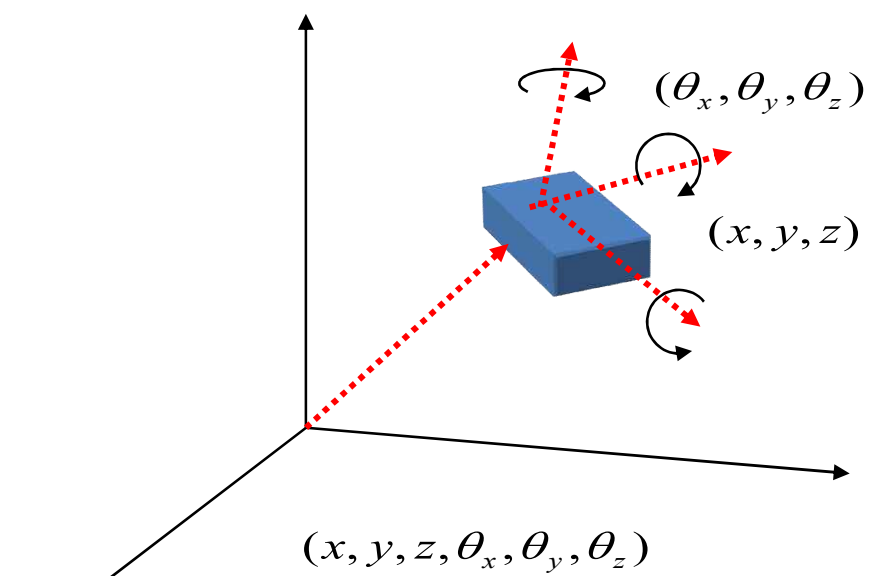


2-D: 3 d.o.f.



3-D: 6 d.o.f.

Degree of freedom

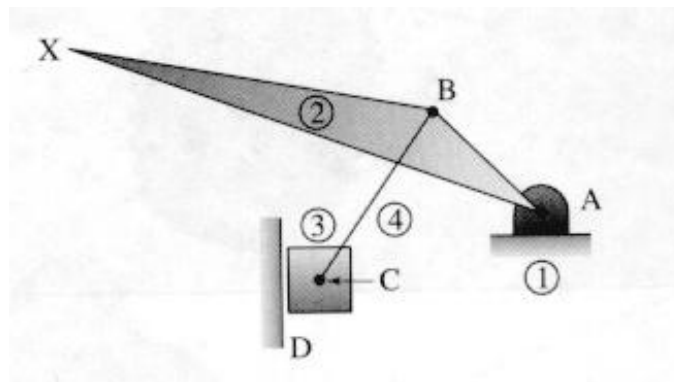
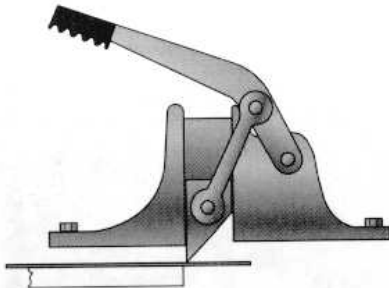
- Grüebler Equation:

$$F = 3(n - 1) - 2j_p - j_h$$

n : Number of link

j_p : Number of joint (Revolute, prismatic)

j_h : Higher order joint (Cam, gear)

