Rack and Pinion: Linear Speed, Force and Travel

Linear speed, force and travel per revolution of a rack and pinion from the pinion pitch diameter (or module and teeth), the speed and torque.

Method: Rolling pitch circle on the rack pitch line

Input parameters

Unit system: SI

Parameter	Value	Unit
Module	3.0000	mm
Pinion teeth	20.000	
Pinion speed	60.000	rpm
Pinion torque	50.000	N·m

Calculated results

Parameter	Value	Unit
Pitch diameter m z	60.000	mm
Travel per revolution π d	188.50	mm
Linear speed	11.310	m/min
Linear force 2T/d	1.6667	kN
Power	314.16	W

Formula and method

$$d = mz, \quad v = \pi d N, \quad F = \frac{2T}{d}$$

Variables

m	Module	m
z	Pinion teeth	-
N	Pinion speed	1/s
T	Pinion torque	N·m
d	Pitch diameter m z	m
s	Travel per revolution π d	m
v	Linear speed	m/s
F	Linear force 2T/d	N
P	Power	W

Method and standards

Pitch circle kinematics.

Assumptions and limits

- No slip, friction neglected.

References

- Rolling pitch circle on the rack pitch line

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/machine-design/rack-and-pinion

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.