CHAPTER 15

HYDRAULIC PUMPS

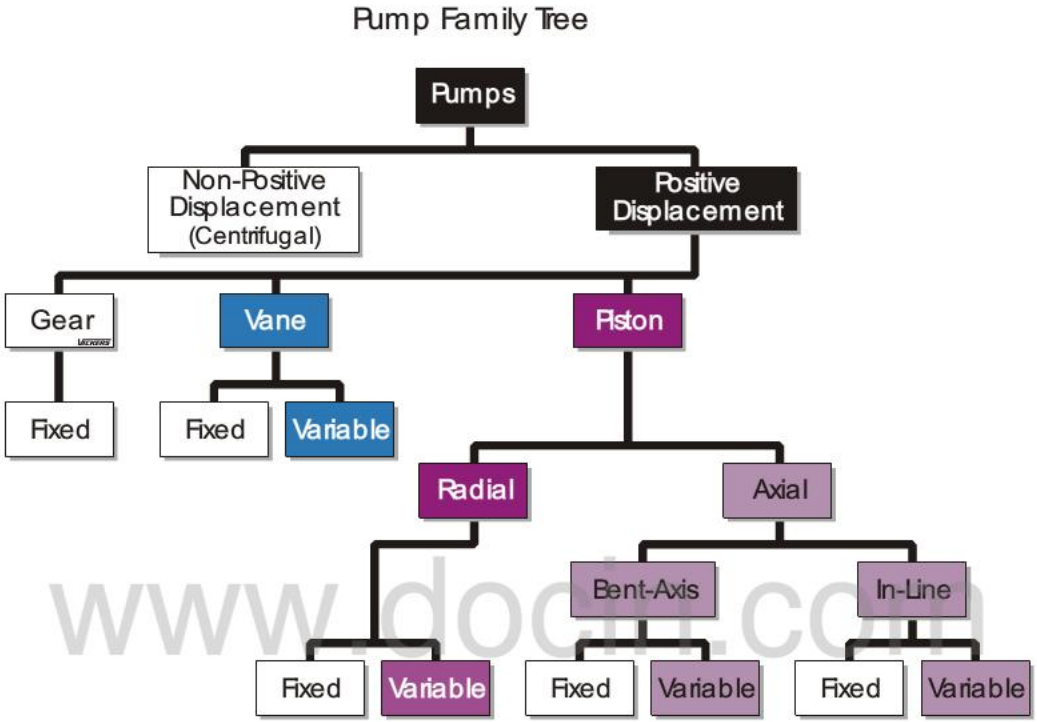


Figure 15-1 Pump categories

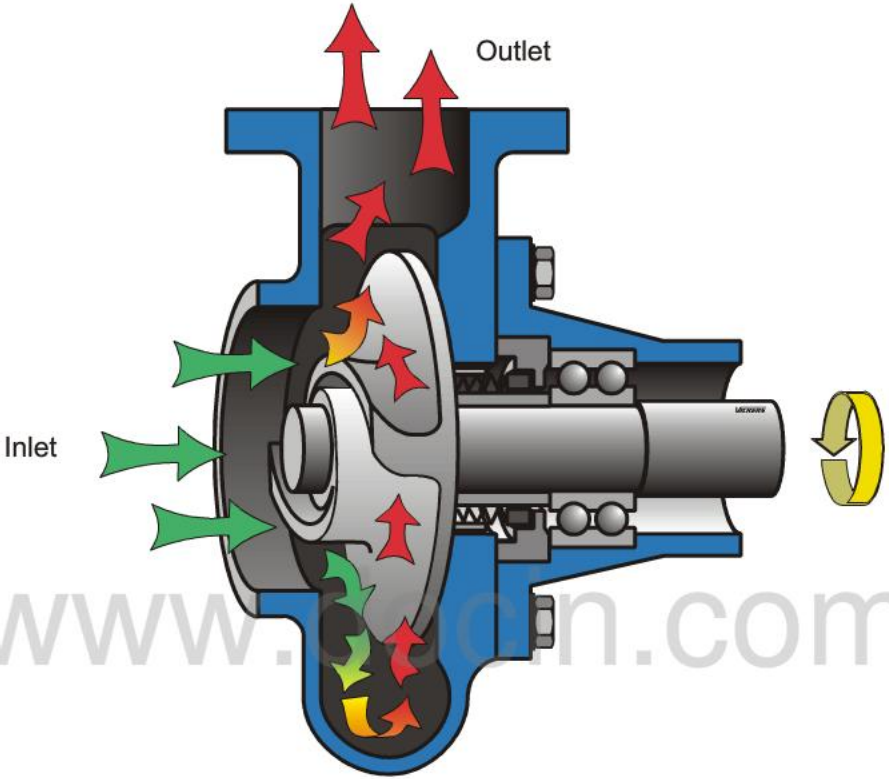


Figure 15-2 Non-Positive Displacement Pump

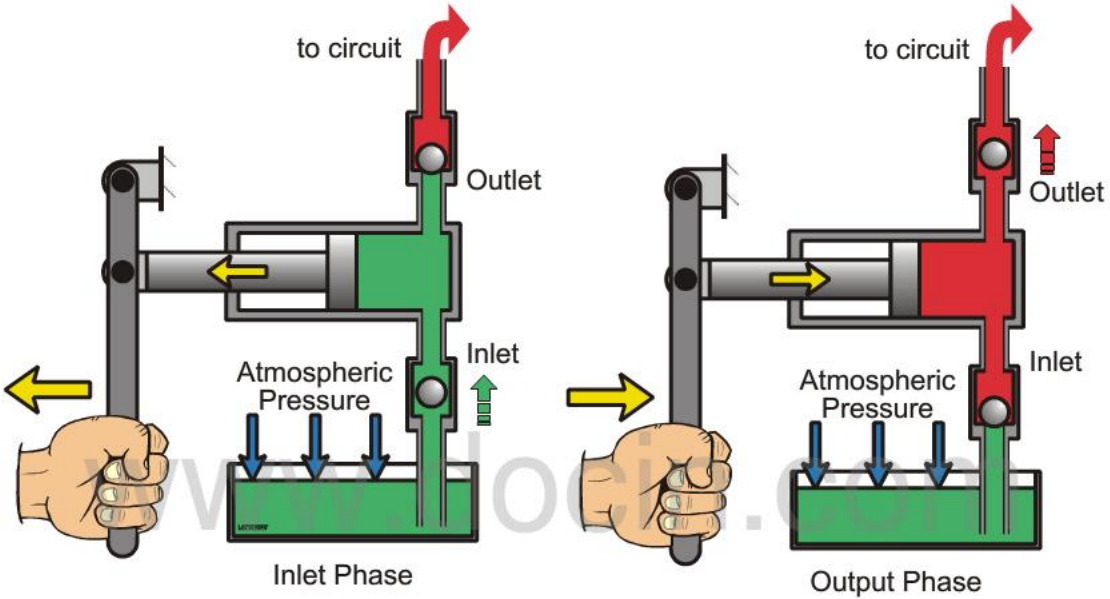


Figure 15-3 Positive displacement pump

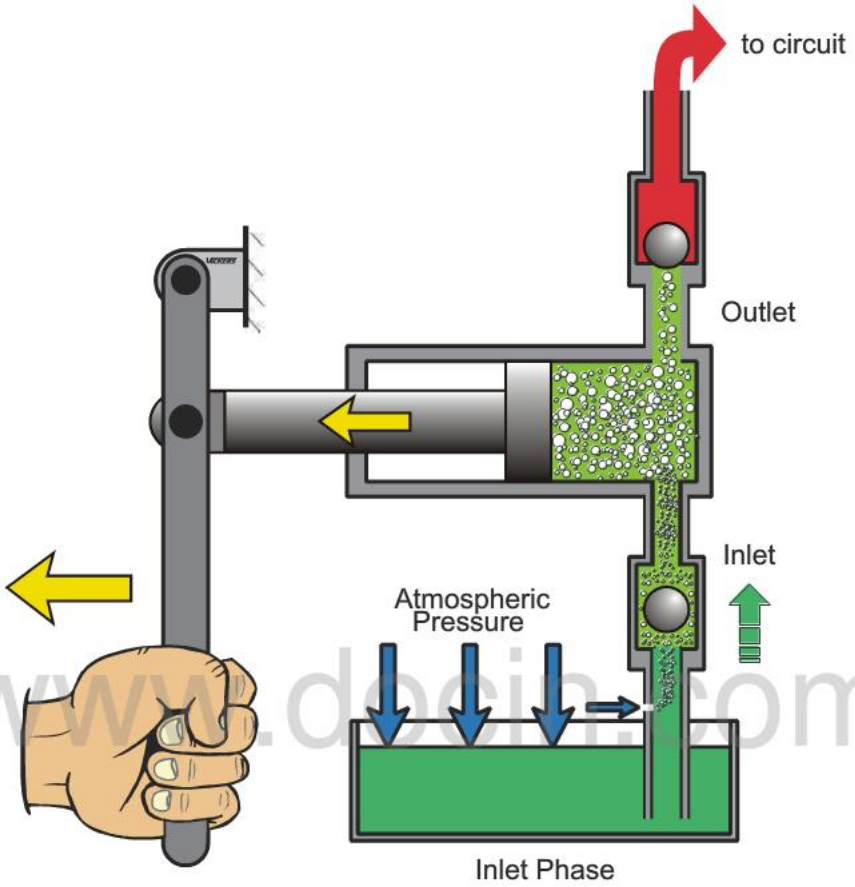


Figure 15-4 Aerated fluid caused by inlet air leak

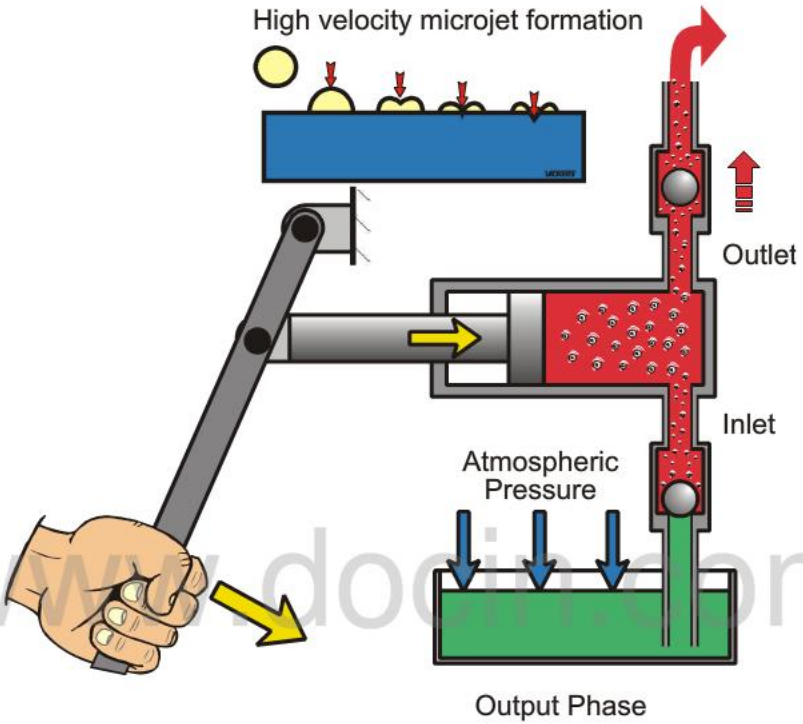


Figure 15-5 Pressurizing the fluid collapses the bubbles

Figure 15-6 Piston pump valve plate erosion caused by aeration or cavitation

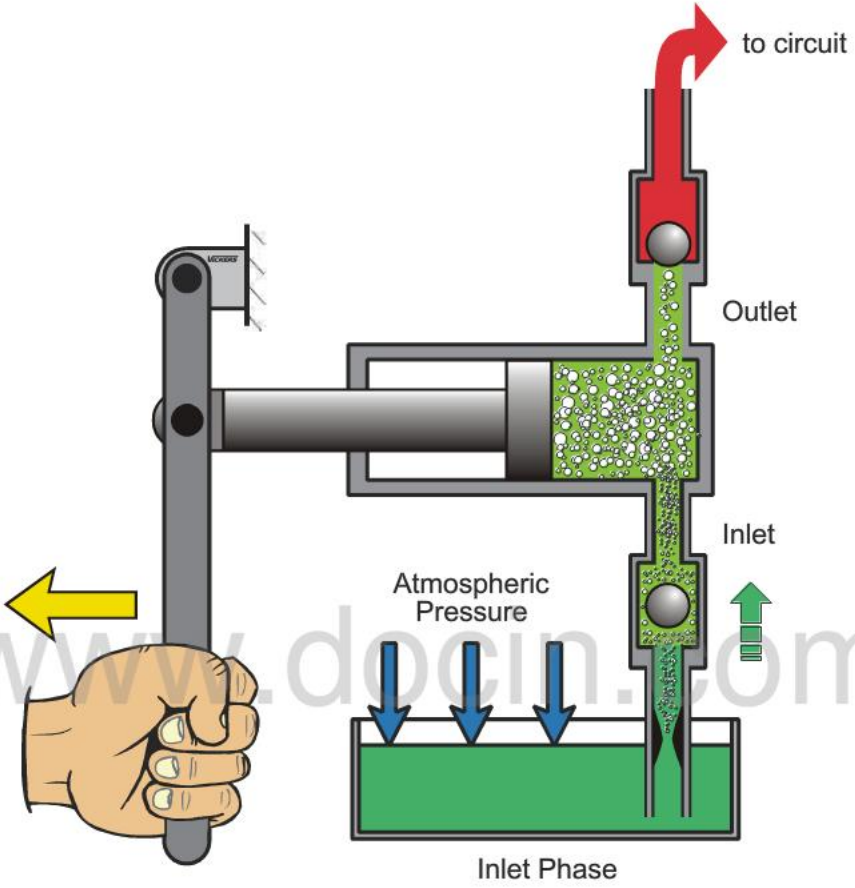


Figure 15-7 Cavitation bubbles formed by a restricted inlet

Causes of Cavitation and Aeration

Causes of Cavitation	*Causes of Aeration*
1. Clogged or restricted strainer	1. Low reservoir fluid level
2. High fluid viscosity	2. Defective pump shaft seal
3. Low fluid temperature	3. Return line above fluid level
4. Clogged reservoir breather	4. Improper baffling in the reservoir
5. Pump inlet line too small	5. Loose fitting on pump inlet line
6. Pump too far above reservoir	6. Defective seal on pump inlet line
7. Pump too far from reservoir	7. Incorrect reservoir design
8. Excessive pump RPM	8. Porous hose on pump inlet line
9. Too many bends in pump inlet line	
10. Collapsed hose on pump inlet line	
11. Restriction on pump inlet line	
12. Failure of supercharge pump	