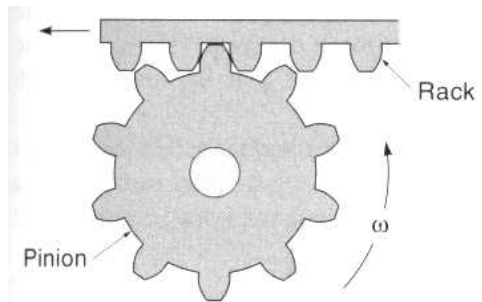


$$n = 4 \quad j_p = 4 \quad j_h = 0$$

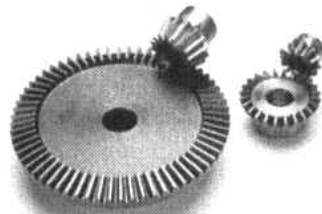
$$F = 3(n - 1) - 2j_p - j_h = 1$$

Kinematic Chain

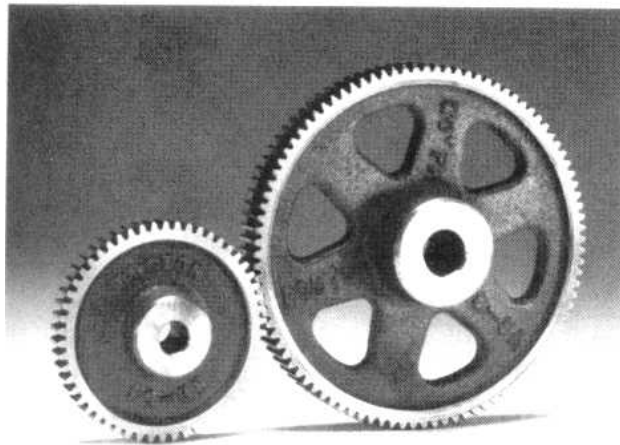




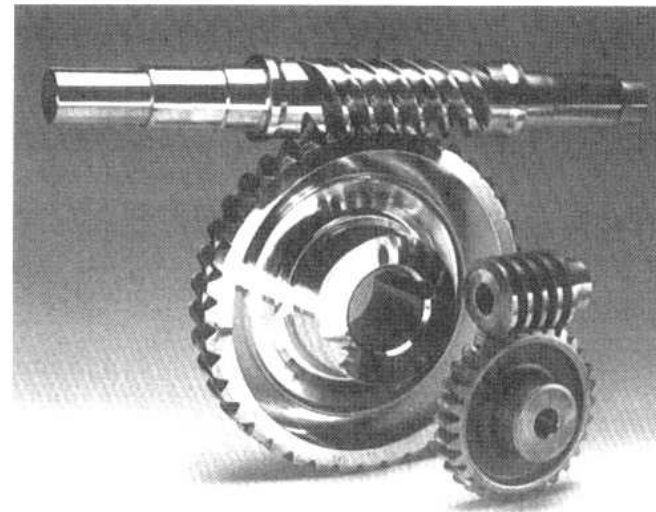
(a) Rack and pinion



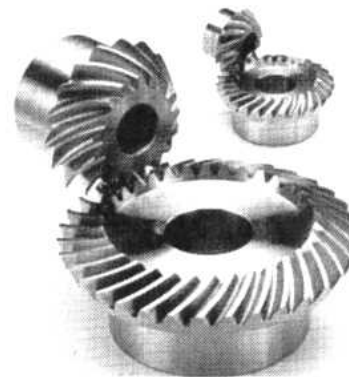
(b) Straight bevel gears



(c) Spur gears

