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FAILURE ANALYSIS

A Guide to Analyzing Axial Piston Pump Failures

Oilgear Company
Milwaukee, USA

Innovative Fluid Power

80-776, Rev. 4/05

Typical Failure Modes

- Contamination
- Fluid Issue
- Over Pressurization
- Improper Inlet Condition
- Case To Inlet Differential
- Miscellaneous

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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

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PISTON THAT SEIZED IN BORE

Note Metal Transfer

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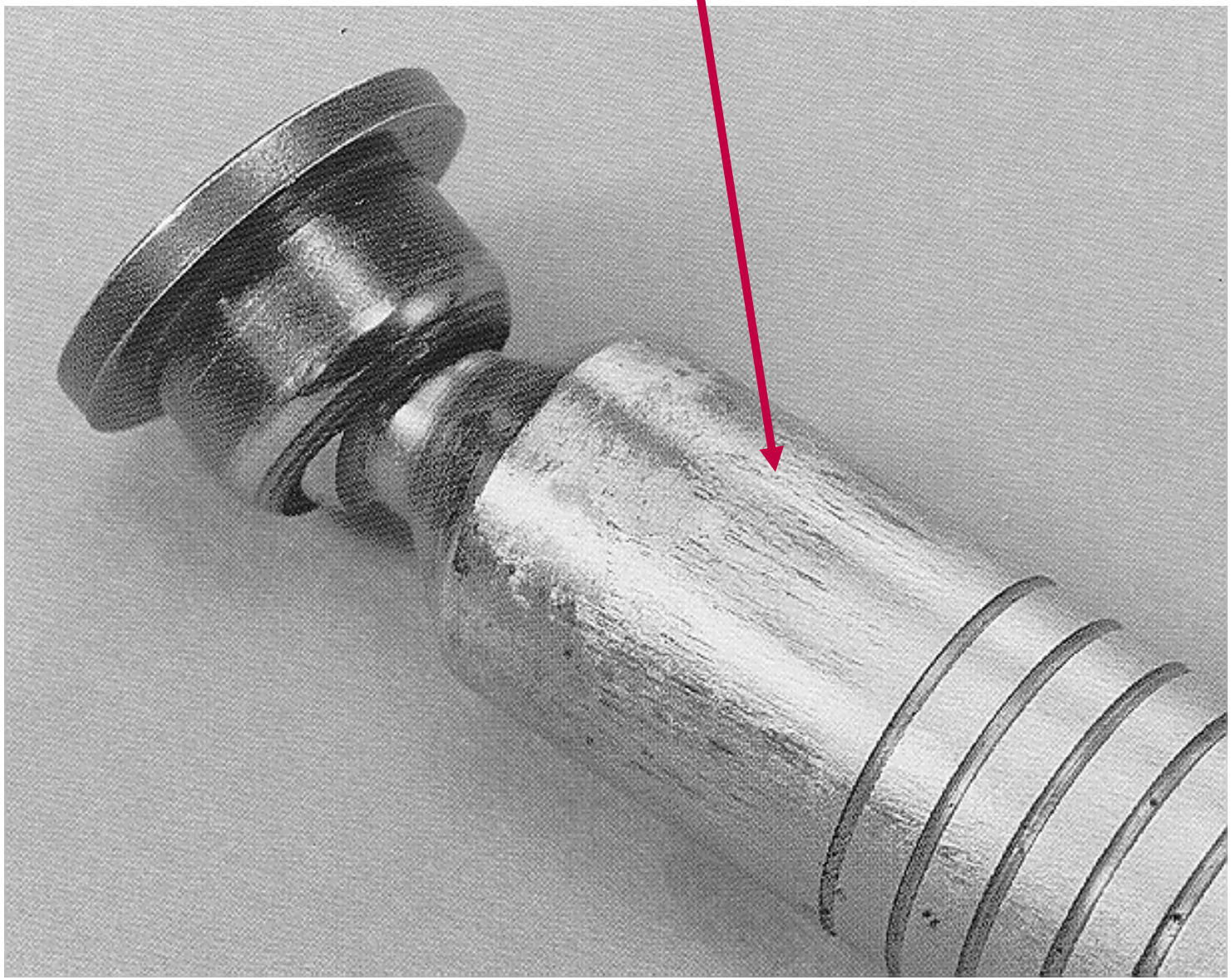
VERTICAL SCRATCHES: A Clear Indication of Contamination



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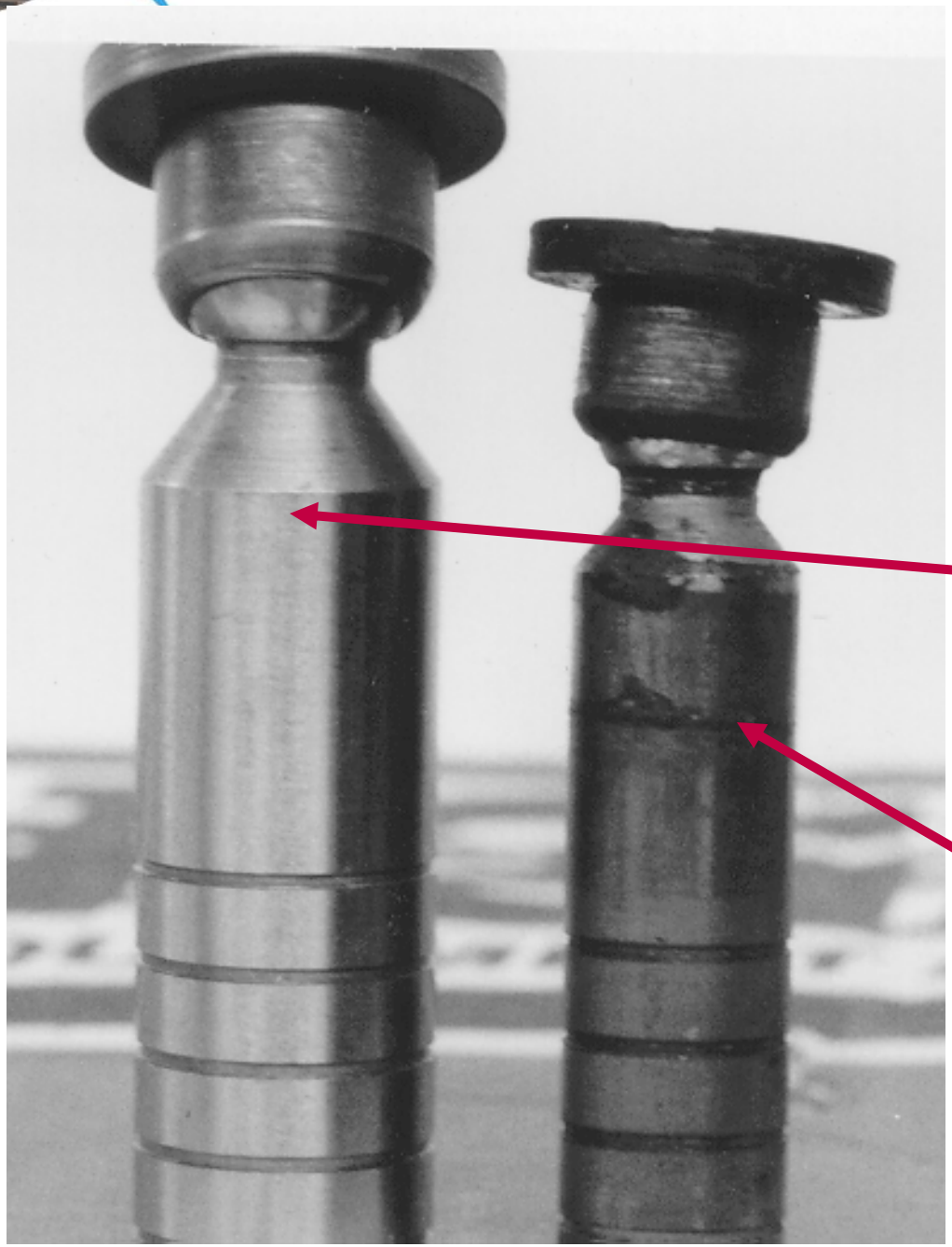
DULL AND SCRATCHY FINISH



