Hydraulic pumps 201

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Agenda

- Introduction
- Inline pump characteristics
- Basic inline pump operation
- Pump demonstration video
- Pump functional groups & problems
- Questions

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Introduction

- This discussion will acquaint participants with the inner-workings of the Eaton hydraulic inline pump
- Additionally we will look at the various functions and potential problem areas within the pump

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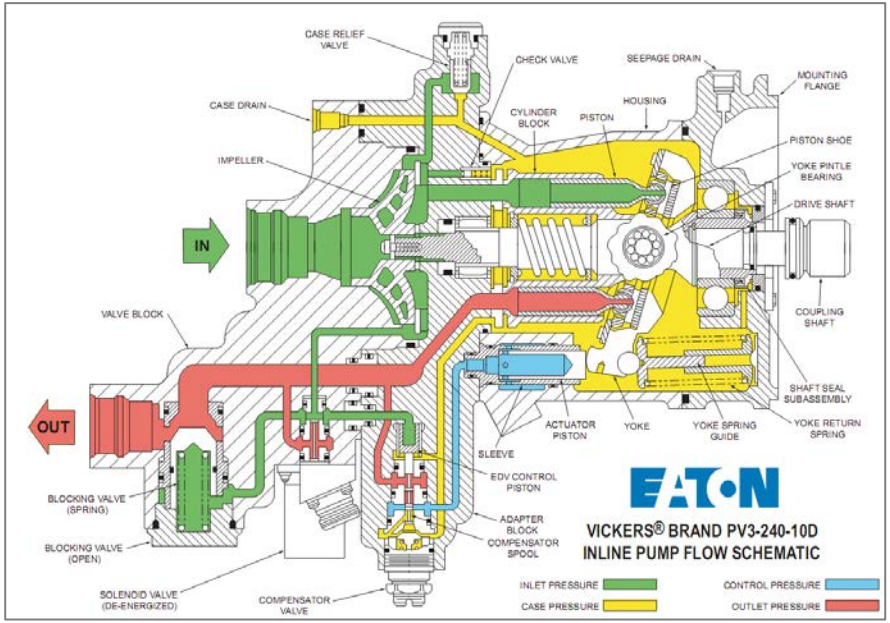
Eaton inline pump characteristics

- An inline pump refers to the orientation of the pistons relative to the primary axis of rotation
  - All Eaton inline pumps are of the positive displacement type
- **A positive displacement pump always discharges a specified volume of fluid except for internal losses regardless of the developed pressure except when limited by available torque**



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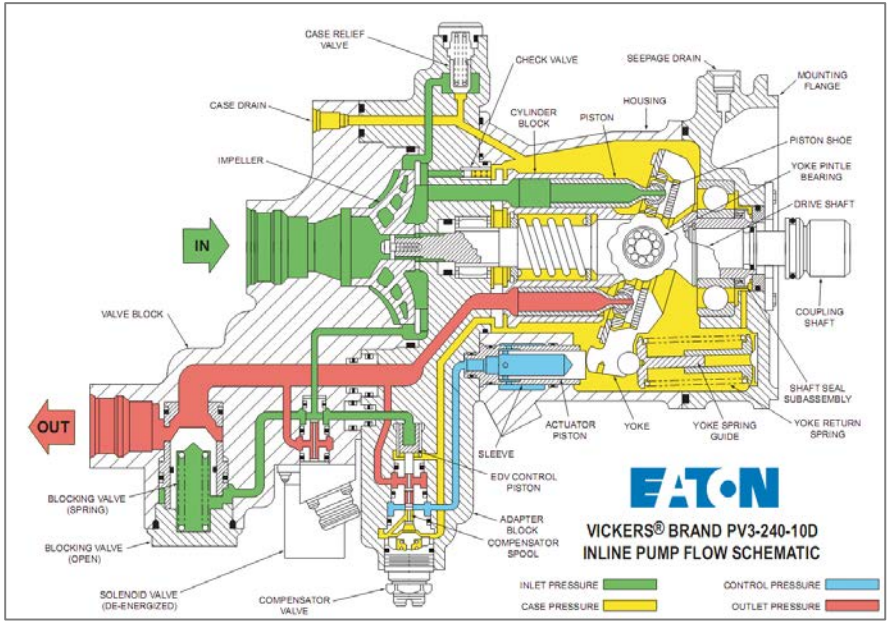
Basic inline pump operation

Operation

- The drive shaft is driven by the coupling shaft through the interface with the gearbox
- The cylinder block is driven by the interfacing drive shaft spline
- The pistons are driven by the cylinder block bores
- The piston reciprocation within the bore is caused through interaction between the piston & shoe subassembly and the max stroked yoke subassembly



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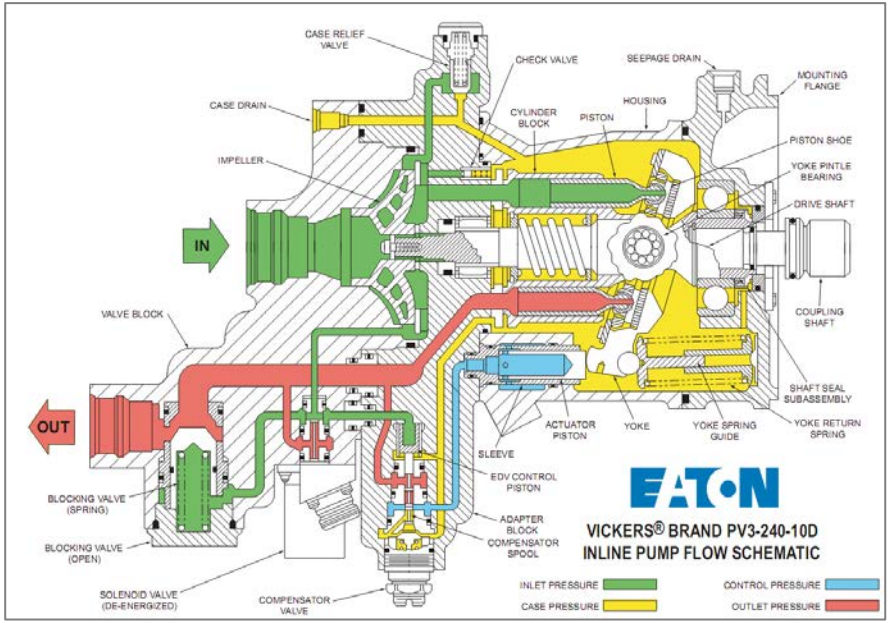
Basic inline pump operation

Operation (cont.)

