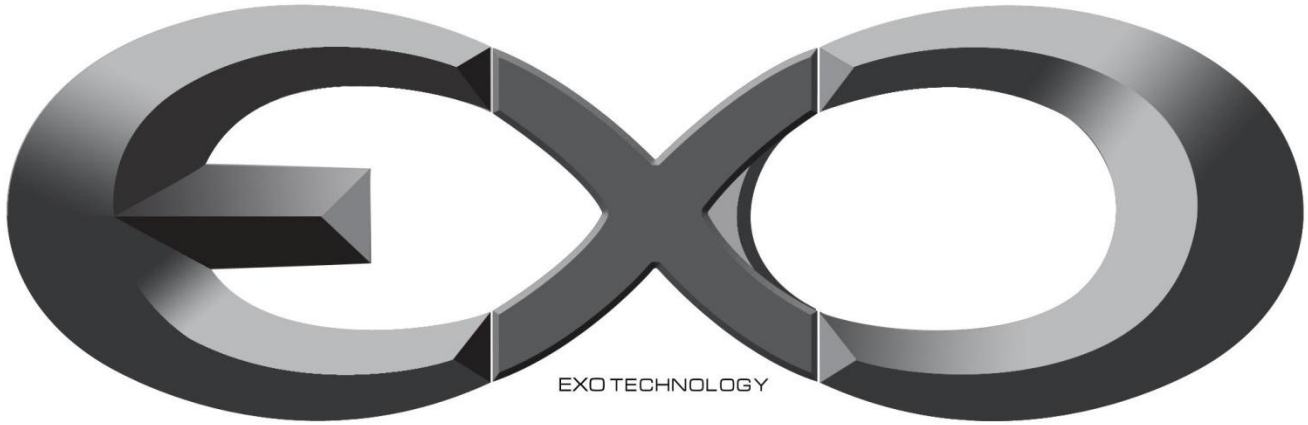
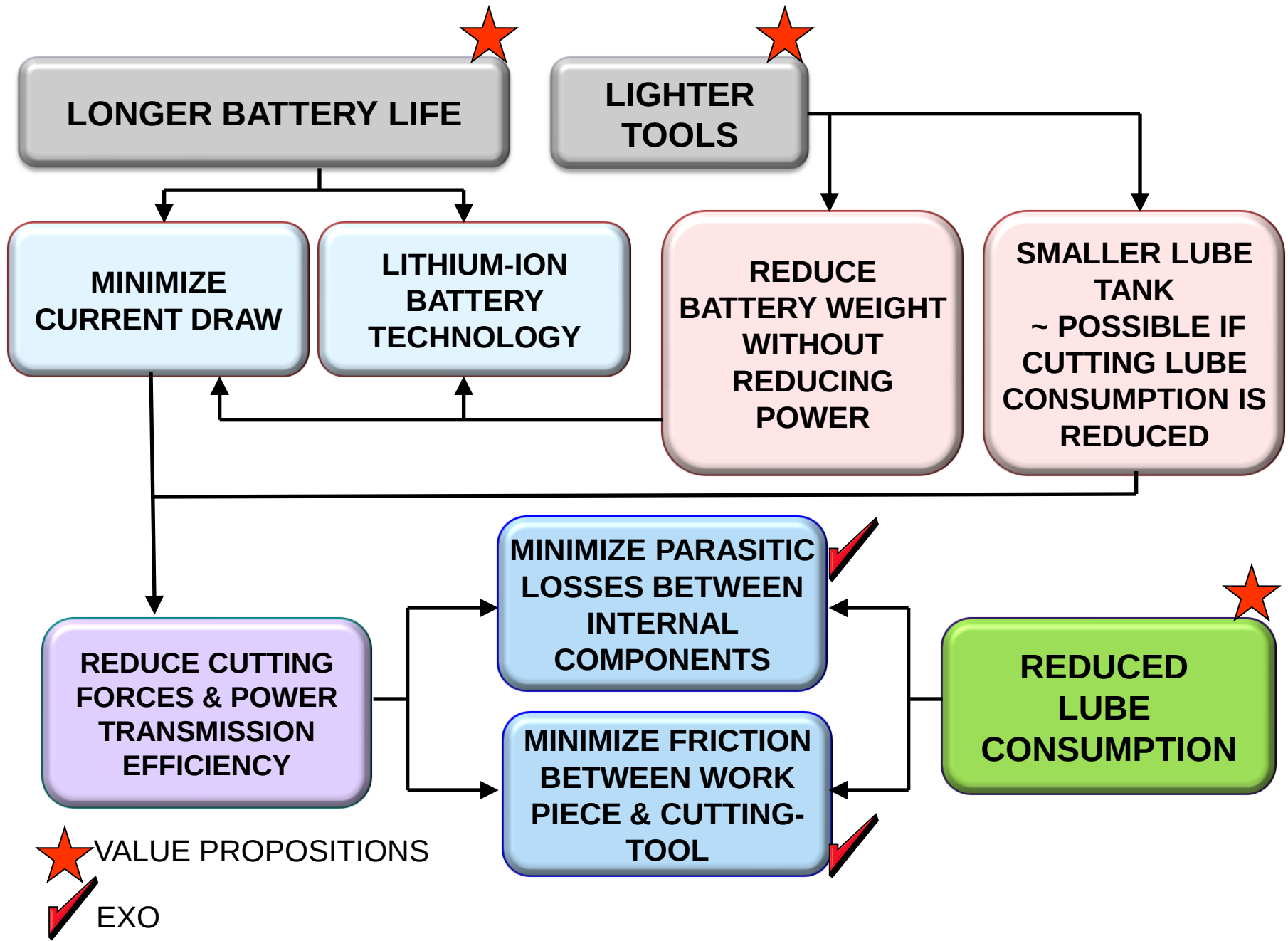
EXO TECHNOLOGY
for Premium Power Tools



INNOVATIONS IN POWER TOOLS

- ❑ LIGHT-WEIGHT TOOLS
- ❑ LONGER BATTERY LIFE
- ❑ HIGHER POWER OUTPUT
- ❑ “GREEN”