Figure 15-8 Causes of aeration and cavitation

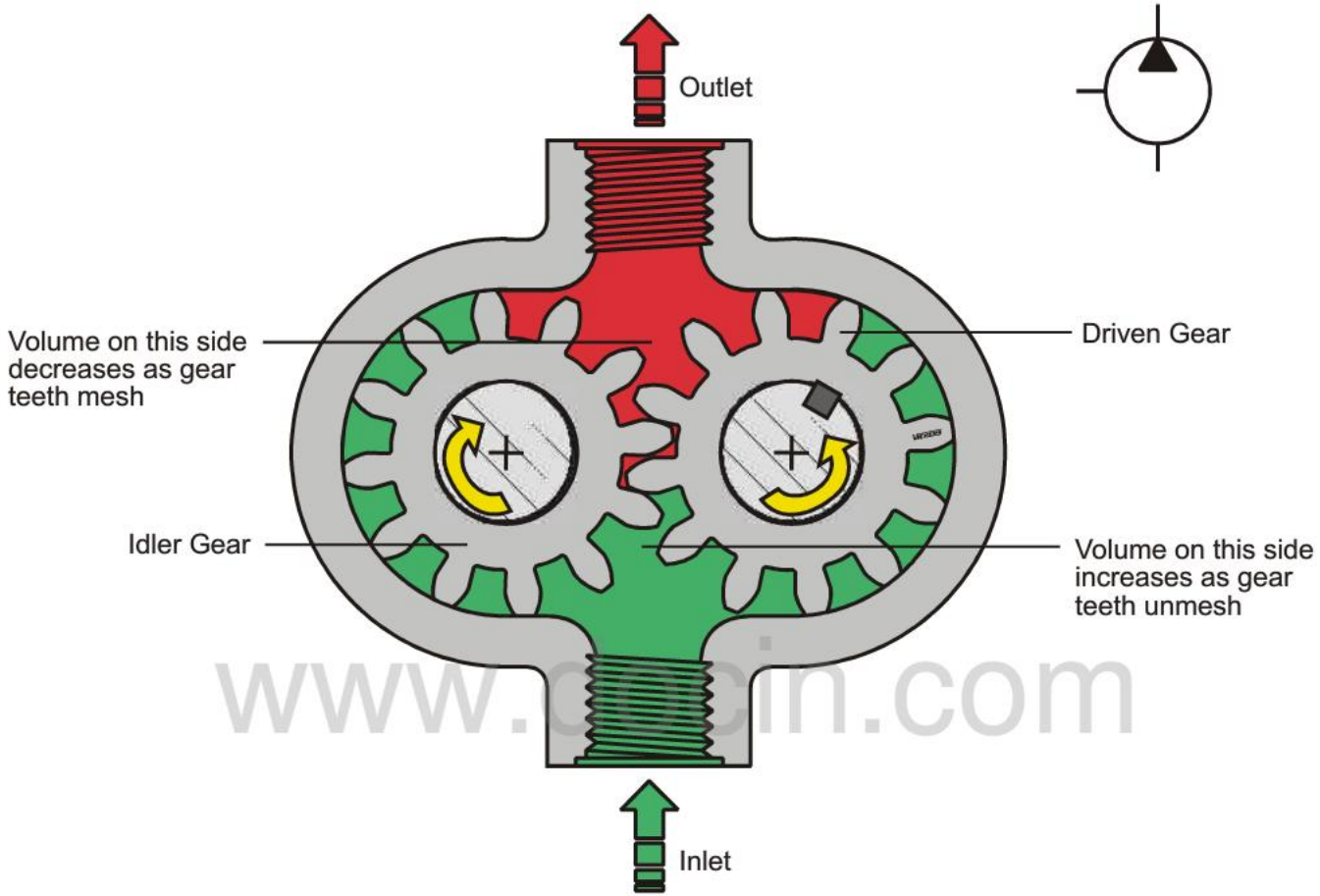


Figure 15-9 External gear pump

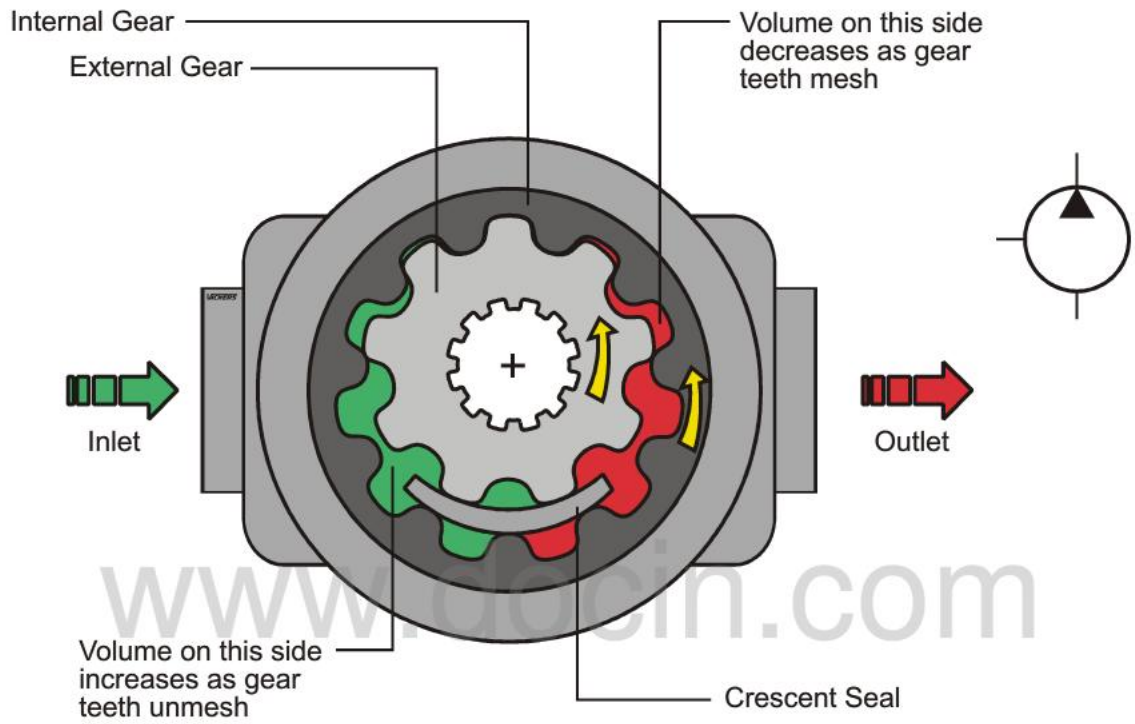


Figure 15-10 Crescent seal type internal gear pump

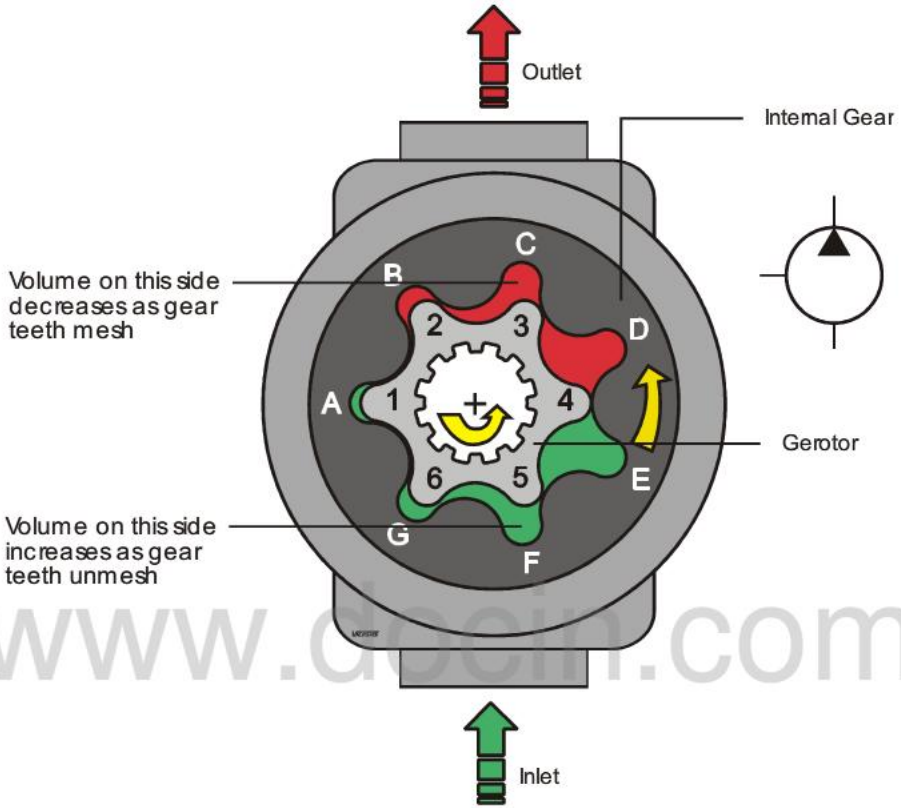


Figure 15-11 Gerotor Type Internal Gear Pump

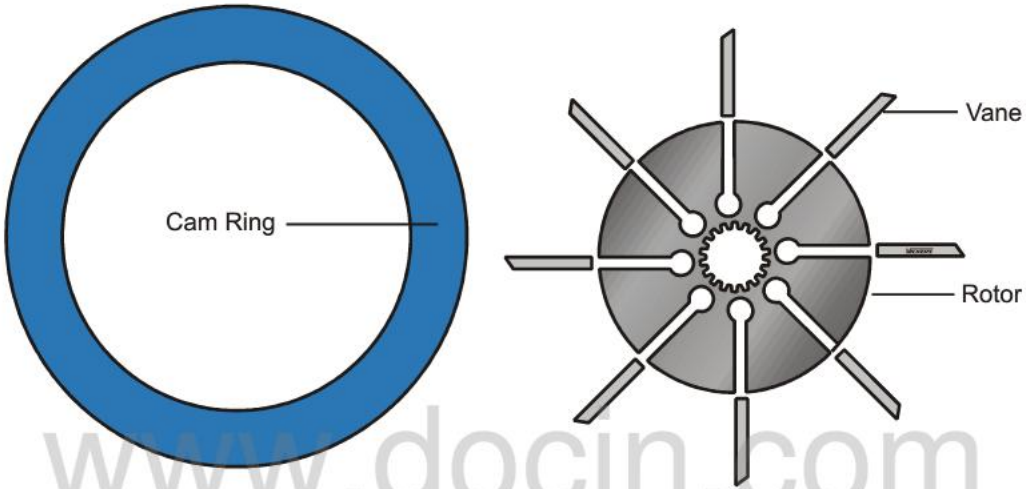


Figure 15-12 Basic pumping elements of a vane pump

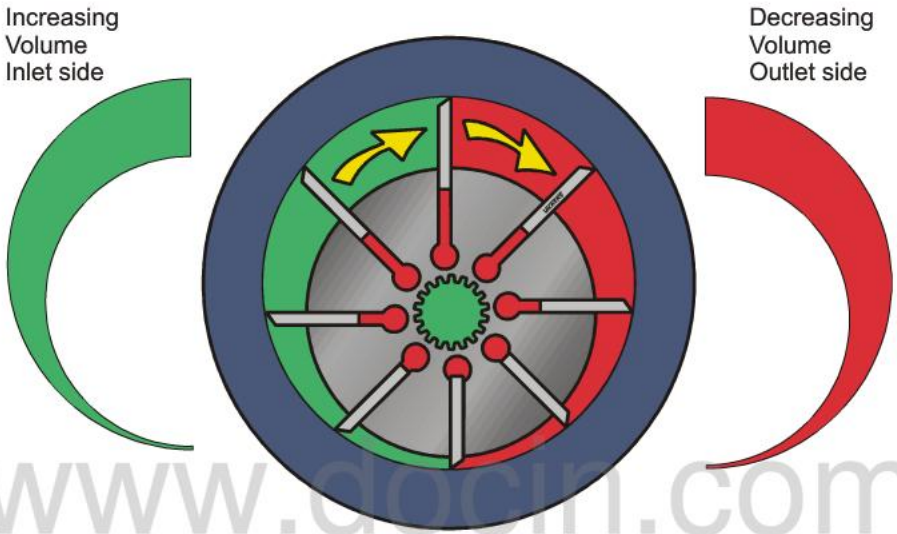


Figure 15-13 Eccentricity between rotor and cam ring

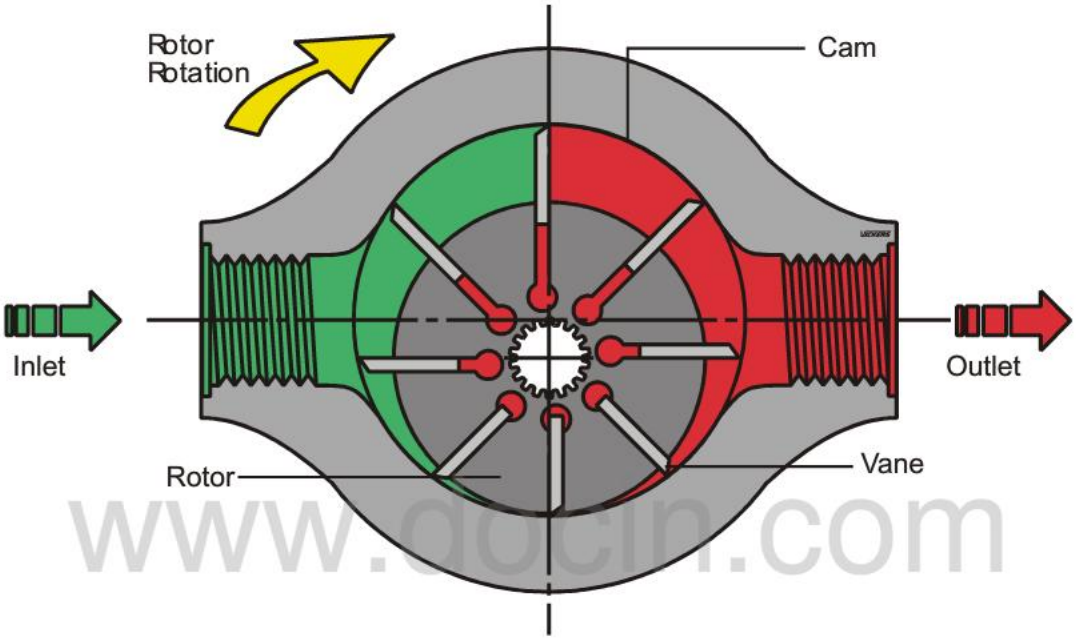


Figure 15-14 Rotating group with inlet and outlet ports

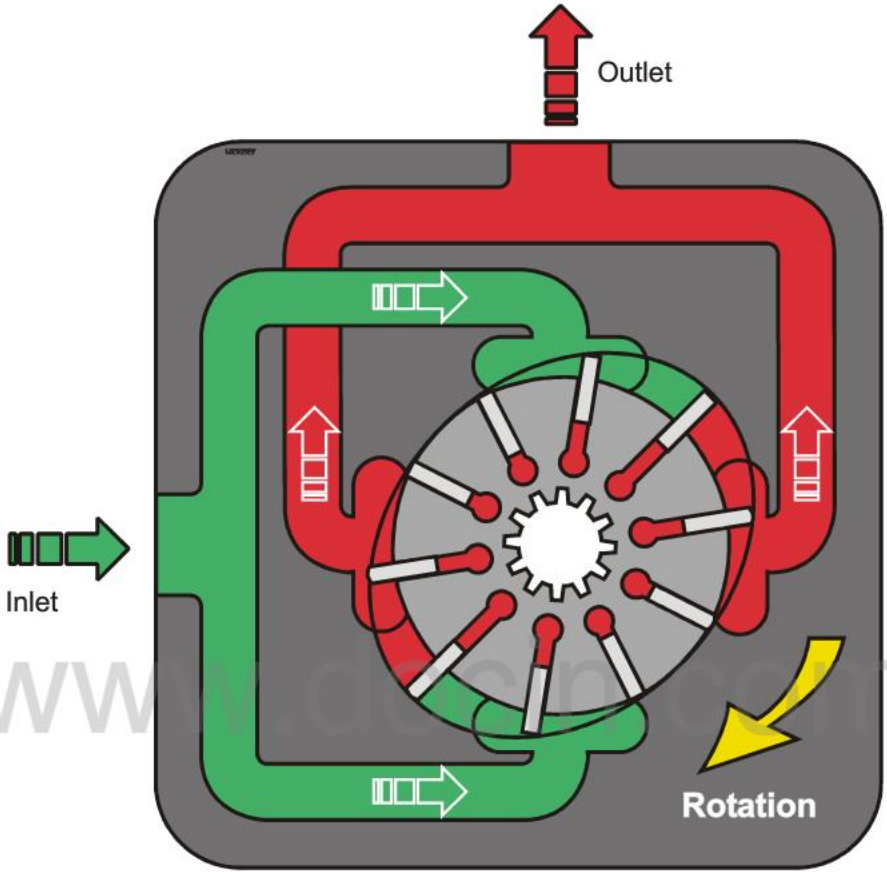


Figure 15-15 Balanced vane pump design

