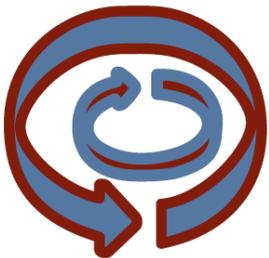


Wear and Friction Testing

STLE Houston



Wear and Friction Resources, Tomball and Portland

Wear Testing

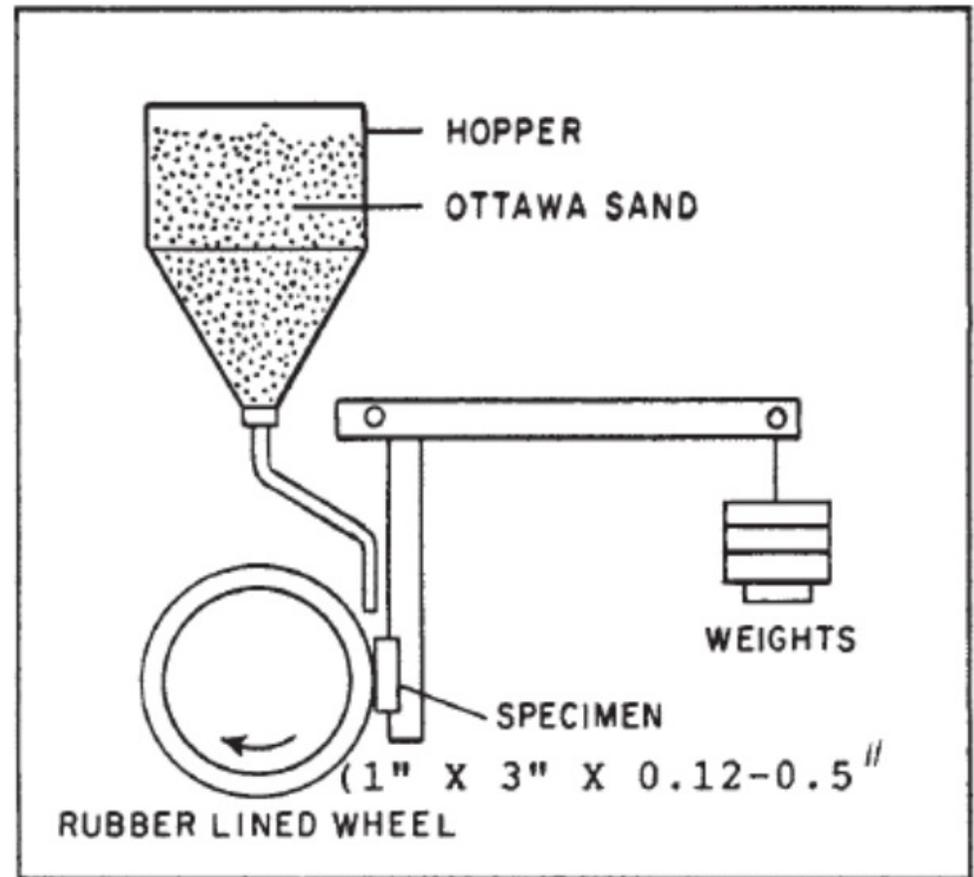
- Used to help select or screen materials for a given application
- Controls variables that impossible to control in revenue service
- Standardized tests are comparable across different sources
- Purpose-built tests include important revenue service parameters

Wear Testing: Abrasion

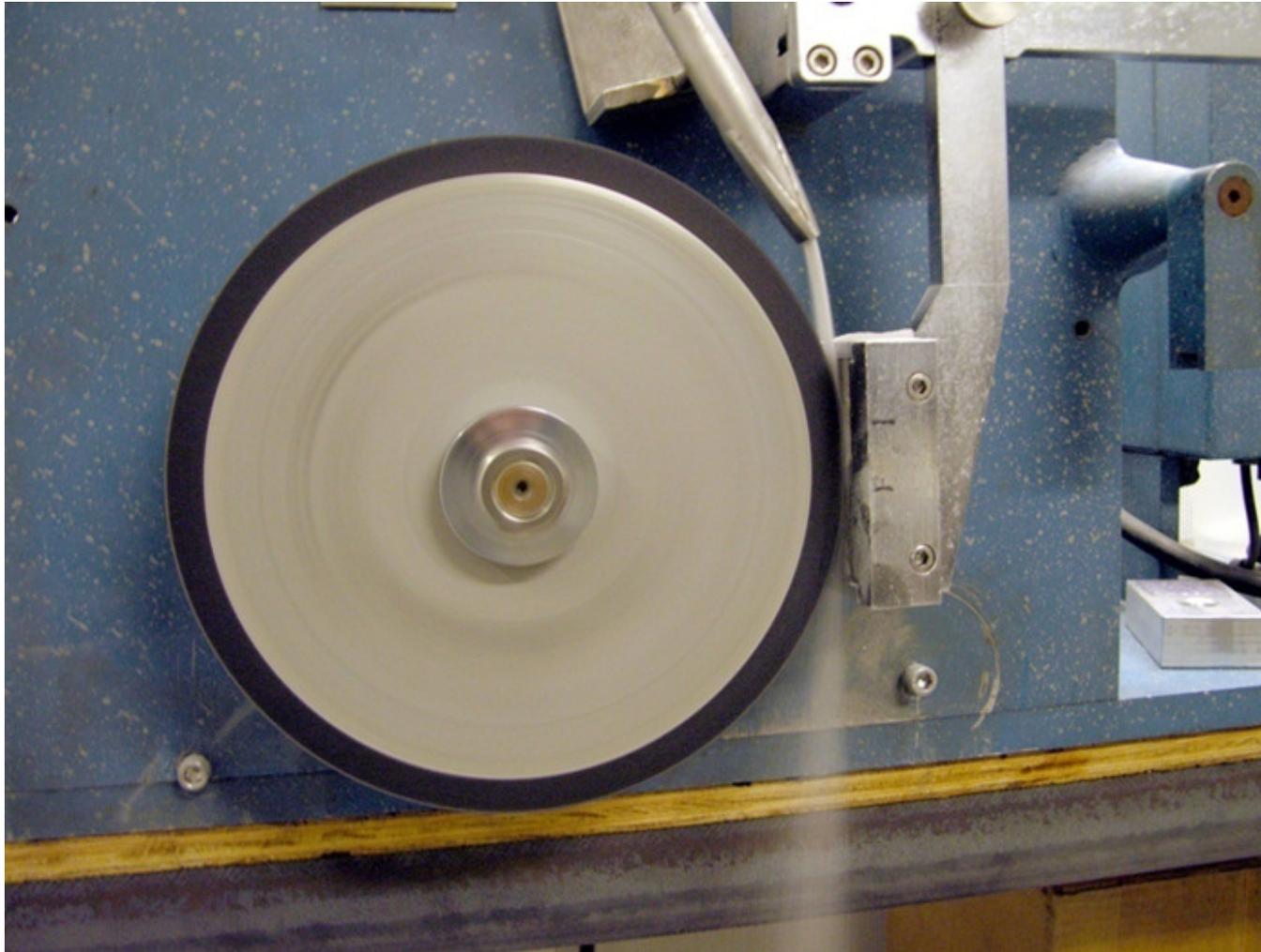
- ASTM G65 Dry Sand Rubber Wheel
 - 50/70 mesh rounded SiO_2
 - 30 pound normal force
 - 60 Shore A rubber wheel
 - 6000 revolutions
 - Low stress abrasion