- The piston reciprocation within the bore causes fluid to be drawn into the bore from the inlet port and forced to the outlet port
- As pressure is built in the outlet circuit it is sensed by the compensator and pressure is routed to the actuator piston
- The actuator piston de-strokes the yoke against the yoke spring to reduce flow



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Pump operation - drive shaft and bearing

Drive shaft

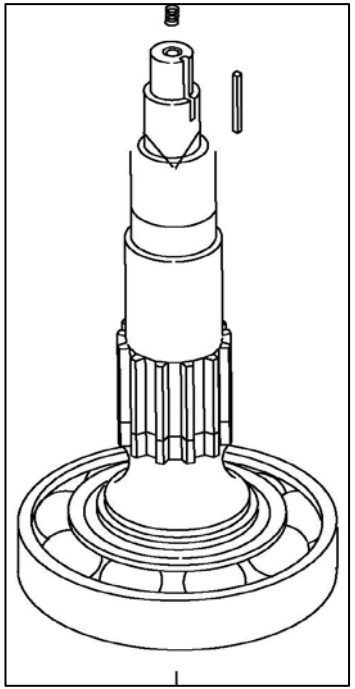
- A simple, single-piece design held in accurate alignment by two anti-friction bearings

Spline

- Drives the cylinder block through a major diameter fit, crowned slightly to provide cylinder block self-alignment

Bearings

- Located at each end of the shaft allowing for significantly minimized bearing size



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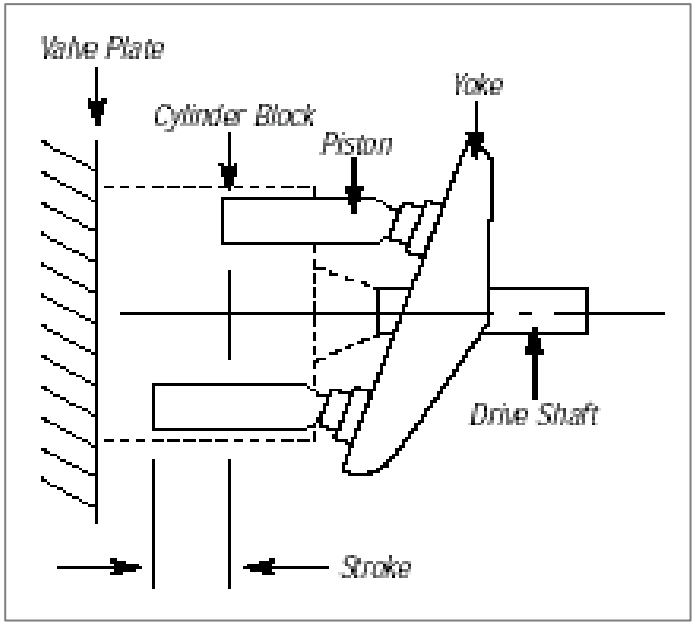
Pump operation - intake stroke

Intake

- During the first half of a rotation, each piston shoe sub-assembly follows the yoke angle away from the valve plate
  - Causing the piston to be withdrawn from the cylinder block
  - Supplying fluid to the cylinder block bore through the valve plate inlet port
- Further rotation seals the captured fluid within the piston and cylinder block bore



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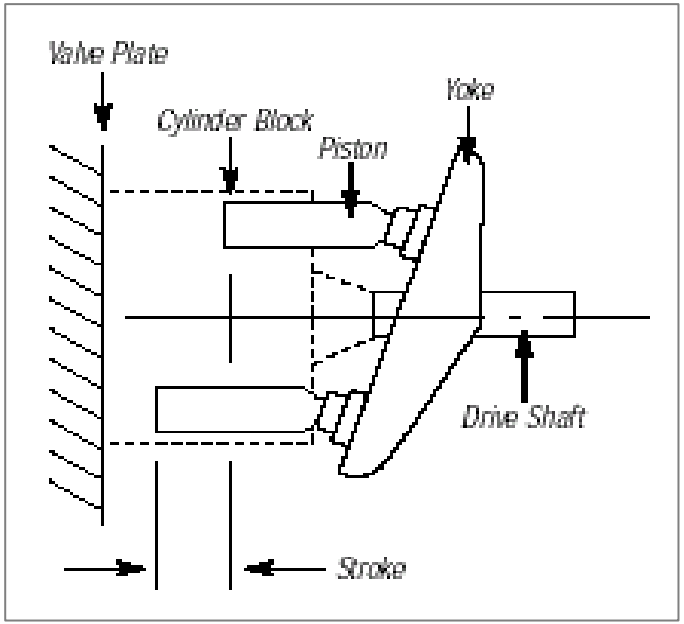
Pump operation - discharge stroke

Discharge stroke

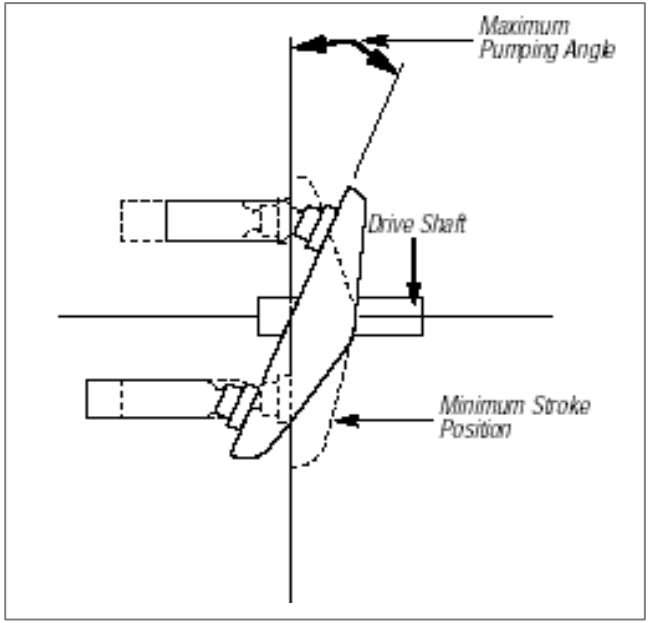
- During the second half of a rotation, each piston shoe sub-assembly inserted into the cylinder block bore
  - Forcing hydraulic fluid from the cylinder block bore through the valve plate and into the high pressure outlet circuit