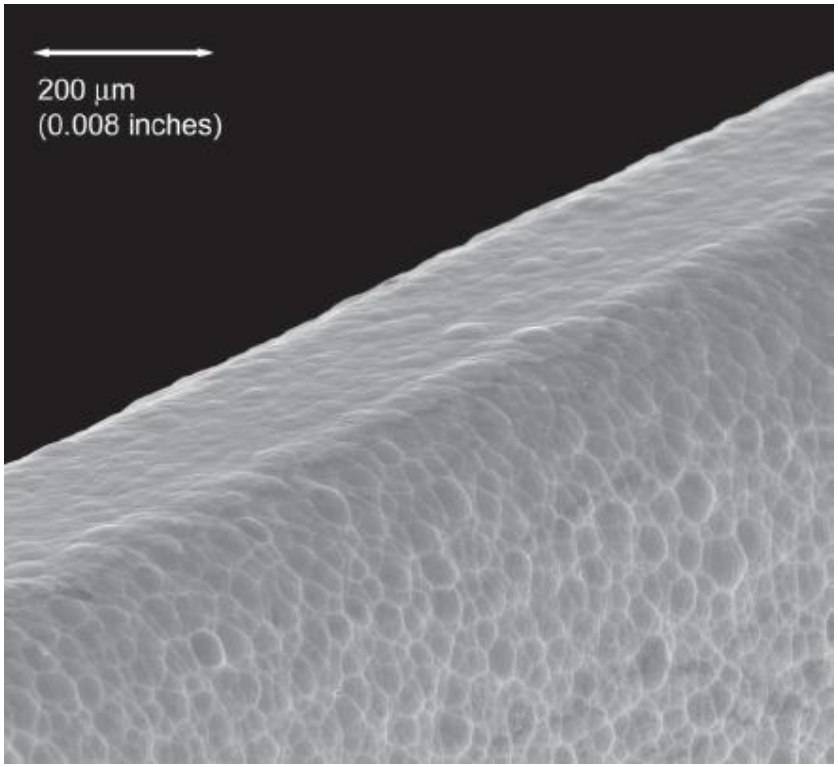
INNOVATION POSSIBILITIES FOR POWER TOOLS



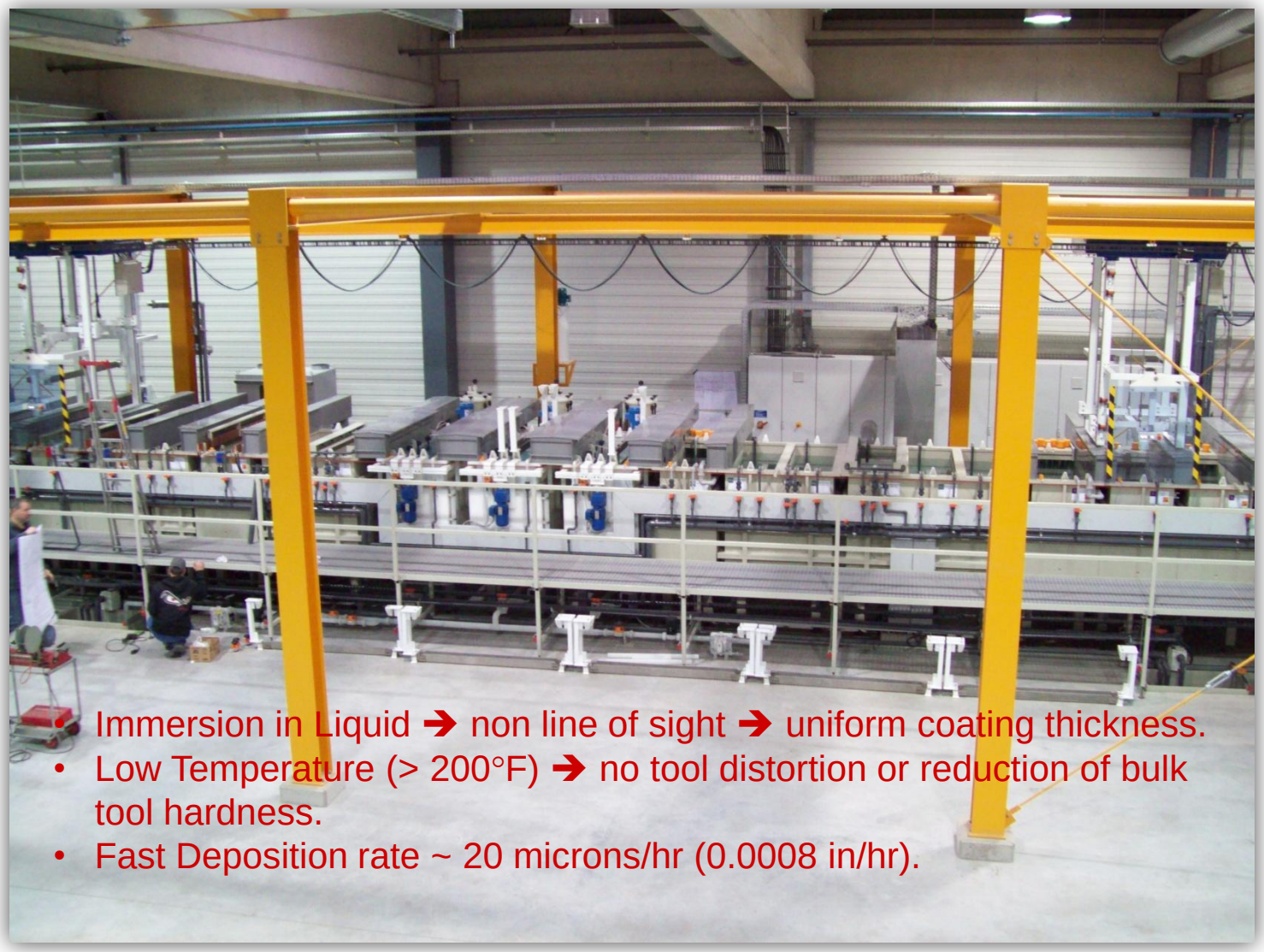
INTRODUCTION TO EXO TECHNOLOGY

EXO FEATURES

- A proprietary inter-metallic nickel based coatings technology.
- Under development over the past 6 years - $50m in investment.
- Unique combination of properties ideally suited for cutting and wear-protection applications for tooling and industrial machinery wear parts & components.
  - Hardness
  - Toughness
  - Lubricity
  - Low coefficient of friction
  - Surface topography



EXO TECHNOLOGY PROCESS LINE

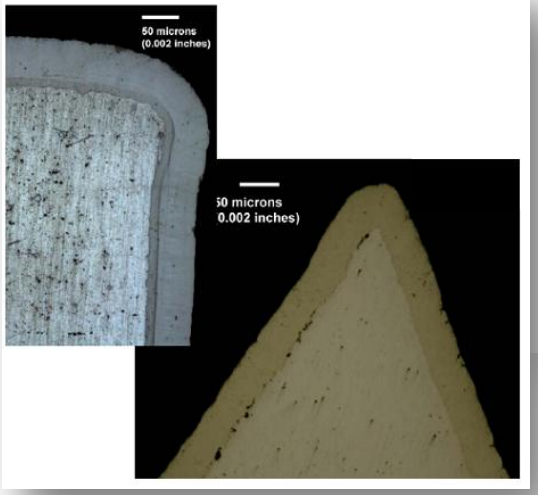


- Immersion in Liquid ➔ non line of sight ➔ uniform coating thickness.
- Low Temperature (> 200°F) ➔ no tool distortion or reduction of bulk tool hardness.
- Fast Deposition rate ~ 20 microns/hr (0.0008 in/hr).

