SOHRE TURBOMACHINERY®

SHAFT-RIDING BRUSHES

128 MAIN STREET • P. O. BOX 1099 • MONSON, MASSACHUSETTS 01057-1099 • U. S. A.
PHONE 413-267-0590 or 800-207-2195 • FAX 413-267-0592 or 413-267-0590

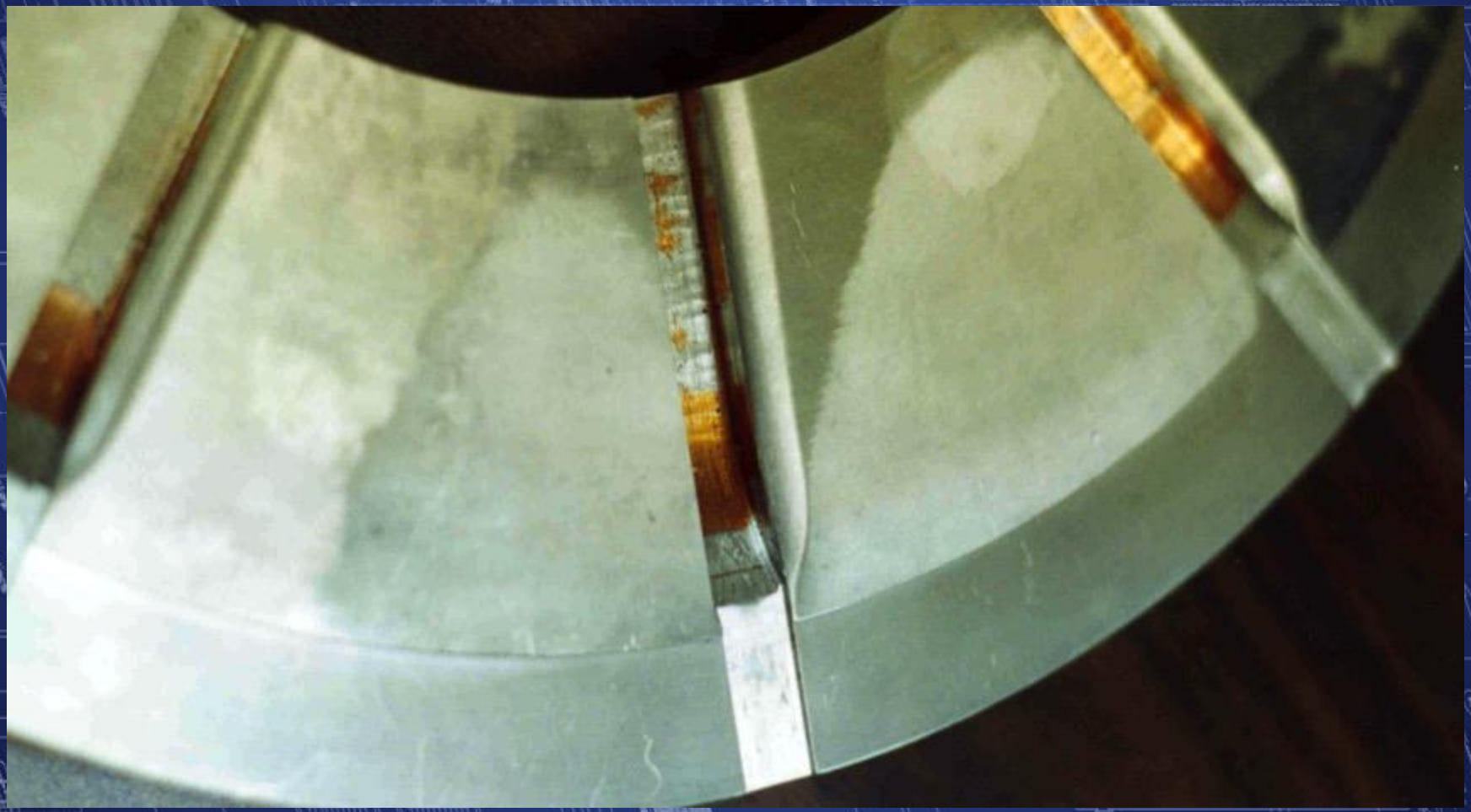
PRESENTATION OUTLINE

1. *Overview*
   - » *Impact of shaft current*
   - » *Causes of shaft current*
   - » *What can be done about shaft currents?*
   - » *Measurements and Importance of baseline data*
2. *Sources of shaft currents*
3. *Sohre Brushes*
   - » *Why Sohre Brushes*
   - » *General guidelines*
   - » *Brush models and typical installations*
4. *Brush Maintenance*
   - » *Alignment*
   - » *Insulation testing*
5. *Voltage/current measurement and monitoring*