Wear Testing: Abrasion

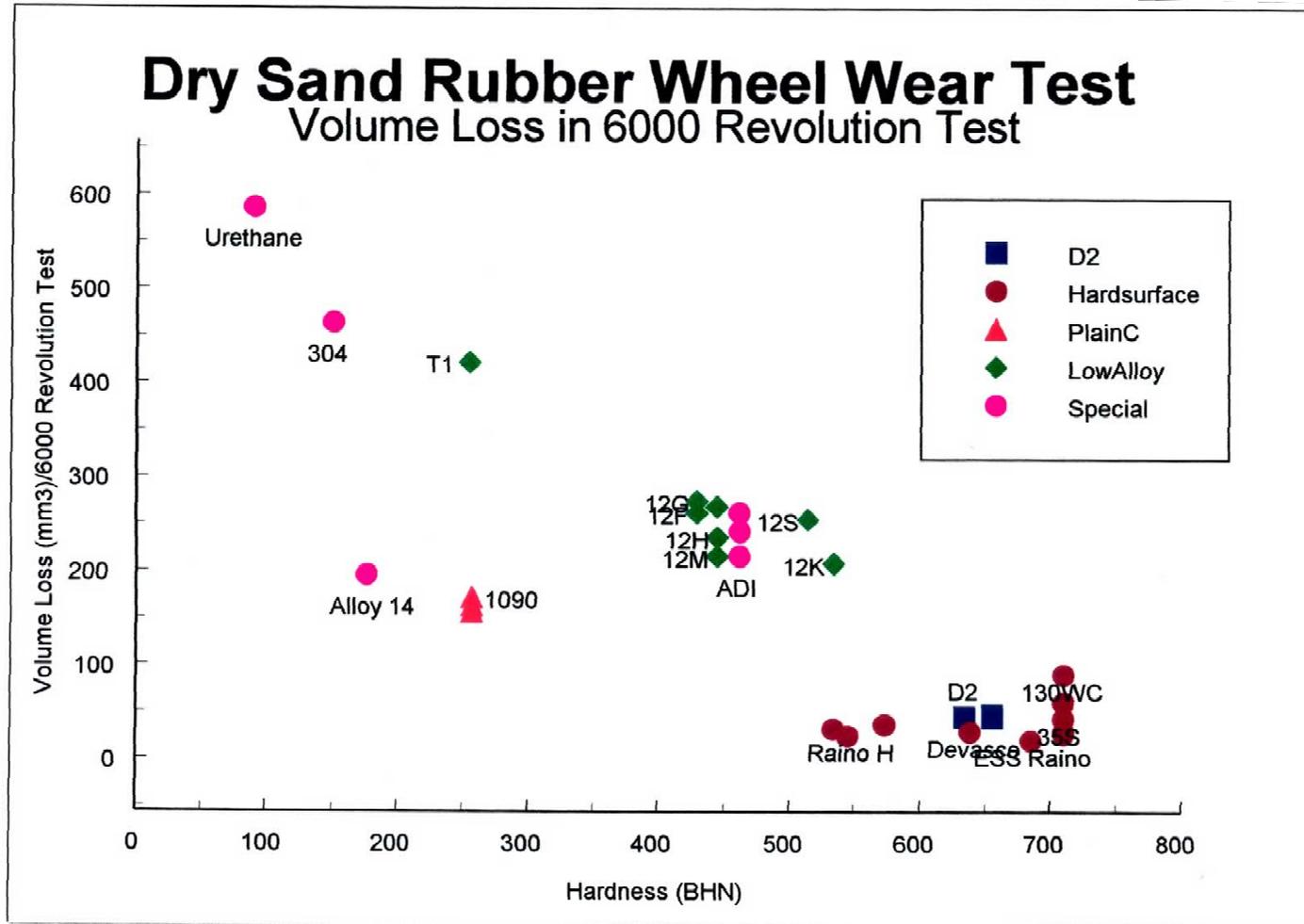
- Ability to rank relative wear resistance
- Tar sand screening tool
- Widely used and accepted
- Good correlation with sample hardness



