

TRAINING: GEAR RACKS

The previous issues of PIC Design® product training have explained the basics of transmitting rotary motion through spur gears. This issue will explain a different gear function; rotary motion to linear motion by means of a gear rack.

PIC® offers a number of gear racks that can be used with our standard spur gear offerings. A basic understanding of gear rack systems will be useful when dealing with the products that use them, like automotive rack and pinion steering, linear actuators and encoders, and adjustable optics in microscopes.

HOW GEARS AND RACKS INTERACT

- As with other gear types, meshing gears and racks must have the same pitch.
- The number of gear teeth advanced radially equals the number of rack teeth advanced linearly.
- The following is a formula for rotary to linear motion:

$$\left[\begin{array}{c} \text{Pinion Rotation in Radians} \\ \text{PINION ROTATION} \\ \text{(DEGREES)} \end{array} \times \frac{2\pi}{360} \right] \times \left[\begin{array}{c} \text{Pinion Pitch Radius} \\ \frac{\#TEETH \text{ PINION}}{PITCH} \times \frac{1}{2} \end{array} \right] = \begin{array}{c} \text{Arc Length of Pinion Rotation} \\ \text{at Pitch Diameter} \\ \text{LINEAR MOVEMENT} \\ \text{(INCHES)} \end{array}$$

- The length of the circle segment between gear teeth at the pitch diameter is the same as the length of the line segment between rack teeth at the pitch line.

Linear Pitch Rack = Circular Pitch Gear

- At this tangency between the pitch diameter of the gear and pitch line of the rack, rolling without slipping is an accurate model.