EXO TECHNOLOGY FEATURES

NOT A LINE-OF-SIGHT PROCESS

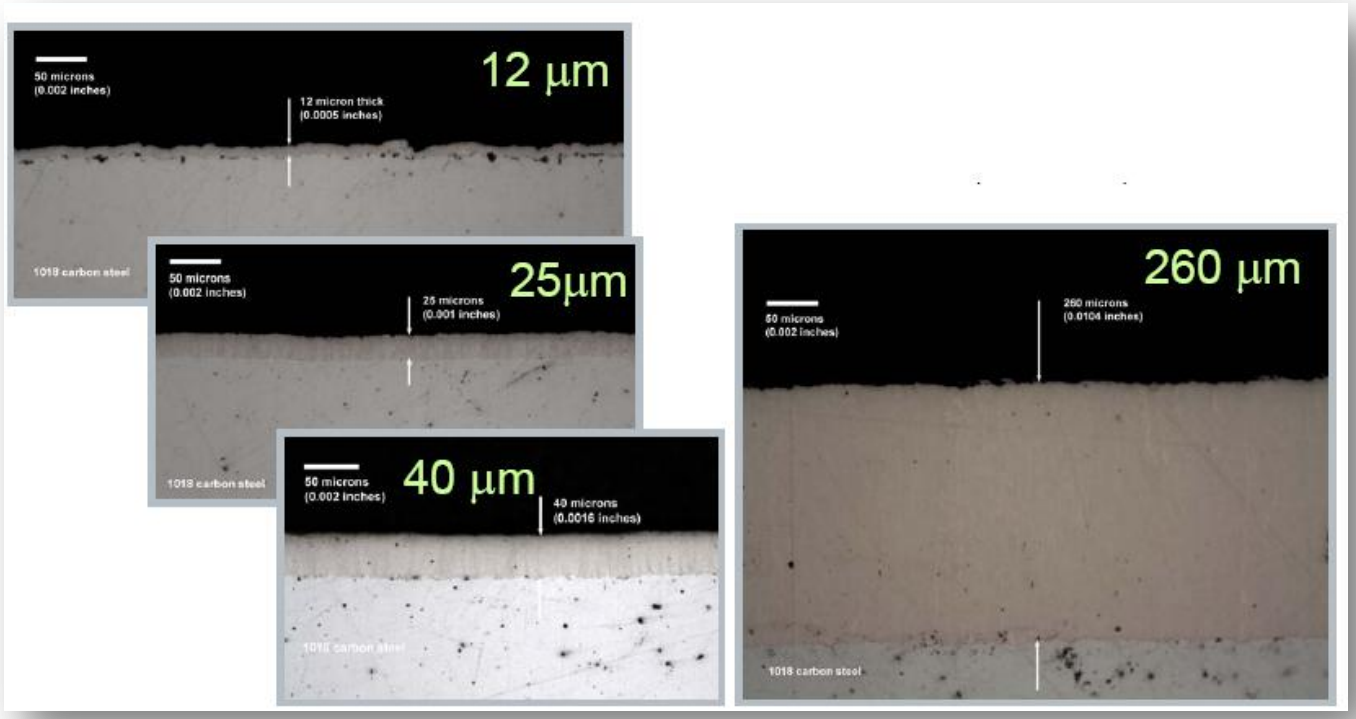
- Complicated geometry components can be coated with a uniform coating thickness. No edge build-up.
- Through holes and cavities can be coated to a tight tolerance finish.



EXO TECHNOLOGY FEATURES

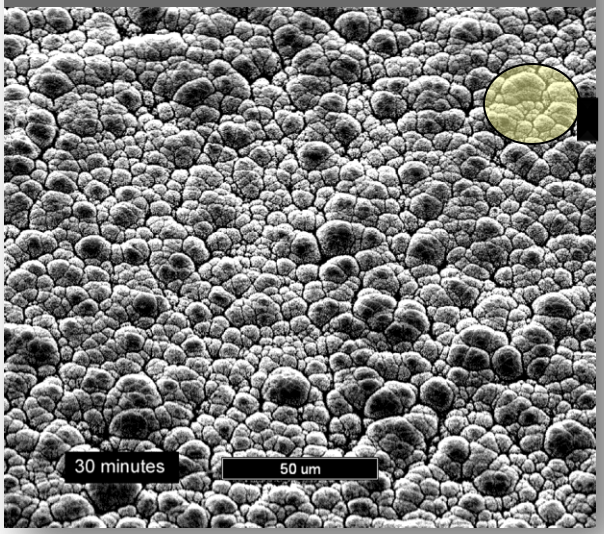
WIDE RANGE OF COATING THICKNESS POSSIBLE

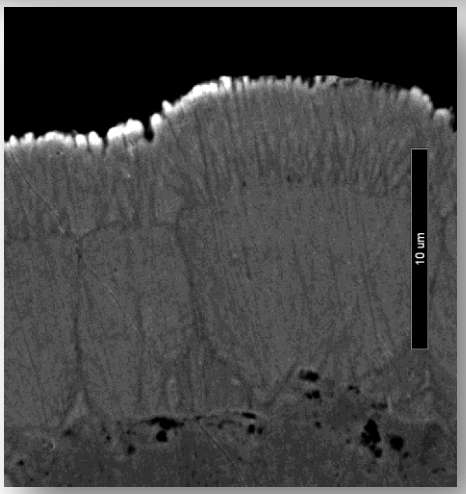
- Depending upon application – typical 10 microns (0.0004 in.) to 100 (0.004 in.) microns. Possible: 800 microns (0.032 in.)
- If coating is used in a sacrificial mode, there is substantial thickness to wear through – so a prolonged component life is possible.