Normal Appearance:
A Mirror Finish

Abnormal Appearance:
A Steel Wool Look

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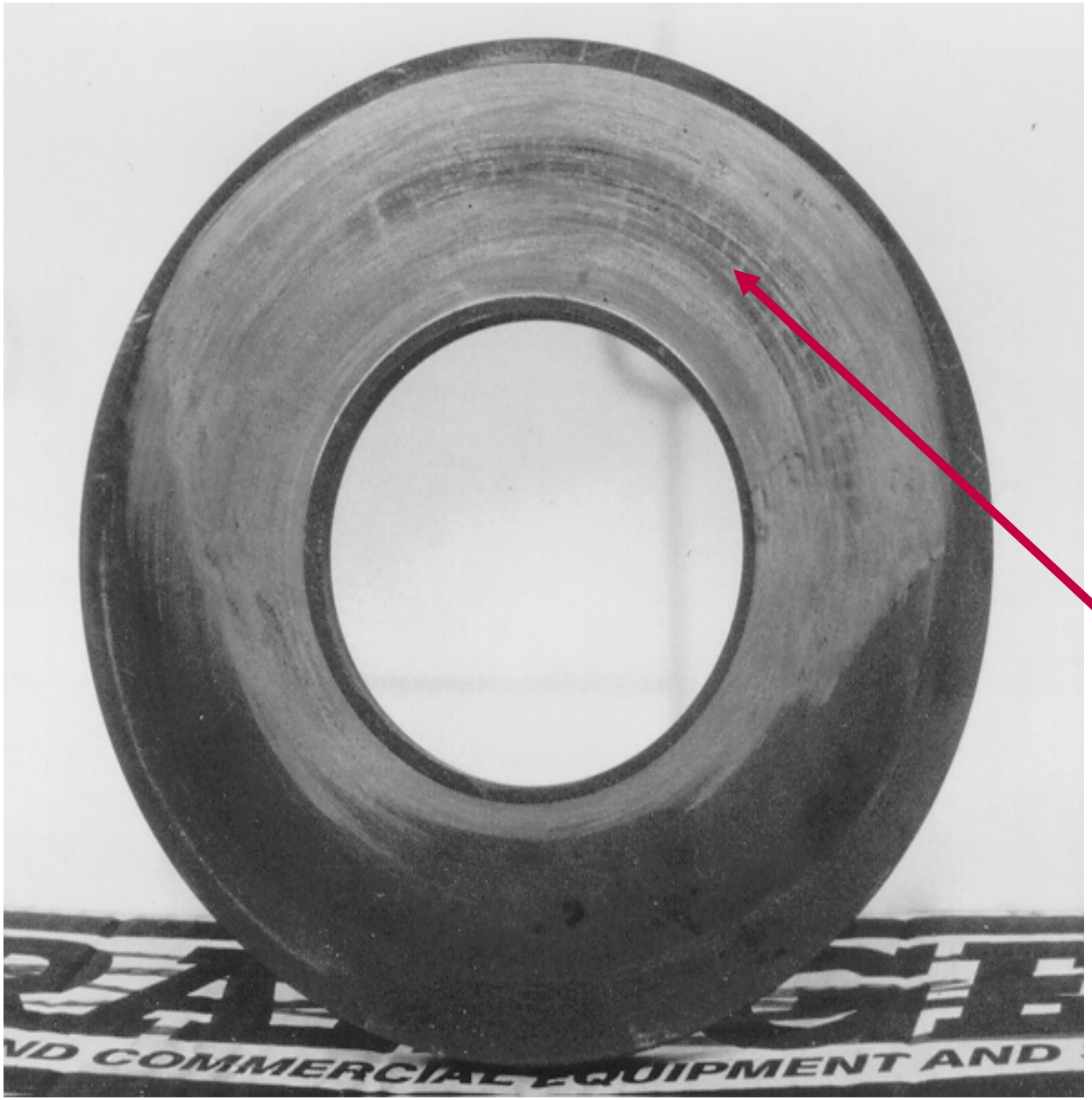

SHOE WEAR PLATE SHOWING SIGNS OF WEAR DUE TO DIRT

Scratchy Uneven Wear

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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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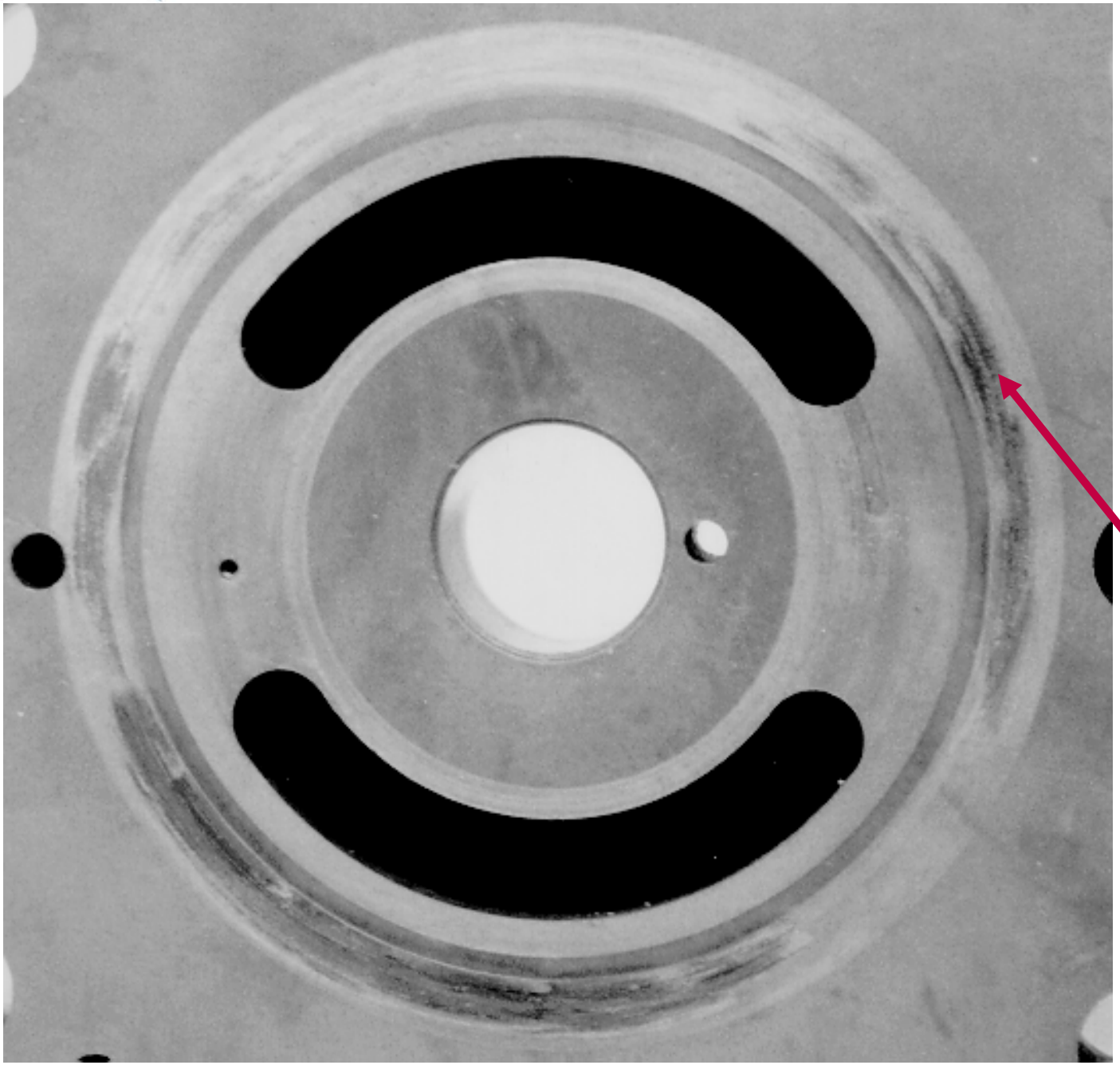
VALVE PLATE RUN ON A BAD FLUID