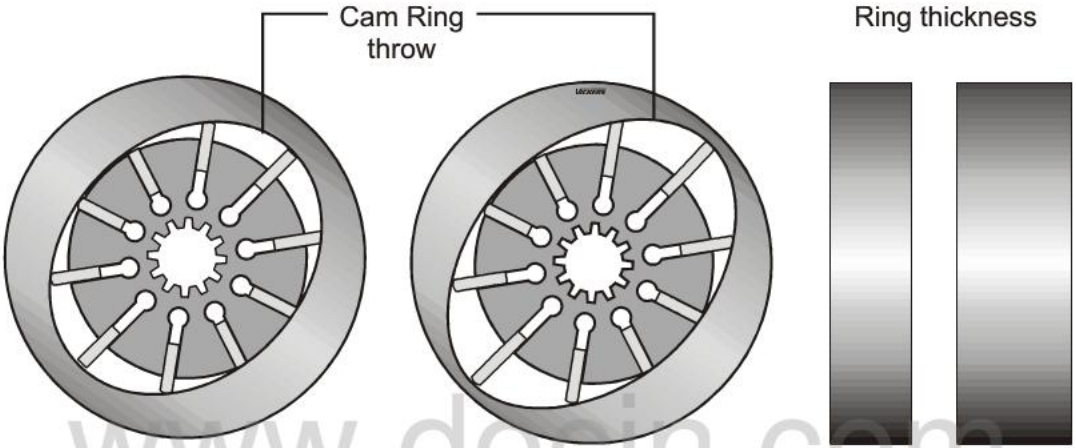


Figure 15-16 Interchangeable cam rings provide a selection of flows

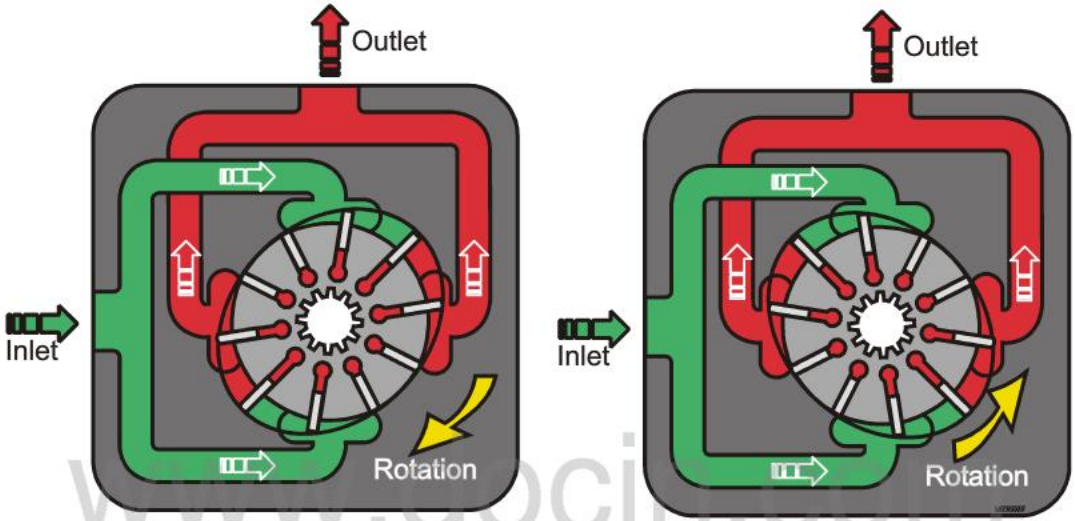


Figure 15-17 Rotating the cam ring 180° reverses the direction of rotation

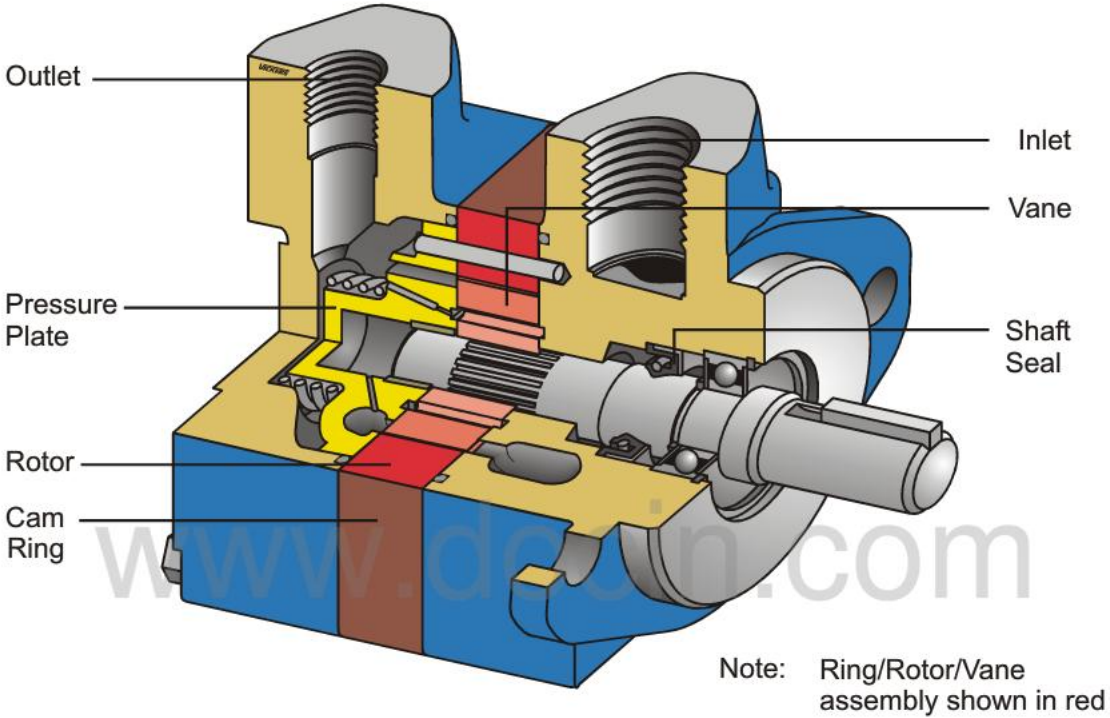


Figure 15-18 Fixed displacement 撈quare pump

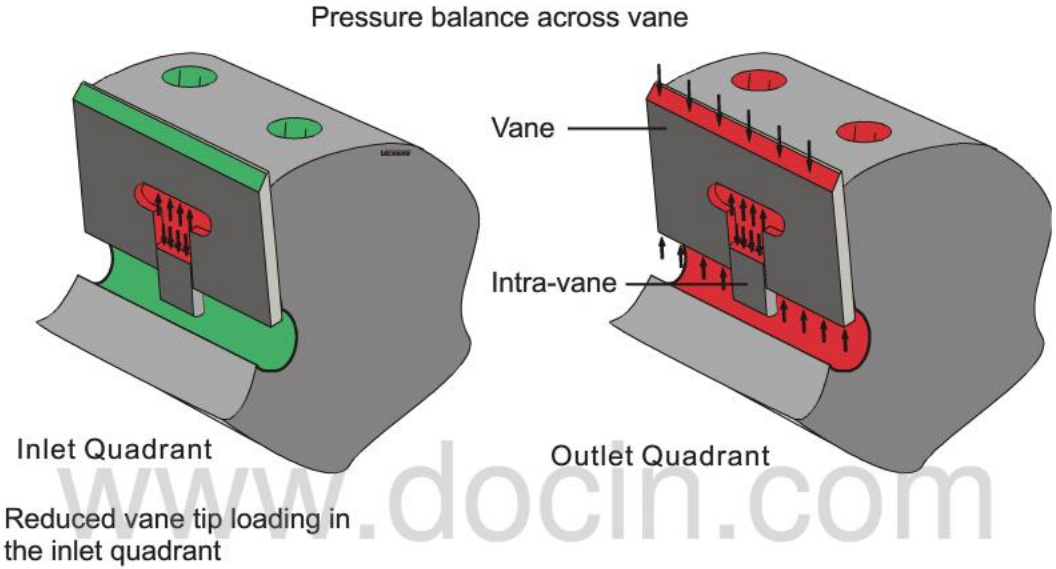


Figure 15-19 Vane and intra-vane assembly

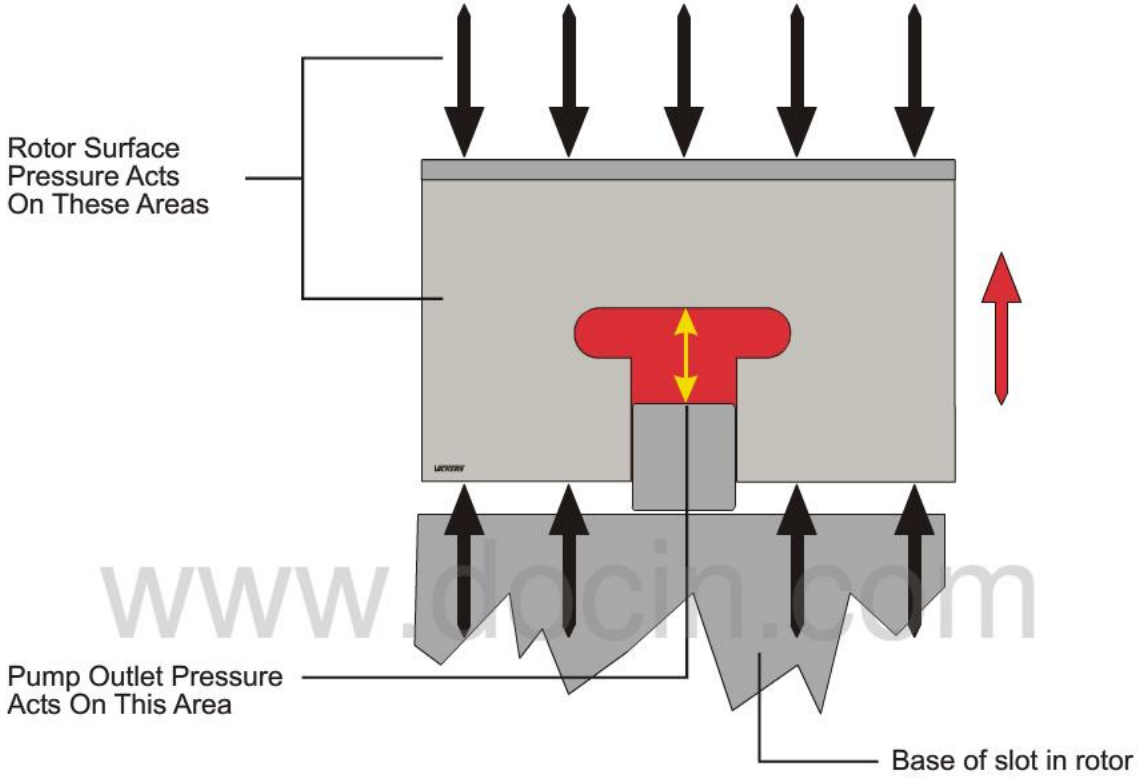


Figure 15-20 Outlet pressure in the intra-vane area assures vane-cam contact

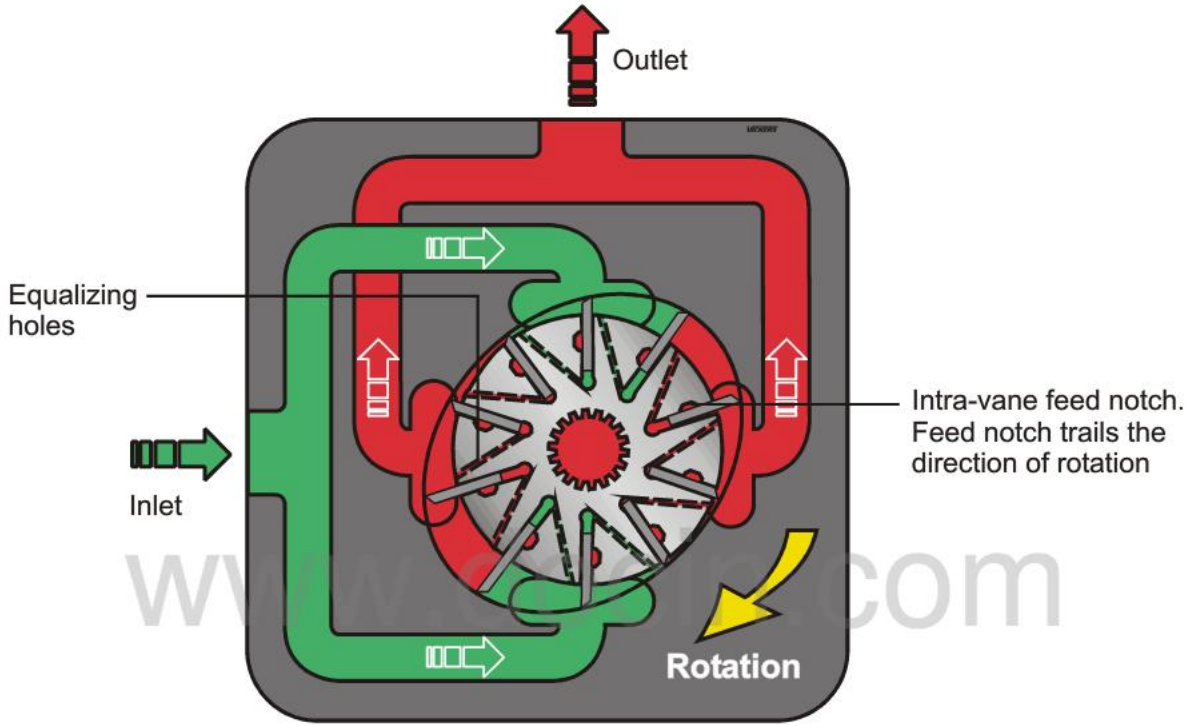


Figure 15-21 Porting in rotor and side plates provides vane pressure balance

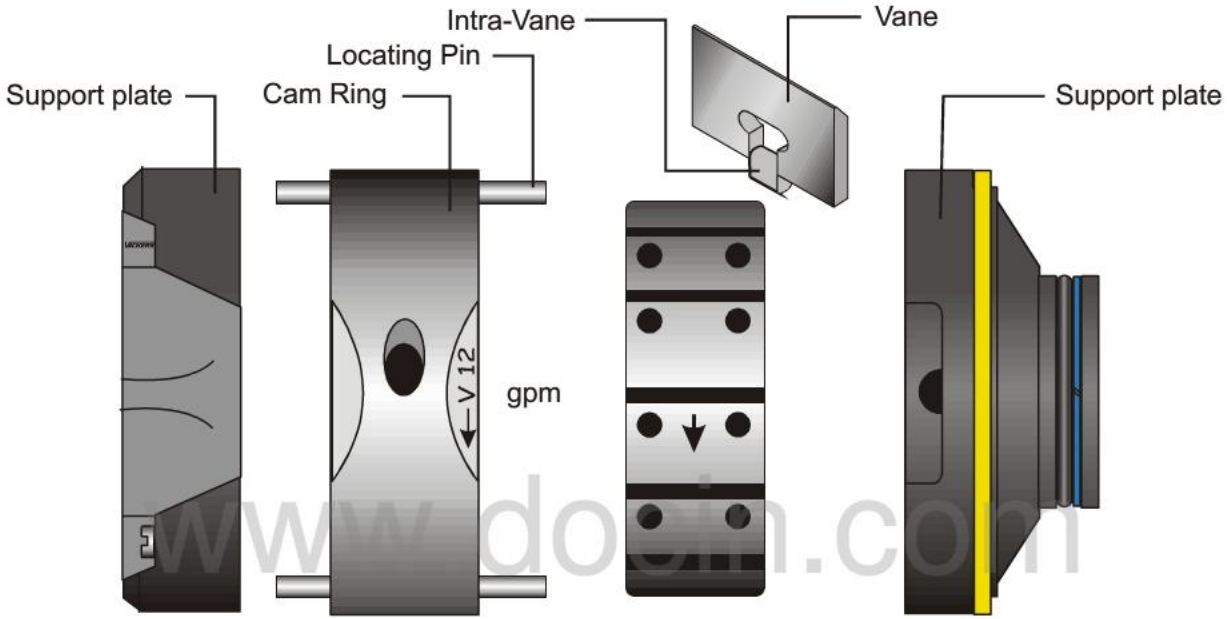


Figure 15-22 High performance pump cartridge components