MICROSTRUCTURE & TOPOGRAPHY

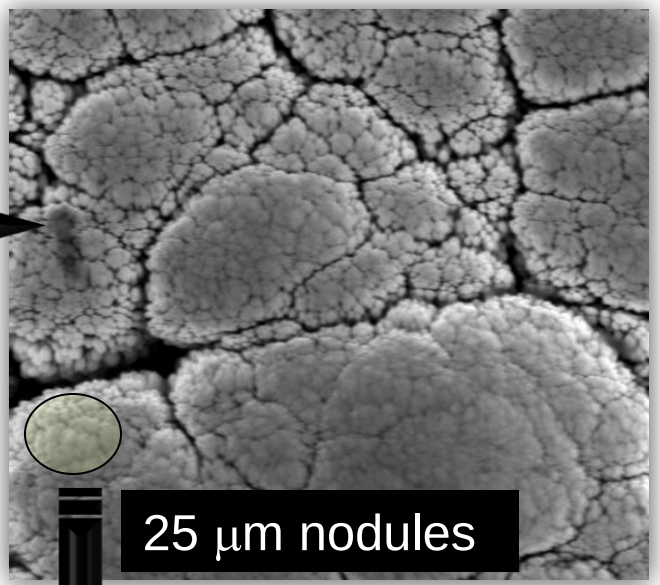
Nodular surface texture

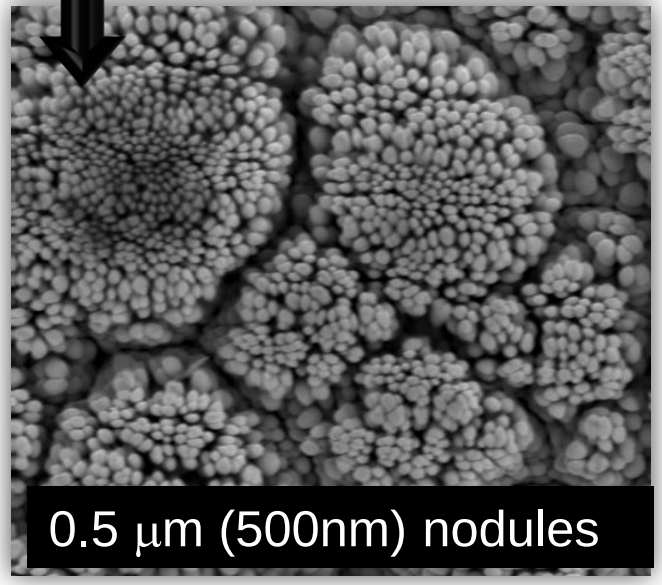




- **Large surface area to dissipate heat.**
- **Low sliding contact area minimizes friction forces.**

Columnar grain structure



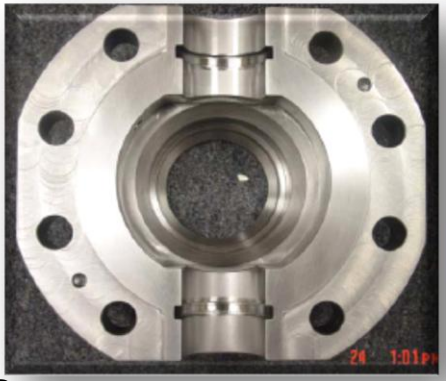


EXO TECHNOLOGY FEATURES

LOW COEF. OF FRICTION / HIGH LUBRICITY

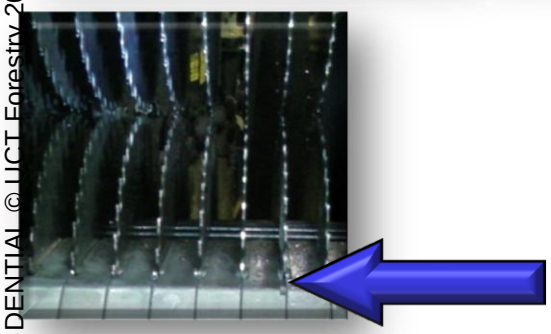
- The material has inherently low coefficient of friction. This property coupled with the unique surface topography, gives coated surfaces a high degree of lubricity, making them ideally suited for SLIDING / ADHESIVE WEAR & GALLING application.

VALVE SEATING & VALVE TRUNION



EXTRUSION SCREW & BARELL

LINER HANGERS



EXO GUIDE-PADS FOR LUMBER MILL SAW GANGS

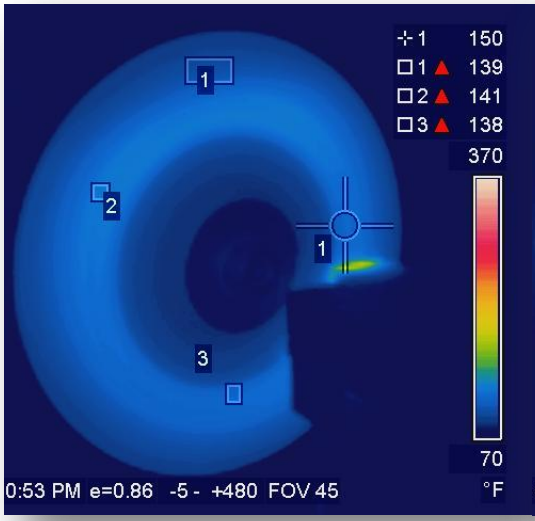
EXO GREASE-LESS GUNS

EXO TECHNOLOGY FEATURES

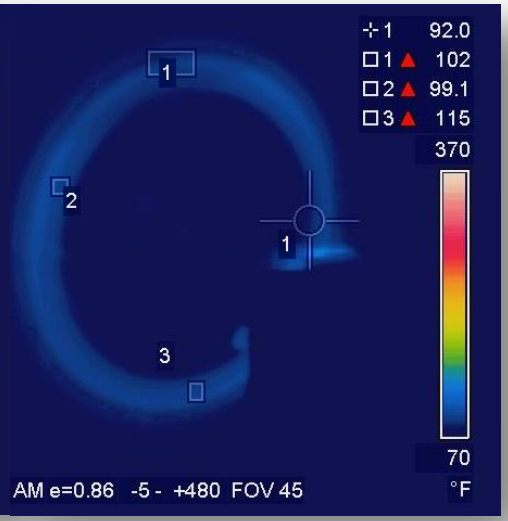
UNIQUE SURFACE TOPOGRAPHY

- Large surface area to maximize heat dissipation from the surface
  - Cooler temperatures ➔ better mechanical stability of tools (especially thin bodied) and components.
  - Modified heat-signature.