Note the Smeared Running Surface

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WORN FULCRUM BALL

Typical Failure on Low Lubricity Fluid

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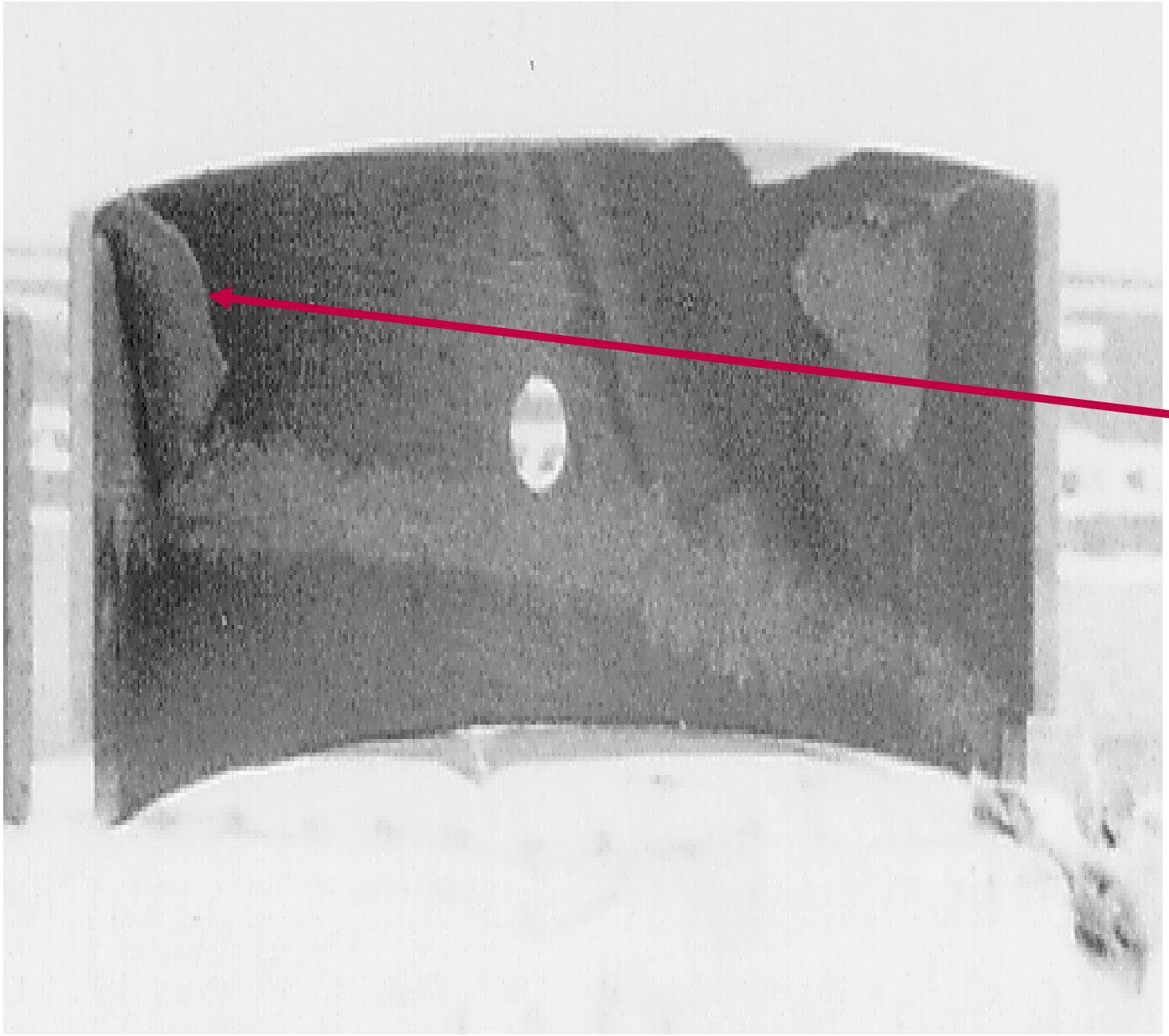
WORN SADDLE BEARING



Note the Material has Delaminated

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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)

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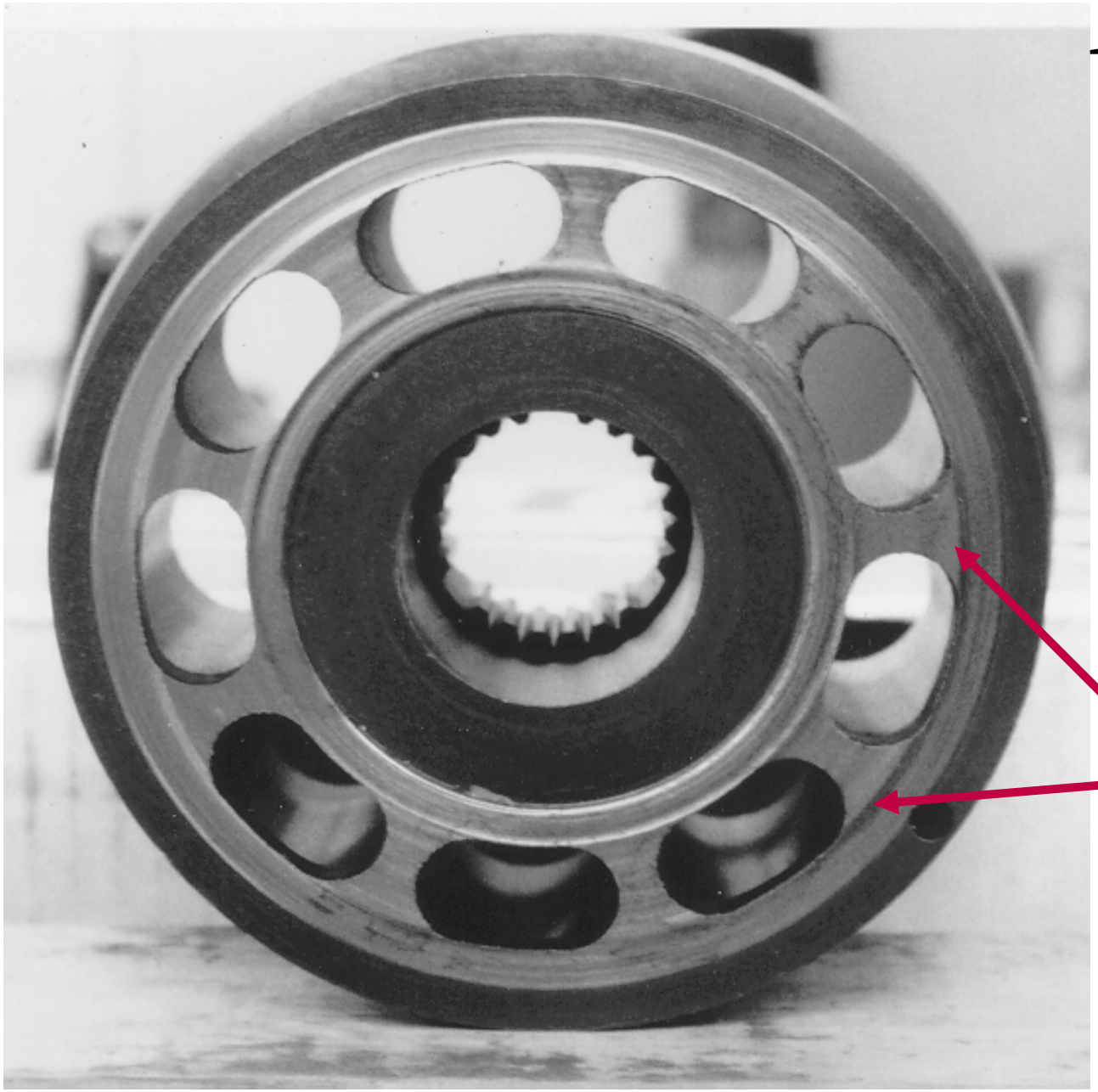
EXCESSIVE WEAR ON CYLINDER FACE