ASTM G65



ASTM G65



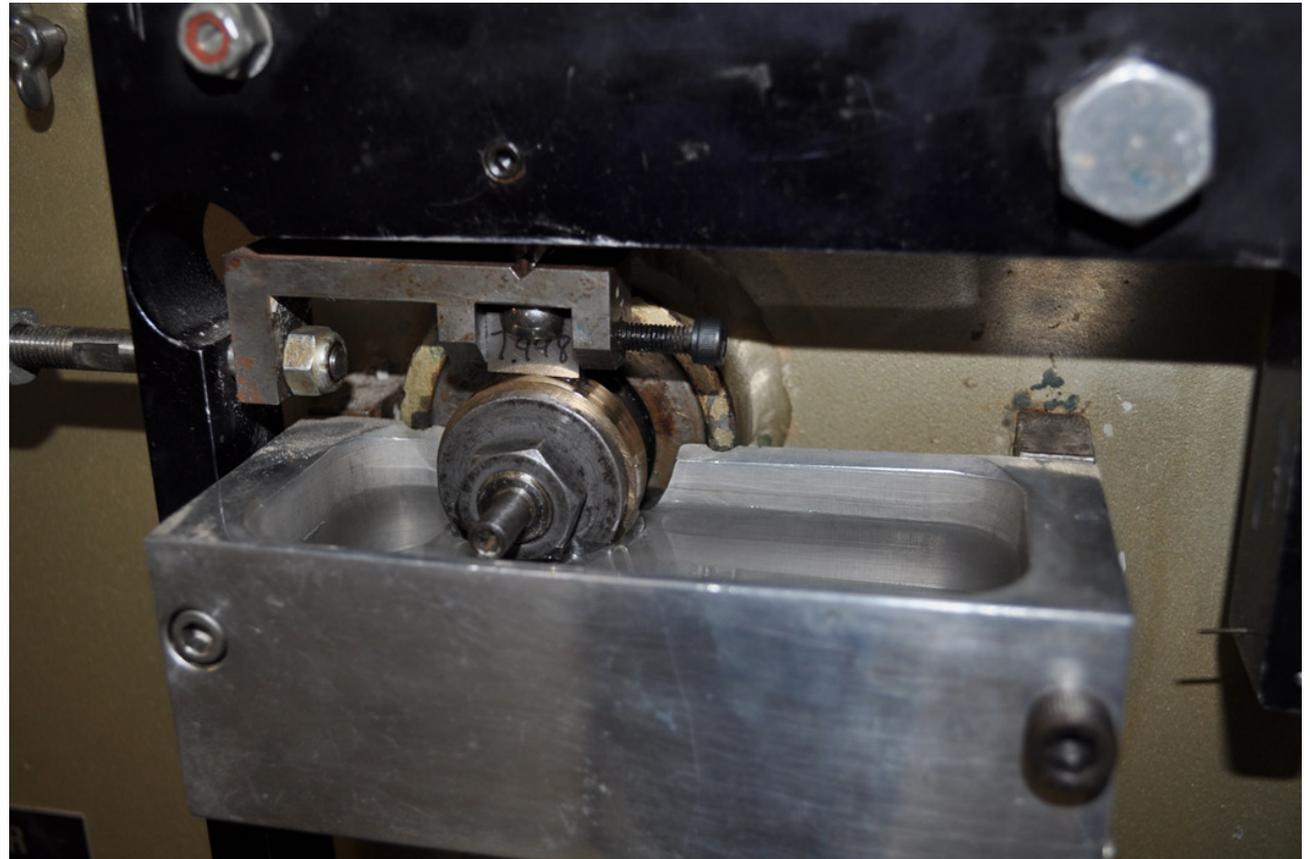
ASTM G65

- G65 vs. tungsten carbide embedded hardsurfacing



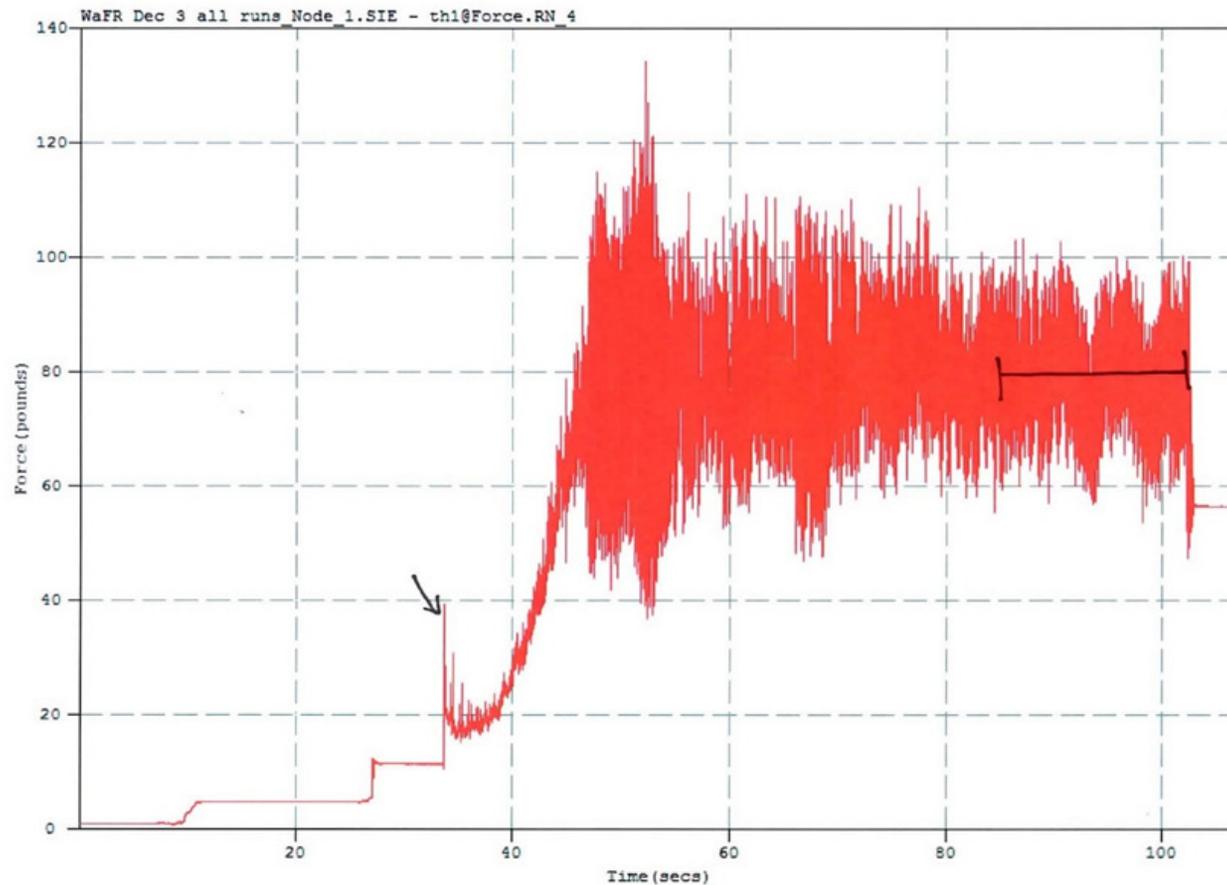
Friction Testing

- ASTM G77
block-on-
ring



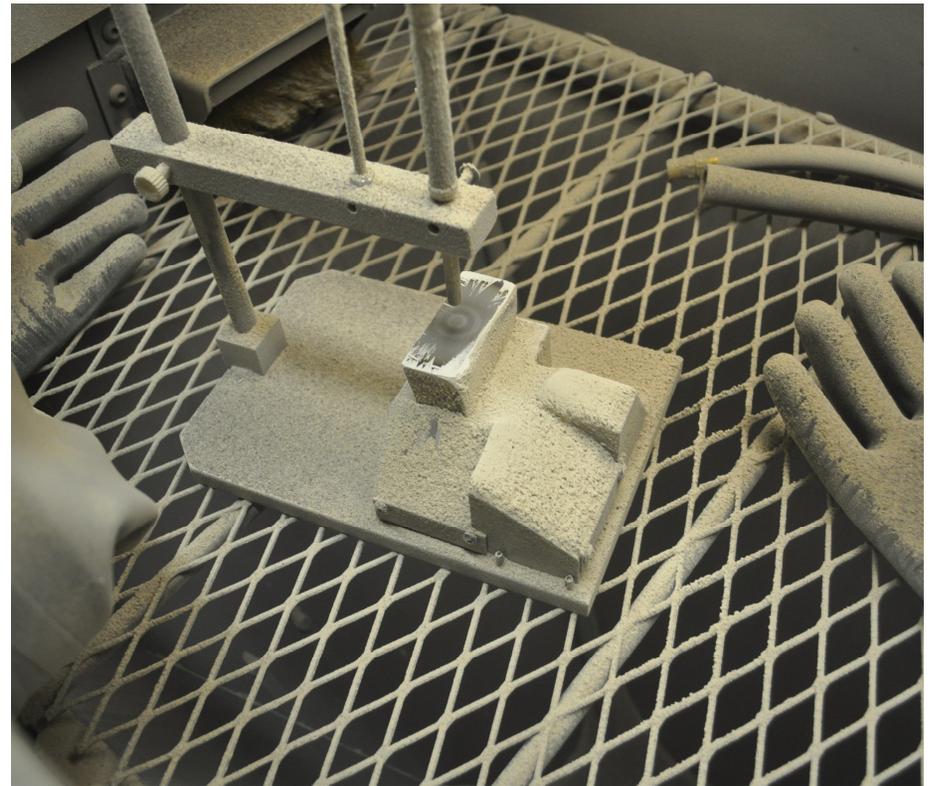
Friction Coefficient

Salt Water – Full Plot



Erosion

- ASTM G76: erosion with gas jet
 - Abrasive medium can be any material that can consistently delivered
 - Angles between 0° and 90°
 - Particle velocity up to 150 m/sec



Erosion

- Factors that affect erosion rates
 - Velocity
 - Impingement Angle
 - Erosive media
 - Size, shape, hardness
 - Hardness of surface

Erosion

Air foil leading edge

Windscreen clouding



