Jet *(Meter per Second)*
- **v_f** Final Velocity *(Meter per Second)*
- **$v_{tangential}$** Tangential Velocity *(Meter per Second)*
- **w** Work Done *(Kilojoule)*
- **w_f** Weight of Fluid *(Newton)*
- **η** Efficiency of Jet
- **τ** Torque Exerted on Wheel *(Newton Meter)*
- **ω** Angular Velocity *(Radian per Second)*
- **Ω** Angular Speed *(Revolution per Second)*

Constants, Functions, Measurements used in list of Torque Exerted on a Wheel with Radial Curved Vanes Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- 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: **Weight** in Kilogram (kg) *Weight Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Energy** in Kilojoule (KJ) *Energy Unit Conversion*
- Measurement: **Power** in Watt (W) *Power Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s), Revolution per Second (rev/s) *Angular Velocity Unit Conversion*
- Measurement: **Torque** in Newton Meter (N*m) *Torque Unit Conversion*
- Measurement: **Angular Momentum** in Kilogram Square Meter per Second (kg*m²/s) *Angular Momentum Unit Conversion*
- Measurement: **Momentum** in Kilogram Meter per Second (kg*m/s) *Momentum Unit Conversion*

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