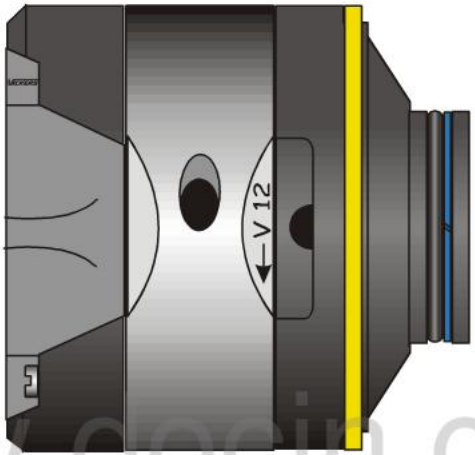


Figure 15-23 Intra-vane pump cartridge assembly

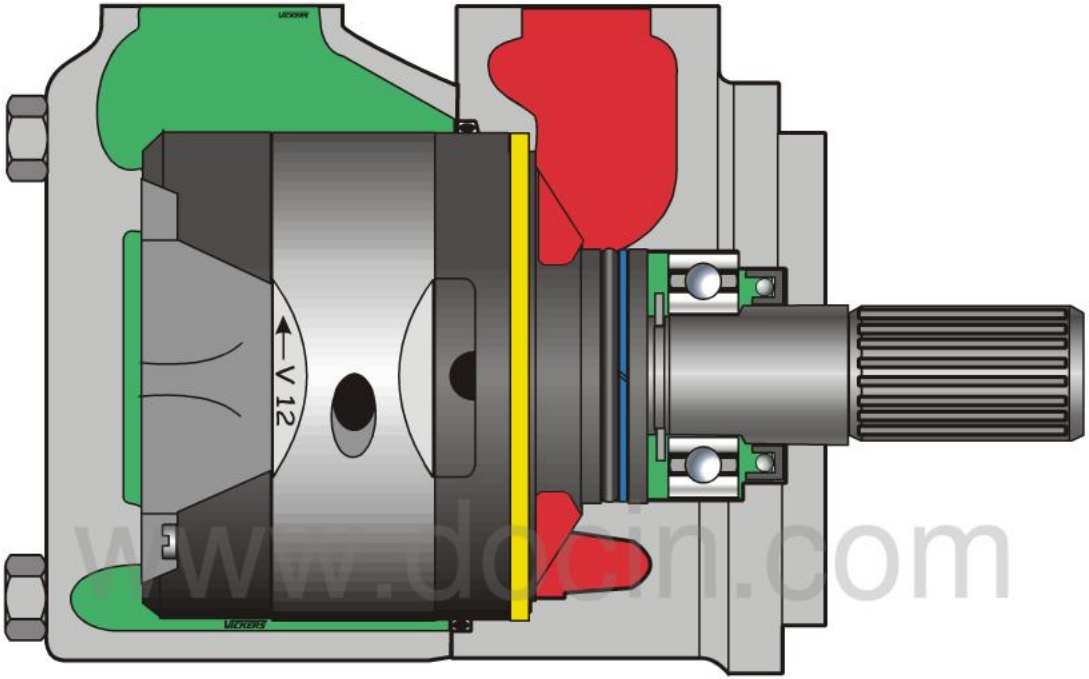


Figure 15-24 Intra-vane pump cartridge installed

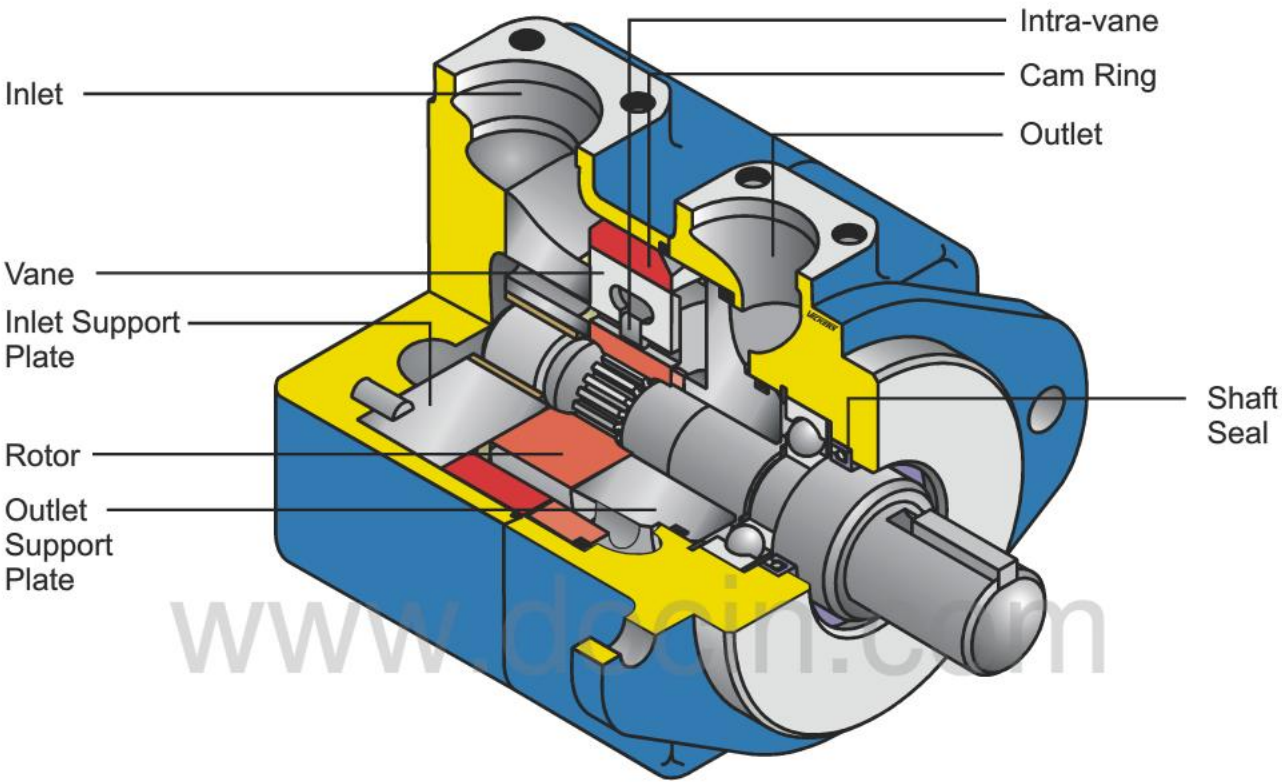


Figure 15-25 Intra-vane pump assembly

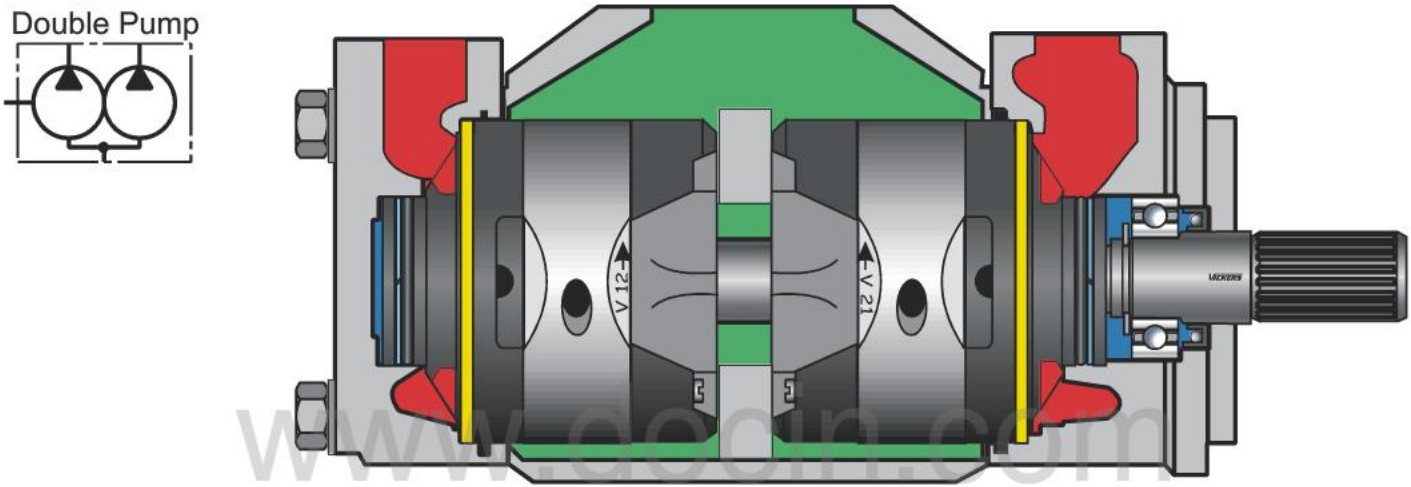


Figure 15-26 A double pump with a single inlet

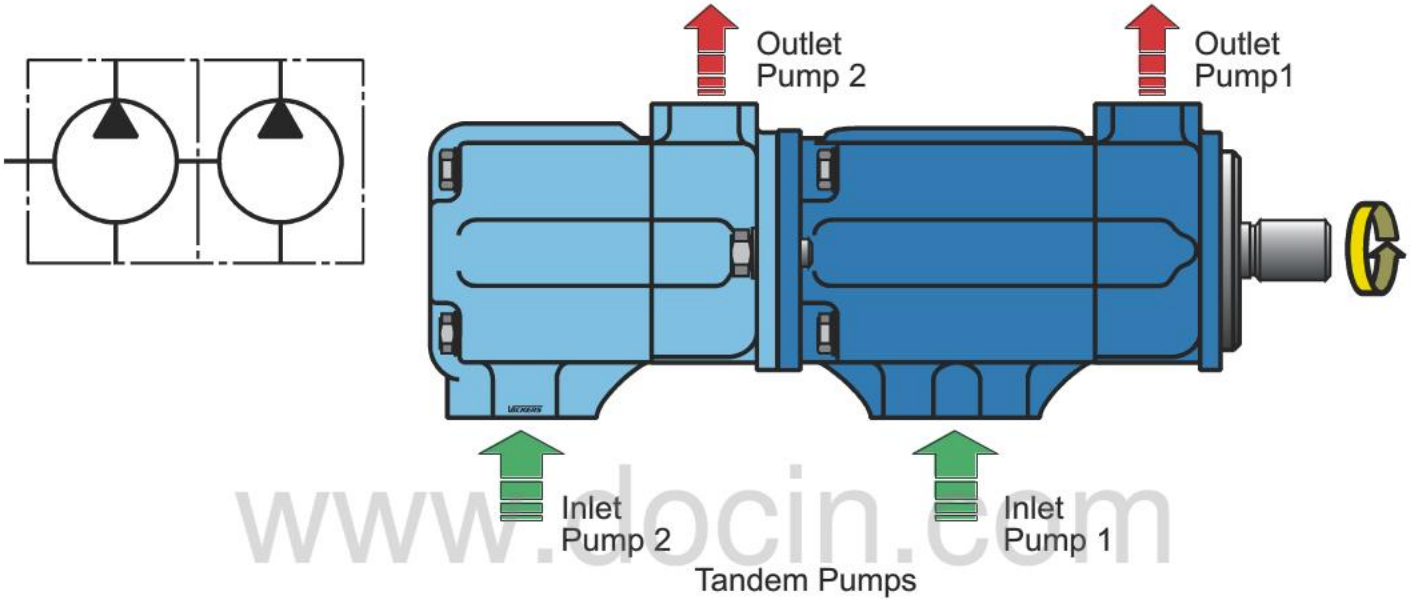
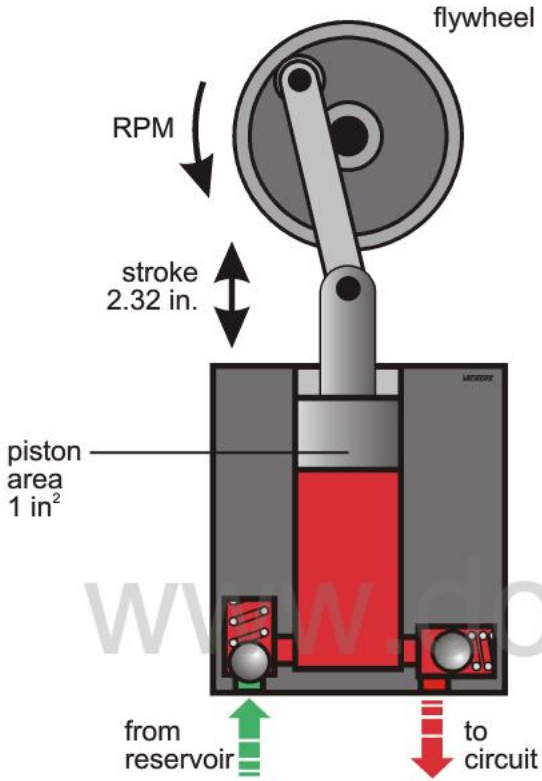


Figure 15-27 A double (tandem) pump with separate inlets



A pump's displacement is the amount of fluid discharged per revolution of the input shaft.

Displacement is usually measured in in^3/rev (sometimes abreviated CIR or CID)