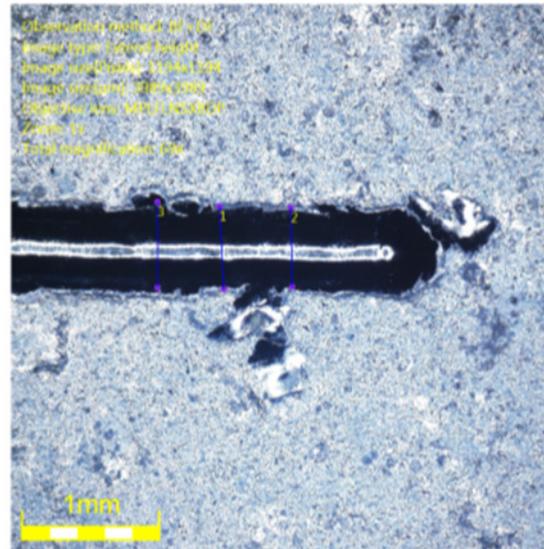
Scratch Testing

- ASTM G171
 - Diamond stylus
 - 0 to 50 N (11 lbs)
 - Constant or ramped load
 - ASTM standard has list of defined damage types (spalling, ploughing, flaking, cracking, etc.)



Scratch Testing

- ASTM G171
 - ASTM standard has list of defined damage types (spalling, ploughing, flaking, cracking, etc.)
 - Test metrics include scratch depth and width



User ID: ADMIN
User name: ADMINISTRATOR
Description: ADMIN USER

hv10_0026
[Acquisition parameters]
Observation method: BF+DF
Image type: Extend height
Image size[Pixels]: 1194x1194
Image size[μm]: 3989x3989
Objective lens: MPLFLN5XBDP
Zoom: 1x
Total magnification: 69x