UNCOATED



COATED

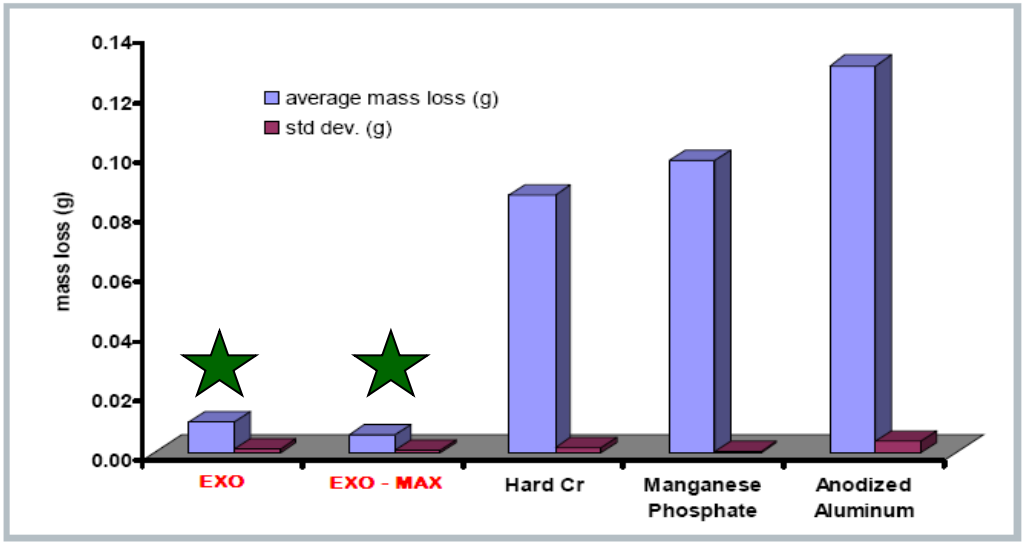


COATED MORTAR TUBES

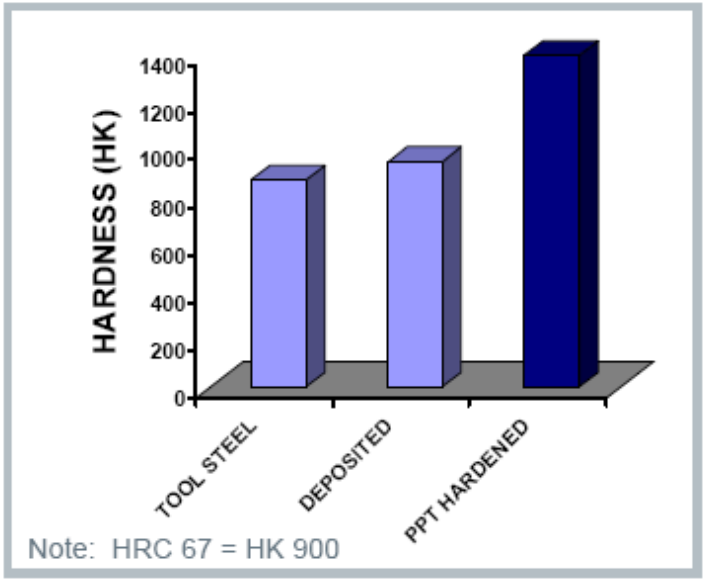
EXO TECHNOLOGY FEATURES

WEAR RESISTANCE

- Adequate hardness, that can be tailored over a range of 900 – 1400 Knoop, depending upon the application.



ASTM G65 Procedure C

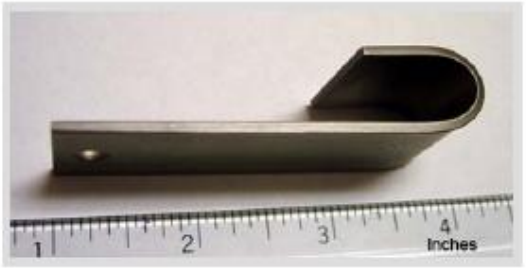


EXO TECHNOLOGY FEATURES

MECHANICAL INTEGRITY

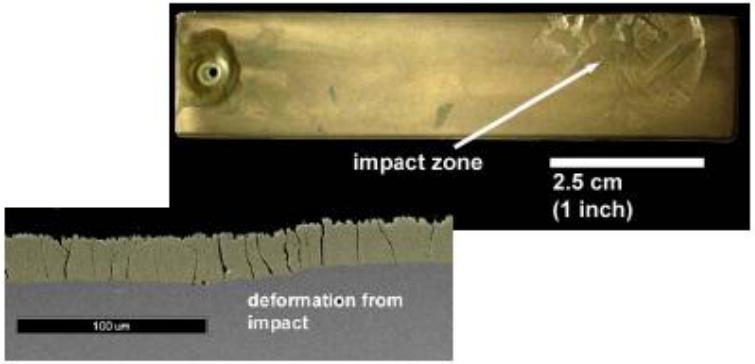
- Excellent bonding to most surfaces
- Bending & Impact resistance

BENDING DEFORMATION
(survives 180° bend test)



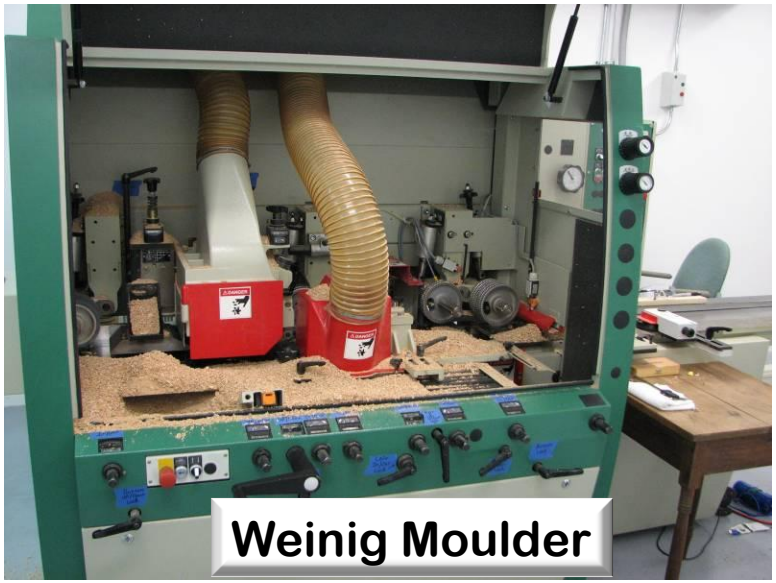
TENSILE BOND
> 70 MPa
(> 10,000 psi)
(exceeds test ability)

IMPACT
(no delamination)