Figure 15-28 The piston pump concept

Figure 15.29 A Radial Piston Pump

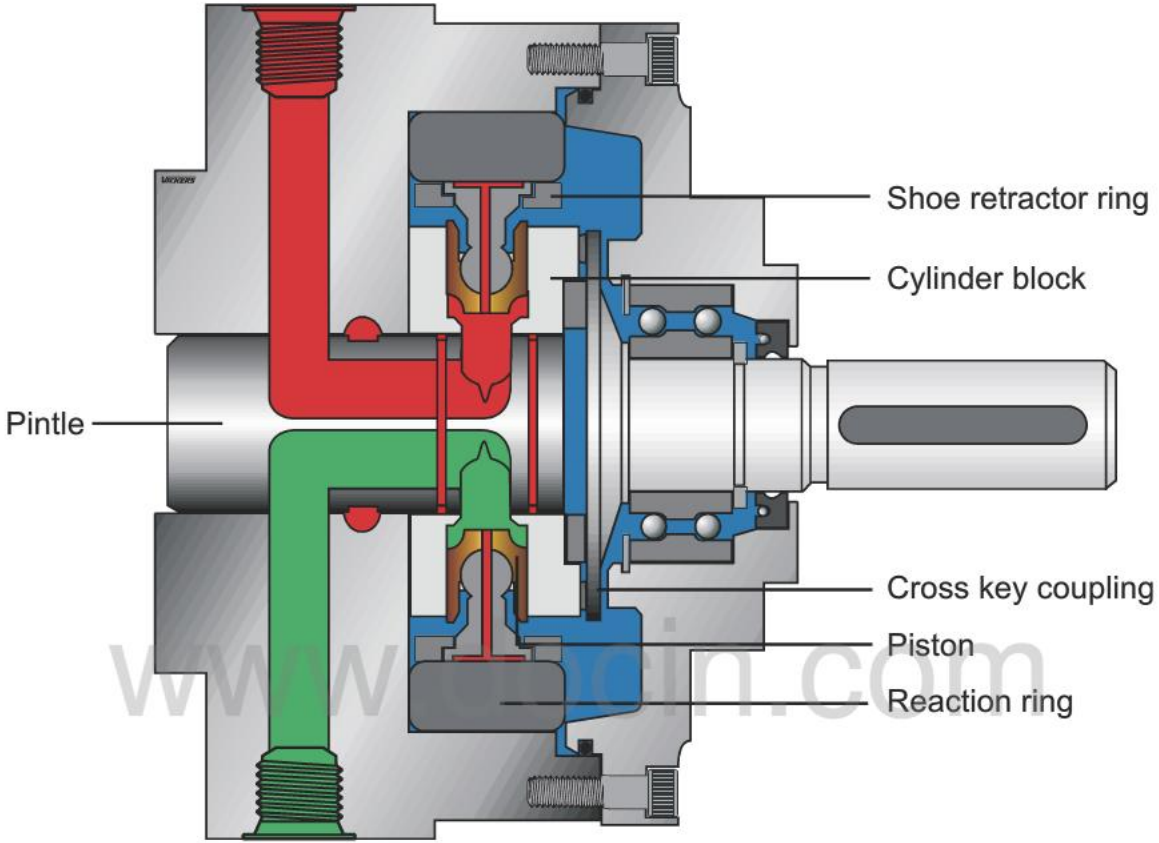


Figure 15-30 Pintle porting in a radial piston pump

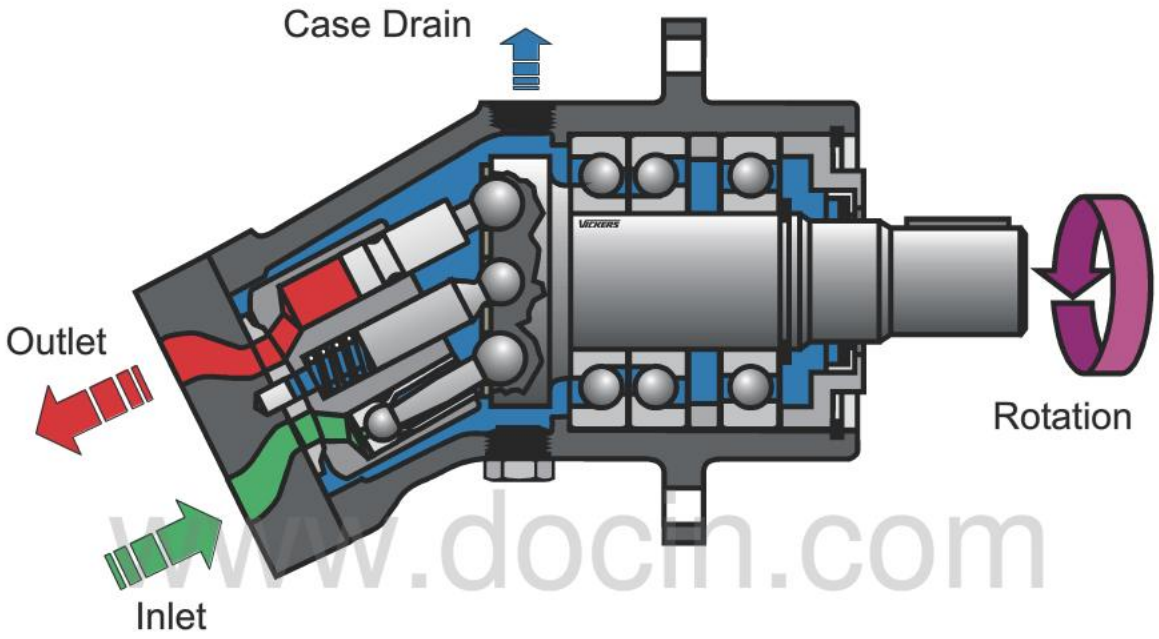


Figure 15-31 A bent-axis piston pump

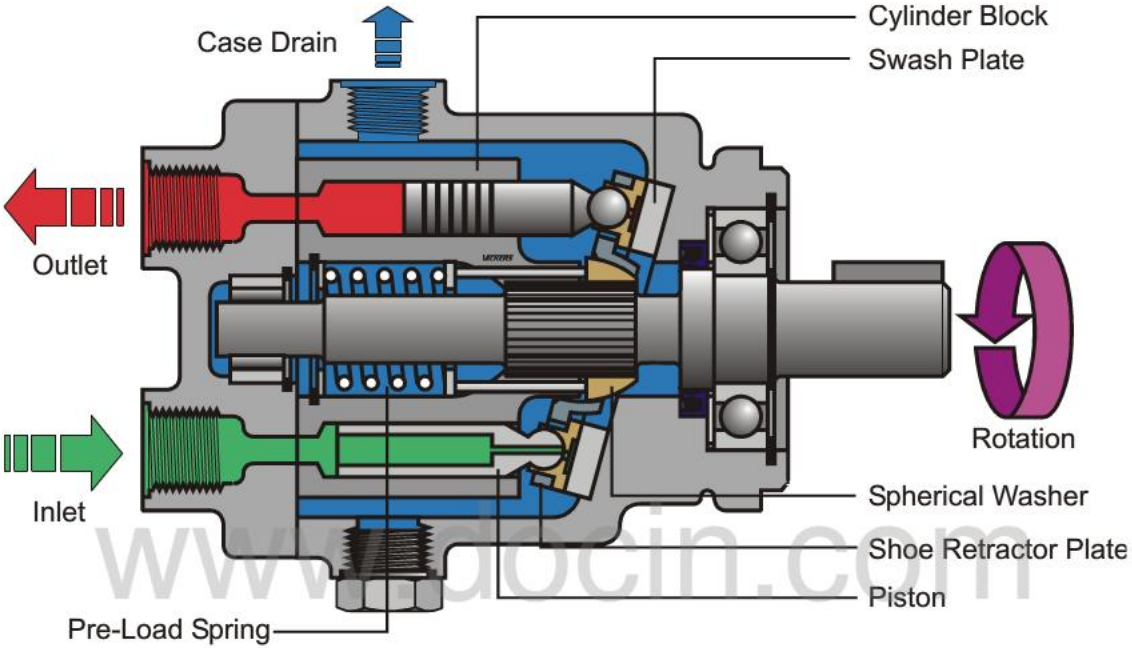


Figure 15-32 An in-line piston pump

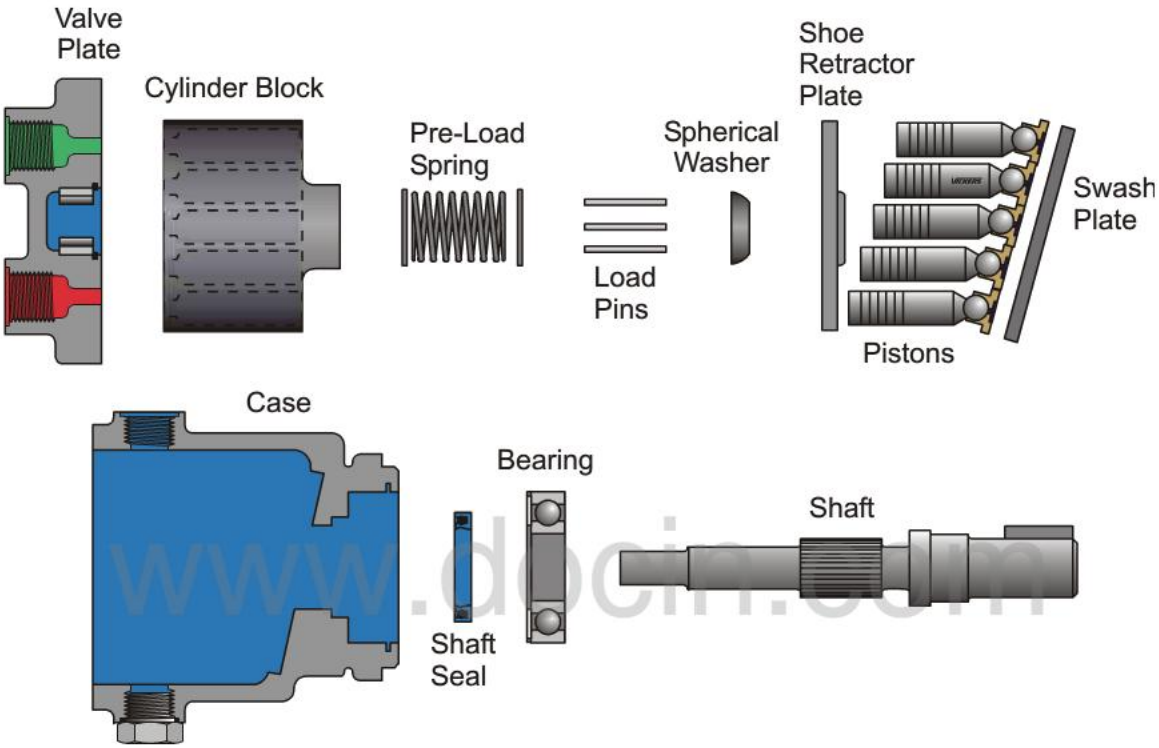


Figure 15-33 Components of an in-line piston pump

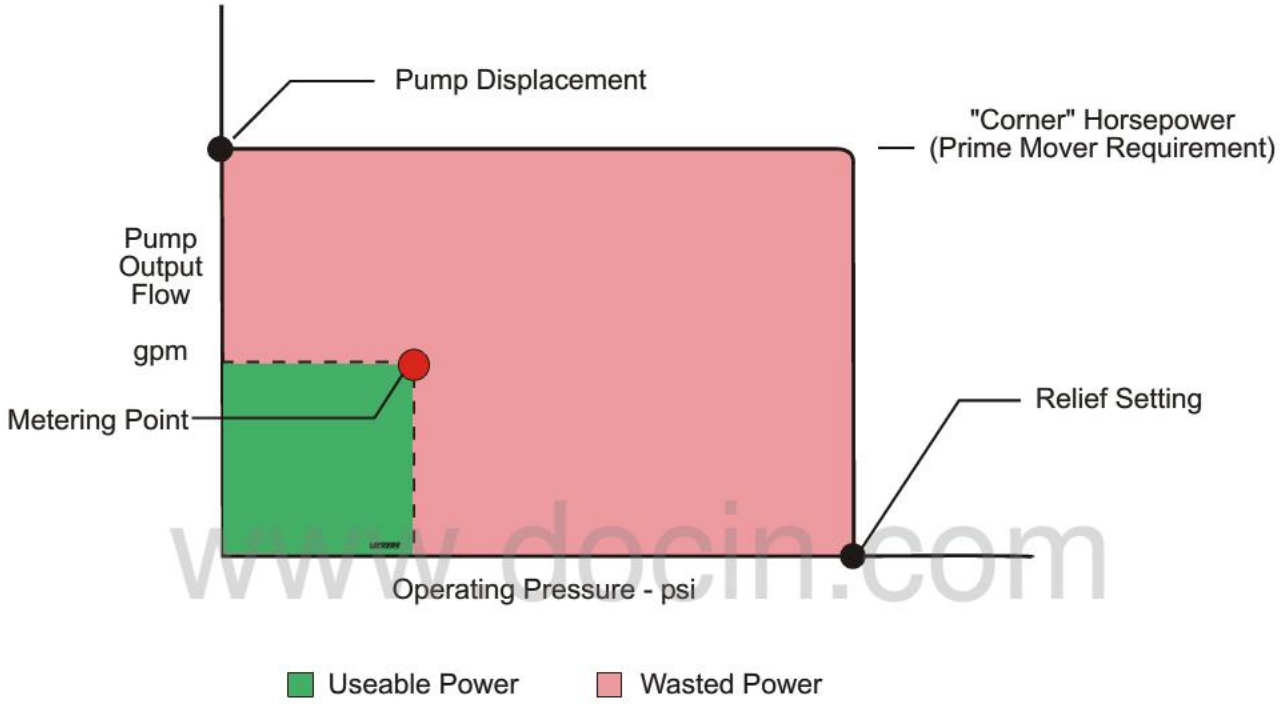


Figure 15-34 Metering losses in a fixed displacement system

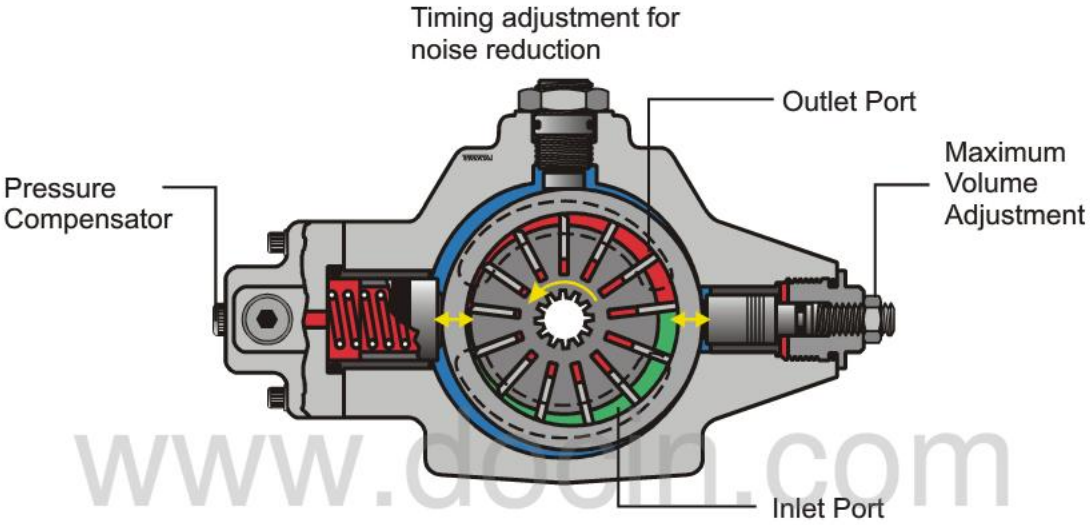