Comment

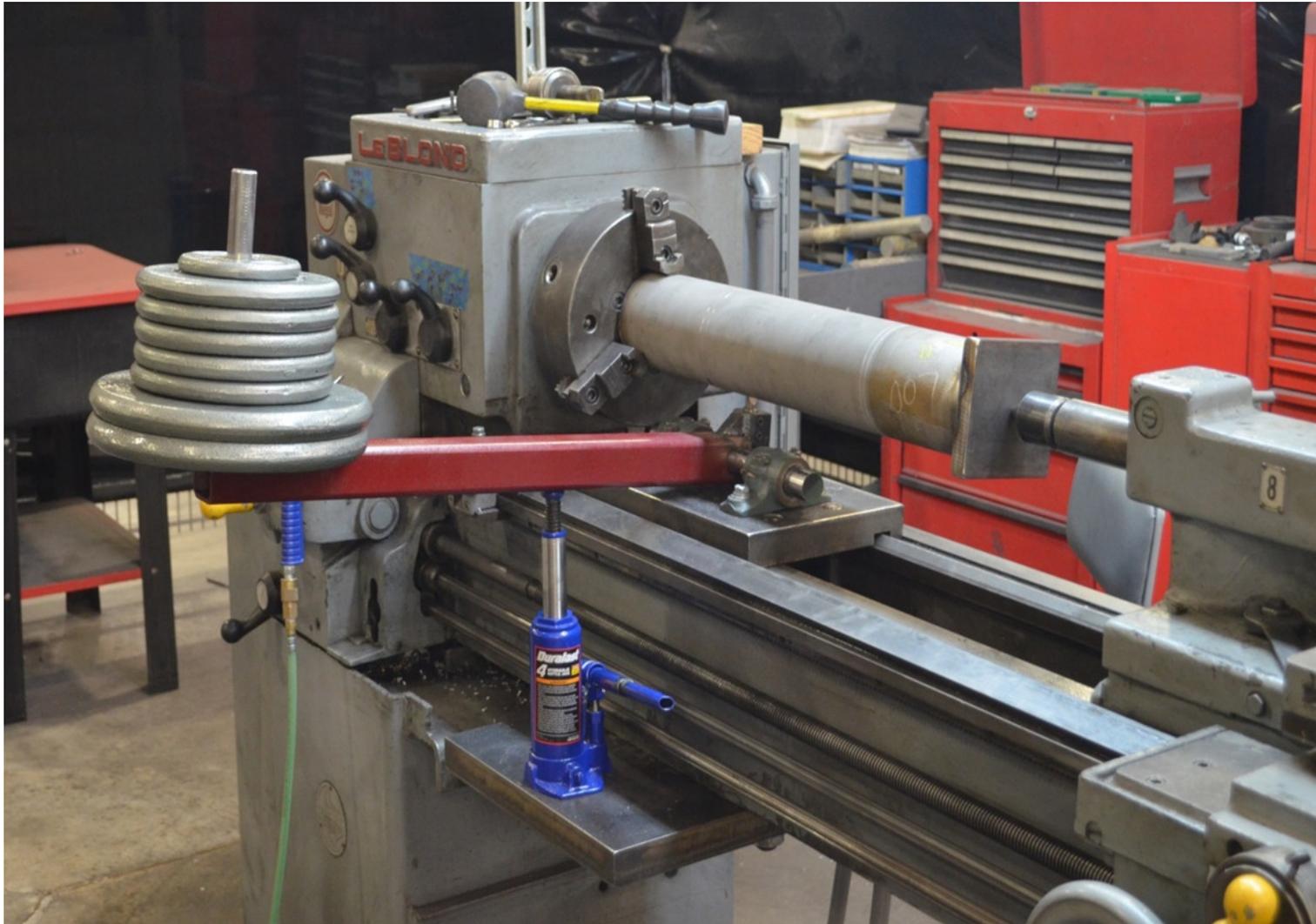
No.	Result	Distance[μm]	File name
1		603.852	hv10_0026
2		577.146	hv10_0026
3		623.840	hv10_0026
Count		3	
Average		601.613	0
Max.		623.840	0
Min.		577.146	0
Range		46.694	0
σ		19.128	0
3σ		57.385	0
Tolerance		Off	Off
Upper tolerance		0	0
Standard		0	0
Lower tolerance		0	0

Scratch Testing

- Modified ASTM G171 scratch test
 - Well deviation (branching)
 - Machined edges of casing rubbing against drill string
 - What type and thickness of a protective coating will protect the drill string?

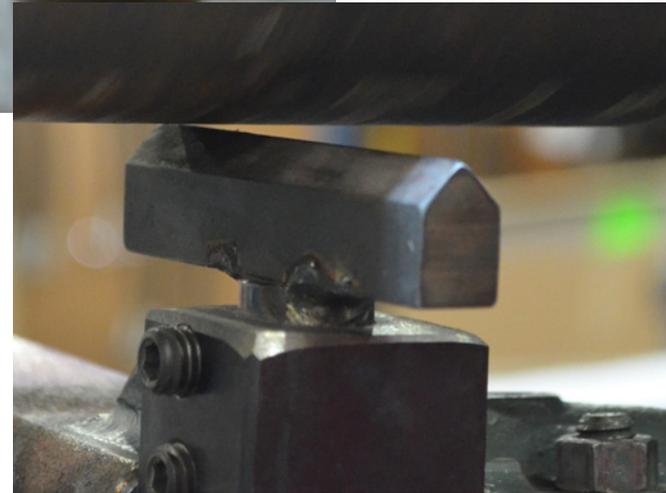
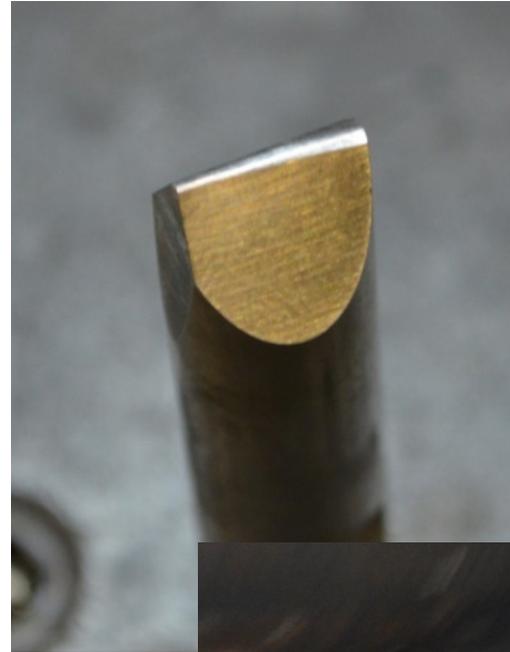