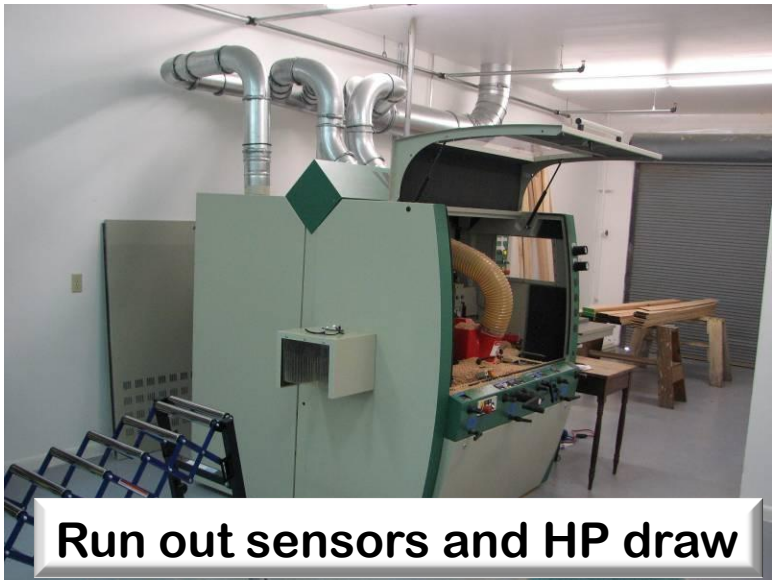


TESTING
EXO-TECHNOLOGY

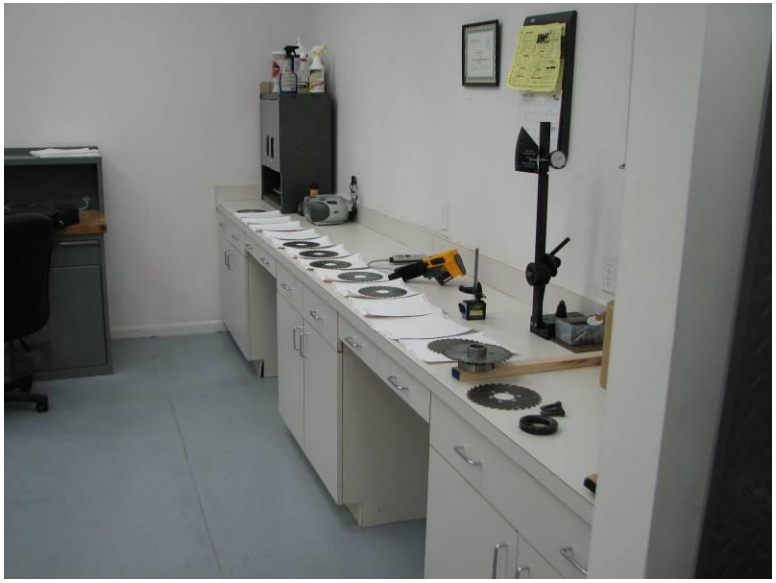
UCT Forestry Testing Laboratory



Weinig Moulder



Run out sensors and HP draw



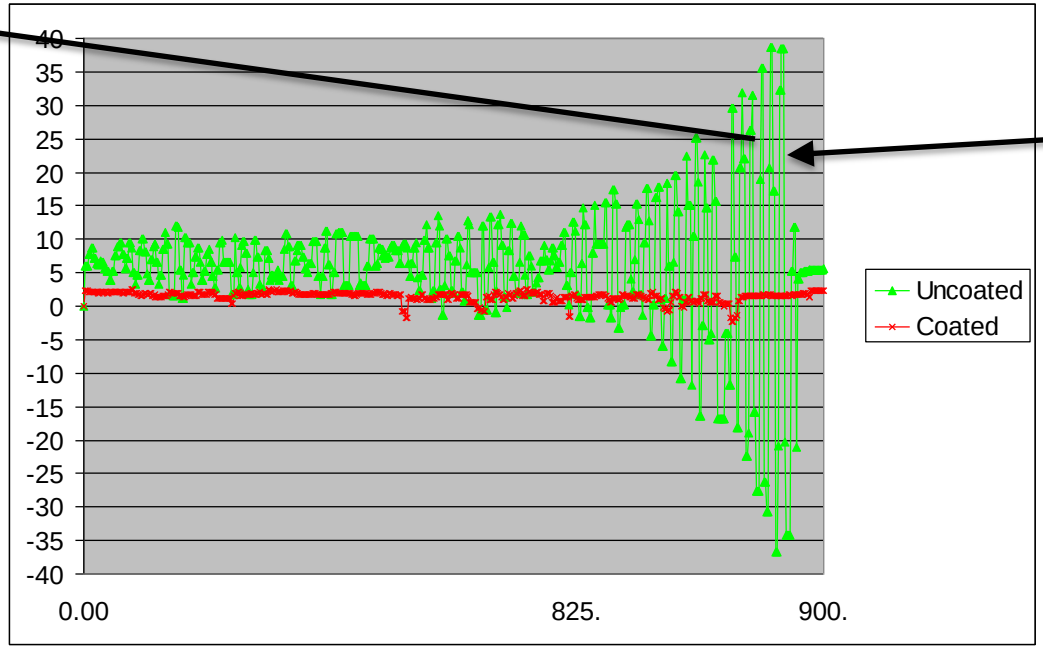
TESTING PROTOCOL

- SAW BLADES MANUFACTURED BY STS ➔ 180 mm DIAMETER, 1.35 mm KERF, 1.10 mm PLATE, TIP-TO-BODY CLEARANCE: 0.006”
- WORK PIECE MATERIAL: RED OAK
- MEASURE AMPERAGE DRAW, DYNAMIC RUN-OUT AND TOOL TEMPERATURE AS A FUNCTION OF LINEAL FEET OF WOOD STRIPS CUT BY THE SAW.