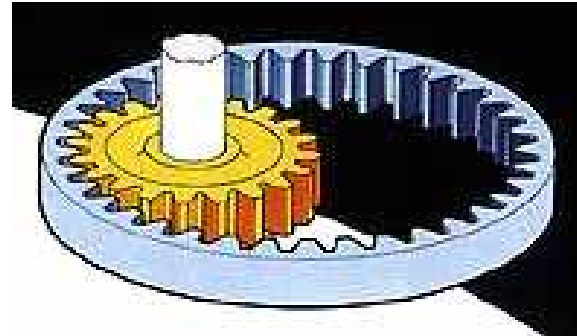


(d) Worm and worm gears



(e) Spiral bevel gears

Spur Gear



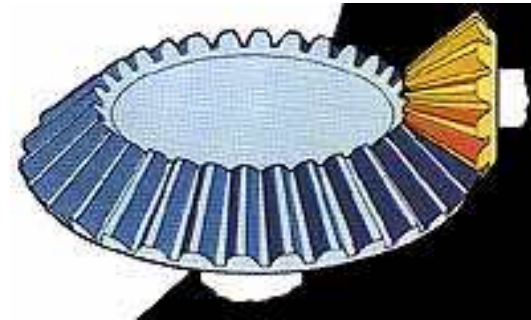
Helical Gear

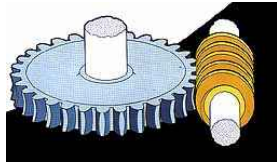


Helical Gear

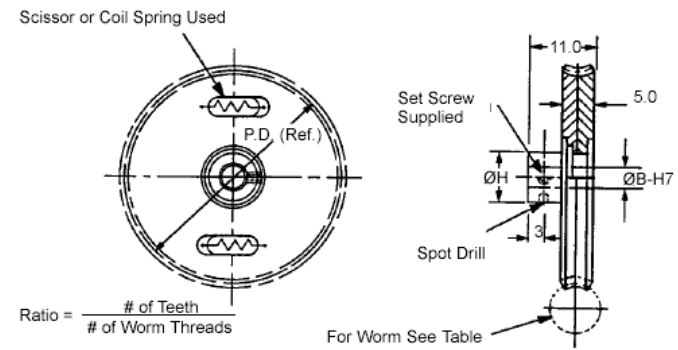


Bevel Gear

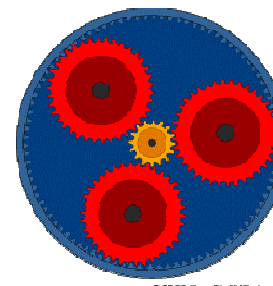
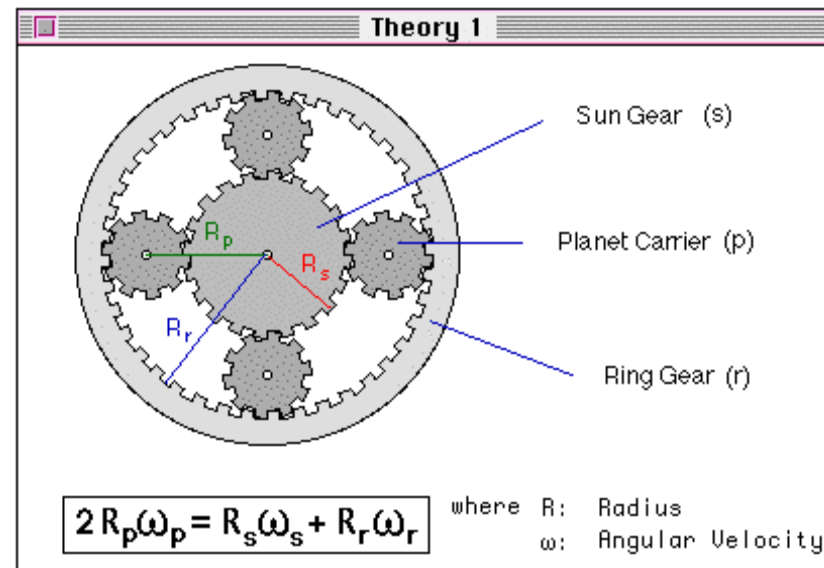
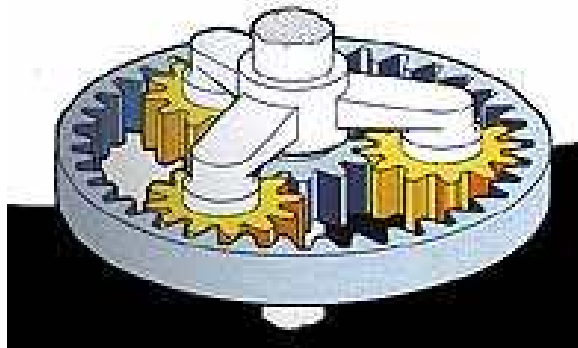