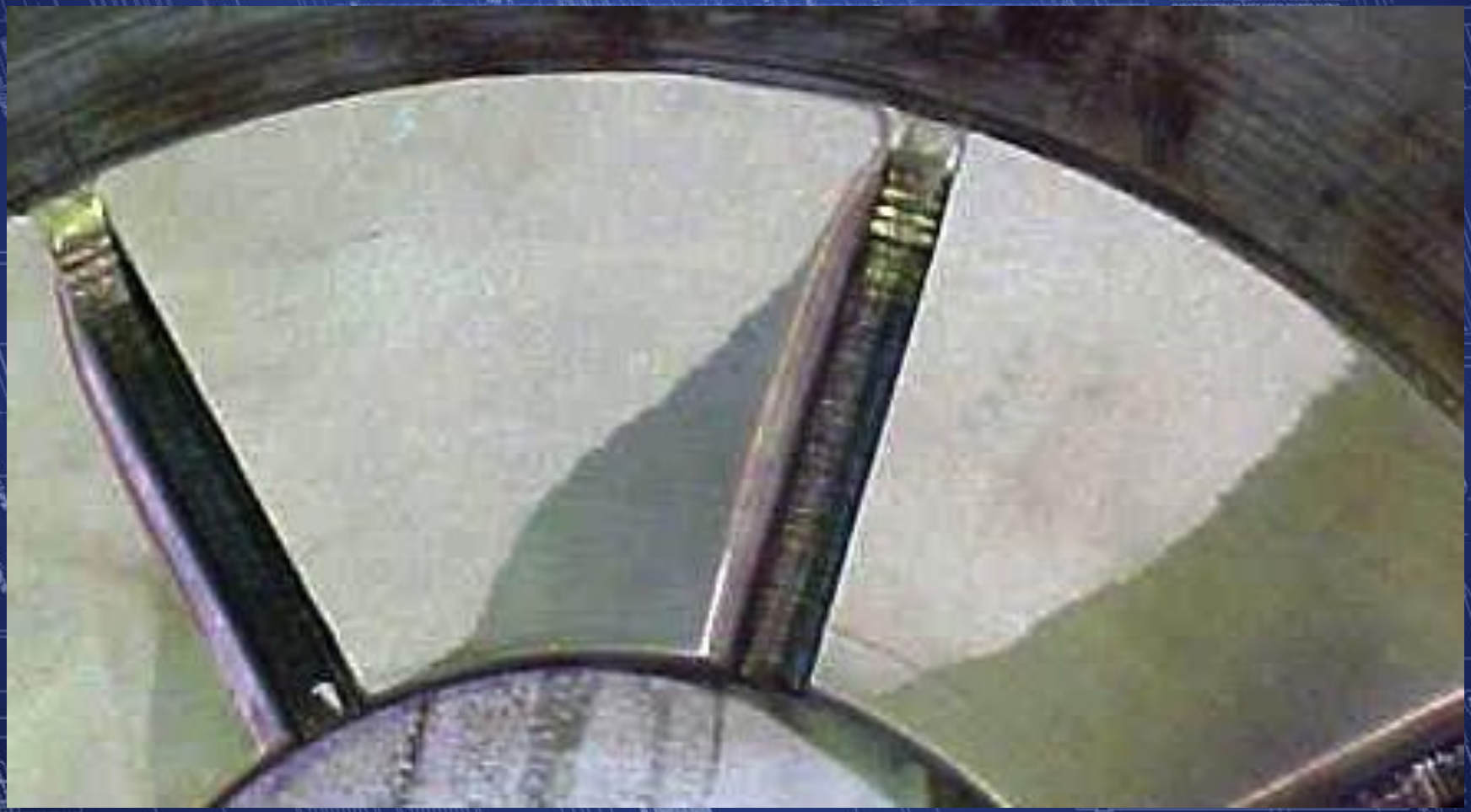
Impact of Shaft Current/Voltage

- Spark erosion:
  - Thrust and journal bearing damage
  - Damaged Gears and seals
- Incorrect instrumentation readings
- Shaft current problems can be difficult to detect when machine is not in operation