Cutting 1½” Red Oak

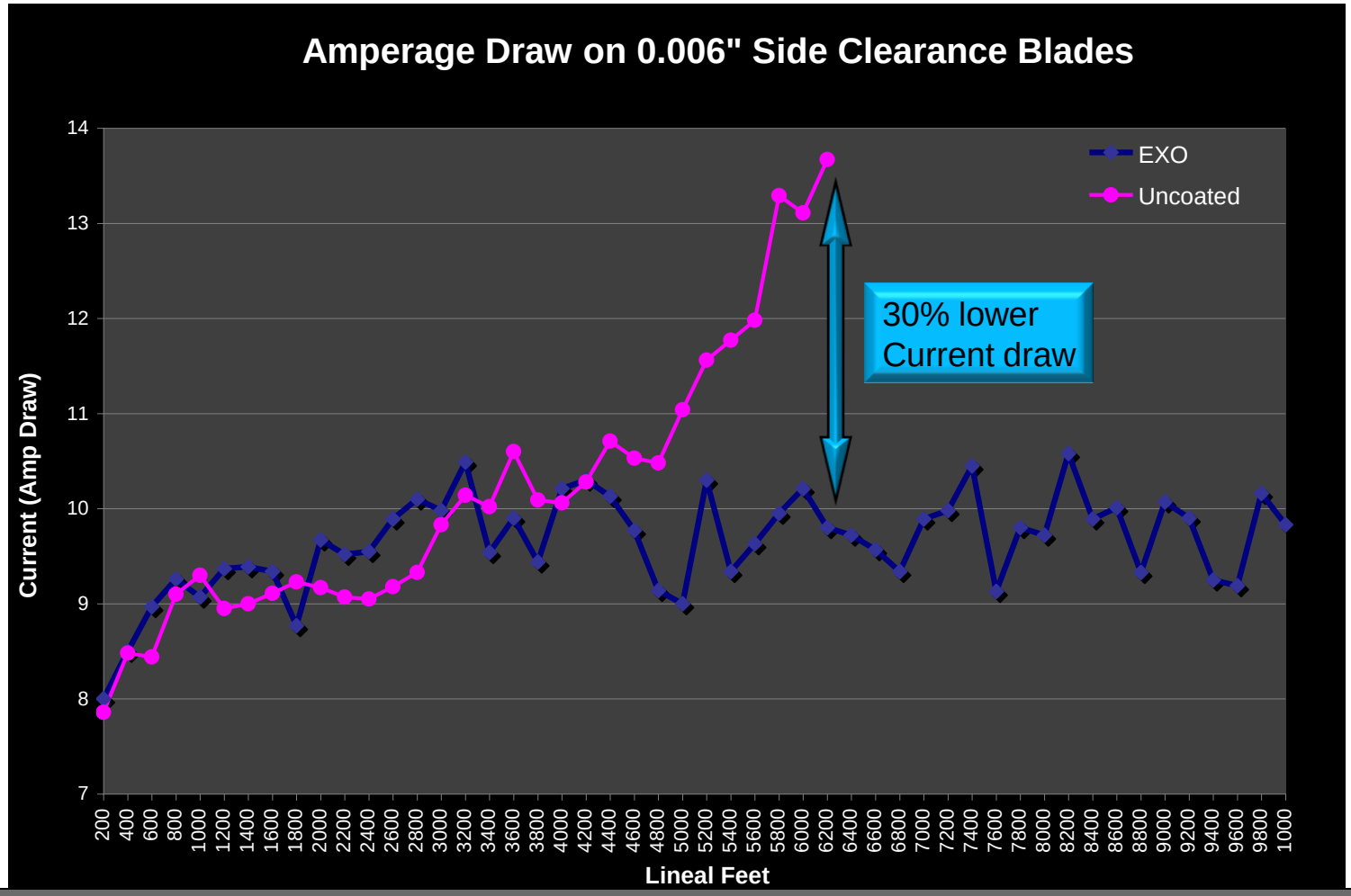
Resin Build-up

Cut Deviation



Blade run-out

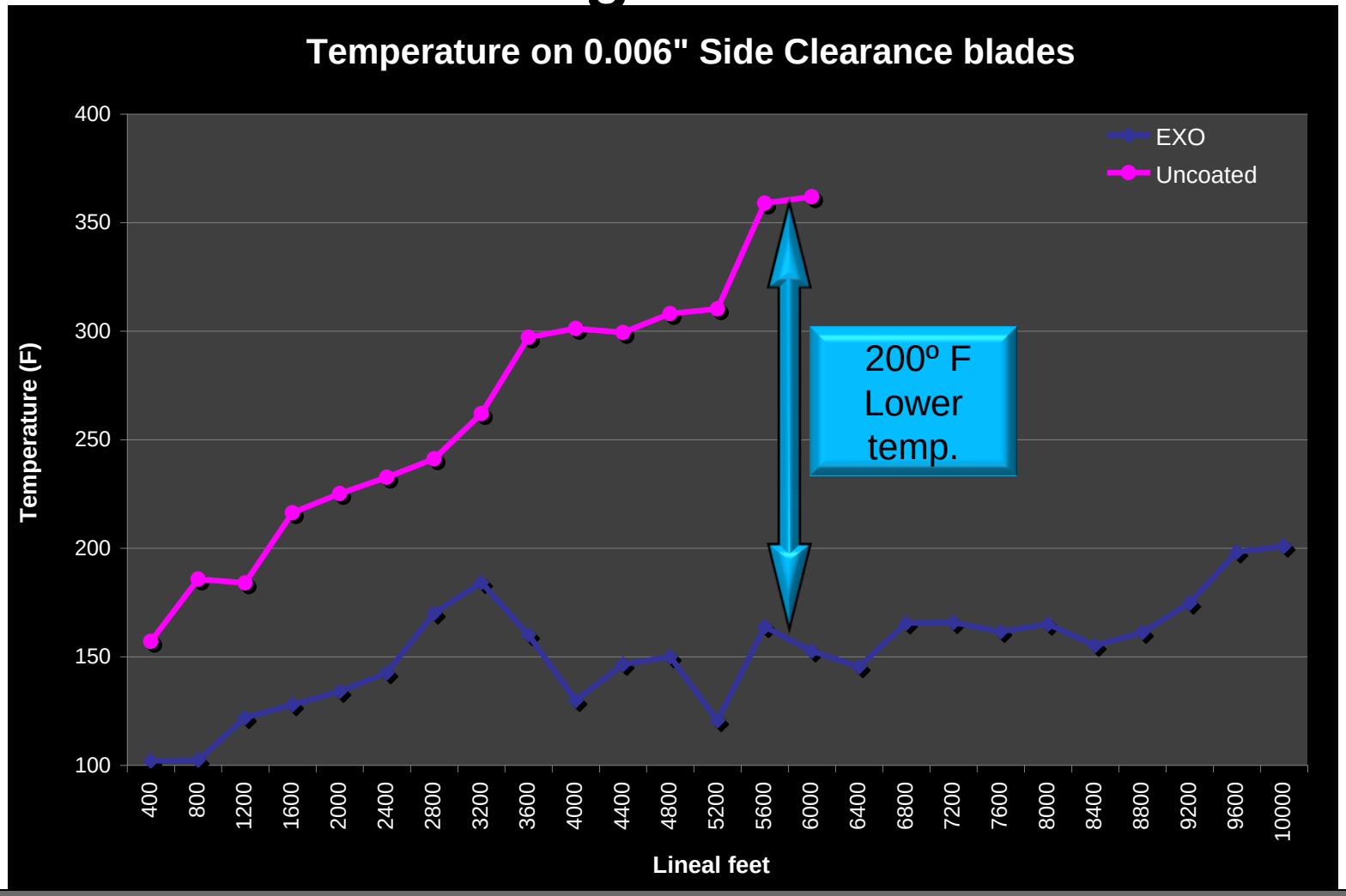
Cutting Test Data



Nodular surface topography ➔ Low sliding contact area minimizes friction forces.