Scratch Testing

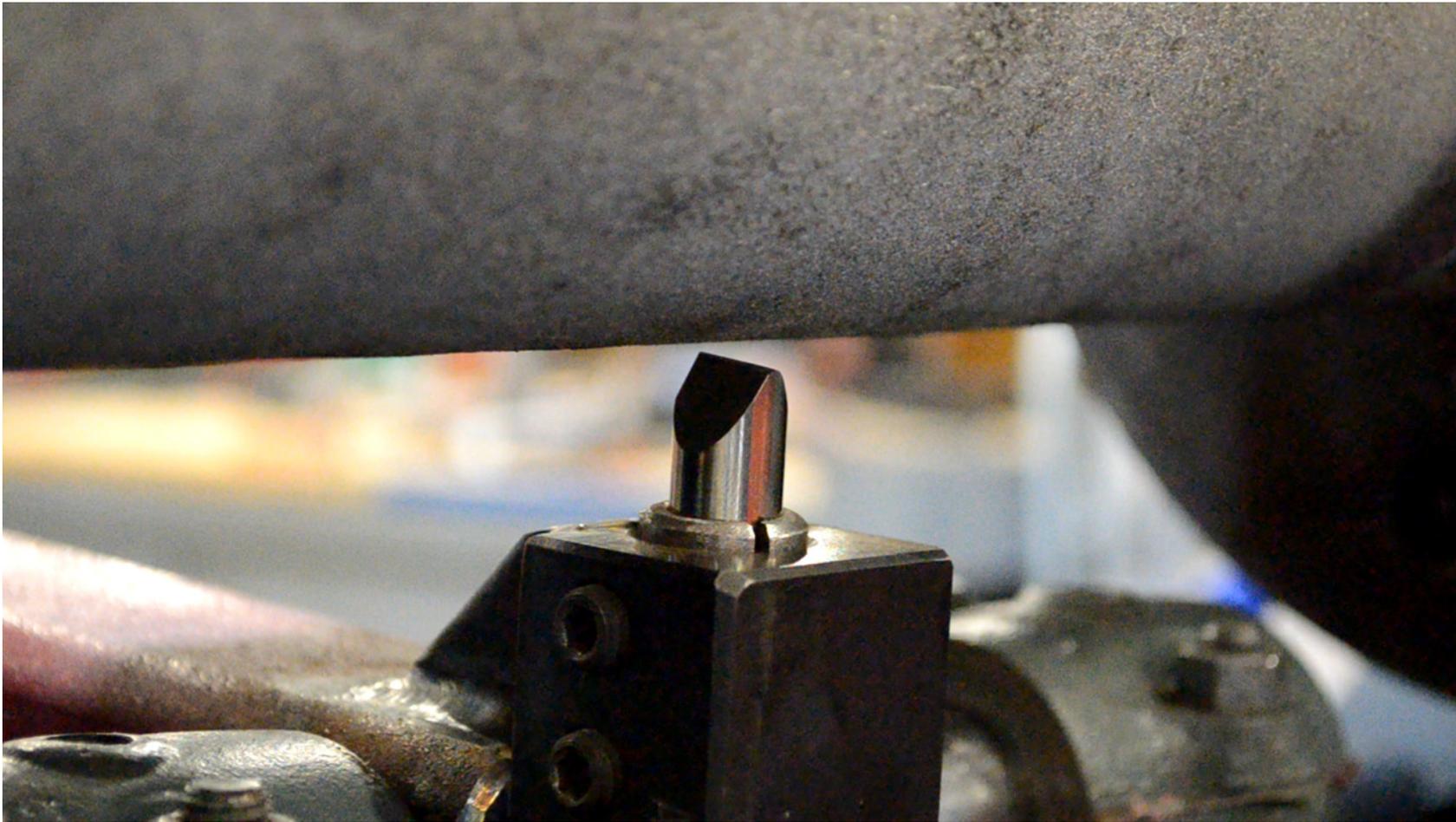


Scratch Testing

- M2 tool steel
- 4340 heat treated bar



Scratch Testing

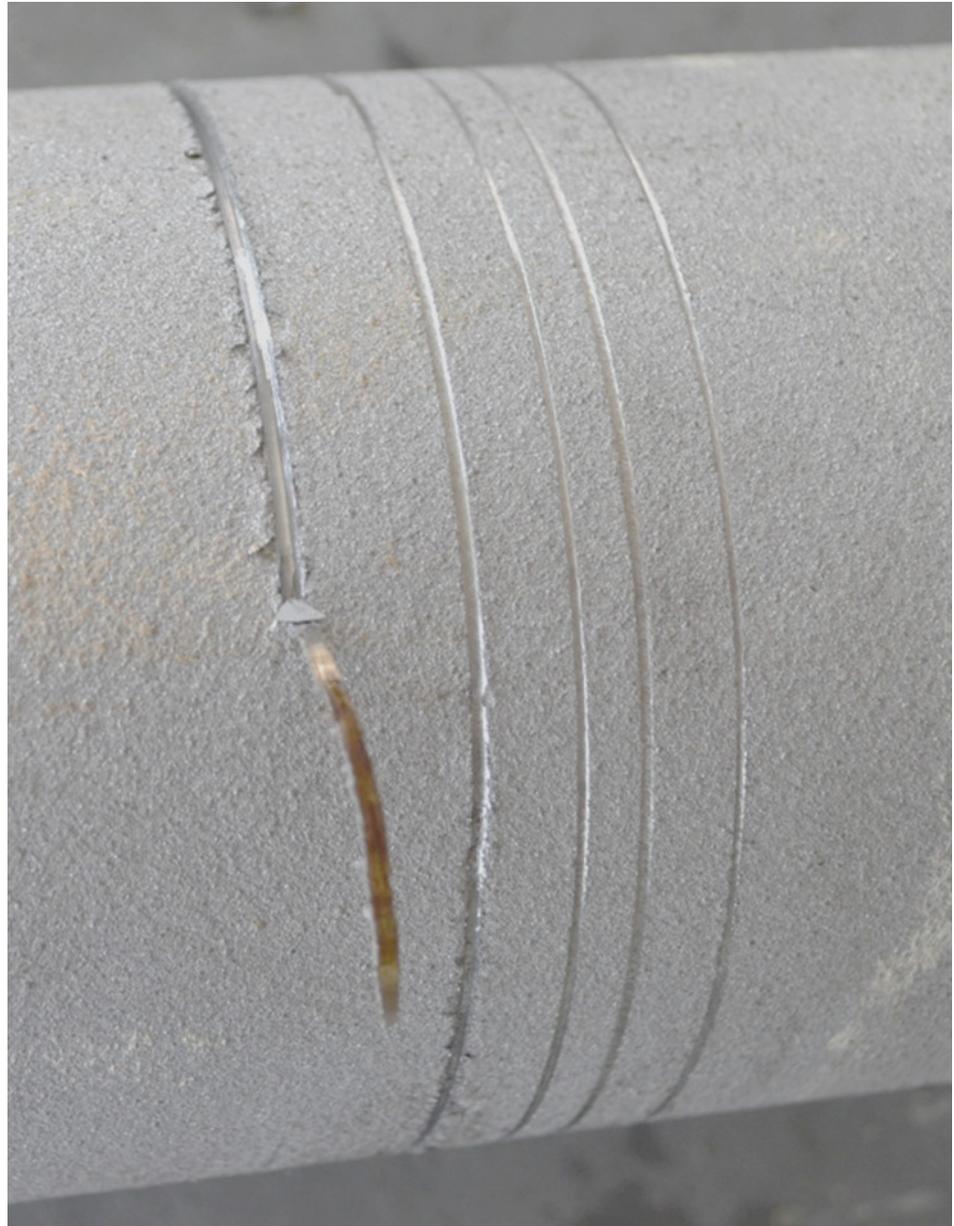