Figure 15-35 Variable Displacement Vane Pump

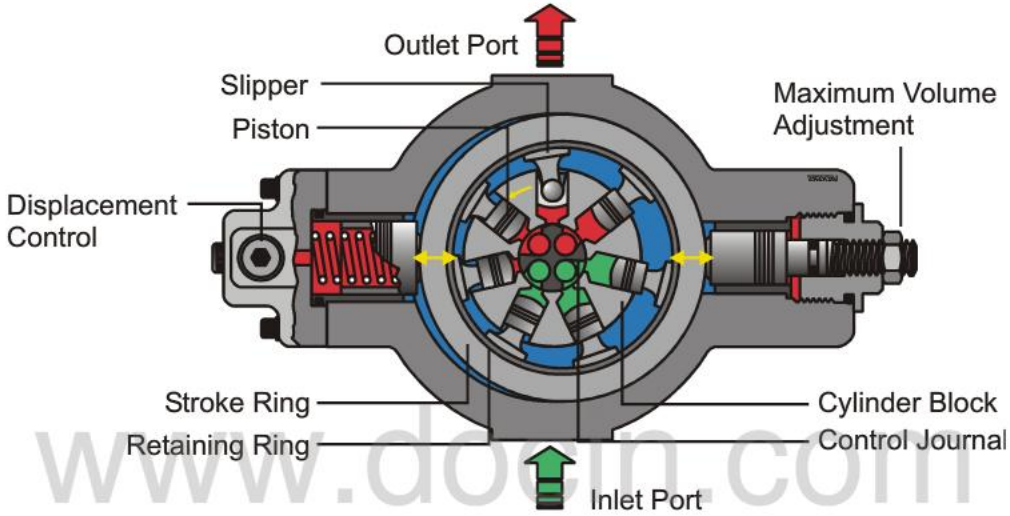


Figure 15-36 Variable displacement radial piston pump

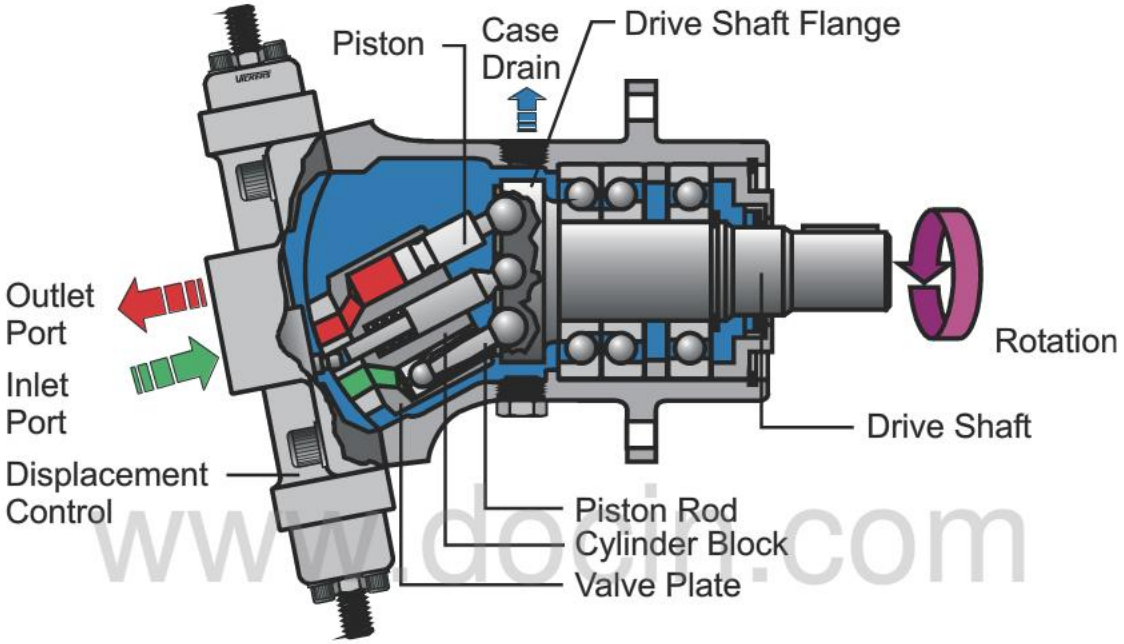


Figure 15-37 Variable displacement bent axis piston pump

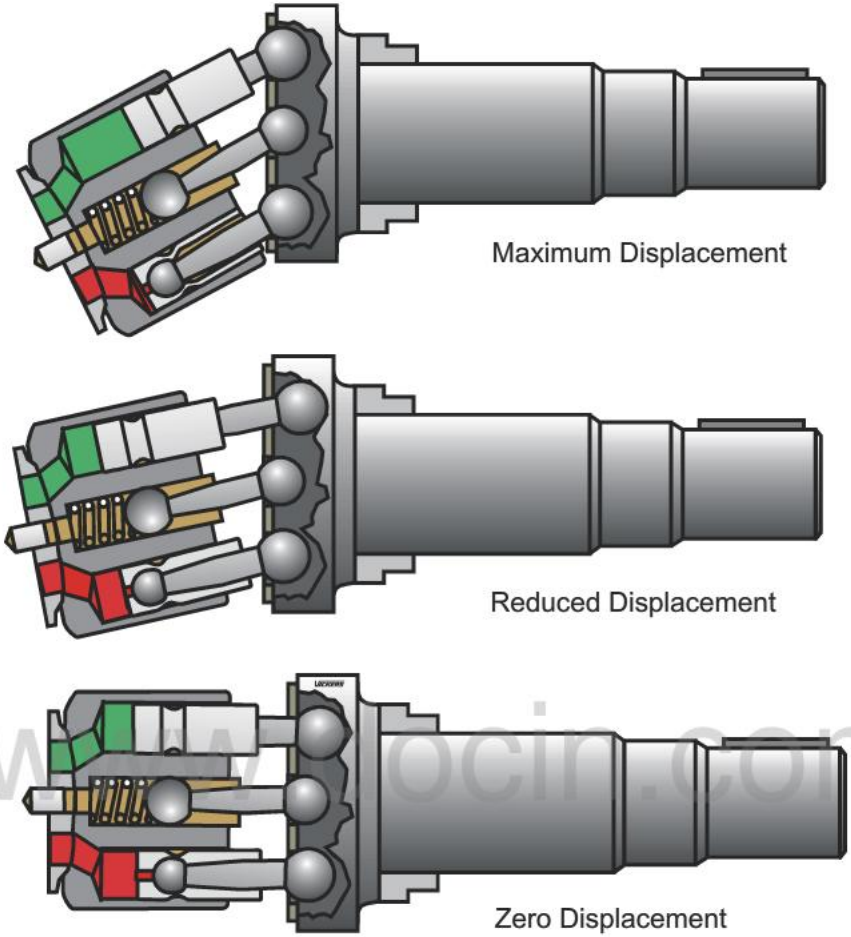


Figure 15-38 Displacement is controlled by the angle of the cylinder block

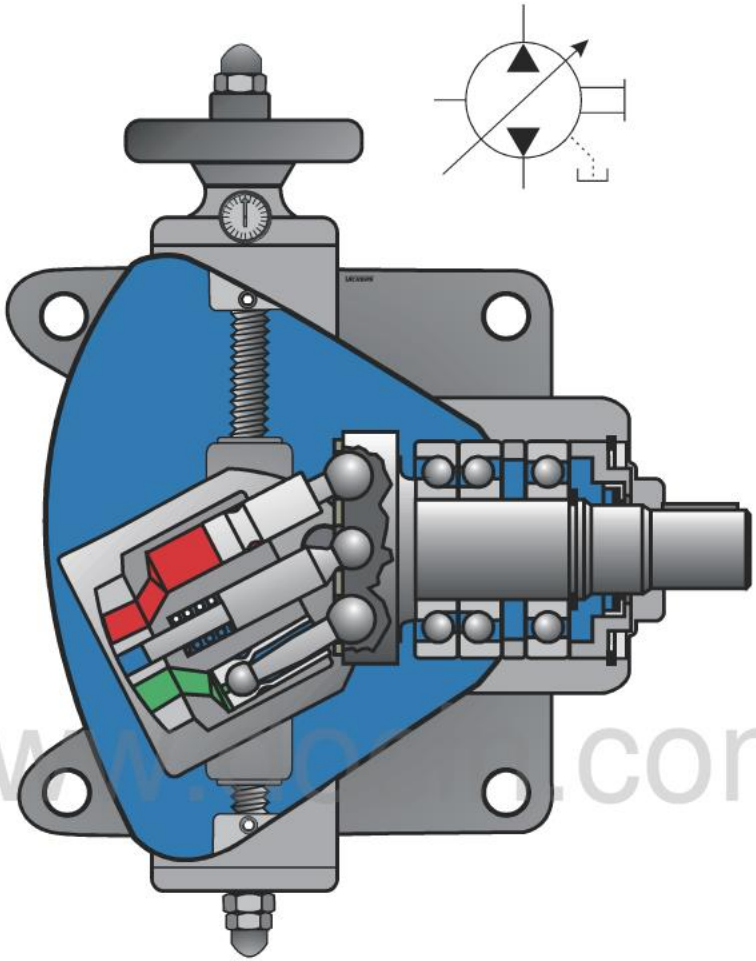


Figure 15-39 Mechanical Displacement Control

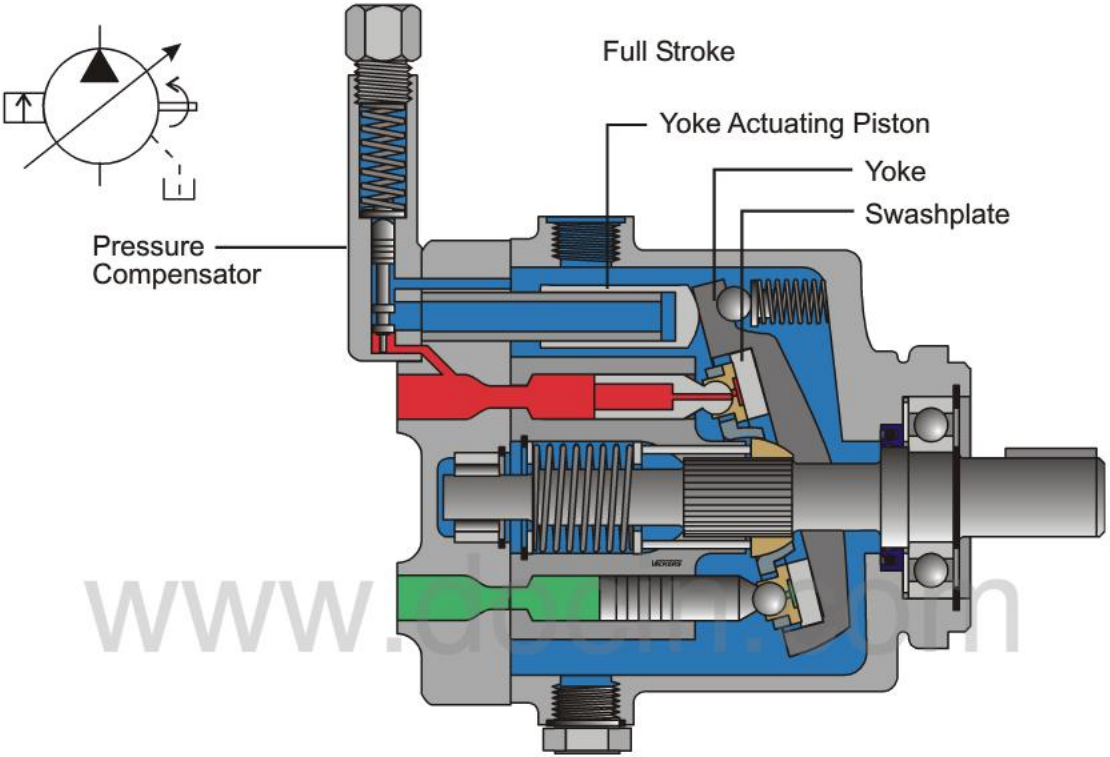


Figure 15-40 Cross section of an in-line piston pump

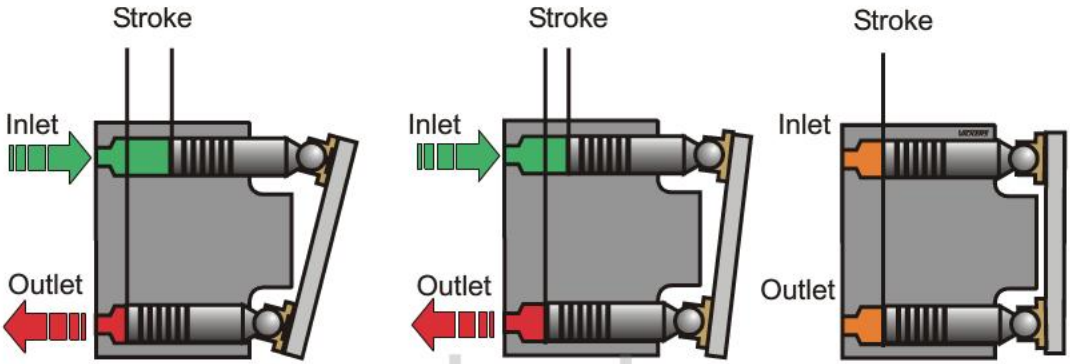