Cracks Would Appear Between Kidneys

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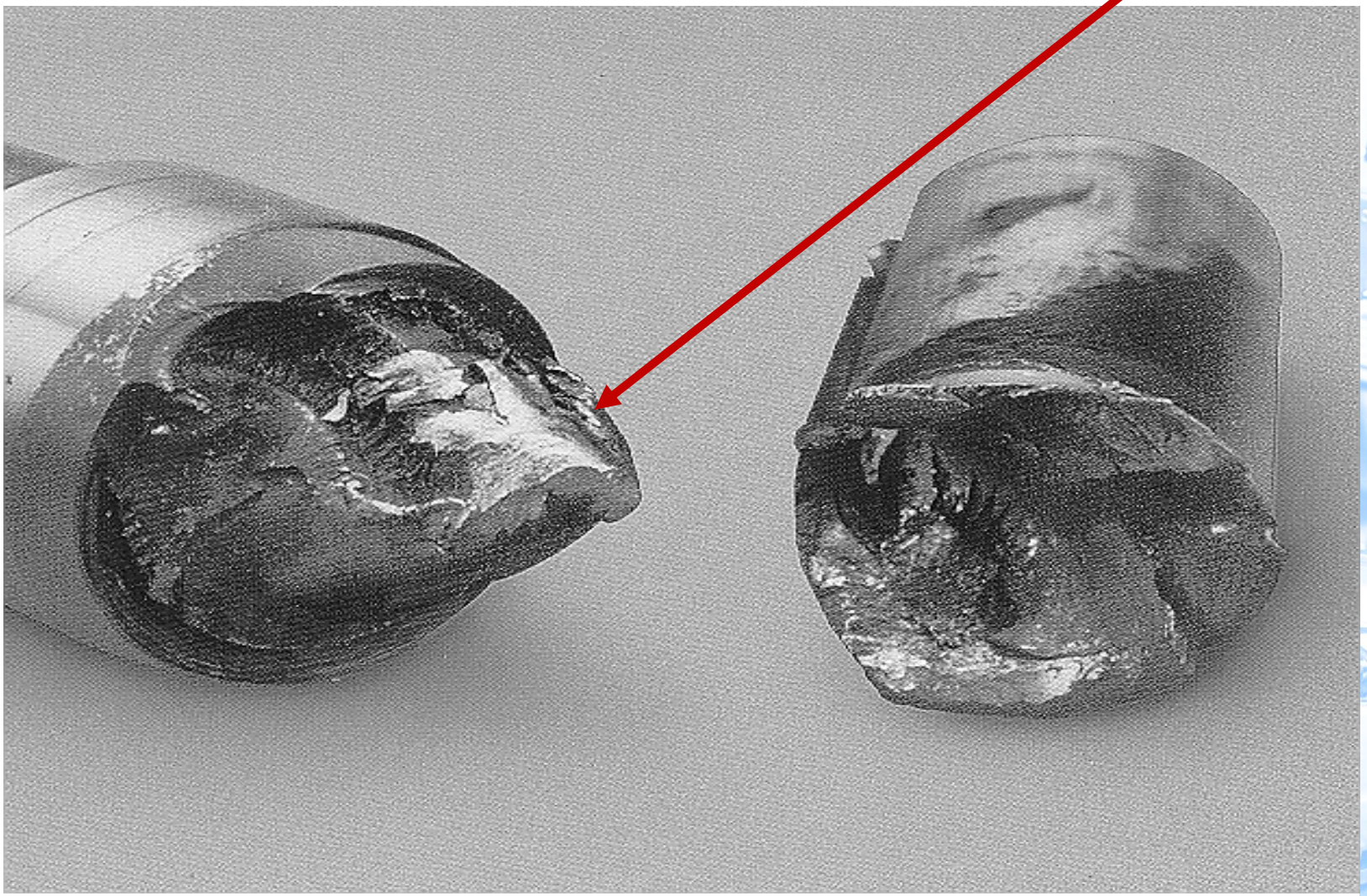
TORSIONAL FATIGUE:

Note Cone Shaped Failure



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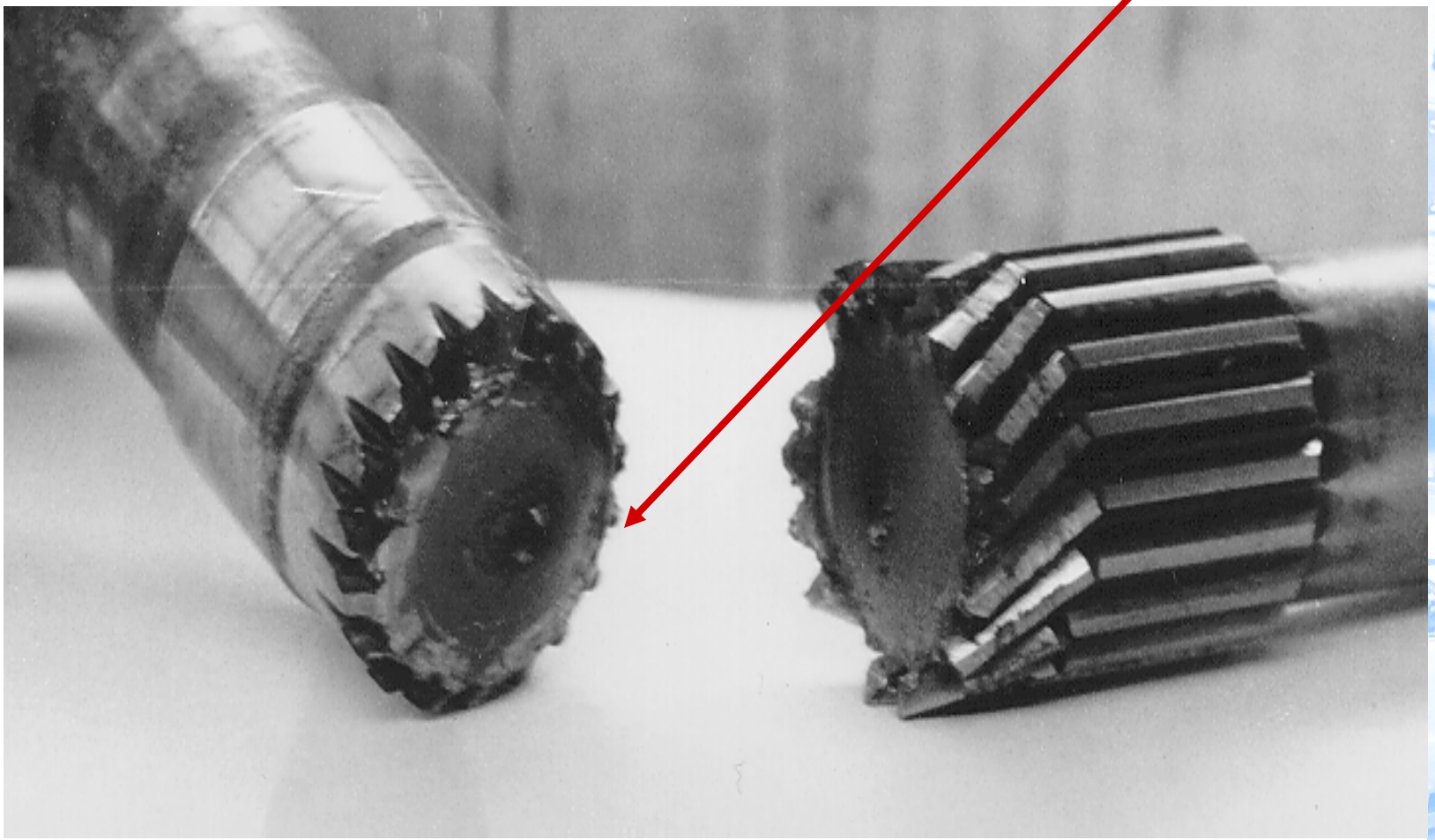
BENDING FATIGUE FAILURE

