First Application of a Plasma Coating on an Inner Diameter

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March 15, 2005

HCAT Meeting

Greensboro, North Carolina

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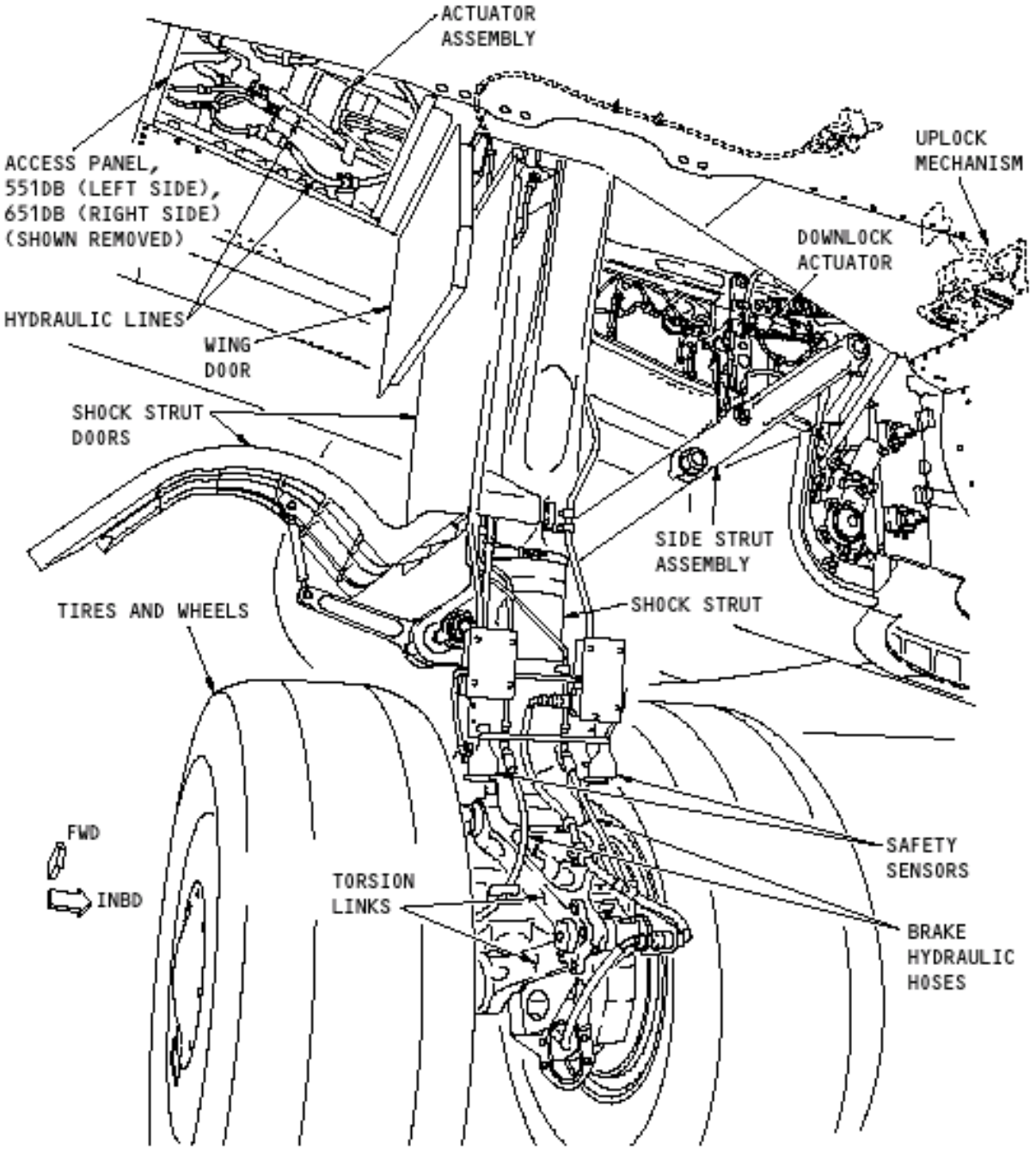
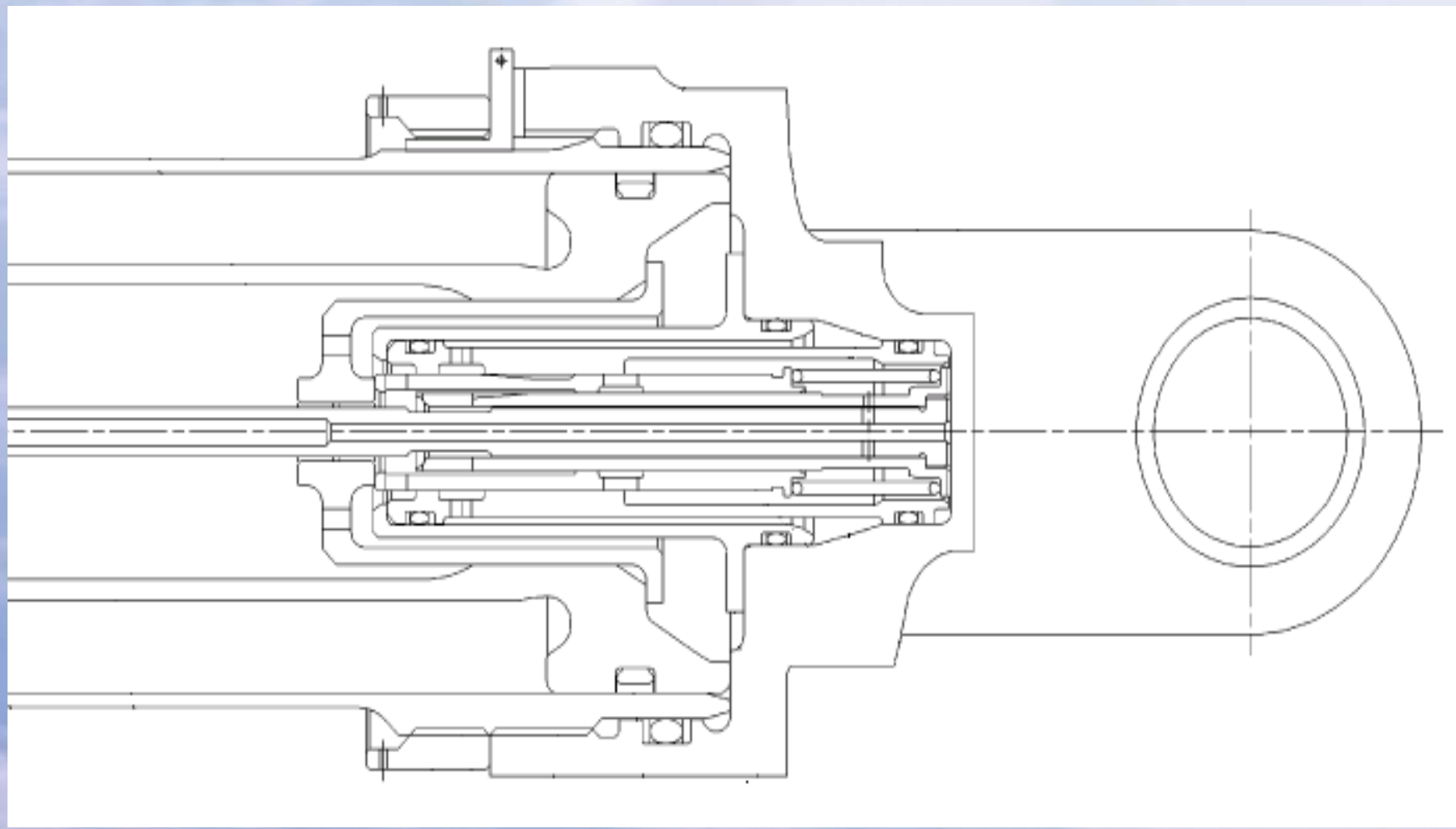
Situation