Pump operation - variable displacement

Yoke angle and displacement

- The angle of the yoke determines the displacement
  - At full flow, the yoke angle is maximized allowing for the full extension of the piston into the cylinder block
    - At near zero flow, the angle of the yoke is minimized, resulting in no displacement of the piston or flow from the pump
      - Internal and quiescent leakage cause a minimum amount of flow to always be present



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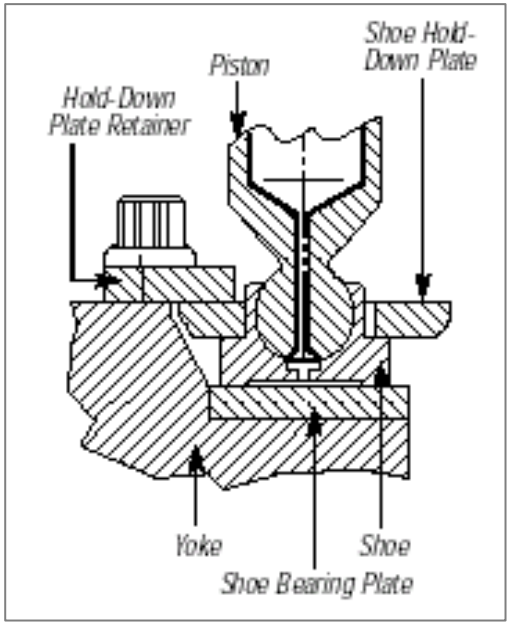
Pump operation - yoke subassembly

Shoe bearing plate

- Allows accurate lapping of the bearing surface and optimum wear material selection

Piston shoe hold-down plate

- Also Known as “Dial Plate” or “Shoe Retainer Plate”
- Guides Piston Shoe position through pump rotation
- Used to establish Shoe running clearance
- Supplies force during the Piston extraction out of the cylinder block bore



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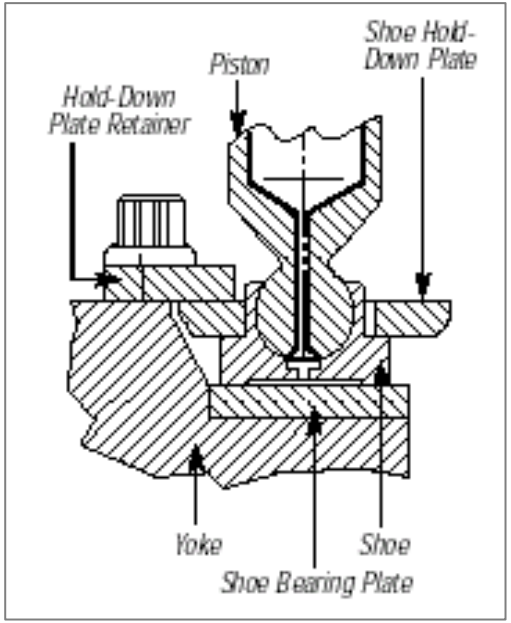
Pump operation - yoke subassembly

Shoe hold-down plate retainer

- Provides positive retention of the shoe hold-down plate during the intake stroke
- This retainer is secured to the yoke by screws
- Retainer design and arrangement improve the high-speed capability of the pump



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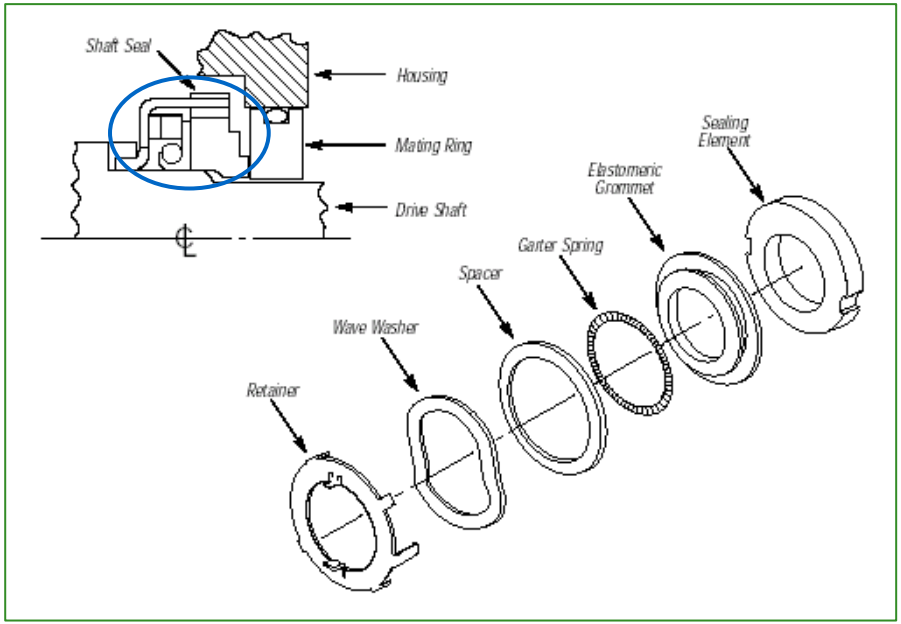
Pump operation - shaft seal assembly

Seal operation

- Element
  - Made of high quality bearing grade bronzes or carbon
  - Rotates with the shaft driven by the two retainer tabs
- Mating Ring
  - Made of high quality steels and remains stationary in the housing
  - Sealed at outer diameter by O-ring



