Gear Drives

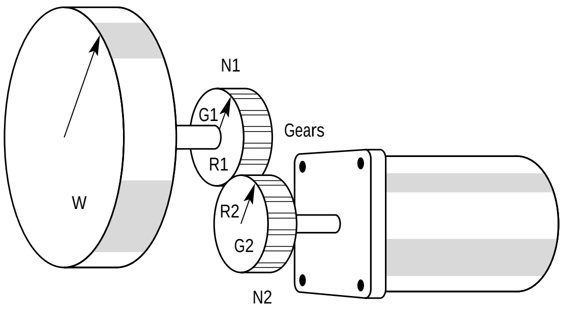
Traditional gear drives are more commonly used with step motors. The fine resolution of a microstepping motor can make gearing unnecessary in many applications. Gears generally have undesirable efficiency, wear characteristics, backlash, and can be noisy.

Gears are useful, however, when very large inertias must be moved because the inertia of the load reflected back to the motor through the gearing is divided by the square of the gear ratio.

In this manner, large inertial loads can be moved while maintaining a good load-inertia to rotor-inertia ratio (less than 10:1).

Gear Driven Loads

R – Radius	R = ______	inches
R(1) – Radius gear #1	R(1) = ______	inches
R(2) – Radius gear #2	R(2) = ______	inches
N(1) – Number of teeth G#1	N(1) = ______	
N(2) – Number of teeth G#2	N(2) = ______	
G – Gear ratio $\frac{N(1)}{N(2)}$	G = ______	
W – Weight of load	W = ______	ounces
W(1) – Weight G#1	W(1) = ______	ounces
W(2) – Weight G#2	W(2) = ______	ounces
L – Length	L = ______	inches
F – Friction	F = ______	
BT – Breakaway torque	BT = ______	ounce/inches



Gear Drive Formulas

$$J_{Load} = \frac{W_{Load}}{2} R^2_{Load} \left(\frac{N_{Gear\ 2}}{N_{Gear\ 1}}\right)^2$$

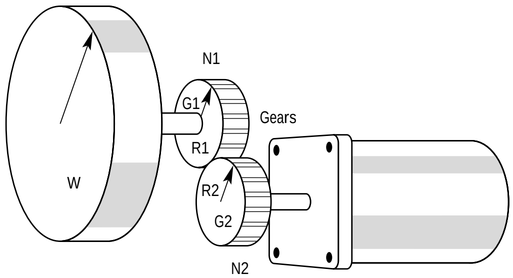
or

$$J_{Load} = \frac{\pi L_{Load} \rho_{Load}}{2} R^4_{Load} \left(\frac{N_{Gear\ 2}}{N_{Gear\ 1}}\right)^2$$

$$J_{Gear1} = \frac{W_{Gear1}}{2} R^2_{Gear1} \left(\frac{N_{Gear\ 2}}{N_{Gear\ 1}}\right)^2$$

$$J_{Gear2} = \frac{W_{Gear2}}{2} R^2_{Gear2}$$

$$T_{Total} = \frac{1}{g} \left(J_{Load} + J_{Gear1} + J_{Gear2} + J_{Motor}\right) \frac{\omega}{t}$$



Where:

- J = inertia, oz-in (gm-cm^2) “as seen by the motor”
- T = torque, oz-in (gm-cm)
- W = weight, oz (gm)
- R = radius, in. (cm)
- N = number of gear teeth (constant)
- L = length, in (cm)
- ρ = density, oz/in^3 (gm/cm^3)
- ω = angular velocity, radians/sec @ motor shaft
- t = time, seconds
- g = gravity constant, 386 in/sec^2