Moment of Inertia by Trifilar Suspension

Mass moment of inertia of a part from the torsional oscillation periods of a trifilar (three-wire) platform with and without it, and the part's radius of gyration.

Method: Small-oscillation theory of the trifilar pendulum

Input parameters

Unit system: SI

Parameter	Value	Unit
Platform mass	2.5000	kg
Part mass	4.0000	kg
Radius of the wire attachment circle	200.00	mm
Wire length	1.5000	m
Period, empty platform	2.4000	s
Period with the part	2.1000	s

Calculated results

Parameter	Value	Unit
Platform moment of inertia	0.095388	kg·m²
Total moment of inertia	0.18988	kg·m²
Part moment of inertia	0.094493	kg·m²
Part radius of gyration	153.70	mm

Notes for this case

• For small twists the platform rises as it rotates, giving simple harmonic motion with I = mgr²T²/(4π²L), where r is the radius of the three equally spaced wires and L their length. Subtract the empty platform's inertia to get the part's, about the vertical axis through the platform centre; place the part's centre of mass on that axis. Time many oscillations and keep the amplitude small (a few degrees).

Formula and method

$$I = \frac{m g r^2 T^2}{4\pi^2 L}, \quad I_{part} = I_t - I_p, \quad k = \sqrt{\frac{I_{part}}{m}}$$

Variables

m_p	Platform mass	kg
m	Part mass	kg
r	Radius of the wire attachment circle	m
L	Wire length	m
T_0	Period, empty platform	s
T_1	Period with the part	s
I_p	Platform moment of inertia	kg·m²
I_t	Total moment of inertia	kg·m²
I	Part moment of inertia	kg·m²
k	Part radius of gyration	m

Method and standards

Trifilar suspension.

Assumptions and limits

- Small amplitude; equal wire lengths; inextensible wires.

References

Small-oscillation theory of the trifilar pendulum

Report details

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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/mechanical/statics-dynamics/trifilar-moment-of-inertia

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.