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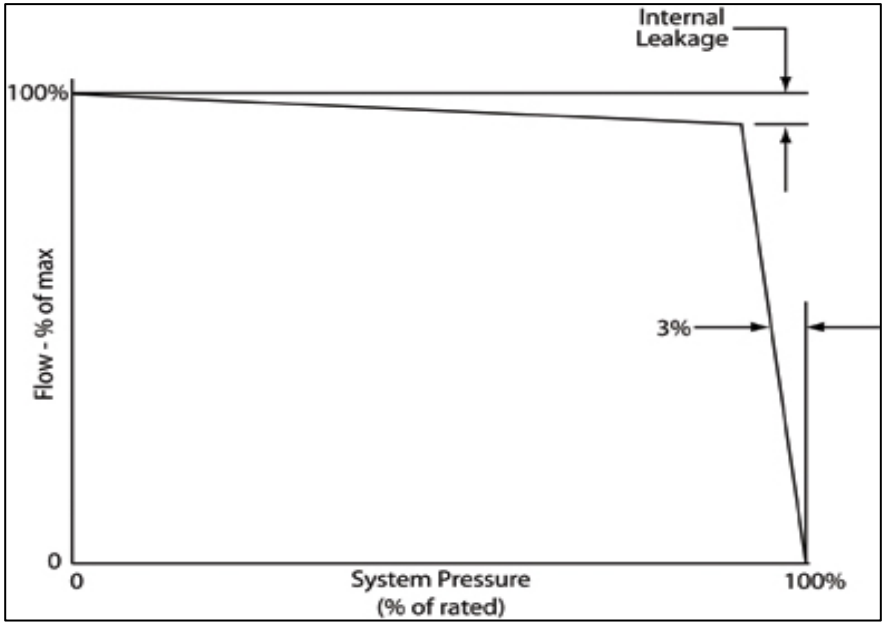
Pressure control - flat cut-off compensator

Flat cut-off type

- Provides nearly constant flow through the entire pressure range
  - Limits the system pressure increase to about 3% from full flow to zero flow



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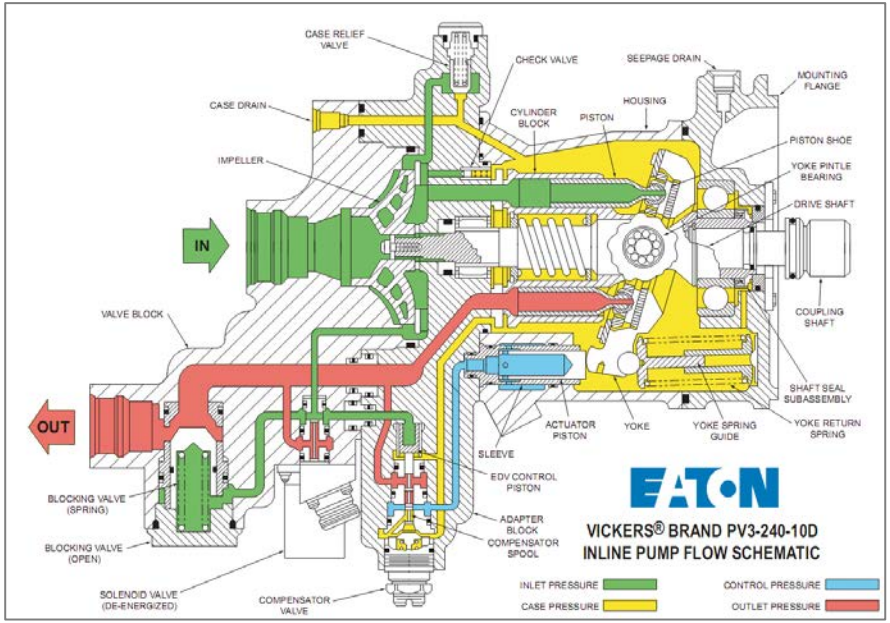
EDV valve and blocking valve

Normal operation

- The solenoid valve is de-energized
- The blocking valve is maintained in the open position
- The pump pressure compensator operates normally to provide full outlet pressure



Basic pump operations

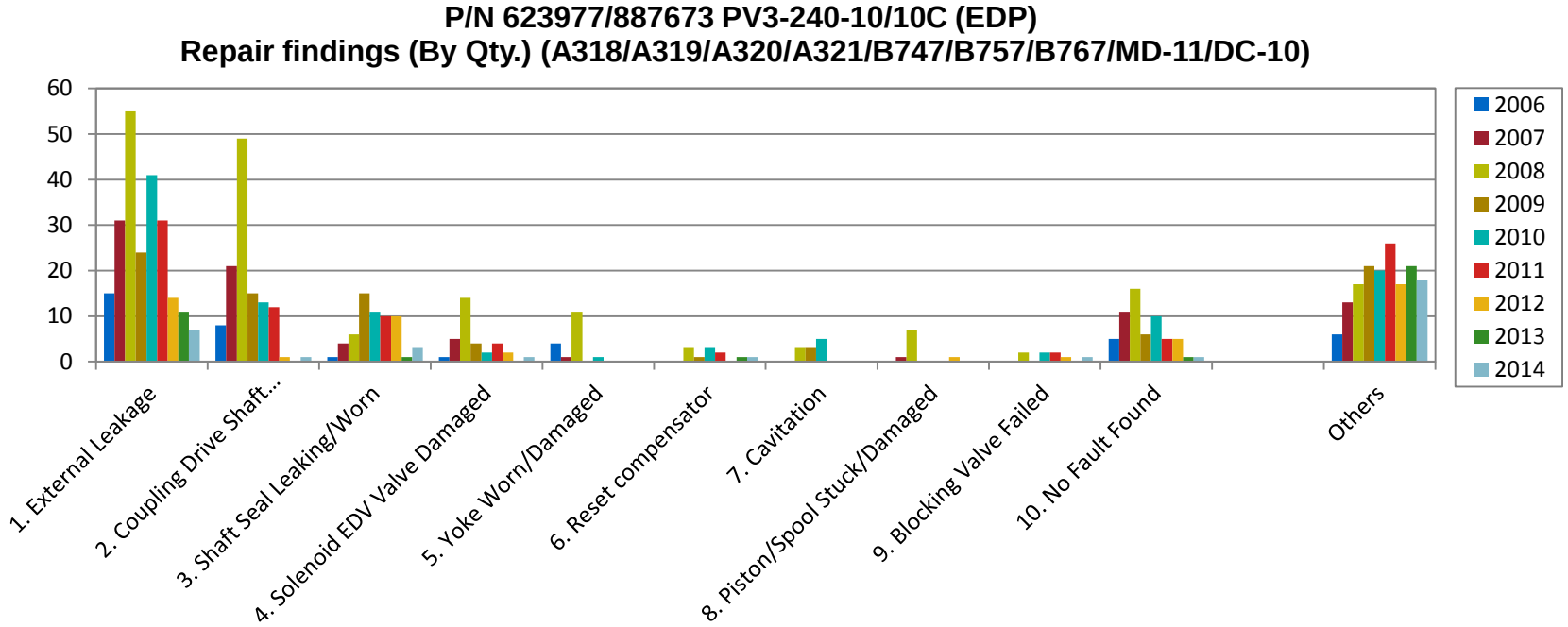
Insert pump animation

Functional groups

We will discuss the basic functions and their failure modes. These functional groups include:

- Fluid containment
- Cooling, lubrication and cleansing
- Pumping (Flow generation)
- Control (Pressure regulation)

Functional group shop findings



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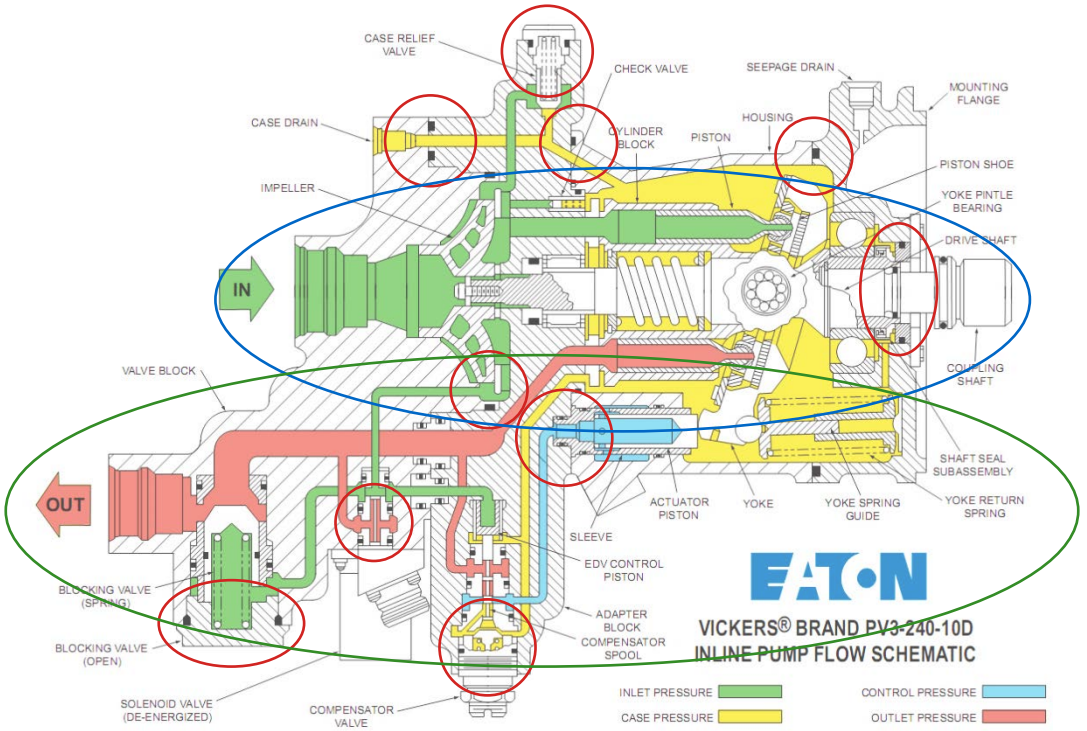
Functional groups

- Fluid containment
- Cooling/cleansing
- Pumping (flow)
- Controls (pressure)



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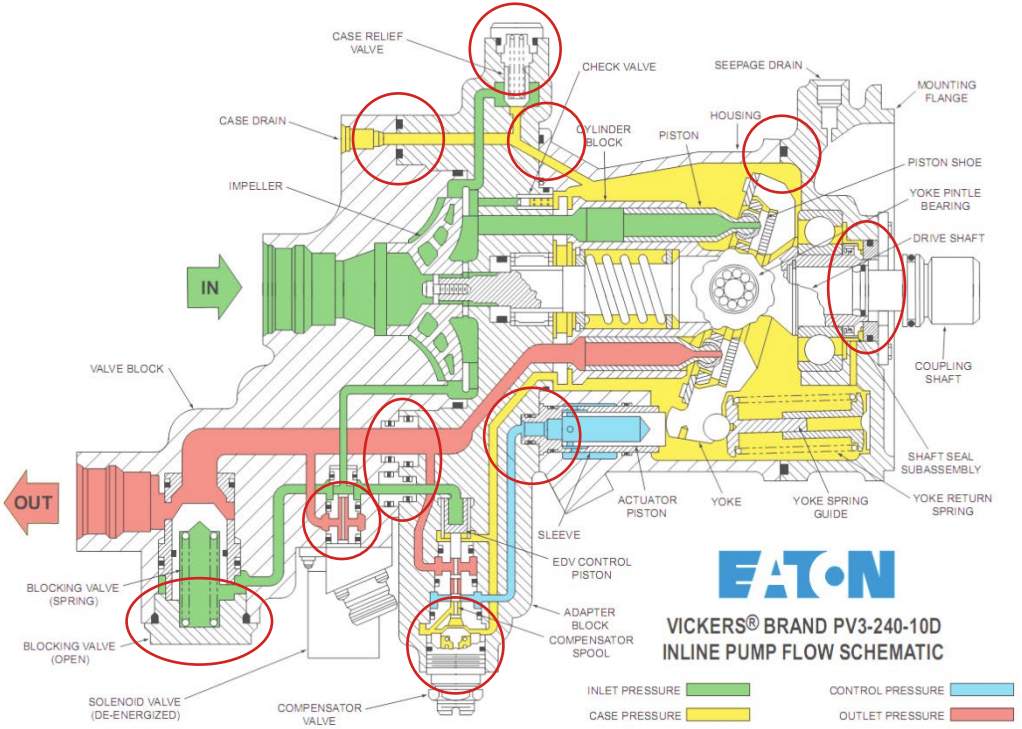
Fluid containment functional group

Maintains the hydraulic fluid within the body of the pump and prevents external fluid leakage.