- A fully functional unit was showing early stages of wear
- 15-5PH 170-200KSI
- Bare ID



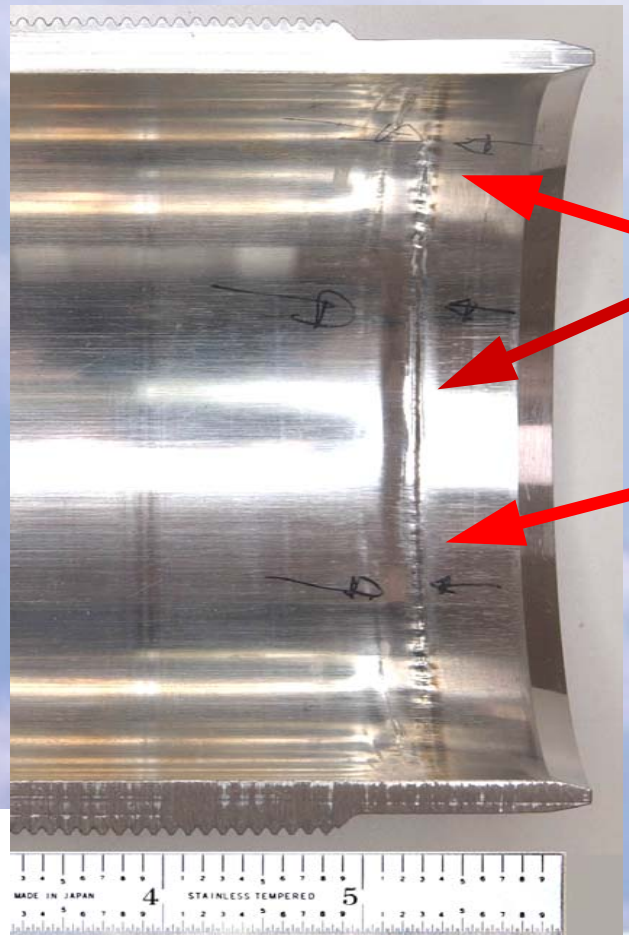
RIGHT MAIN LANDING GEAR
(LEFT MAIN LANDING GEAR IS EQUIVALENT)

MLG Retract Actuator



Actuator Barrel

- Groove caused by abrasive seal and piston wear combined with hydraulic fluid erosion and polishing