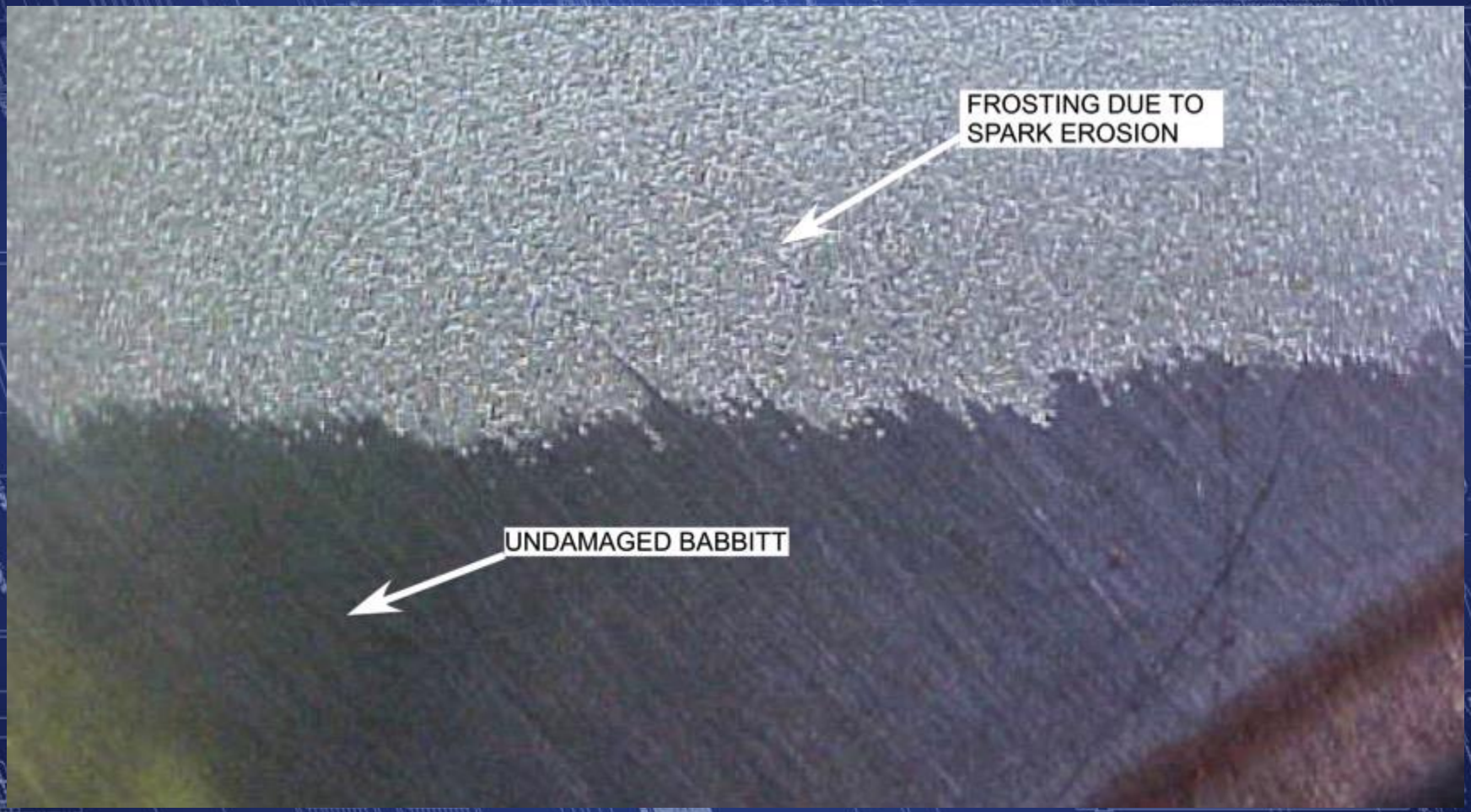
FROSTED THRUST BEARING



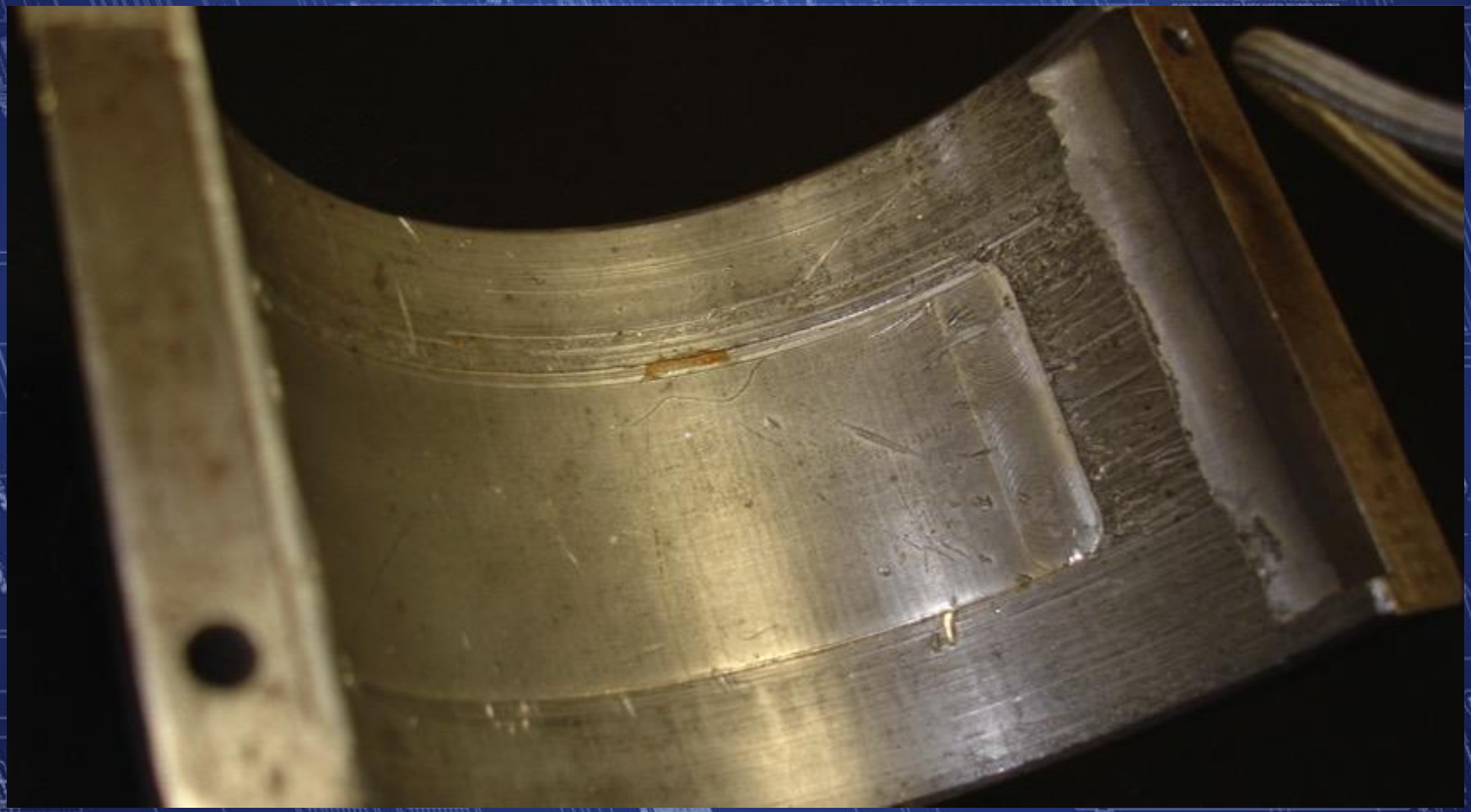
FROSTED THRUST BEARING 2



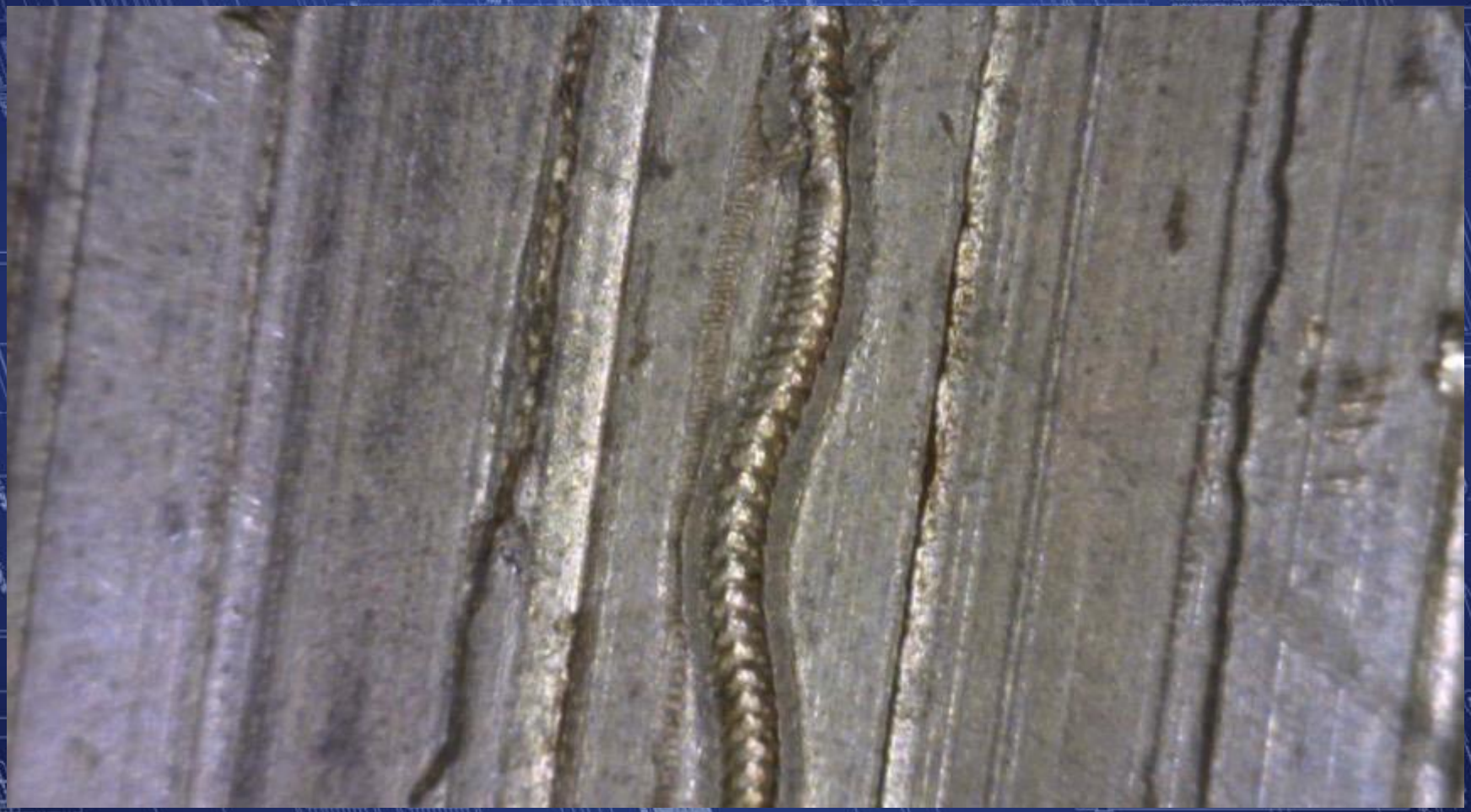
MAGNIFIED FROSTING



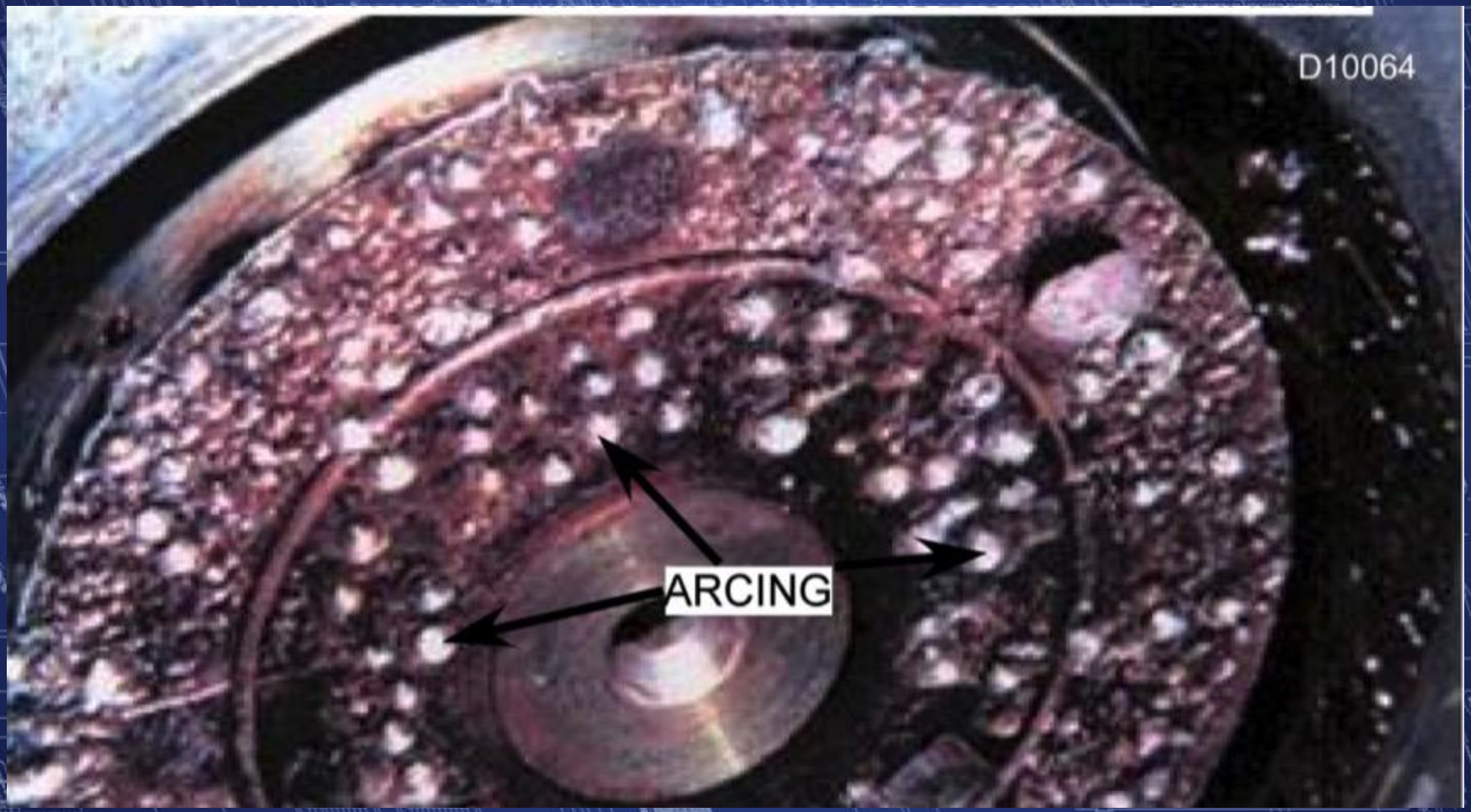
BEARING SPARK TRACKS



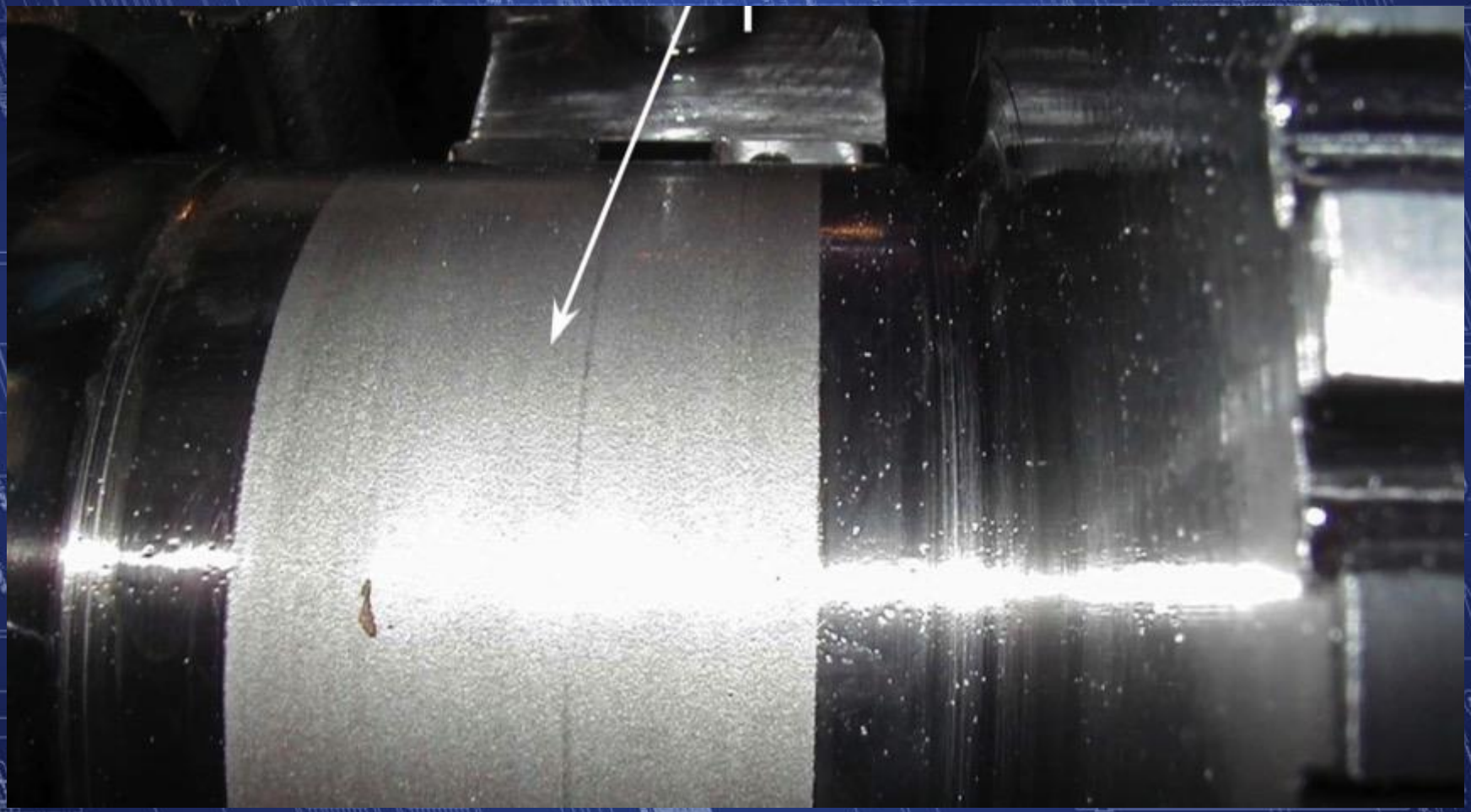
