FAILURE ANALYSIS
A Guide to Analyzing Axial Piston Pump Failures

Oilgear Company
Milwaukee, USA
Typical Failure Modes

- Contamination
- Fluid Issue
- Over Pressurization
- Improper Inlet Condition
- Case To Inlet Differential
- Miscellaneous
CONTAMINATION
10 Micron, Beta 10 of 4 or Better
ISO Contamination Grade of 21/19/16

- PISTON SEIZED IN BORE, PULLS SHOE OFF
- PISTONS SHOW FINE SCRATCHES, DULL FINISH
- EXCESSIVE WEAR ON SWASHBLOCK FACE, SHOE FACE AND VALVE PLATE FACE
- EXCESSIVE WEAR ON SADDLE BEARINGS
- HYDRO-DYNAMIC BEARING WORN
- CONTROL UNSTABLE: PISTON STICKING, COMPENSATOR SPOOL STUCK OR WORN, ORIFICE IN CONTROL PISTON PLUGGED
PISTON THAT SEIZED IN BORE

Note Metal Transfer
VERTICAL SCRATCHES: A Clear Indication of Contamination
DULL AND SCRATCHY FINISH

Normal Appearance: A Mirror Finish

Abnormal Appearance: A Steel Wool Look
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SHOE WEAR PLATE SHOWING SIGNS OF WEAR DUE TO DIRT

Scratchy Uneven Wear
Fluid Issue

Viscosity too Low, Operating Temperature too High, Not a Hydraulic Fluid, Fluid Breaking Down

- PISTON SEIZED IN BORE, PULLS PISTON SHOE
- SHOE FACES AND OR VALVE PLATE FACE SMEARED
- BALL WORN THROUGH SHOE RETAINER
- SHAFT SEAL LEAKS
- CAVITATION, AIR ENTRAINMENT
- EXCESSIVE SADDLE BEARING WEAR
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VALVE PLATE RUN ON A BAD FLUID

Note the Smeared Running Surface
WORN FULCRUM BALL

Typical Failure on Low Lubricity Fluid
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WORN SADDLE BEARING

Note the Material has Delaminated
OVER PRESSURIZATION/_SPIKES

Spike Relief Always Recommended

- Excessive swashblock face, cylinder to valve plate wear
- Pistons broken at necks
- Broken shaft where cylinder rides
- Broken tail shaft (dual)
- Control pin broken
- Cylinder cracked between kidneys
- Control O-ring, gasket failure (PVW)
EXCESSIVE WEAR ON CYLINDER FACE

Cracks Would Appear Between Kidneys
TORSIONAL FATIGUE:

Note Cone Shaped Failure
BENDING FATIGUE 

FAILURE

Note Straight Break
IMPROPER INLET CONDITIONS

Suction Strainer not Recommended

- CAVITATION ON VALVE PLATE FACE
- NOISE (MARBLE SOUND)
CAVITATION ON COMPRESSION BRIDGE
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CASE TO INLET DIFFERENTIAL

In General Differential Cannot Exceed 10 PSI

- SHOE EDGES ROUNDED
- SHOES LOOSE ON BALLS
- SWASHBLOCK WEAR, HALF MOON SHAPE
- EXCESSIVE WEAR ON BACK OF SHOE FLANGES
- SEAL RETAINER BENT
WHAT DOES CASE PRESSURE DO?

30 PSI AT INLET, 0 PSI CASE
TROUBLE !!!!!
STAGES OF DAMAGE DUE TO SHOE LIFT

3rd Stage
2nd Stage
1st Stage
THE FINAL STAGE OF SHOE LIFT
HALF MOON SHAPED MARKS

A Sure Sign of Shoe Lift
ROLLED SHOES: THE TELL TALE OF SHOE LIFT
WEAR ON SHOE RETAINER FROM SHOE FLANGES
BENT SEAL RETAINER
MISCELLANEOUS

• INPUT SHAFT BROKEN
  ‣ MISALIGNMENT
  ‣ TORQUE REVERSAL

• CONTROL INSTABILITY
  ‣ AIR
  ‣ INCREASE CONTROL PISTON ORIFICE

• PUMP VIBRATES
  ‣ MISALIGNMENT
  ‣ COUPLING HALF'S TOUCHING
HELPFUL HINTS FOR ANALYZING BASKET CASES

● The last piece to fail will have the least amount of damage

● Try to piece together the broken parts. This may seem like a waste of time but many times you will observe things which can help you determine the original cause of failure.

● Get the history of events:
  ‣ What recently changed?
  ‣ What was going on just prior to failure?
  ‣ How long was pump run?
  ‣ Talk to the operators
KEYS TO FAILURE ANALYSIS

- Don’t go into a customers problem with a preconceived idea about the cause
- Don’t assume anything, verify everything
- Don’t overlook the obvious