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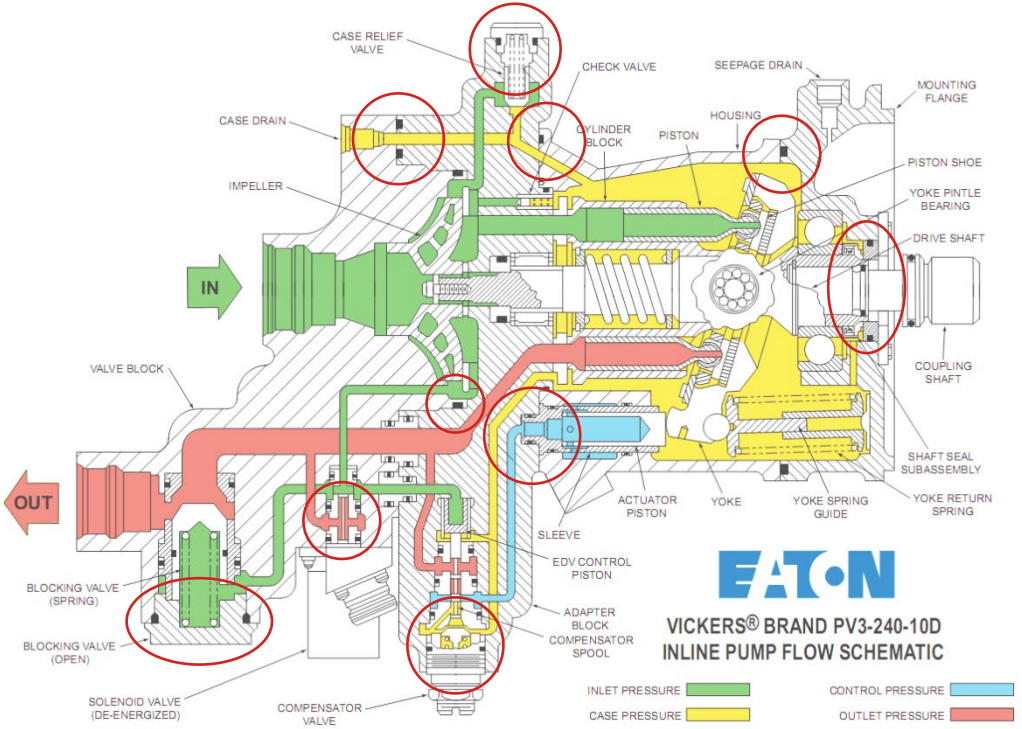
Fluid containment functional group

Loss of fluid containment

- Shaft seal leakage
- Parting line leakage
- Fitting leakage
- External plug leakage
- Leaks at sensing screws
- Structural failure



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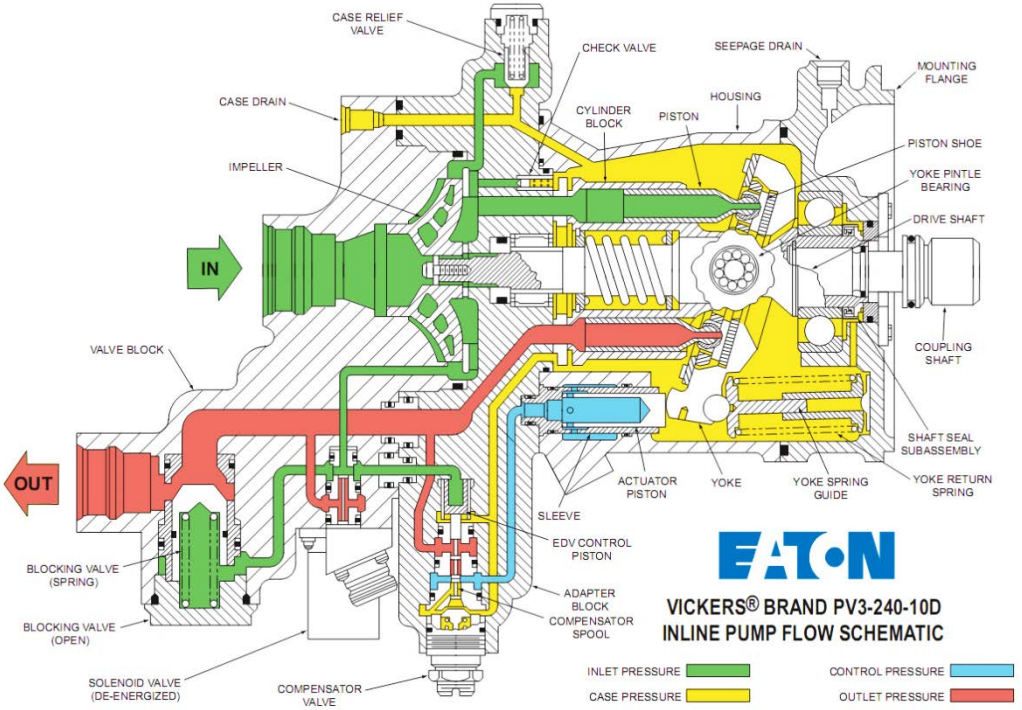
Cooling/cleansing functional group

Fluid flow through the case provides fluid for cooling, lubricating and cleansing. The case pressure also provides the reference for the compensator.