Worm Gear

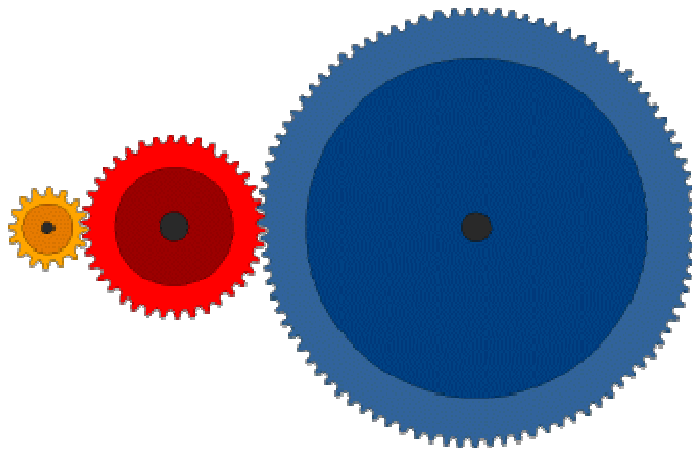


Planetary Gear

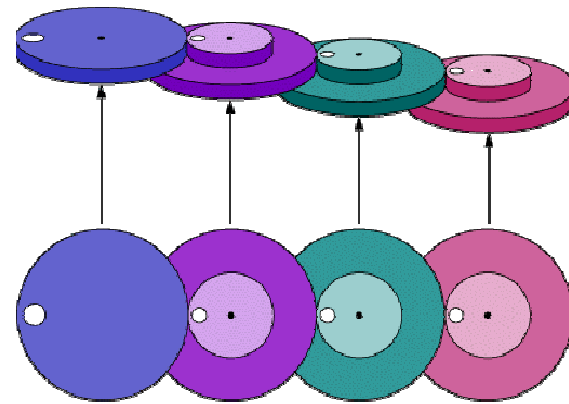


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Gear Train

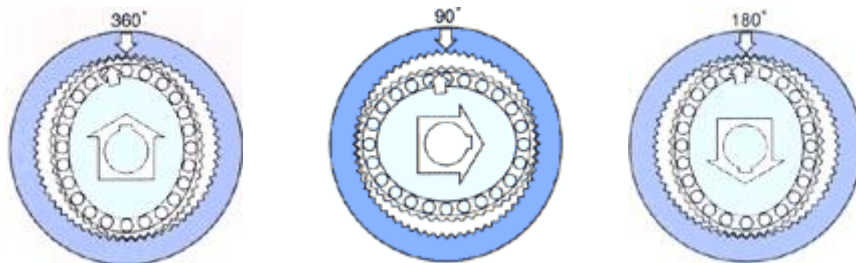
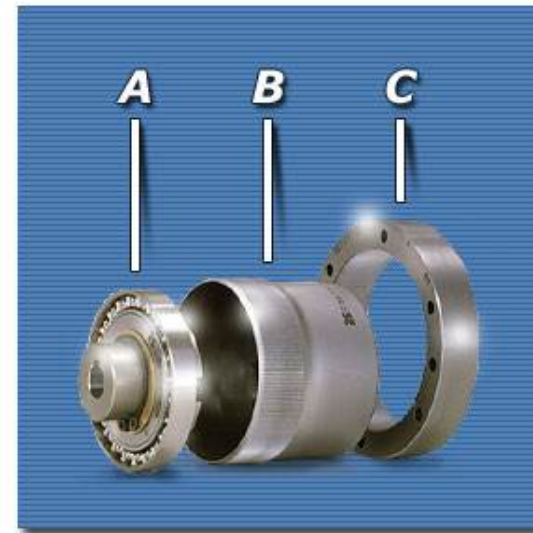


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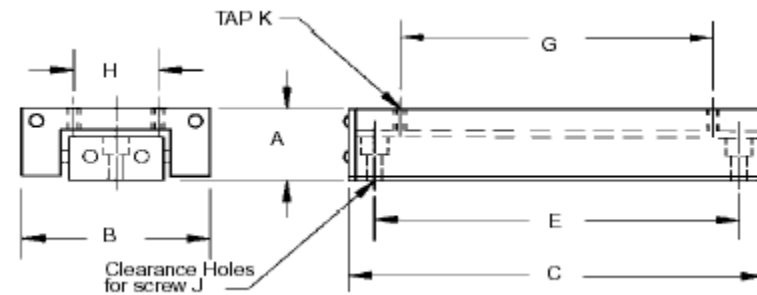
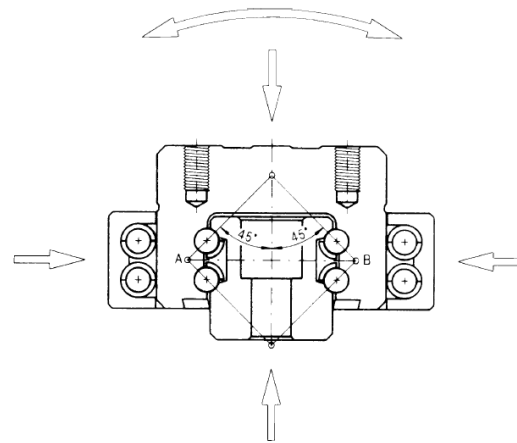
Harmonic Gear



Linear Ball Bearing



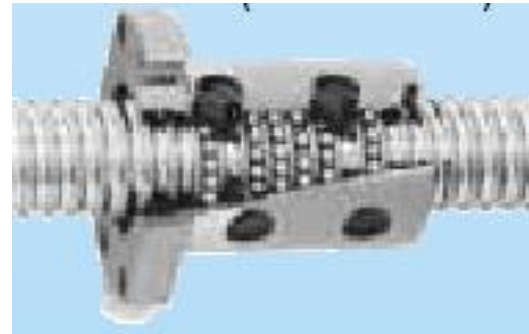
Profile Rail Guide



Ball Screw

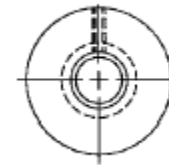
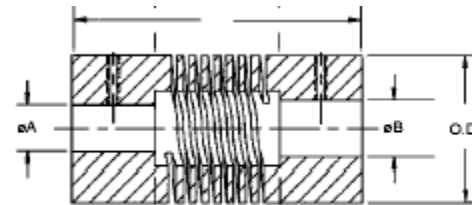


