Flywheel Energy, Inertia and Speed Fluctuation

Moment of inertia of a disc or rim flywheel, its stored kinetic energy, the energy given up between two speeds, the coefficient of fluctuation and rim speed.

Method: Rigid-body rotation; E = I ω²/2 (classical mechanics)

Input parameters

Unit system: SI

Parameter	Value	Unit
Flywheel	Solid disc (I = m r²/2)	
Mass	500.00	kg
Outer radius	0.60000	m
Moment of inertia (when entered)	90.000	kg·m²
Highest speed	1,500.0	rpm
Lowest speed	1,450.0	rpm

Calculated results

Parameter	Value	Unit
Moment of inertia	90.000	kg·m²
Kinetic energy at the highest speed	1,110.3	kJ
Energy given up from highest to lowest speed	72.788	kJ
Coefficient of speed fluctuation	3.3898	%
Rim speed at the highest speed	94.248	m/s

Notes for this case

• Check the rim speed against the material's safe limit (from the maker or a design text); the hub and arms add a little inertia to a rim flywheel.

Formula and method

$$I = \frac{1}{2} m r^2 \ \text{(disc)}, \quad I = m r^2 \ \text{(rim)}$$

$$E_1 = \frac{1}{2} I \omega_1^2, \quad \Delta E = \frac{1}{2} I (\omega_1^2 - \omega_2^2)$$

$$C_s = \frac{n_1 - n_2}{(n_1 + n_2)/2}, \quad v = \omega_1 r$$

Variables

shape	Flywheel	-
m	Mass	kg
r	Outer radius	m
I	Moment of inertia (when entered)	kg·m²
n_1	Highest speed	1/s
n_2	Lowest speed	1/s
E_1	Kinetic energy at the highest speed	J
ΔE	Energy given up from highest to lowest speed	J
C_s	Coefficient of speed fluctuation	-

v	Rim speed at the highest speed	m/s
ω_1, ω_2	Angular speeds 2πn	rad/s

Method and standards

Kinetic energy of a rotating body; the energy exchanged between two speeds is the difference of the two energies.

Assumptions and limits

- Rigid body; uniform disc or thin rim.
- The rim speed is not compared with a material limit; zero mass or radius is flagged.

References

- Rigid-body rotation
- E = I ω²/2 (classical mechanics)

Report details

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

This calculator online

https://calc.firecad.com/mechanical/machine-design/flywheel-energy

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.