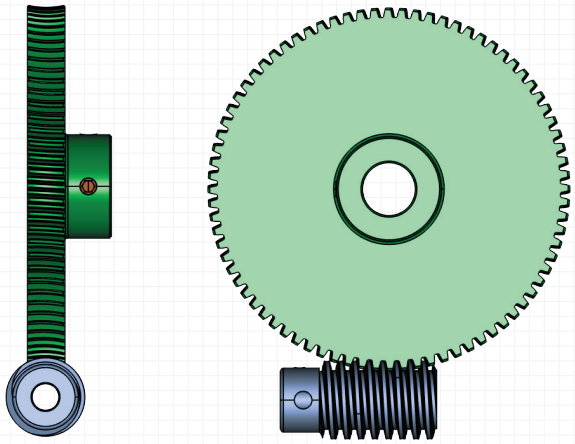
TRAINING: WORM GEARING

Worm gearing can be very useful when a design requires a high ratio, right angle drive, or locking output. PIC Design® specializes in worm gear drives, with our catalog offering both individual gears and assembled worm gearboxes. We can custom make both worms and mating gears for specialized applications, and have anti-backlash designs when precision is critical. The following article will introduce some of the principles of worm gearing.



CHARACTERISTICS AND SET-UP

Worm and Mating Gear:

- The worm is the input gear that is similar to a screw. The "thread" of the screw is essentially a long gear tooth wrapped around the axis of rotation. The tightness of this wrap is tied to the circular spacing of the teeth on the mating gear. The tooth size varies by diametral pitch, like with spur gearing.
- The mating gear looks much like a spur gear, but its teeth are tilted at a slight angle to engage the helix of the worm. The mating gear is also known as the worm gear or worm wheel.

Center Distance:

- Like spur gears, the worm and wheel are spaced so their respective pitch diameters are tangent:

$$\left[\underset{\text{Worm}}{PITCH\ DIAMETER} + \underset{\text{Wheel}}{PITCH\ DIAMETER} \right] \div 2 = CENTER\ DISTANCE$$

Torque:

- The torque relationship between input and output is not as simple as with other types of gearing. The force transmitted is a function of the thread angle and worm pitch diameter. Force is transferred during constant sliding contact, so friction is considerable and wear is more prevalent.

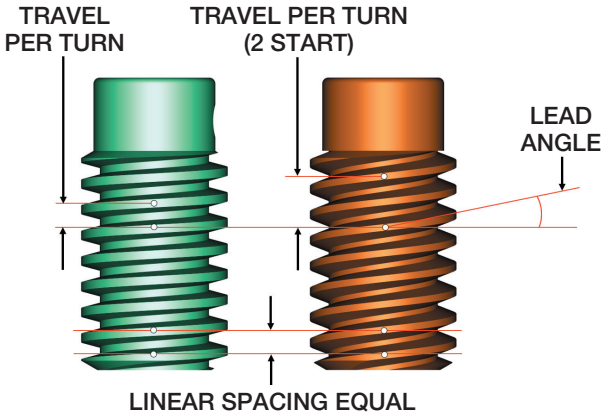
Backdriving:

- The wheel is effectively locked in place unless the worm is moving. This can be a beneficial design feature.

RATIO EXPLAINED

- The gear on the right is a "Two Start" worm, meaning two sets of teeth wrap around the part. To keep the linear spacing of the teeth the same, the angle of wrap is increased so the threads can alternate.
- The angle of wrap, or Lead Angle, must be mimicked by the tooth of the mating wheel.
- The distance one thread travels per turn is twice as great, even though the linear spacing is still the same. Therefore the worm on the right will turn the mating gear twice as fast as the worm on the left.

$$\left[\underset{\text{Wheel}}{\#TEETH} \div \underset{\text{Worm}}{\#STARTS} \right] = GEAR\ RATIO$$



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