Ball Screw



Lead Screw

Coupling



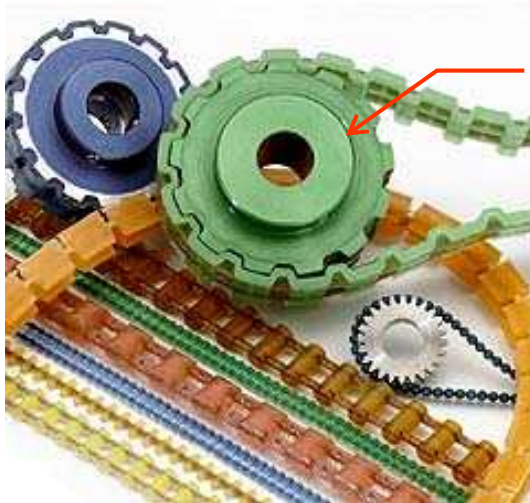
Set Screw Style



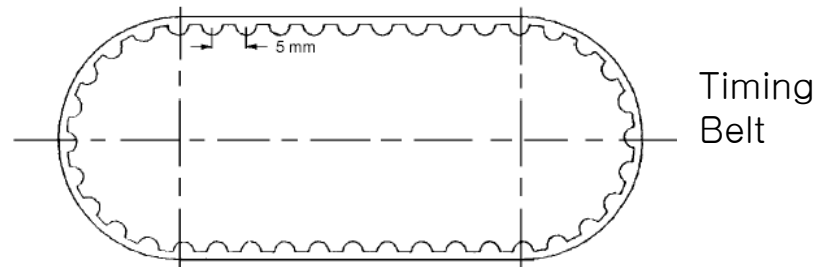
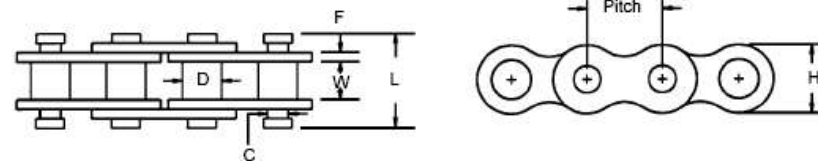
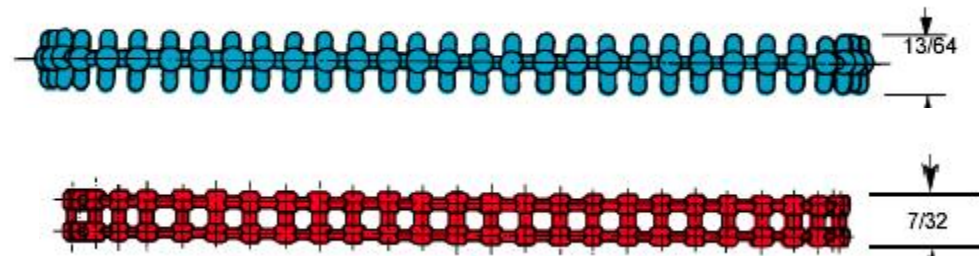
Ball Screw



Chain & Belt

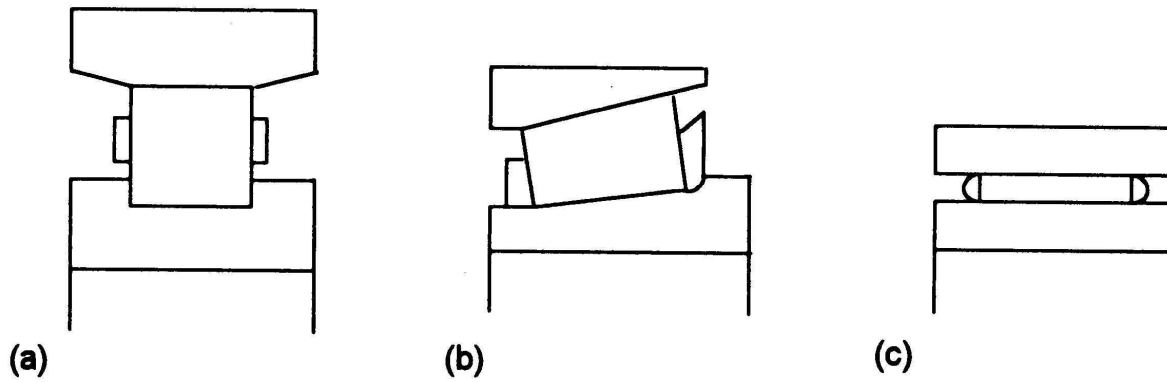


Pulley



Timing Belt

Ball and roller bearings



courtesy of The Timken Co.)