Figure 15-41 Pump displacement is based on swash plate angle

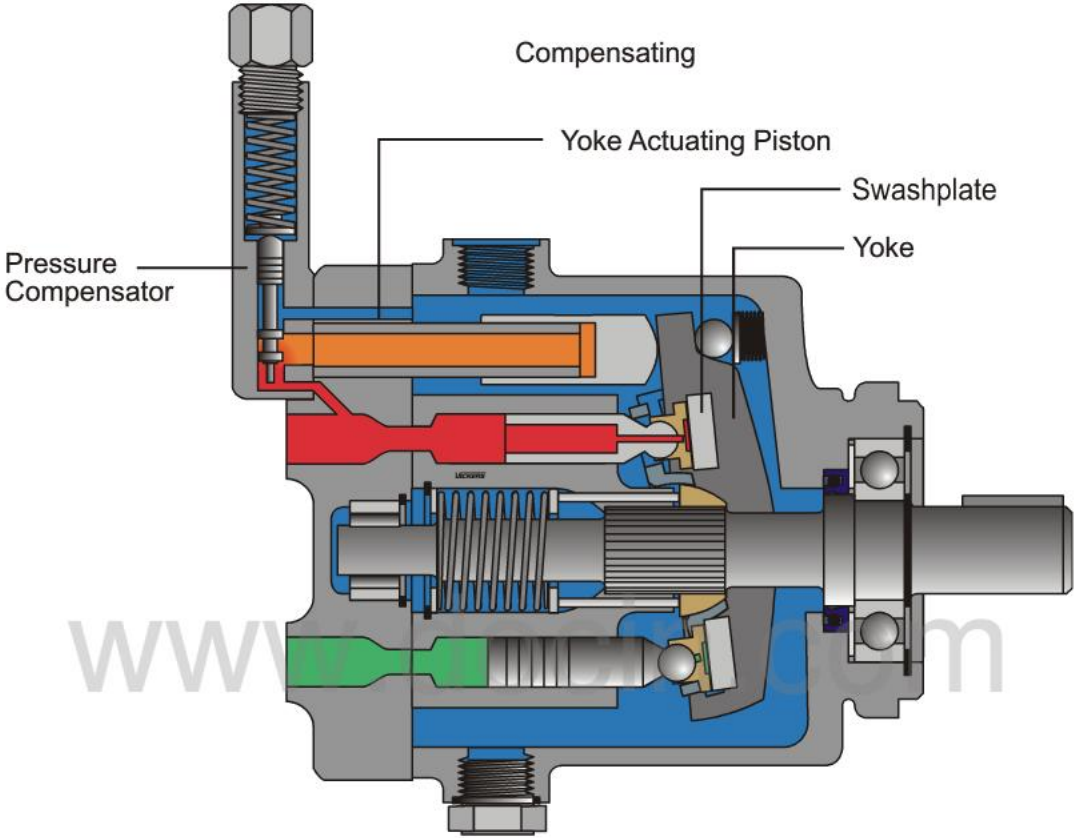


Figure 15-42 Compensators control the stroke adjusting piston

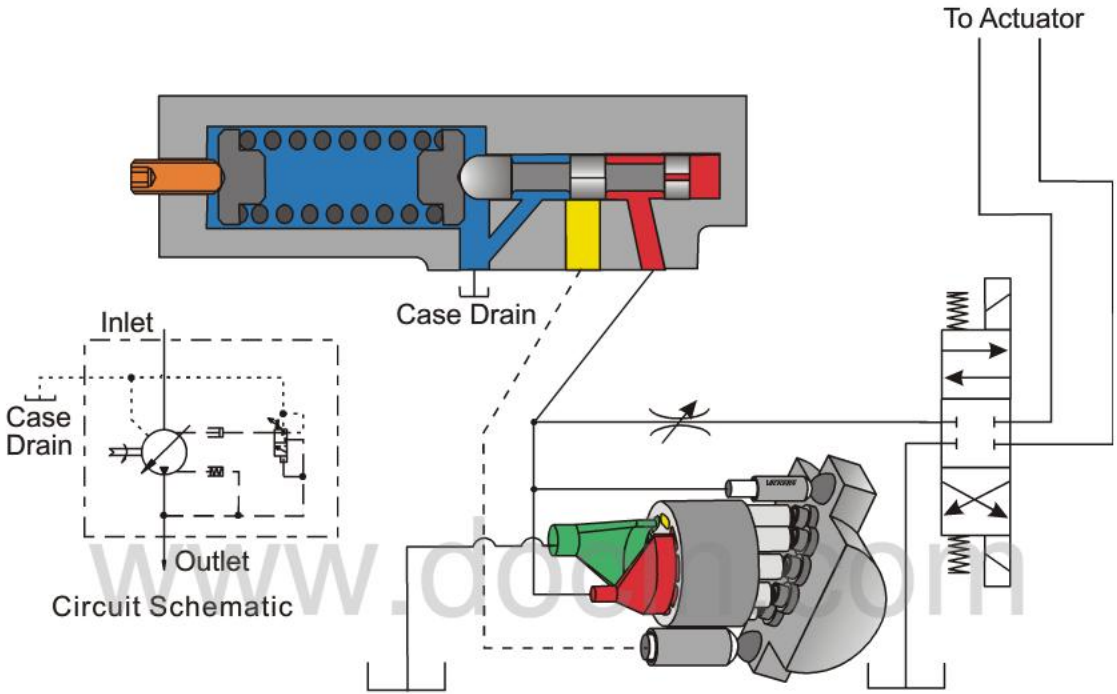


Figure 15-43 Pressure limiting compensator operation

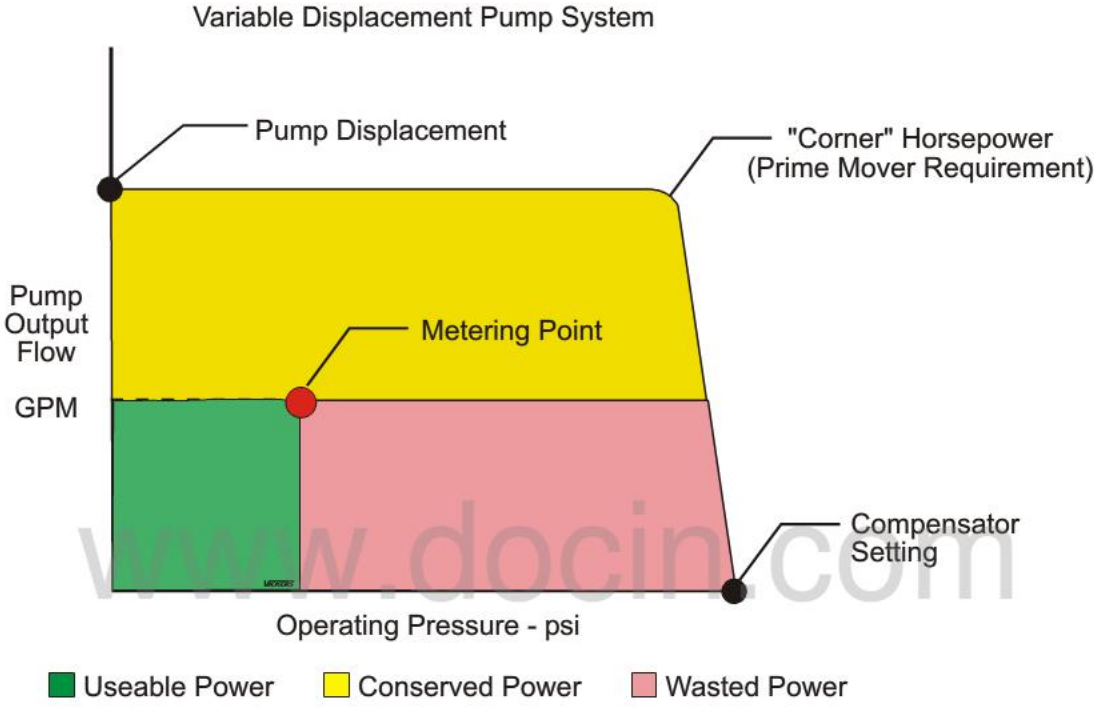


Figure 15-44 Energy saved by pressure compensation

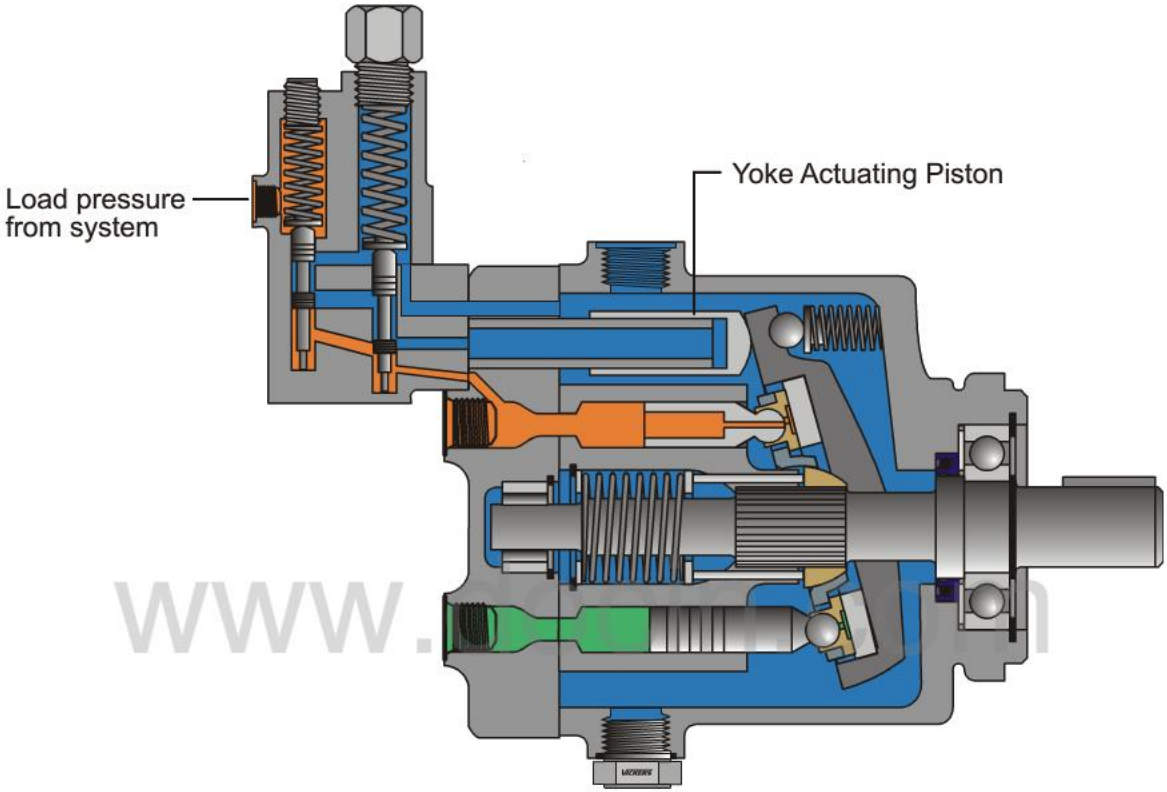


Figure 15-45 Piston pump with load sensing and pressure limiting compensator

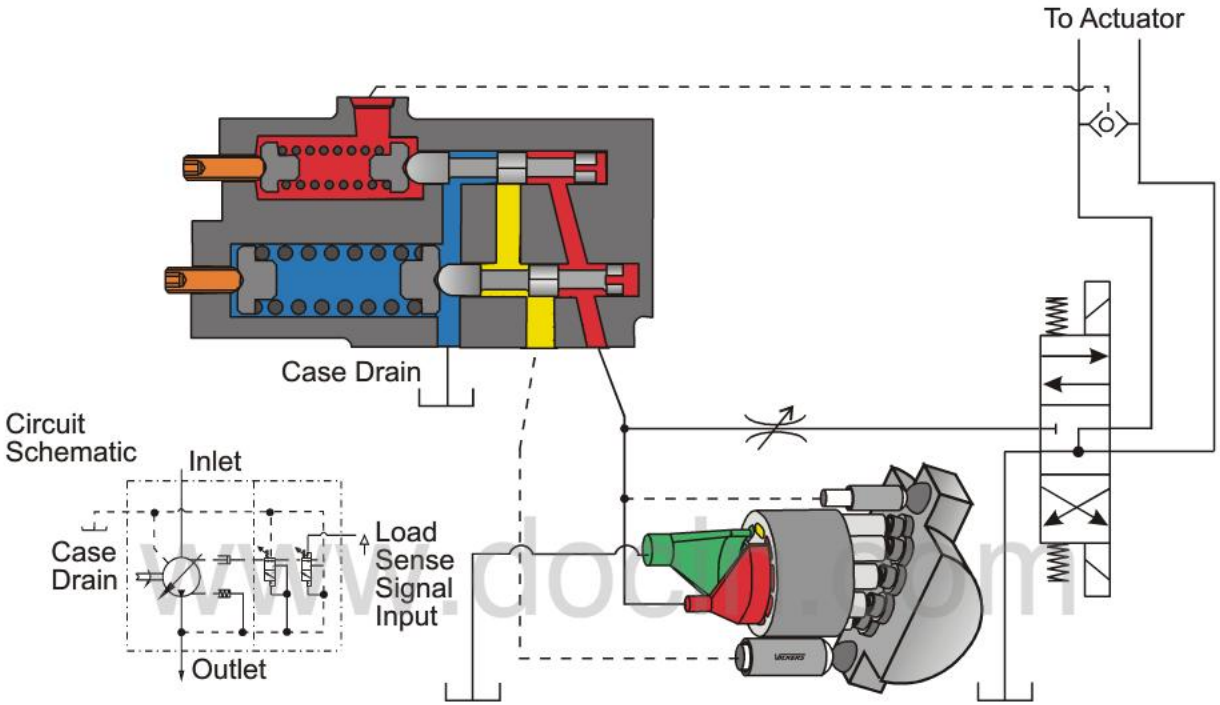


Figure 15-46 Load sensing / pressure limiting compensator operation