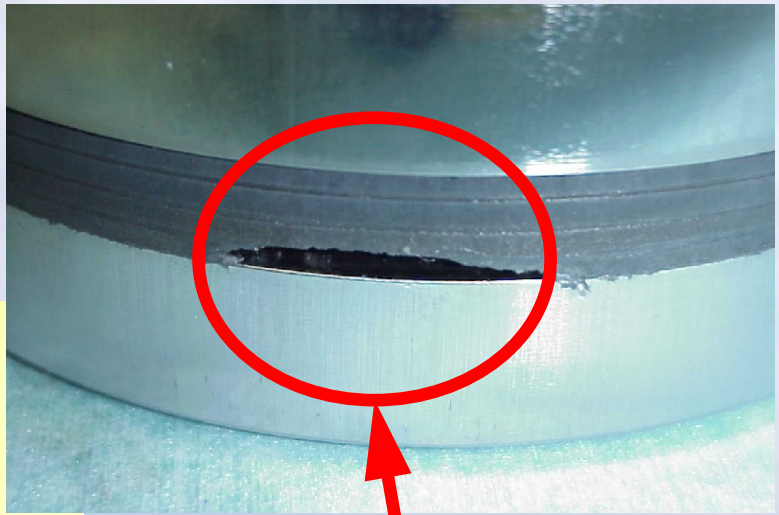


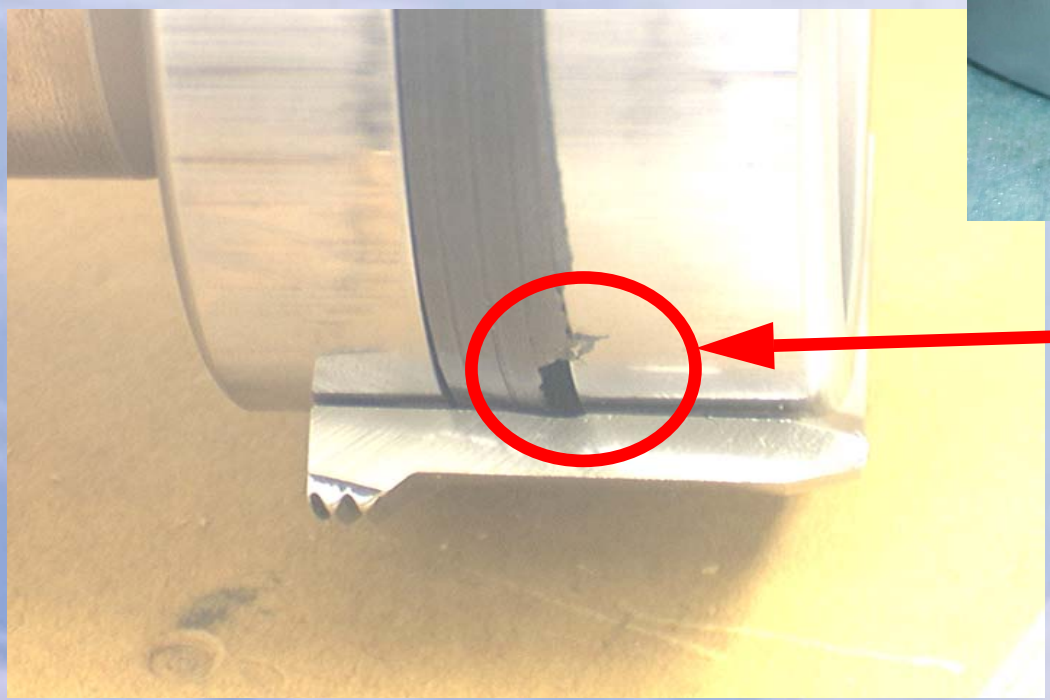
Groove location lines up with seal location when gear is down (actuator is retracted)

Flow erosion marks

Wear is typically over 90-180 degree arc of barrel inside diameter

Main Gear Actuator





Worn piston seal

Root Cause:
Low Amplitude Vibration

- The vibration dries out the bore/seal interface, increasing friction and heat
- This erodes the barrel bore, allowing flow erosion to begin
- The piston seal cap extrudes through the barrel groove and fluid flow erodes the elastomer energizer ring beneath it

Chrome Plating on Inner Diameter

- Enhance wear with chrome plate on the ID
- Re-machine ID to allow for chrome thickness
- Hydrogen Embrittlement