Note Straight Break



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IMPROPER INLET CONDITIONS

Suction Strainer not Recommended

- CAVITATION ON VALVE PLATE FACE
- NOISE (MARBLE SOUND)

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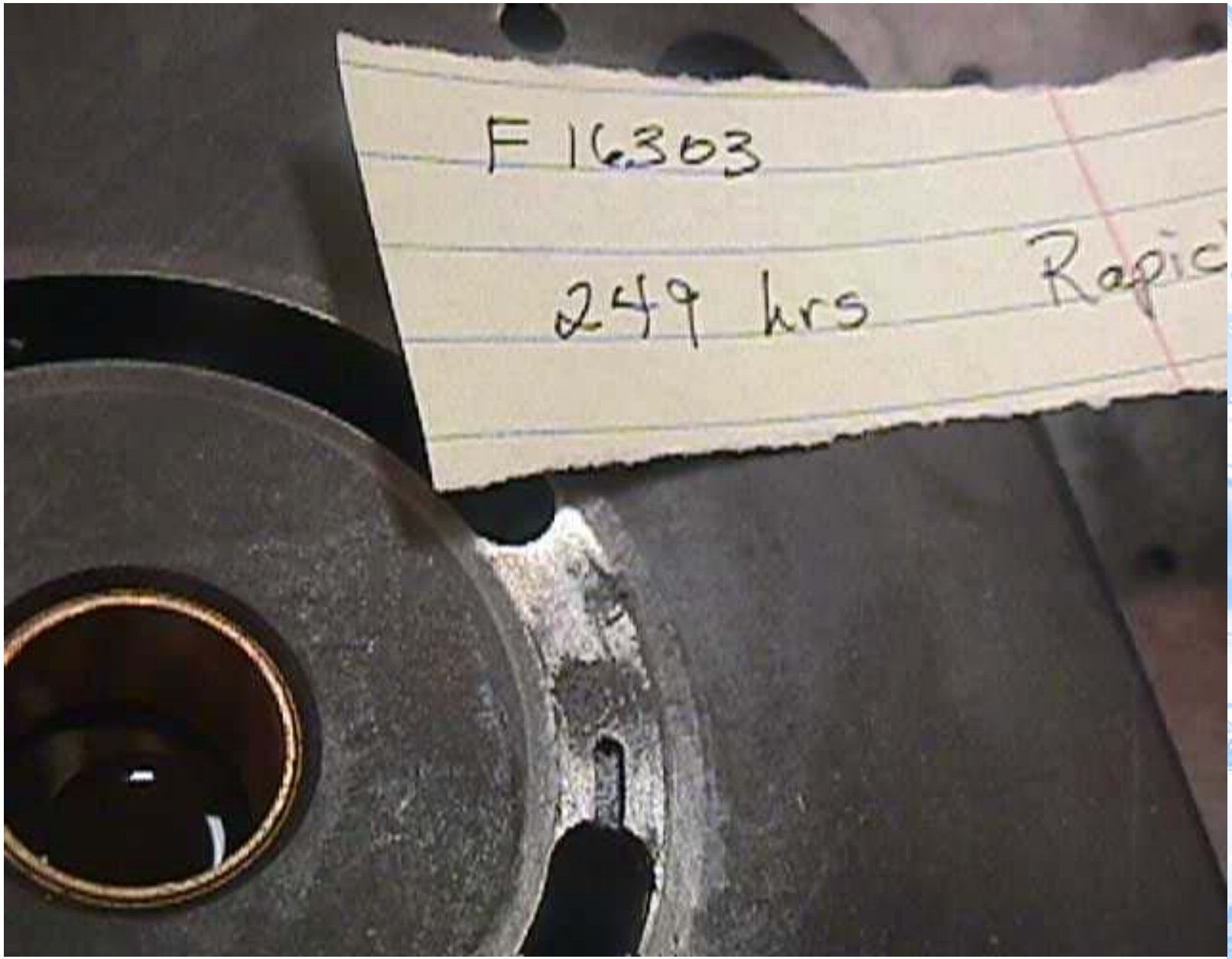
CAVITATION ON COMPRESSION BRIDGE



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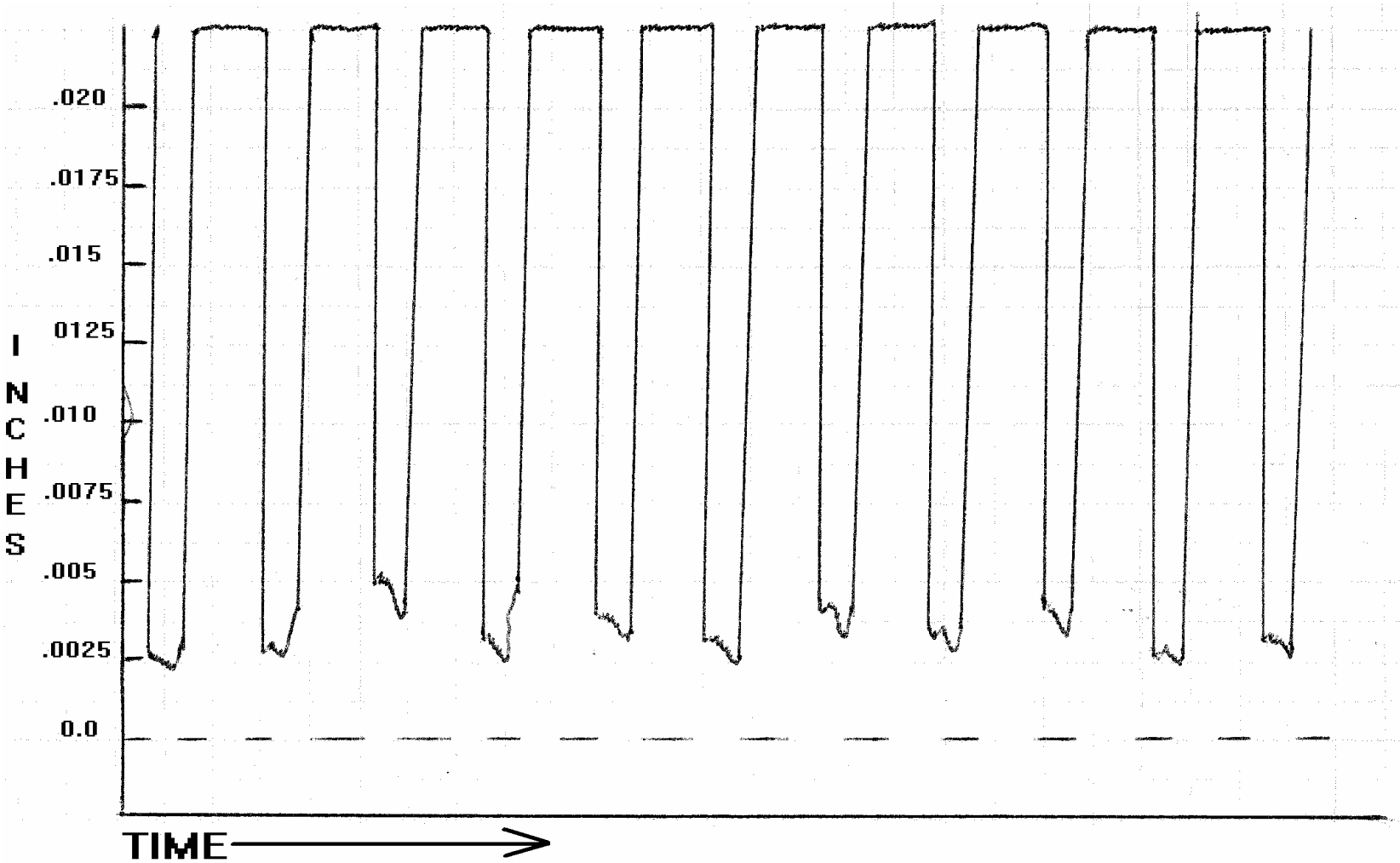
CASE TO INLET DIFFERENTIAL