MAGNIFIED SPARK TRACKS



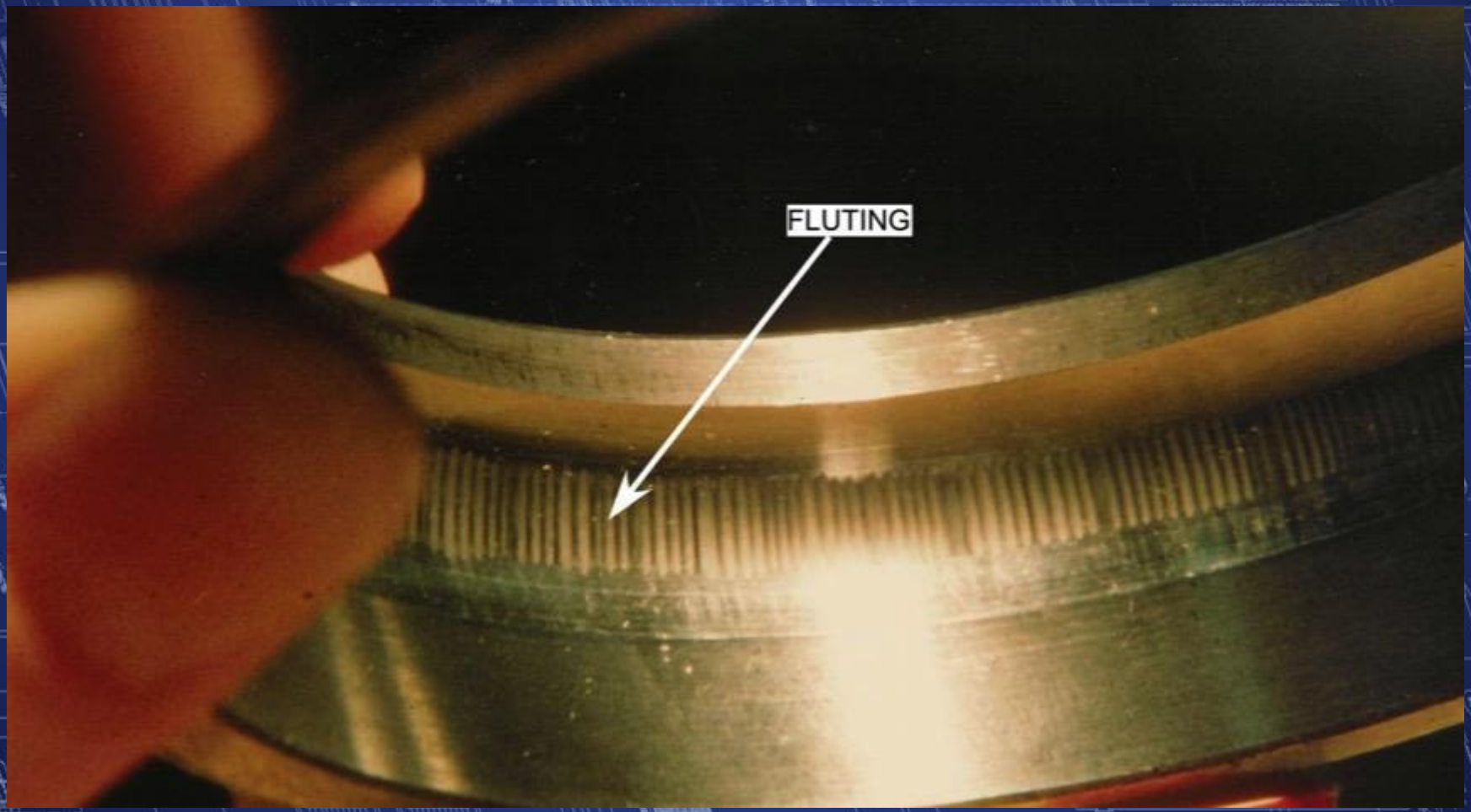
COUPLING FACE – HIGH CURRENT DAMAGE



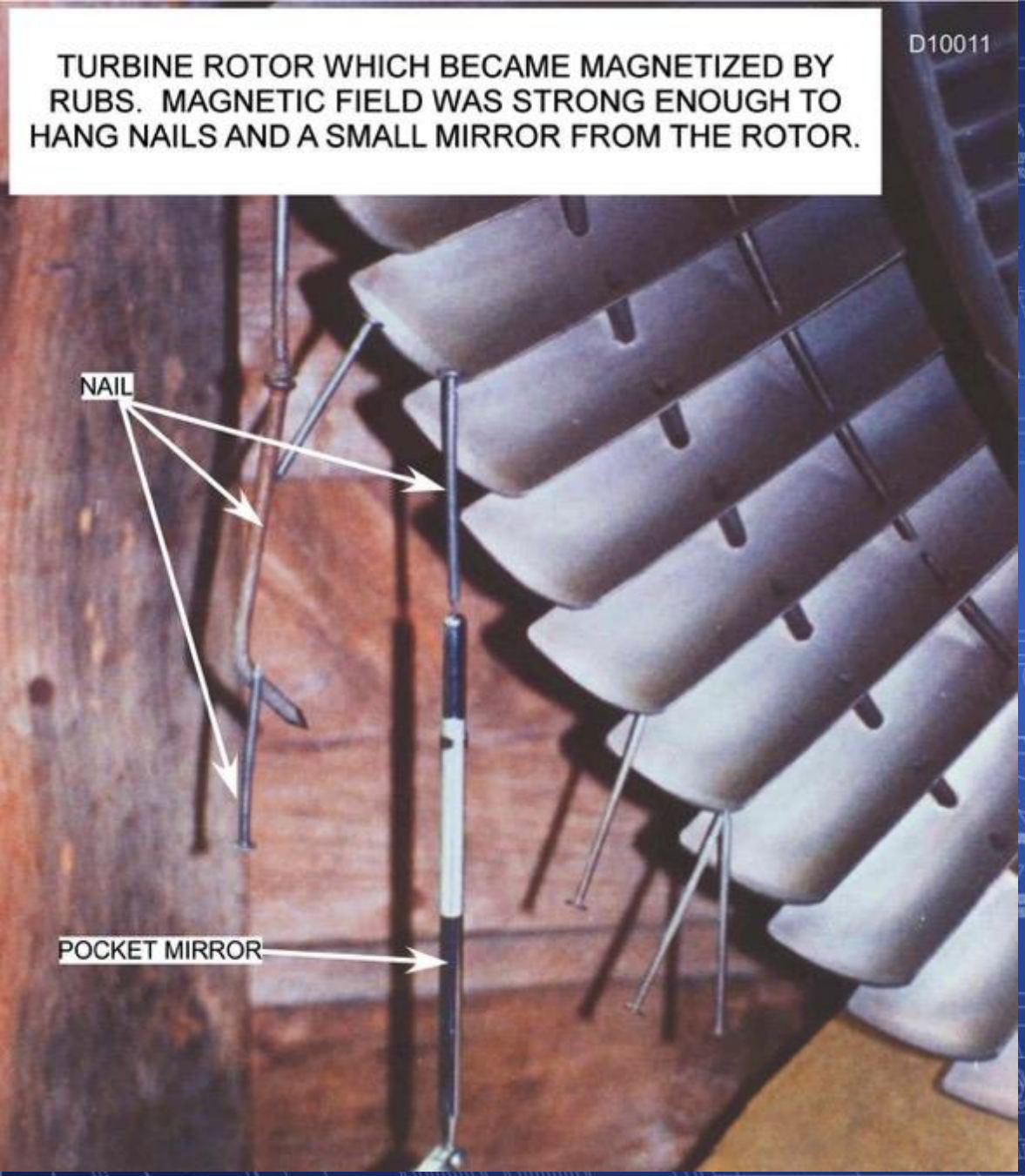
FROSTED SHAFT



ROLLER ELEMENT DAMAGE



MAGNETIZED ROTOR



SOURCES OF SHAFT CURRENT

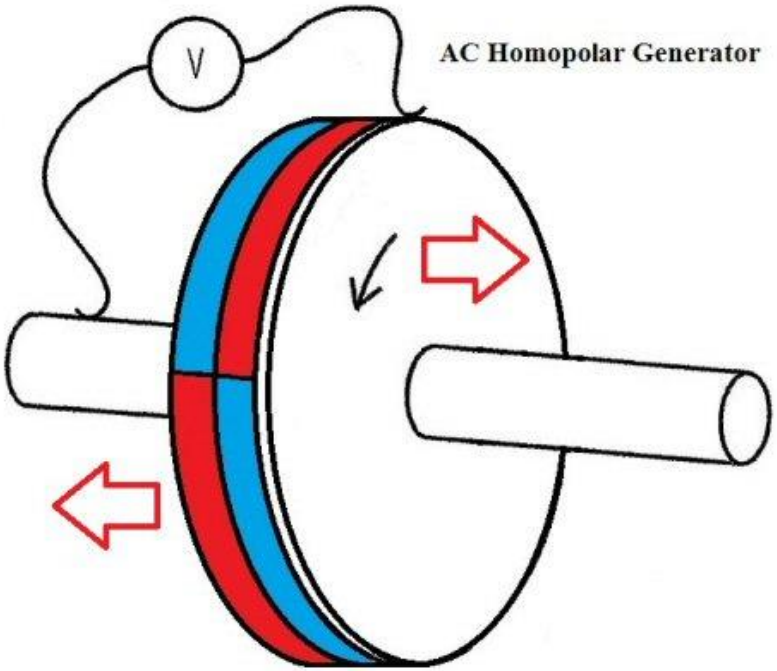
- **STATIC DISCHARGE**
  - *Caused by flow of charged particles*
  - *Turbines, compressors, pumps*
  - *Random high voltage short duration spikes*
  - *Typically low energy*
  - *Can be intermittent and dependent on process conditions*

SOURCES OF SHAFT CURRENT

- GENERATORS
  - Field imbalance
  - Ground faults
  - Static exciter filter issues
- MOTORS
  - Variable frequency drives

SOURCES OF SHAFT CURRENT

- MAGNETIZED ROTORS
  - *Homopolar generator effect*



SOURCES OF SHAFT CURRENT

- HOW DO ROTORS GET MAGNETIZED
  - Electrical currents through the machine
    - Welding and Self-Excitation
  - Impact
  - Manufacturing processes