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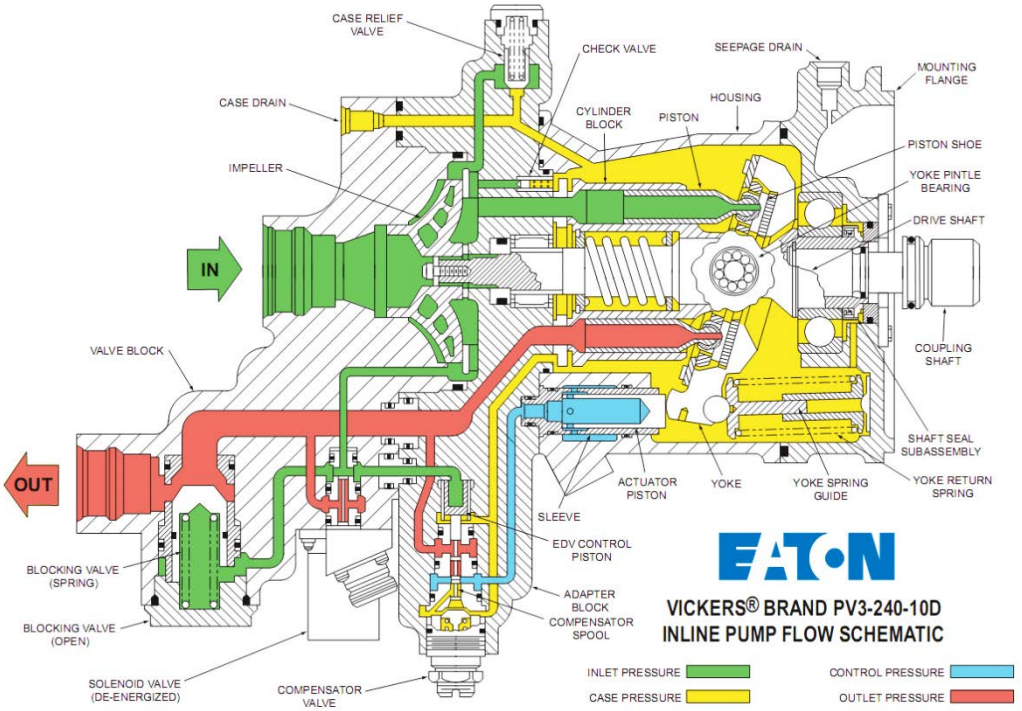
Cooling/cleansing functional group

Restriction indications

- Overheating
- Contamination wear
- High outlet pressure



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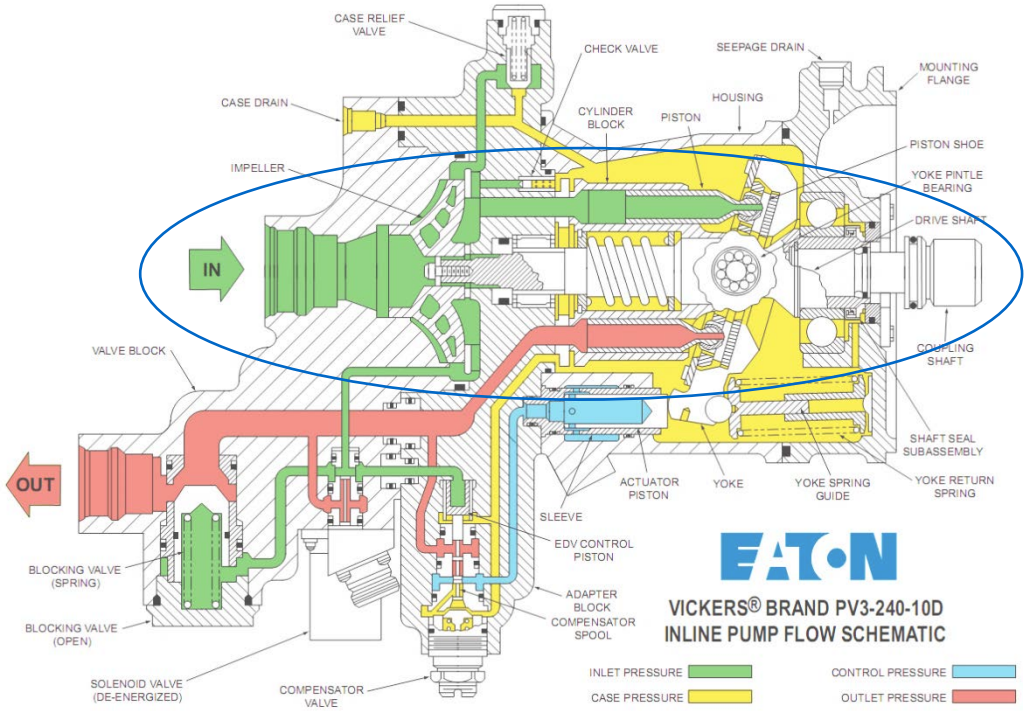
Pumping functional group

This is the group of rotating components that convert the rotary mechanical power into hydrostatic hydraulic power.



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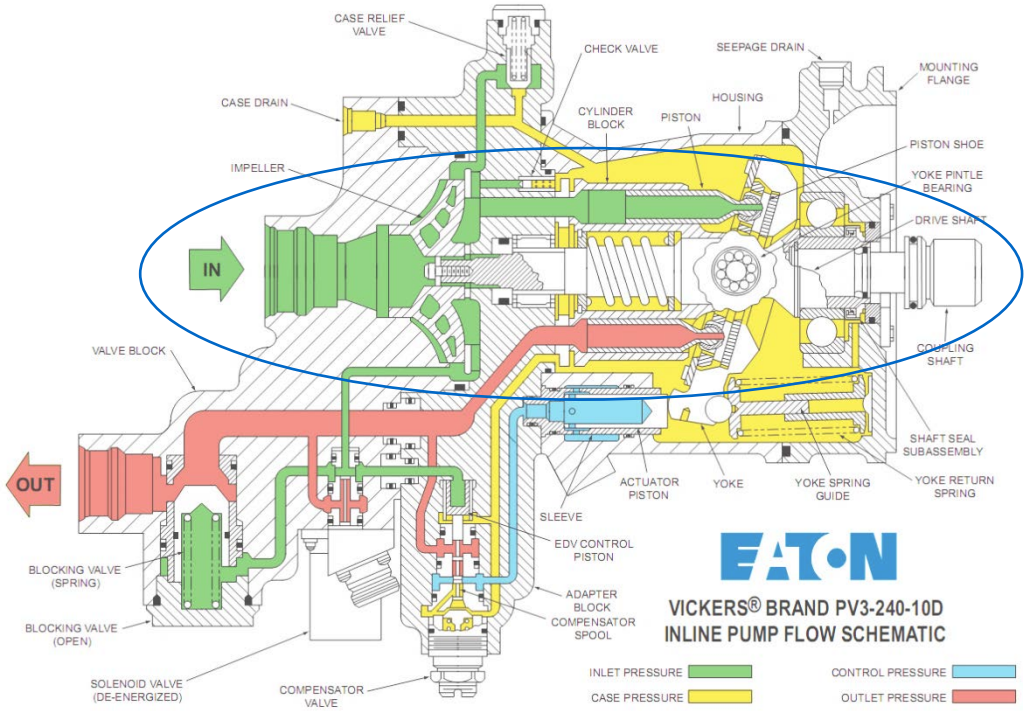
Pumping functional group

