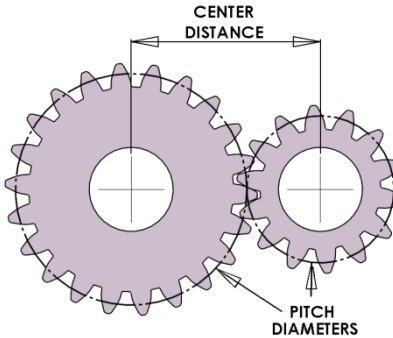


# Training: Issue 3, Gear Setup

While PIC Design can provide a set of gears for most high precision applications, there are a few considerations to take when using the parts to achieve the best performance. Proper setup will ensure the gear mesh will be both durable and accurate.

There is an ideal distance between two meshing gears. At this ideal, tooth contact would be continuous and perfectly smooth. Since this perfect center is impossible to achieve due to manufacturing tolerances in all parts of the assembly, we have to understand what happens when we are close to it.



**Center Distance**

- The size of two meshing gears dictates how far apart they should be. It is governed by a simple equation:

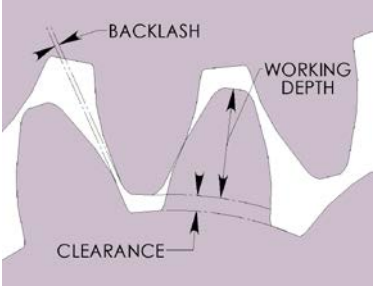
$$\left[ \frac{\# \text{ Teeth 1}}{\text{Pitch}} + \frac{\# \text{ Teeth 2}}{\text{Pitch}} \right] \div 2 = \text{Center Distance}$$


Individual Pitch Diameters

*Remember, meshing gears must have the same pitch!*

**Understanding Backlash**

- When the center distance is smaller than ideal, the gears can become too close together. This interference results in jamming or excessive friction and wear.
- When the center distance is larger than ideal, the result is **backlash**, or clearance between the teeth.
- Backlash is preferable over interference, however the following must be considered:
  - Changes to input speed and direction will need to take up backlash before affecting output.
  - Excessive backlash will disrupt the smooth engagement of the teeth.
  - Clearance from backlash can be advantageous for lubricants and thermal expansion





**Eliminating Backlash**

- For low load, high accuracy applications like sensor drives, Anti-Backlash gears are available.
- What looks like one gear is actually two gears stacked. Springs tie the two gears together and load them in opposite directions.
- The effect is an expanding tooth. Backlash clearance will be taken up until the spring force is overcome.