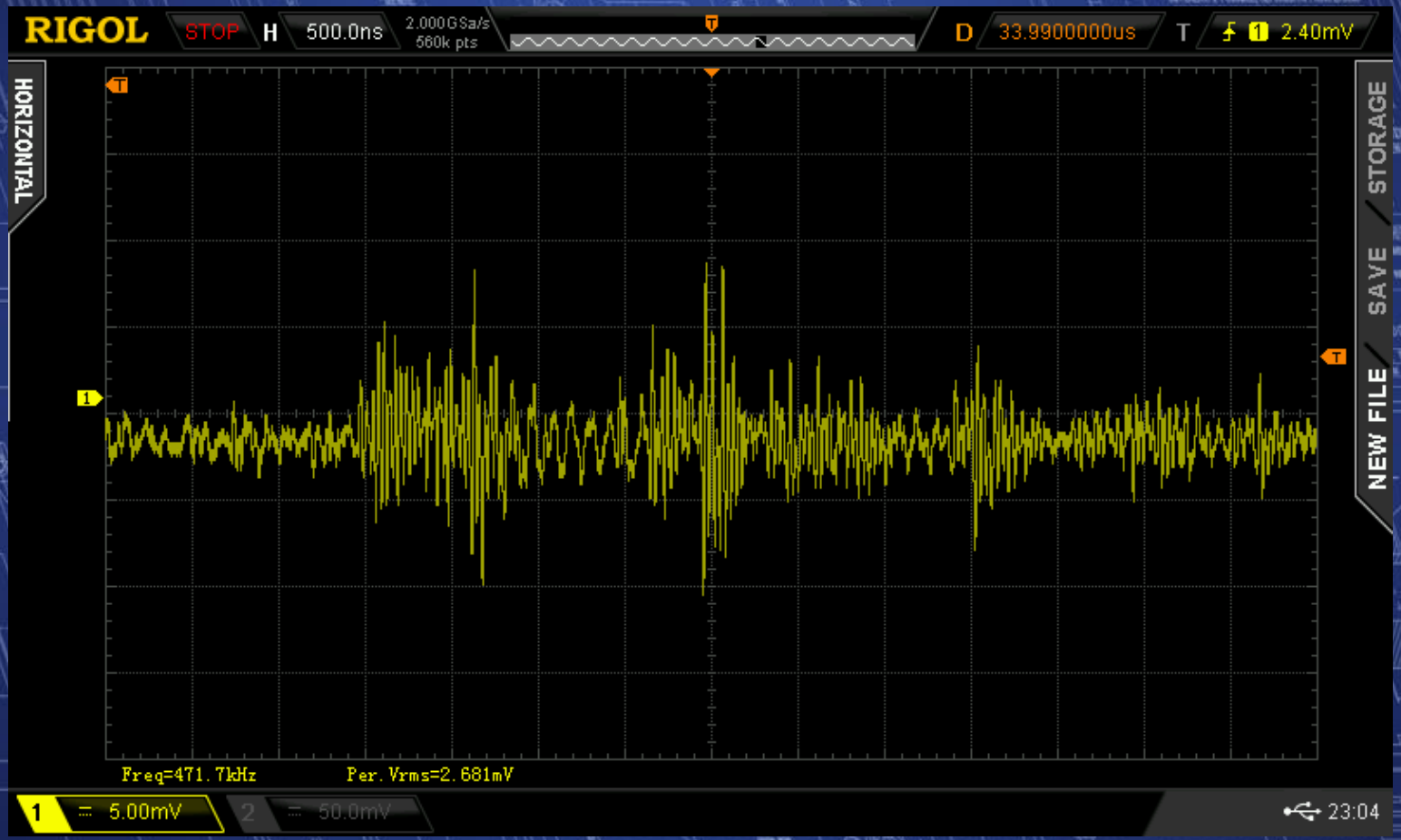
MEASURING SHAFT VOLTAGE

- MEASURING SHAFT VOLTAGE
  - Shaft voltage is Noise
  - Oscilloscope is the ONLY effective tool
- SOMETIMES DIFFICULT TO DO
  - Difficult Environment – Hot and Noisy
  - Oscilloscopes require practice to use effectively
  - Low Voltage High Current
  - High Voltage Short Duration

MEASURING SHAFT VOLTAGE

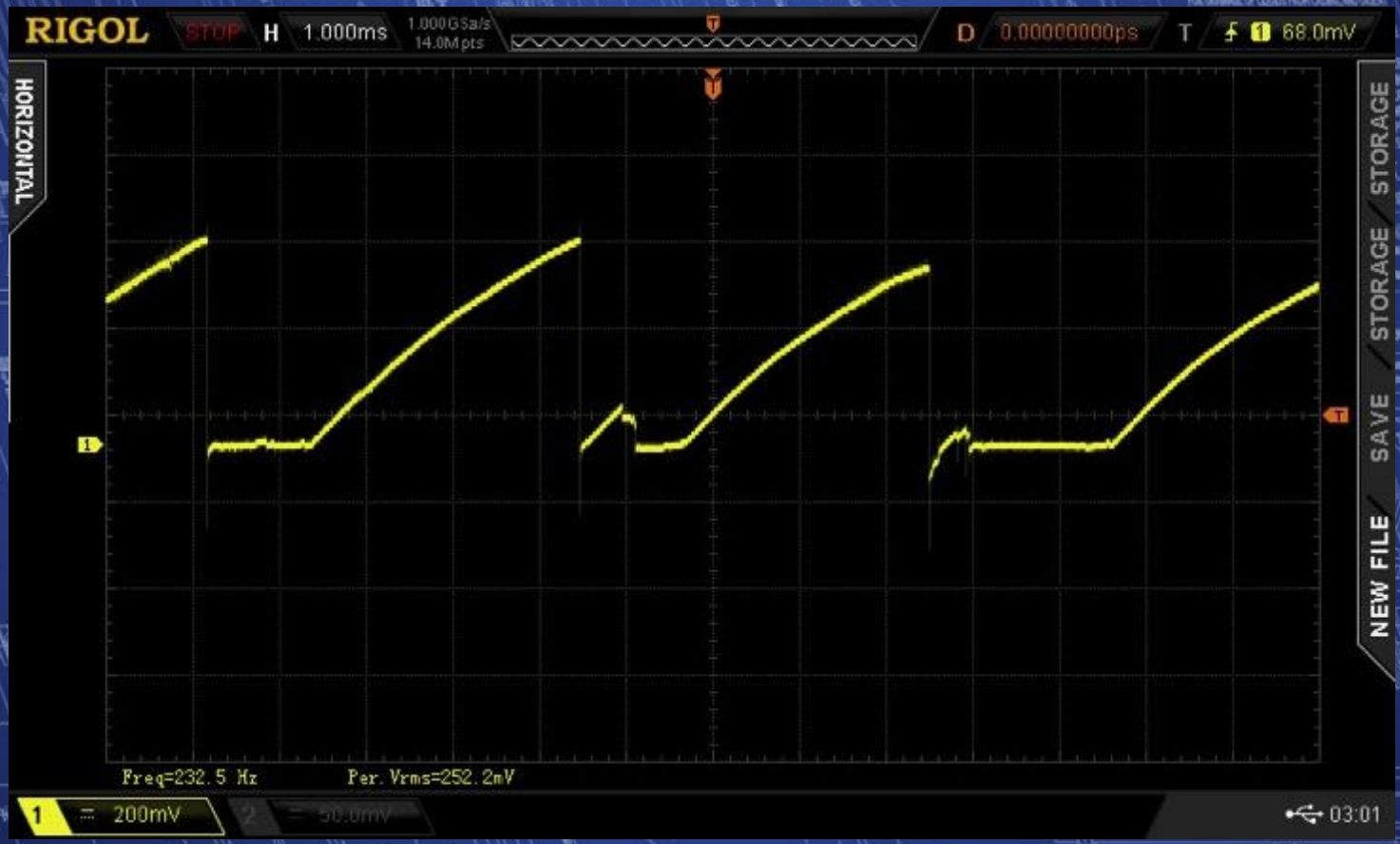
Peak approx. 0.6 V - Measurement taken with 20x probe – 0.2 V/div