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, O PSI CASE

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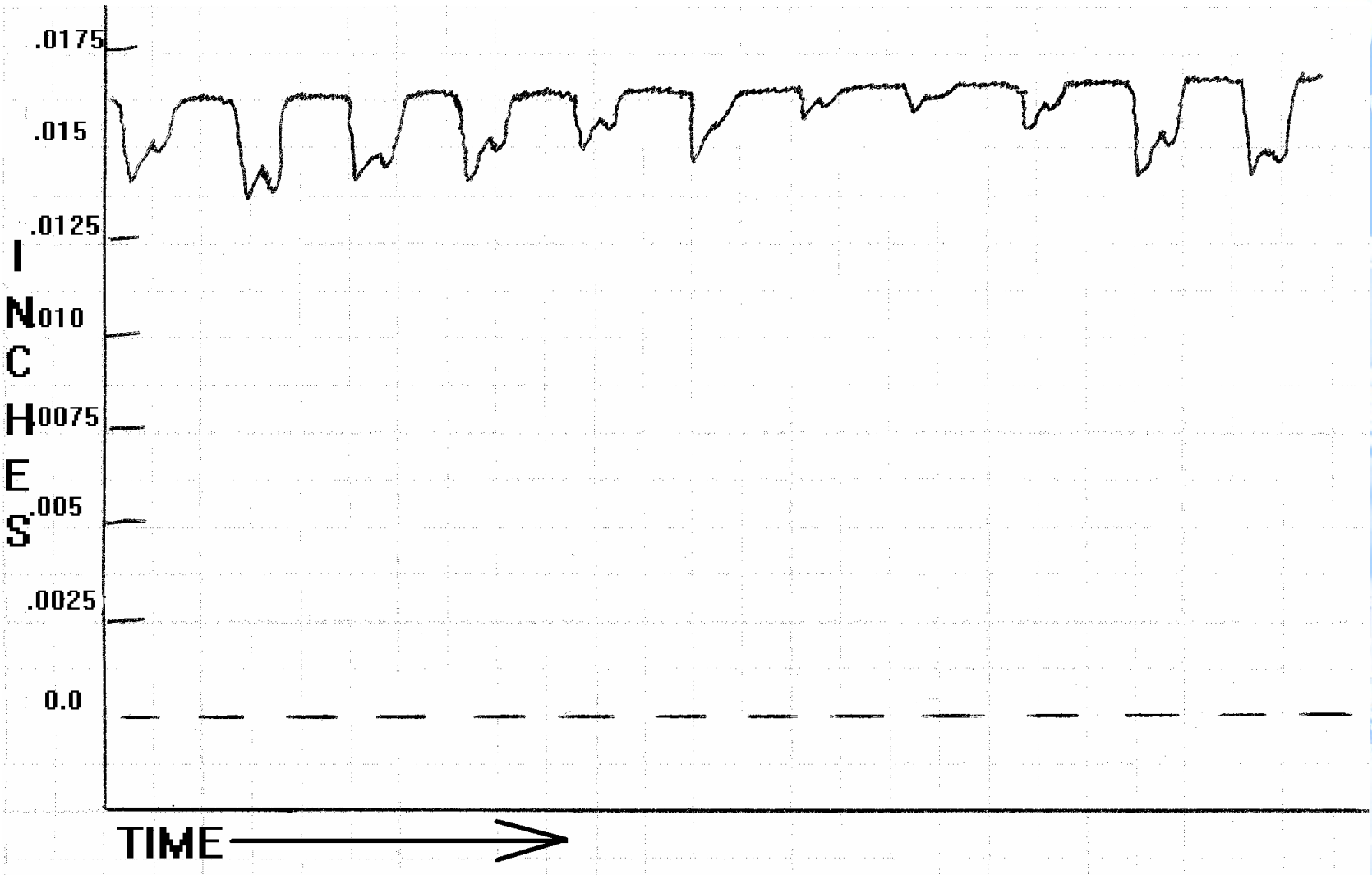
TROUBLE !!!!!



0 PSI INLET, 30 PSI CASE

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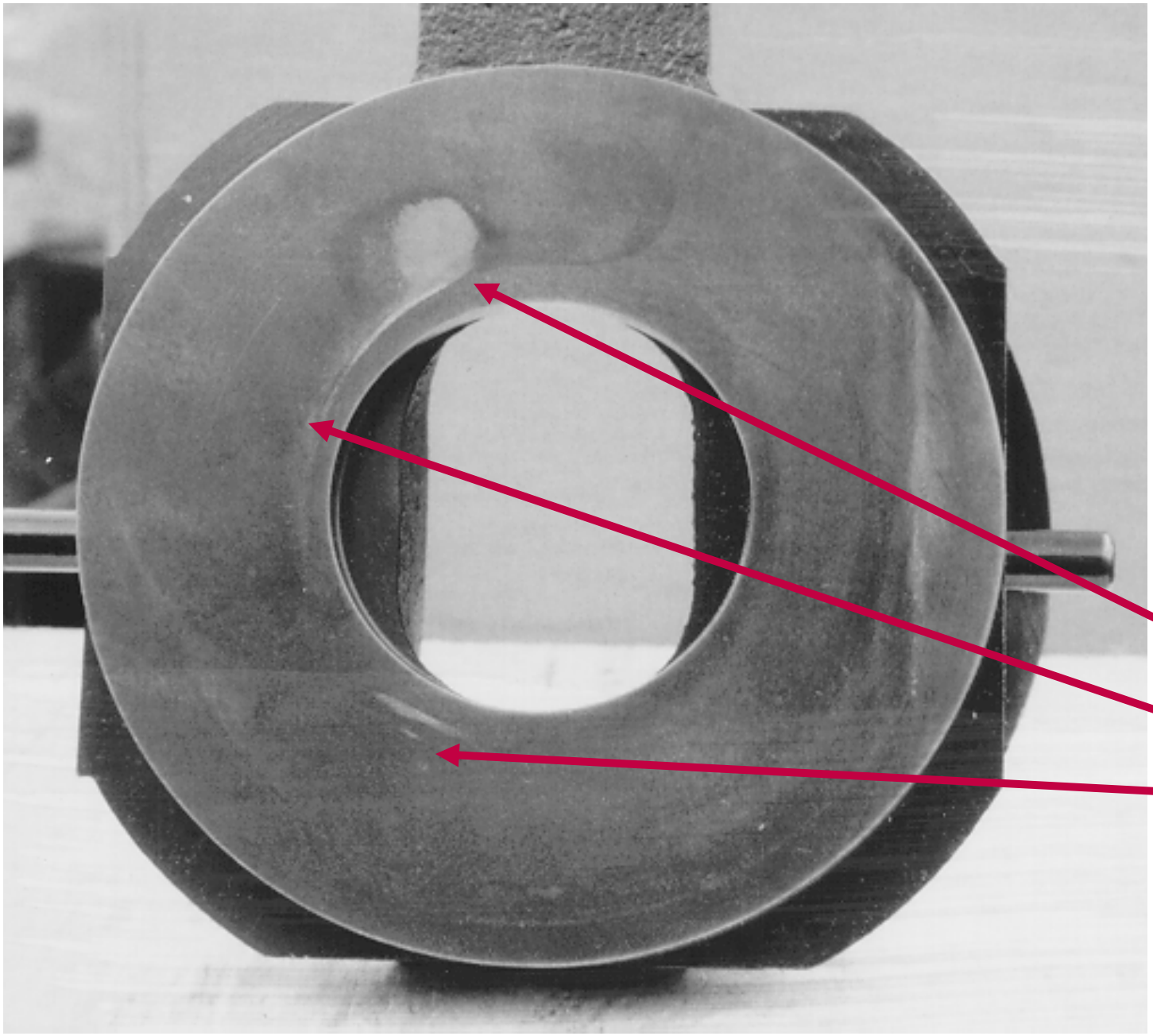
STAGES OF DAMAGE DUE TO SHOE LIFT



