Agitator Power from Power Number

Shaft power of a stirred tank agitator from the impeller power number, speed, diameter and liquid density, with Reynolds number, tip speed and power per volume.

Method: Rushton; Costich and Everett (1950); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Power number of the impeller From the impeller maker's or published curve at your Reynolds number.	5.0000	
Impeller speed	120.00	rpm
Impeller diameter	0.60000	m
Liquid density	1,000.0	kg/m³
Liquid viscosity	1.0000	cP
Tank diameter	1.8000	m
Liquid height	1.8000	m

Calculated results

Parameter	Value	Unit
Impeller Reynolds number	720,000	
Shaft power	3.1104	kW
Shaft torque	247.52	N·m
Tip speed	3.7699	m/s
Liquid volume	4.5804	m³
Power per unit volume	0.67906	kW/m³

Notes for this case

- Ungassed power; gassing and solids change the power number. Add drive losses to size the motor.

Formula and method

$$Re = \frac{\rho N D^2}{\mu}, \quad P = N_p \rho N^3 D^5$$

$$M = \frac{P}{2\pi N}, \quad u_{tip} = \pi N D, \quad V = \frac{\pi T^2}{4} H$$

Variables

N_p	Power number of the impeller	-
N	Impeller speed	1/s
D	Impeller diameter	m
ρ	Liquid density	kg/m³
μ	Liquid viscosity	Pa·s
T	Tank diameter	m
H	Liquid height	m
Re	Impeller Reynolds number	-
P	Shaft power	W

M	Shaft torque	N·m
u_{tip}	Tip speed	m/s
V	Liquid volume	m³
P/V	Power per unit volume	W/m³

Method and standards

The power number collects the impeller geometry; in the turbulent range it is constant, so power varies with $\rho N^3 D^5$.

Assumptions and limits

- Single impeller; baffled tank for the quoted power numbers. Unbaffled tanks (vortexing, Froude-number dependence) and multiple impellers on one shaft are outside scope: the power number entered must already account for them.

References

- Rushton
- Costich and Everett (1950)
- power characteristics of mixing impellers

Report details

Report reference	FCC-D74X-AVQZ (the same inputs always give the same reference)
Generated	17 November 2026, 19:34 UTC
Calculator	Agitator Power from Power Number
Method last reviewed	12 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/reactors/agitator-power

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.