Scratch Testing

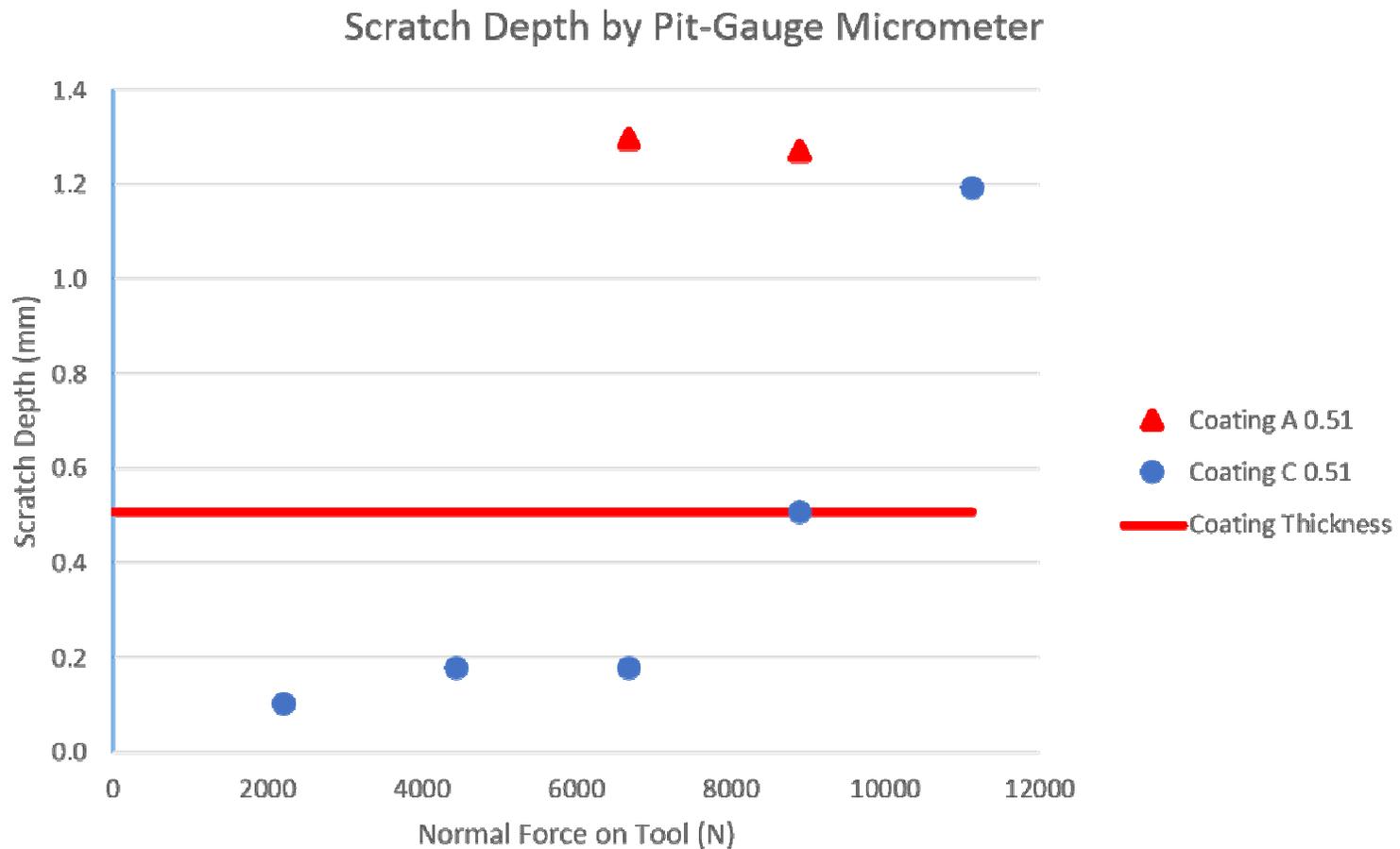


Scratch Testing

- G171
- Thermal spray coating was able to protect the pipe substrate only below certain loads