Wear indications

- Low outlet flow
- High case flow
- Low case pressure
- Noisy operation
- Cavitation
- Temperature increases
- Contamination to filters



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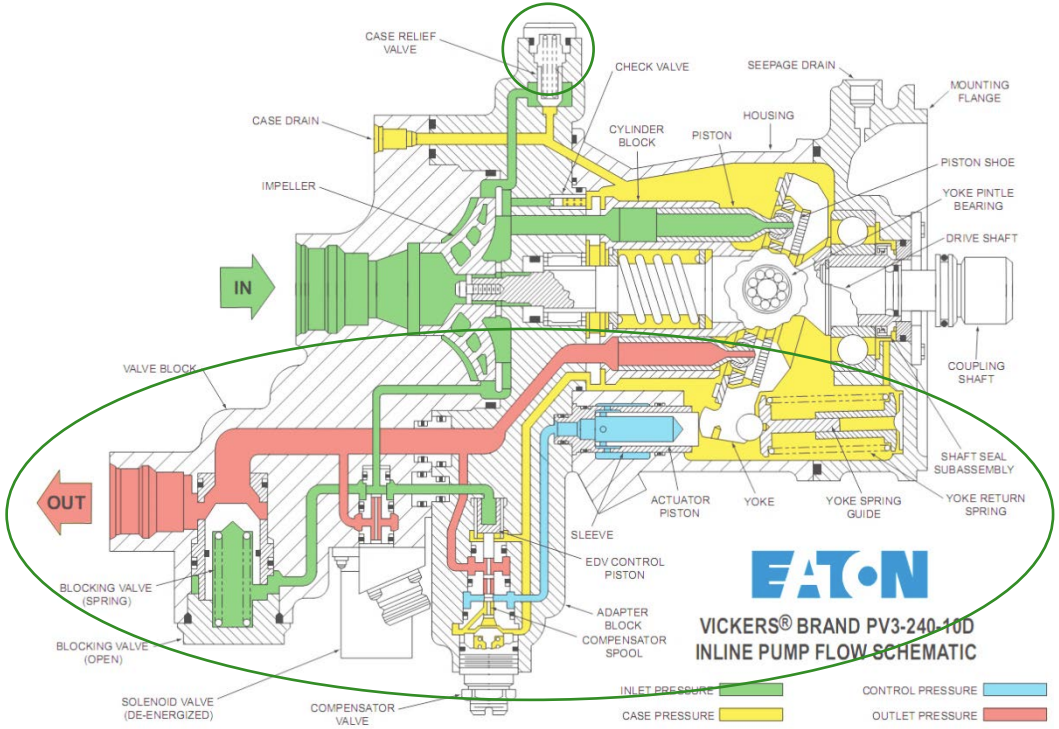
Controls functional group

This group of components senses the outlet pressure and adjusts the pumping components as necessary to meet the system flow demands.



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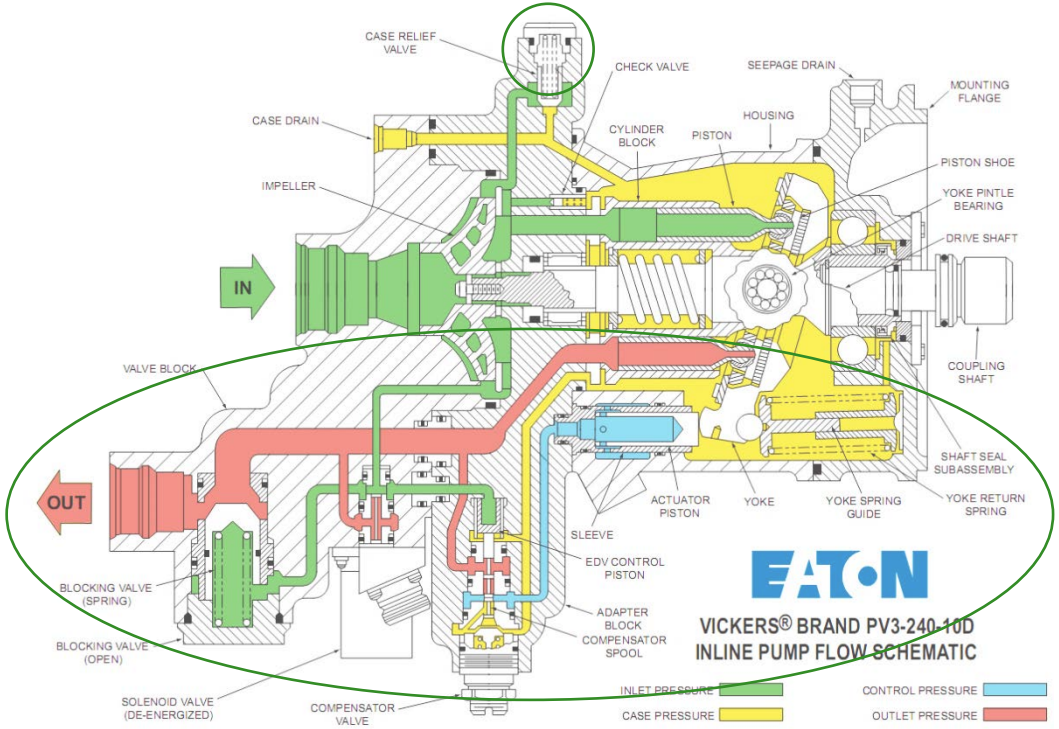
Controls functional group

Wear indications

- Low/high outlet pressure
- Pulsating outlet pressure
- Fail to depressurize
- Noisy operation
- Pressure Overshoot
- Stability
- Blocking valve leakage
- High case pressure
- Cavitation – case leakage
- Spring guide – low delivery



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Questions/Comments

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