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Hydraulic Gear Pump Failure Analysis

Failure Mode: Contamination

Component: Hydraulic Gear Pump

Pump Type: External Gear Pump

Reported Issue: Loss of efficiency, abnormal noise, internal wear, or seizure

1. Summary of Findings

Disassembly and inspection of the hydraulic gear pump revealed internal damage consistent with **solid particle contamination** within the hydraulic system. The observed wear patterns indicate prolonged exposure to abrasive particles circulating through the pump, resulting in accelerated internal wear and loss of performance.

2. Visual Inspection Findings

2.1 Gears

Observations:

- Uniform scoring along gear tooth faces and flanks
- Directional scratches consistent with fluid flow
- Polished or worn gear tips
- Embedded debris visible in some tooth surfaces

Interpretation:

These wear patterns are characteristic of **abrasive particles passing through the gear mesh**, removing material from the gear surfaces over time.

2.2 Pump Housing

Observations:

- Circumferential scoring along the housing bore
- Grooves aligned with gear rotation
- Localized wear in high-flow regions

Interpretation:

Hard particles carried by the hydraulic fluid act as cutting agents between the gears and housing, causing progressive erosion.



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2.3 Wear / Thrust Plates

Observations:

- Heavy scoring and grooving
- Uneven wear patterns
- Evidence of debris embedment

Interpretation:

Contaminants trapped between wear surfaces prevent formation of a proper hydrodynamic oil film, accelerating surface damage.

2.4 Bearings and Shaft

Observations:

- Abrasive wear on bearing surfaces
- Shaft journals show fine circumferential scratches
- No evidence of torsional overload or thermal damage

Interpretation:

Damage indicates continuous exposure to contaminated fluid rather than a sudden mechanical event.

3. Failure Mode Identification

Primary Failure Mode: Solid Particle Contamination

Contamination occurs when foreign material (metal, dirt, sand, seal debris, or degraded hose material) circulates within the hydraulic system, damaging precision components.

4. Likely Sources of Contamination

One or more of the following sources may have contributed:

- Inadequate filtration or bypassing filters
- Filter element failure or improper micron rating
- Introduction of contaminants during maintenance
- Dirty reservoir or open fill ports
- Hose or seal degradation
- System not flushed after prior component failure



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5. Conditions Ruled Out

Based on inspection, the following were ruled out as primary failure causes:

- Cavitation
- Over-pressure
- Manufacturing defects
- Improper assembly
- Lubrication starvation

6. Root Cause

The root cause of the pump failure is determined to be **prolonged operation with contaminated hydraulic fluid**, resulting in abrasive wear of internal components.

7. Corrective Actions & Recommendations

1. Flush entire hydraulic system prior to pump replacement
2. Replace all filters and verify proper micron rating
3. Inspect reservoir cleanliness
4. Analyze fluid contamination levels (ISO cleanliness code)
5. Replace hoses if internal degradation is suspected
6. Implement scheduled fluid sampling and filter changes
7. Verify maintenance procedures prevent contamination ingress