GROUNDED SHAFT STATIC DISCHARGE



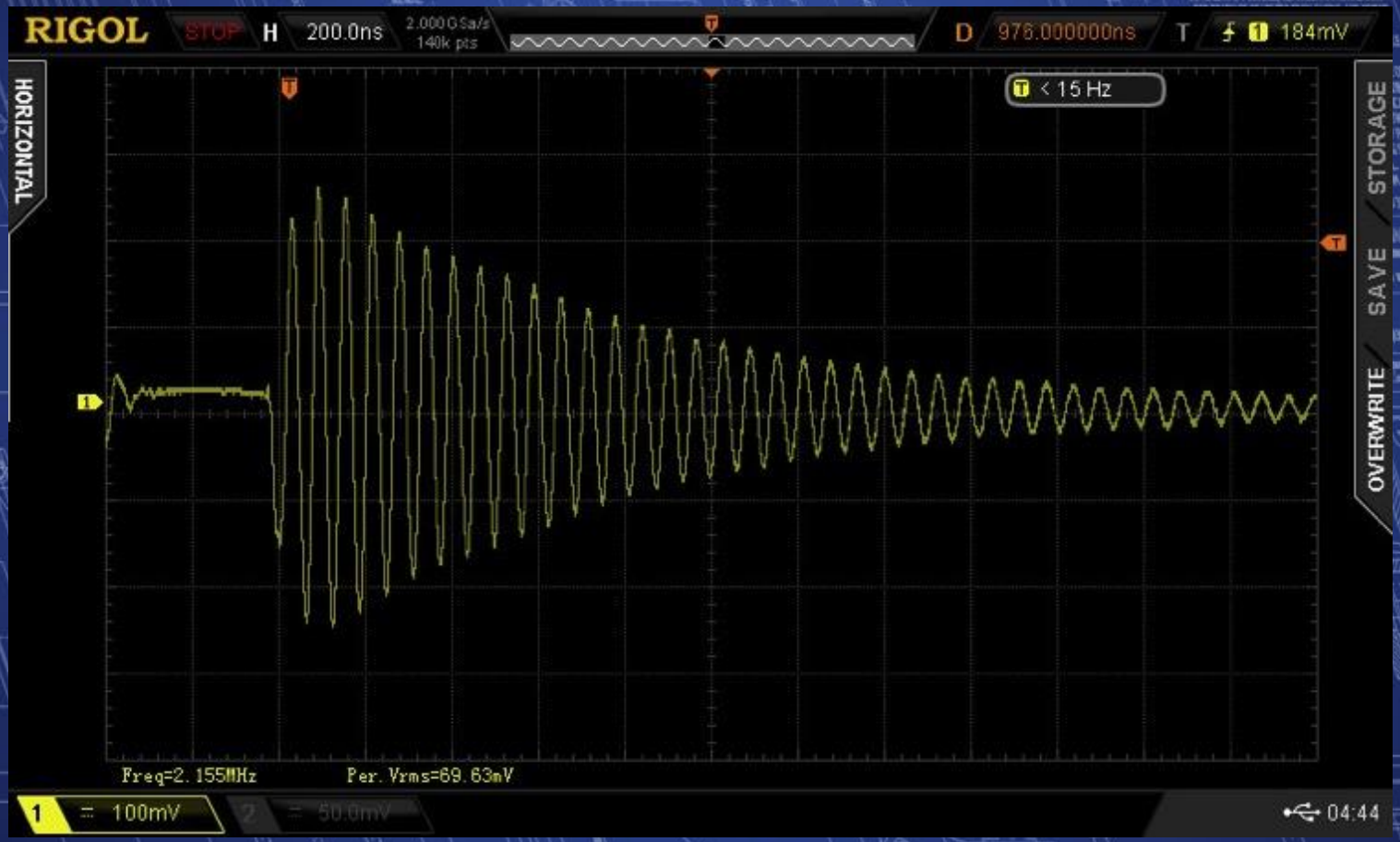
Peak approx. 2 V - Measurement taken with 200x probe – 1 V/div

UNGROUNDED SHAFT STATIC DISCHARGE



Peak approx. 100 V - Measurement taken with 200x probe – 40 V/div

HIGH FREQUENCIES
DAMPING / ATTENUATION NEEDED



Peak approx. 1.4 V - Measurement taken with 5x probe – 0.5 V/div

GROUNDING BRUSHES

- CARBON/GRAPHITE BRUSHES
  - Most common grounding brush material
  - Carbon has a sweet spot
  - Carbon needs moisture to conduct electricity
  - Carbon has a current density sweet spot
- COPPER STRAPS
  - Copper has low resistance
  - Copper straps are inexpensive
  - Copper oxides can impact the resistance to ground and can be abrasive
  - Copper oxide formation is related to current density

SOHRE GROUNDING BRUSHES

- GOLD / SILVER COMPOSITE
  - Expensive
  - Low and consistent conductivity
  - Low maintenance requirements
- ISOLATED PATH TO GROUND
  - Reduced inductive feedback
  - Effective accurate measurement of shaft voltage

ADDRESSING SHAFT CURRENT ISSUES

- ACCEPT THE PROBLEM AND DEAL WITH IT
  - Certain processes and machines produce static discharge
    - Change operating parameters, if possible
    - Size grounding brush accordingly
      - » Brush depletion rate is a power function
- DEMAGNETIZE PARTS
  - The process of reducing the magnetic field is called Degaussing
  - The magnetic field cannot be completely removed
  - The residual magnetic field can increase in intensity without adequate grounding