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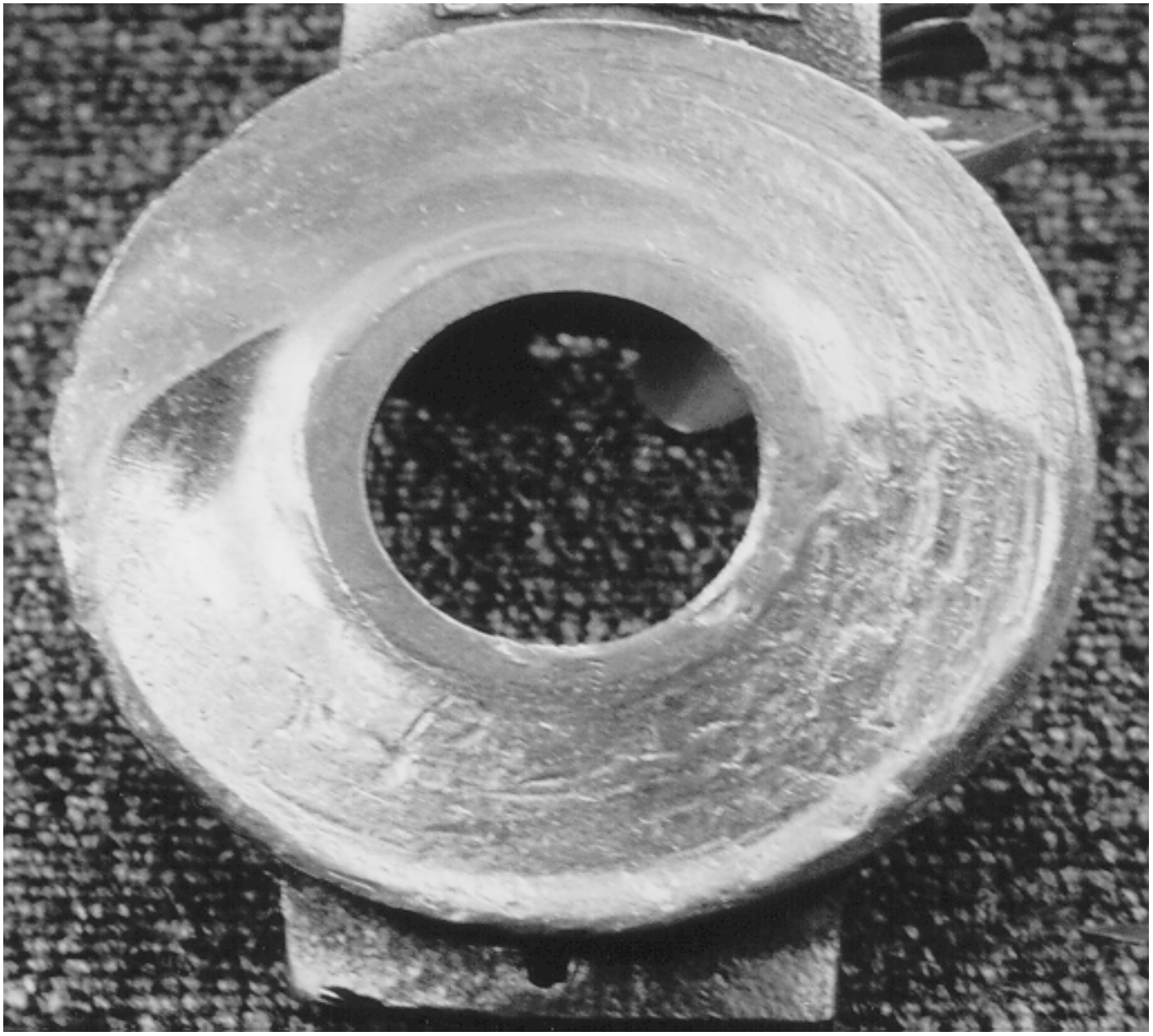

THE FINAL STAGE OF SHOE LIFT

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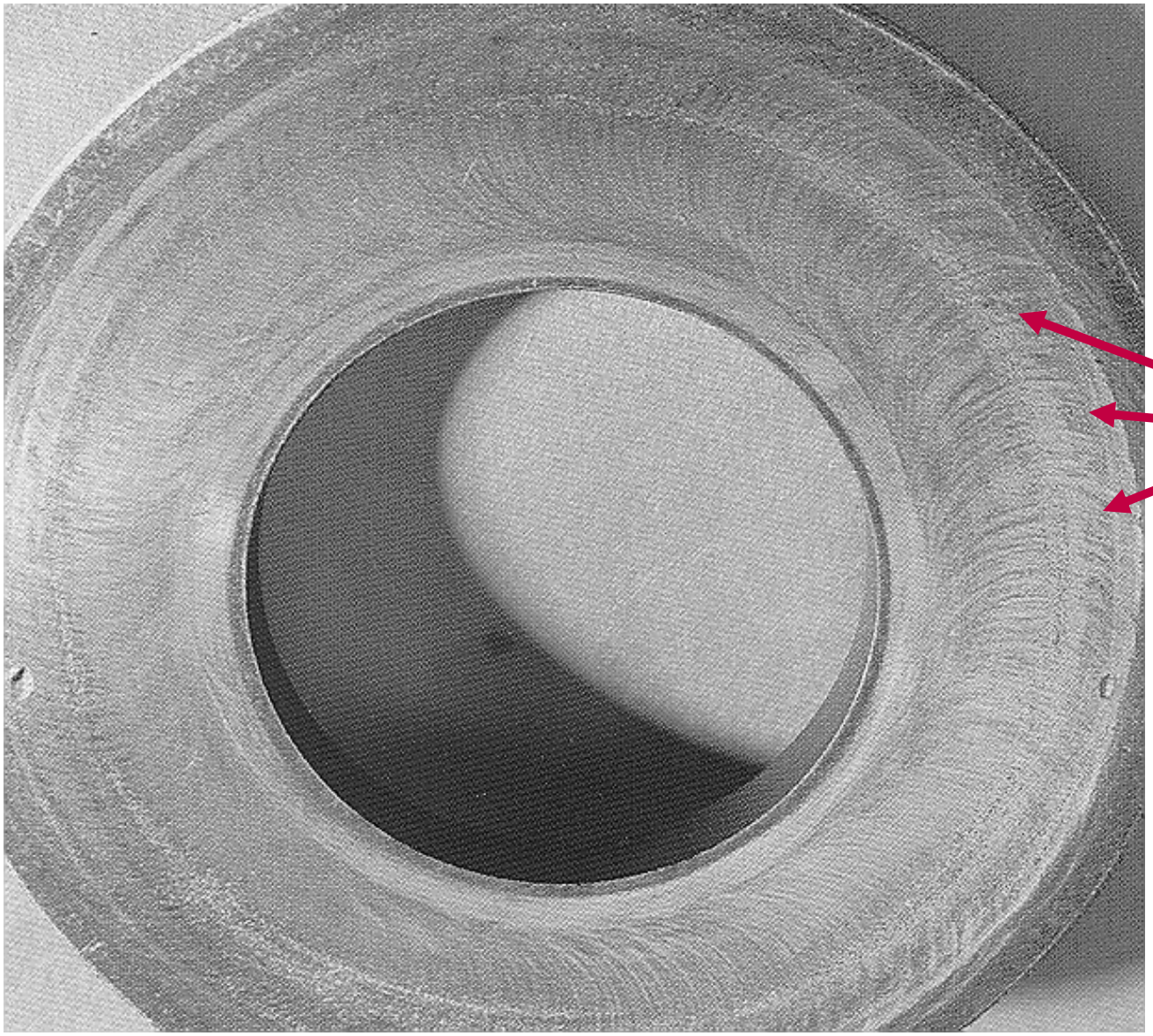
HALF MOON SHAPED MARKS