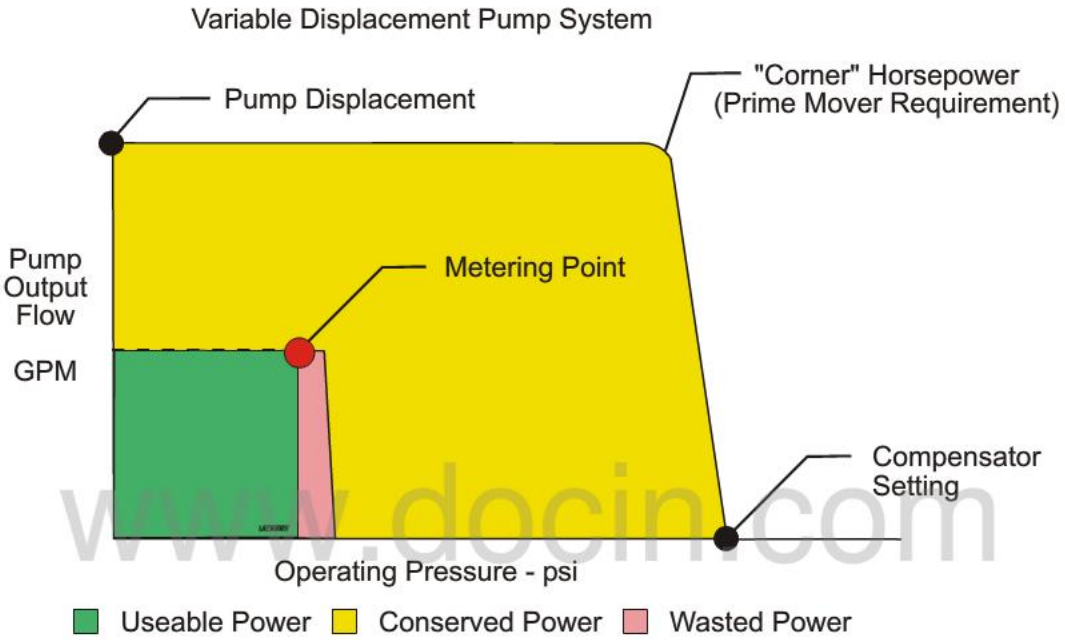


Figure 15-47 Energy savings caused by load sensing

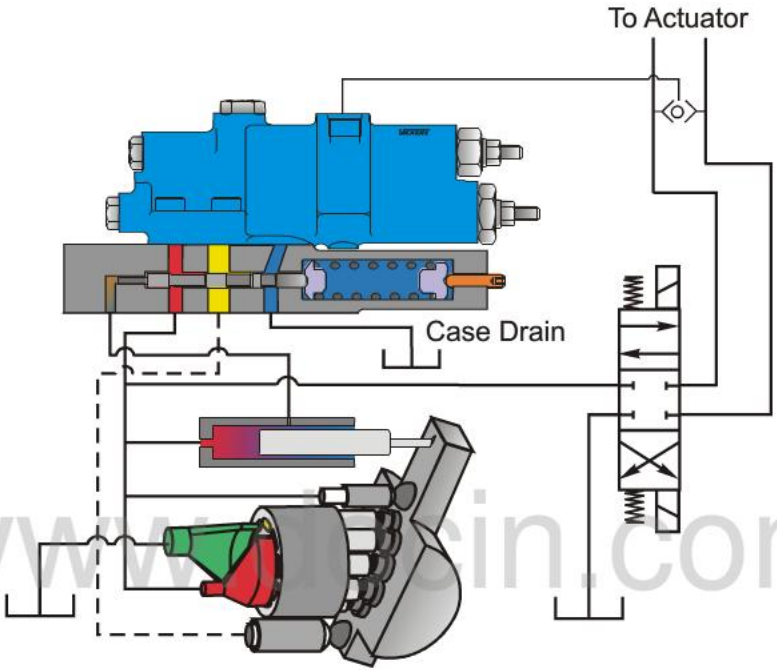


Figure 15-48 Torque limiting compensator operation

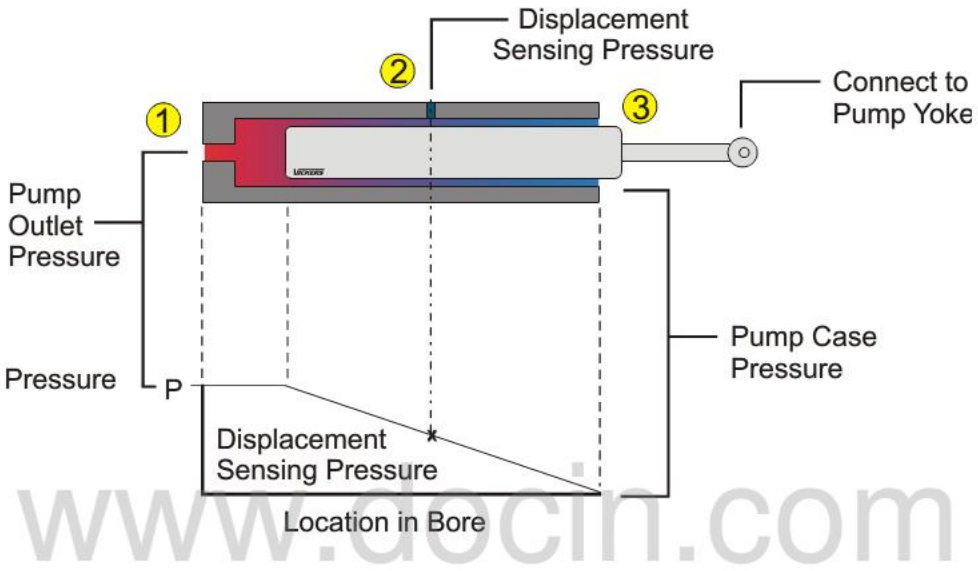


Figure 15-49 Yoke position sensing piston retracted

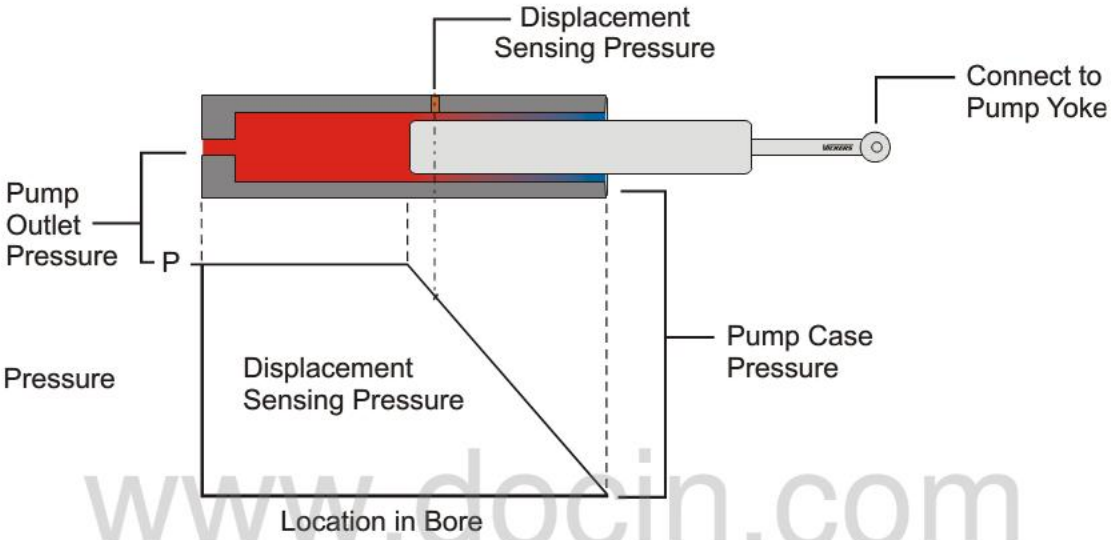


Figure 15-50 Yoke Position sensing piston extended

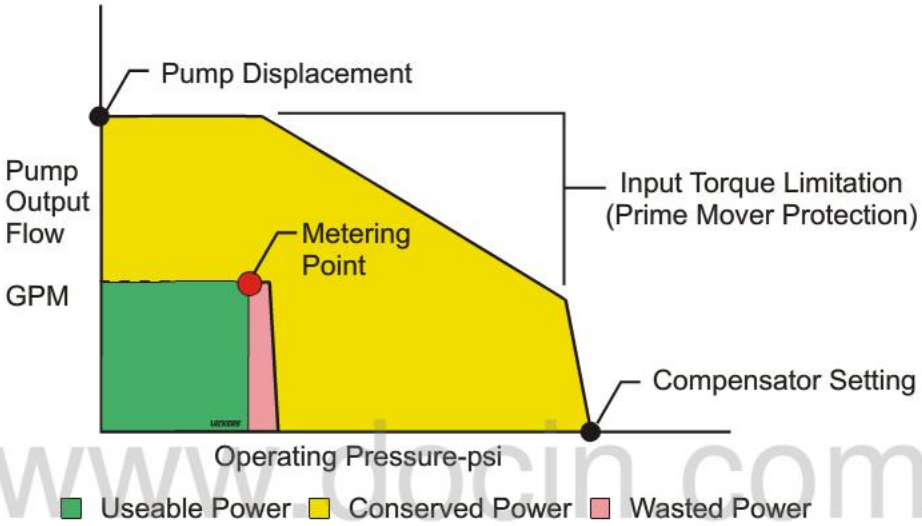


Figure 15-51 Reduced horsepower requirements by reducing corner horsepower

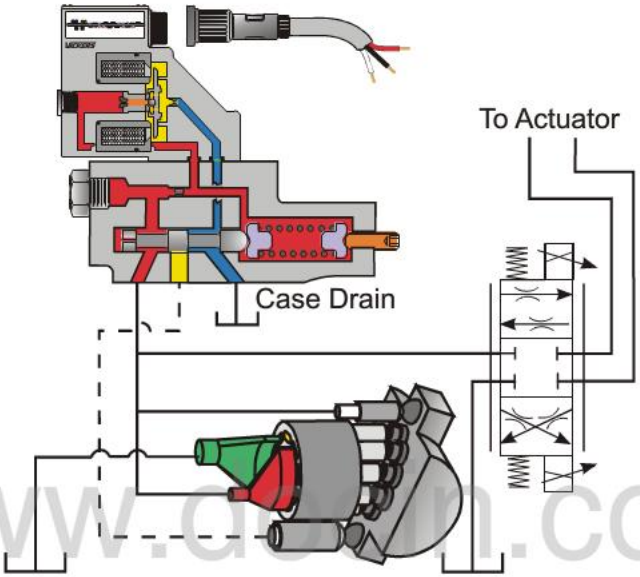


Figure 15-52 Electrohydraulic displacement contro