Belt Length, Wrap Angle and Pulley Speed

Length of an open or crossed belt from pulley diameters and centre distance, with the wrap angle on the small pulley, belt speed and driven speed.

Method: Belt drive geometry

Input parameters

Unit system: SI

Parameter	Value	Unit
Large pulley diameter (pitch)	400.00	mm
Small pulley diameter (pitch)	160.00	mm
Centre distance	800.00	mm
Belt drive	Open belt	
Speed of the small (driving) pulley	1,450.0	rpm

Calculated results

Parameter	Value	Unit
Belt pitch length	2,497.6	mm
Wrap angle on the small pulley	162.75	°
Belt speed	12.147	m/s
Speed of the large pulley (no slip)	580.00	rpm

Formula and method

$$L = 2C + \frac{\pi(D+d)}{2} + \frac{(D \mp d)^2}{4C} \qquad \theta = \pi \mp 2\arcsin\frac{D \mp d}{2C} \qquad v = \pi d\, n_1 \qquad n_2 = n_1 \frac{d}{D}$$

Variables

D	large pulley pitch diameter	m
d	small pulley pitch diameter	m
C	centre distance	m
drive	open or crossed	–
n_1	small pulley speed	rev/s
L	belt pitch length	m
θ	wrap angle on small pulley	rad
v	belt speed	m/s
n_2	large pulley speed	rev/s

Method and standards

Exact geometry of the open belt with the usual series approximation for length (upper signs open, lower signs crossed for the bracketed terms).

Assumptions and limits

- Rigid inextensible belt; no slip.
- The length uses the series approximation; when it differs from the exact L = 2C cos α + π(D+d)/2 + α(D−d) (open belt) by more than 0.5 % the exact length is given in a note.

References

- Belt drive geometry

Report details

Report reference	FCC-2MRG-D70T (the same inputs always give the same reference)
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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/machine-design/belt-length-pulley

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.