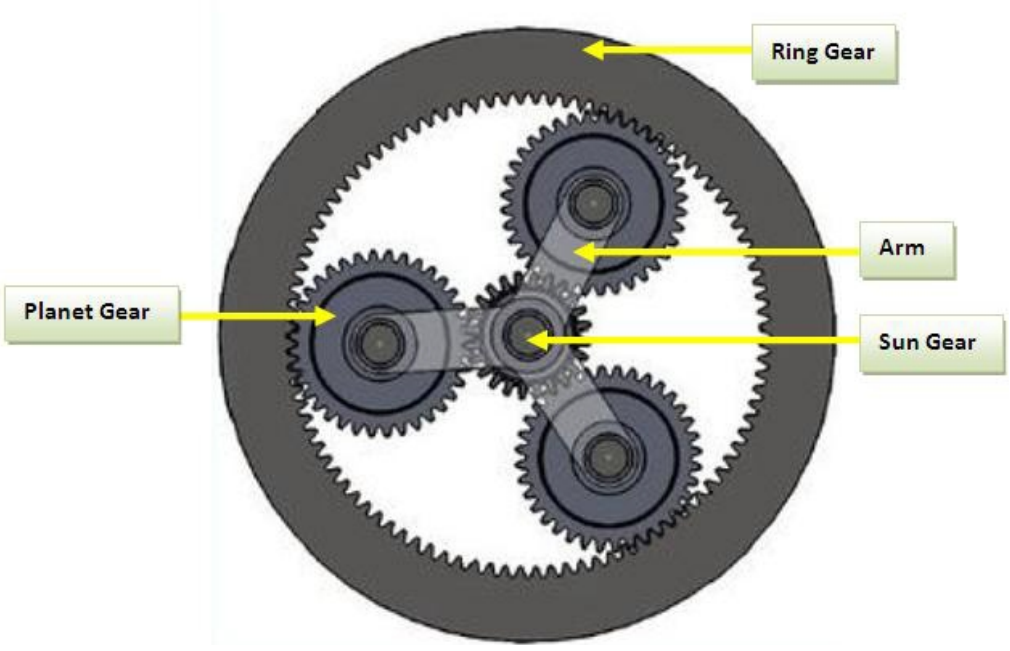
Planetary Gear Design

A planetary gear system, also referred to as epicyclic gearing, consists of three elements – a sun gear, one or more planet gears, and a ring gear. The sun gear is located at the center, and transmits torque to the planet gears that orbit around it. Both are located inside the ring gear. The tooth formation of the sun and planet gears is external, while the ring gear is internal.



Planetary gear systems can vary greatly in size and configuration to produce a broad range of speed ratios and meet various design requirements. They are used in many different applications such as clocks, lunar calendars, car mirrors, toys, gearhead motors and turbine engines.

A planetary gear system will not assemble unless the number of teeth for each gear is selected properly. Once the design requirements are specified, the remaining parameters must be calculated to create a working configuration.

Let's say the desired gear ratio is 5:1. This means the sun gear must make 5 revolutions for each revolution of the output carrier (Note: this assumes that the sun gear is the input, the planet gears drive the output carrier, and the ring gear is stationary. Other configurations are possible depending on the application).

One more design requirement must be specified to do the remaining calculations. Let's say the sun gear must have 24 teeth. The other parameters can be found using the following equations:

R: Gear ratio, to 1
N_r: Number of teeth on the ring gear
N_s: Number of teeth on the sun gear

Plugging in the known values, we get

Solving for N_r, we find that the required number of teeth on the ring gear is 96. We can now begin to solve for the number of teeth on the planet gear:

N_p: Number of teeth on the planet gear(s)

Plugging in the known values, we get

Solving for N_p, we find that the required number of teeth on the planet gear is 36. This is independent of how many planet gears are used.

Note that the pitch of the gears is not specified. These equations hold true regardless of the pitch, but a pitch will ultimately need to be selected when designing a planetary gear system. Either the pitch itself will be a design requirement, or size limitations will be a factor, and the pitch can be selected accordingly.

The following table gives an example of the gears used in a particular planetary system, with all specifications included:

	Sun Gear	Planet Gear	Ring Gear
Quantity	1	3	1
Module	1	1	1
Number of Teeth	24	36	96
Pressure Angle	20°	20°	20°

Nylon

A 1Z 2MYZ1002408

Acetal

A 1P 2MYH10036

Steel

A 1C10MYK10096

These particular gears are all parts offered off-the-shelf by SDP/SI at http://sdp-si.com/estore. They were assembled into a planetary gear system as part of a mechanical drive display created by Danny Khan and the SDP/SI engineering team.
Visit http://sdp-si.com/web/video/mechanicaldrive.htm to see footage of a planetary gear system in action.

SDP/SI has much to offer in the way of planetary gear systems. There are several sizes and styles of planetary gearheads available for speed reduction, and gears to be used as the motor pinions (sun gears). A custom planetary gear system can also be designed from a large selection of spur gears and internal gears. Email sdp-sisupport@sdp-si.com or call 1-516-328-3300 and speak with one of our engineers to ensure that you get the perfect planetary gear system for your application.