Scratch Testing



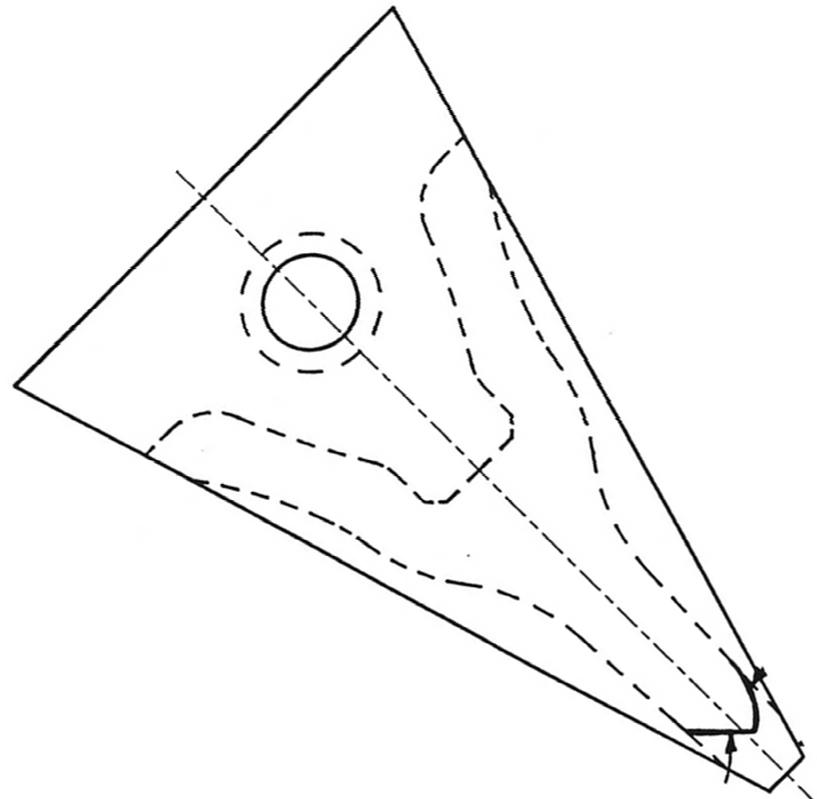
Dragline Bucket Teeth

- Problem: the consumable teeth on a dragline bucket lip wear and lose the ability to penetrate; this causes the bucket to slide across the surface rather than “bite” and dig effectively



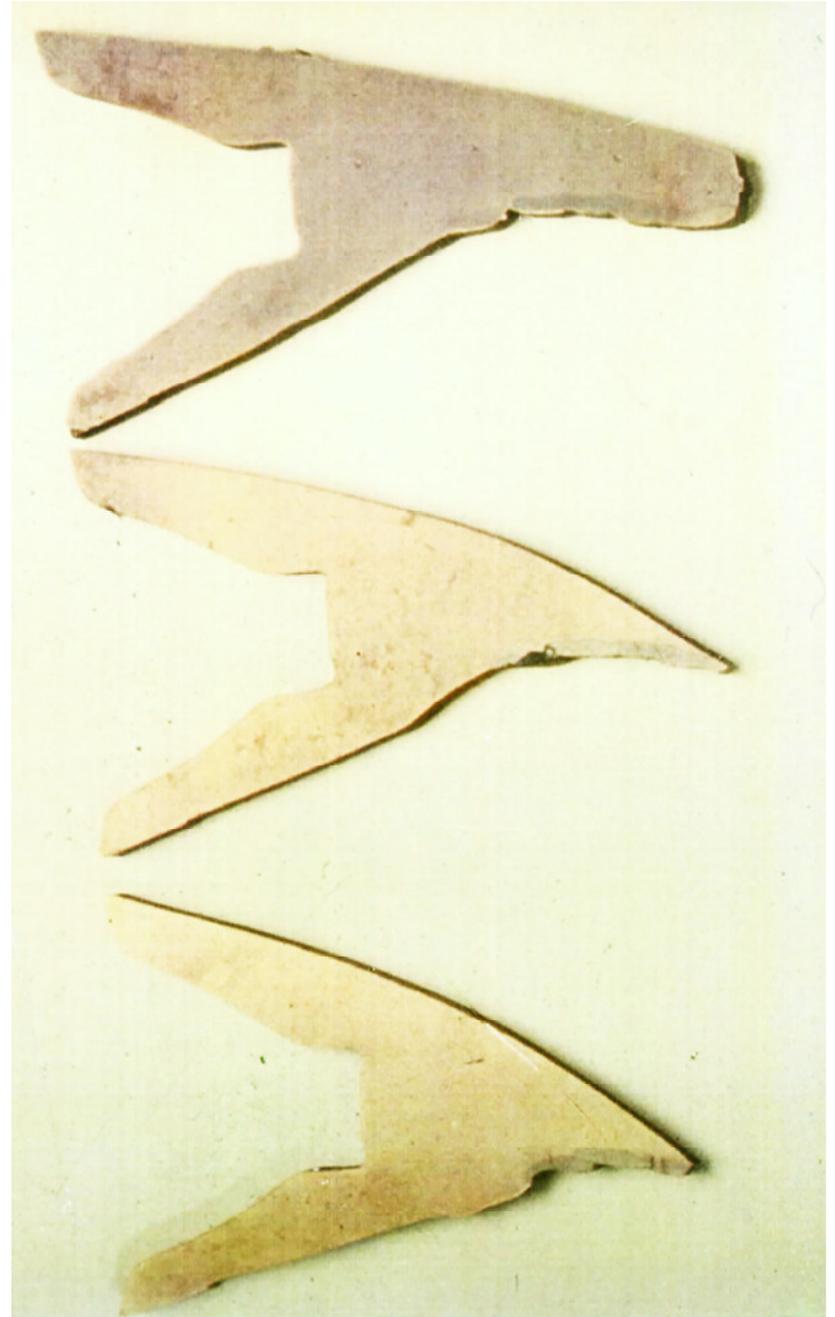
Dragline Bucket Teeth

- The angle-of-attack of the bucket causes a flat wear land on the leading edge of the tooth
- The increased surface area decreases the P_o and prevent the tooth from penetrating the formation



Dragline Bucket Teeth

- Solution: apply hardsurfacing to the highest contact pressure area (bottom of tooth)
- Hardbanding reduces the wear rate on the bottom of the tooth
- Wear on the top of the tooth causes a continuous self-sharpening edge
- Since the tooth remains sharp a greater amount of the tooth volume can be used extending life (from 6 to 72 hours typical)



Wear Testing: Summary

- Select test that produces the same wear mechanism as the application
- Verify that the surface damage matches service components as closely as possible
- Develop relative performances of candidate materials
- Correlate testing data with revenue service