A Sure Sign
of Shoe Lift

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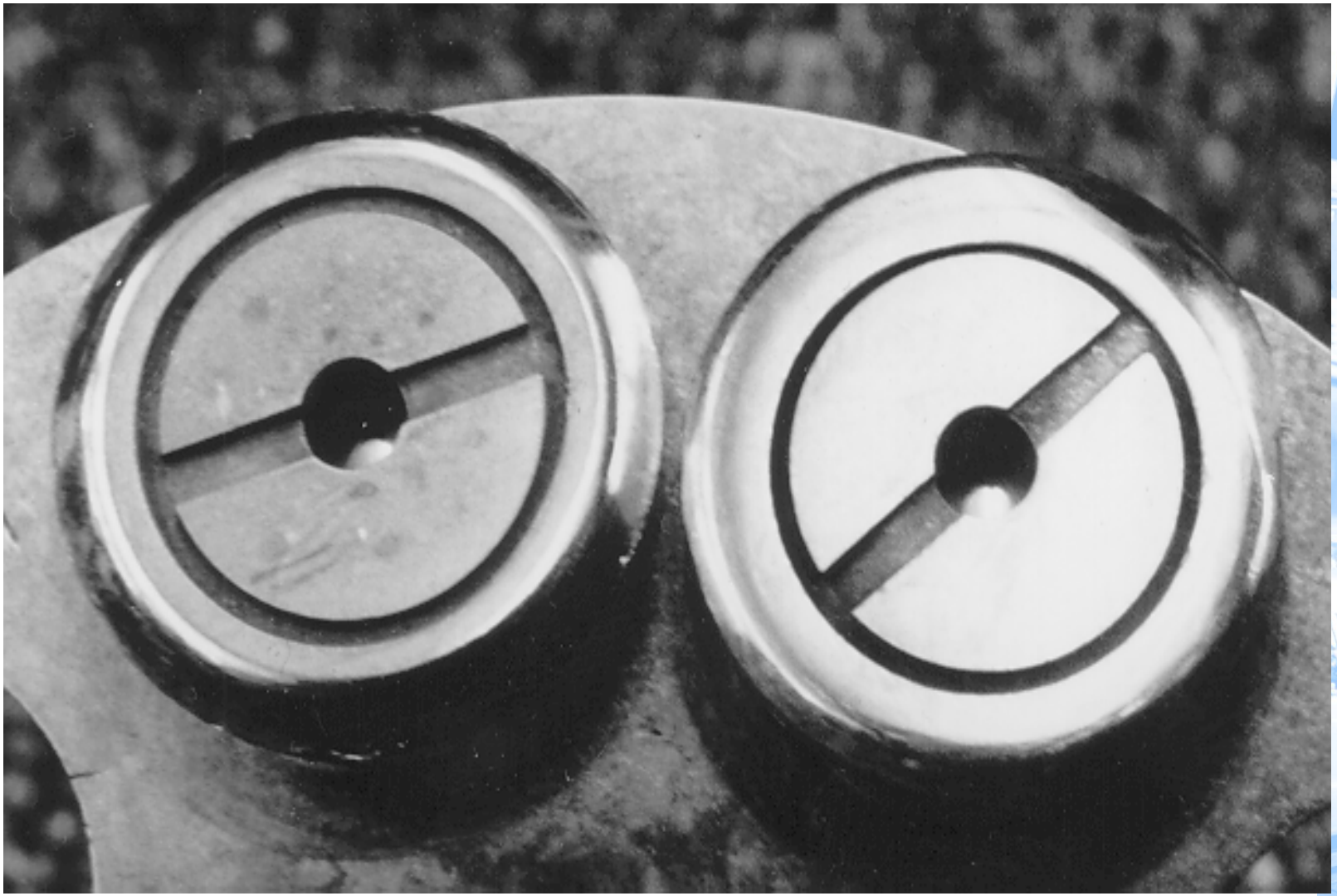
ROLLED SHOES: THE TELL TALE OF SHOE LIFT



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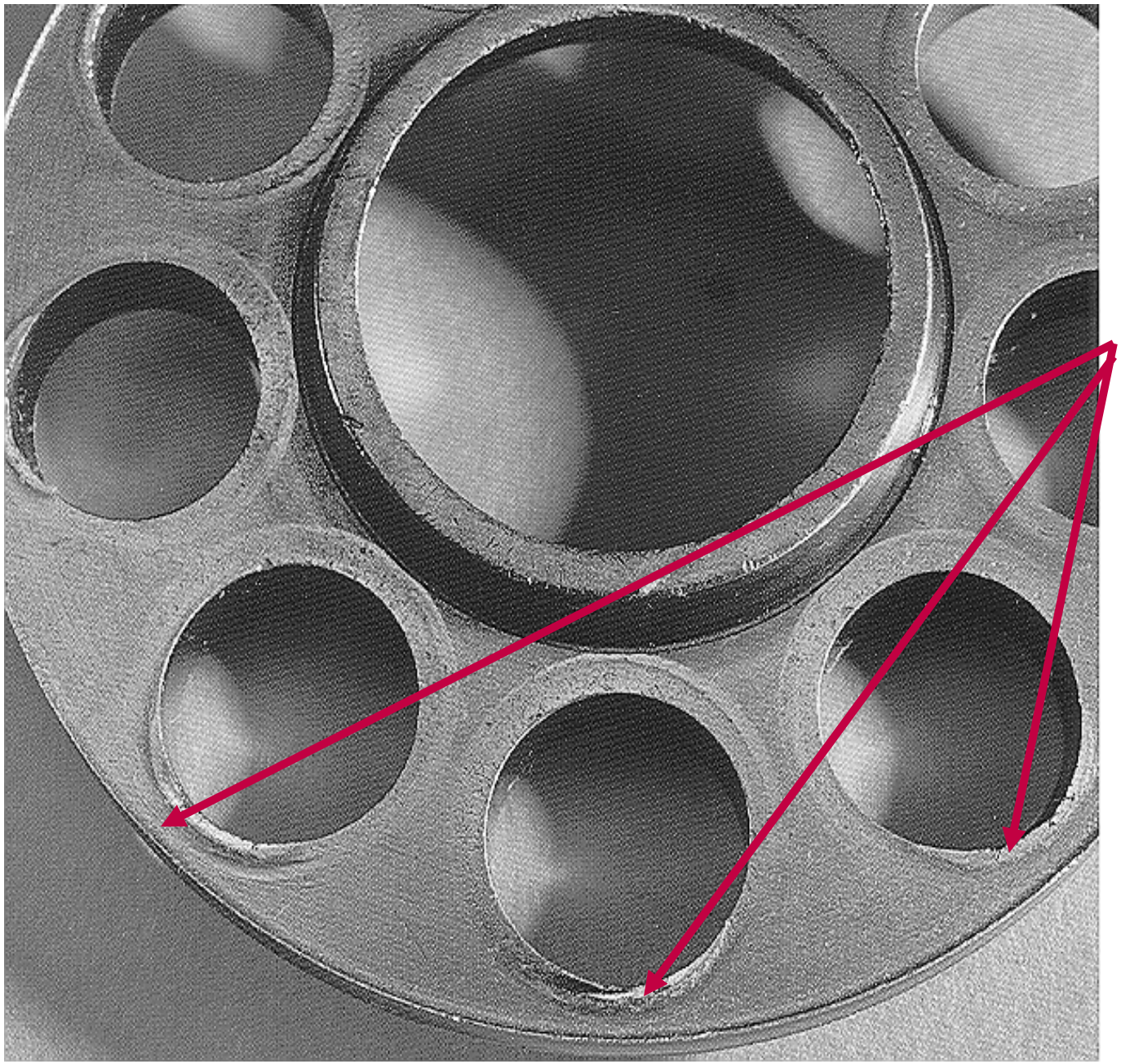
WEAR ON SHOE RETAINER FROM SHOE FLANGES



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BENT SEAL RETAINER

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MISCELLANEOUS

- INPUT SHAFT BROKEN
  - MISALIGNMENT
  - TORQUE REVERSAL
- CONTROL INSTABILITY
  - AIR
  - INCREASE CONTROL PISTON ORIFICE
- PUMP VIBRATES
  - MISALIGNMENT
  - COUPLING HALF'S TOUCHING

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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

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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