Hydrogen Embrittlement

Plasma Coating on Inner Diameter

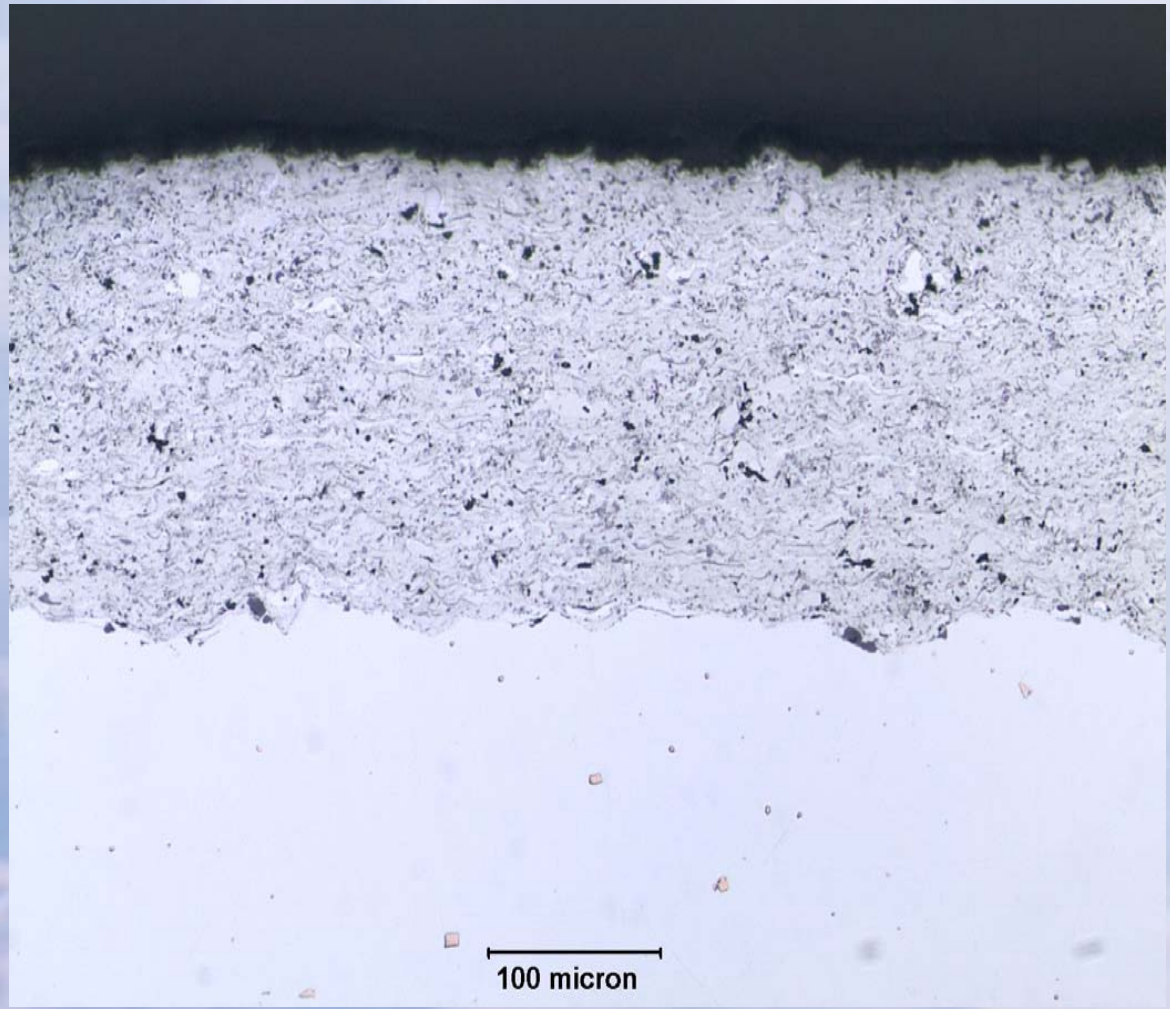
- Chrome carbide-nickel chrome 5CrC+25 (80Ni-20Cr)
- AMS2437C and AMS7875C
- Proof of concept demonstrated – Dec. 2004
- Ni-988 (WC 12Co) 36Ni 8Cr 1.8FE 1.5B 2Si 0.3C
- In process

BOEING®

AMS2437C

- Porosity < 2.0%
- Bond 6539 PSI – Min. 6500 PSI
- HV300 547 – Min. 500
- Finish 11-12Ra Micro inches
- Tp, Bearing Area Ratio - 100

AMS2437C Met Sample



MLG Retract Actuator

MLG Actuator Inner Diameter

Plasma Application

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ID Finishing – Vertical Honing Machine

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Conclusions

- Technical feasibility has been successfully demonstrated
- Plasma coating offers a promising cost-effective repair option
- Can be used as a model for other potential ID applications
- No hydrogen embrittlement issues
- Environmentally friendly