20% lower amperage for coated saws ➔ lower Horse Power & Energy requirements

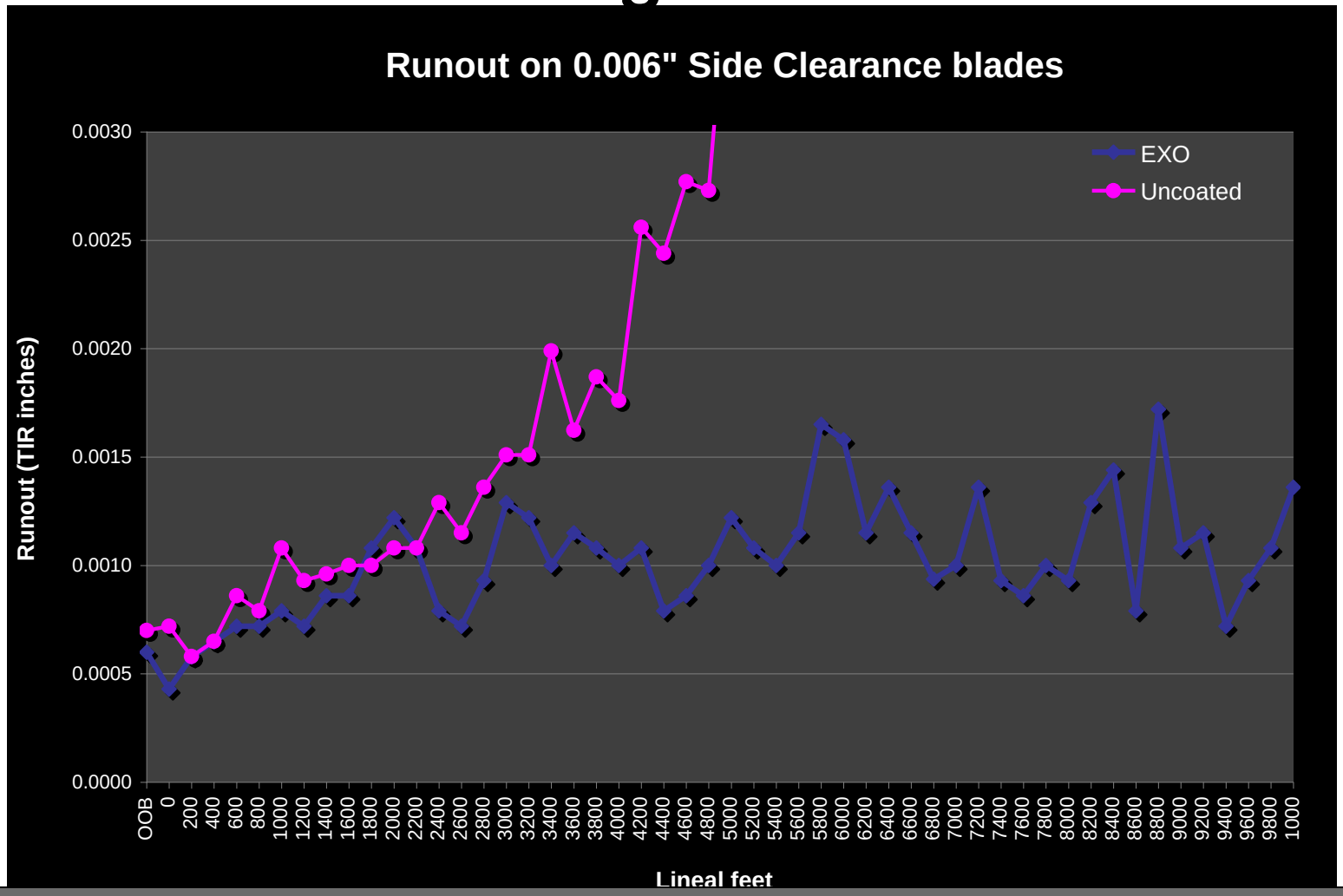
Cutting Test Data



Nodular surface topography ➔ Large surface area ➔ higher heat dissipation rate.

Significantly lower temperature for coated saw

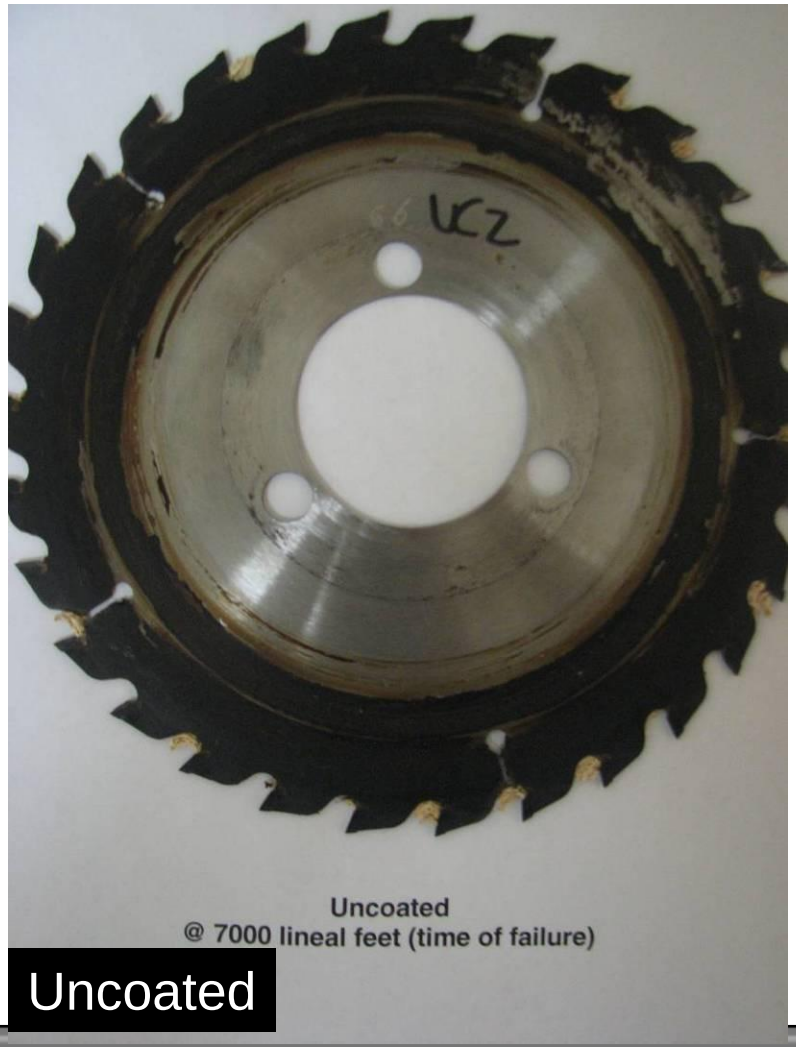
Cutting Test Data



Lower temperature of coated blade ➔ improved mechanical integrity

Significantly lower axial run-out for coated saw

PITCH / RESIN BUILD-UP

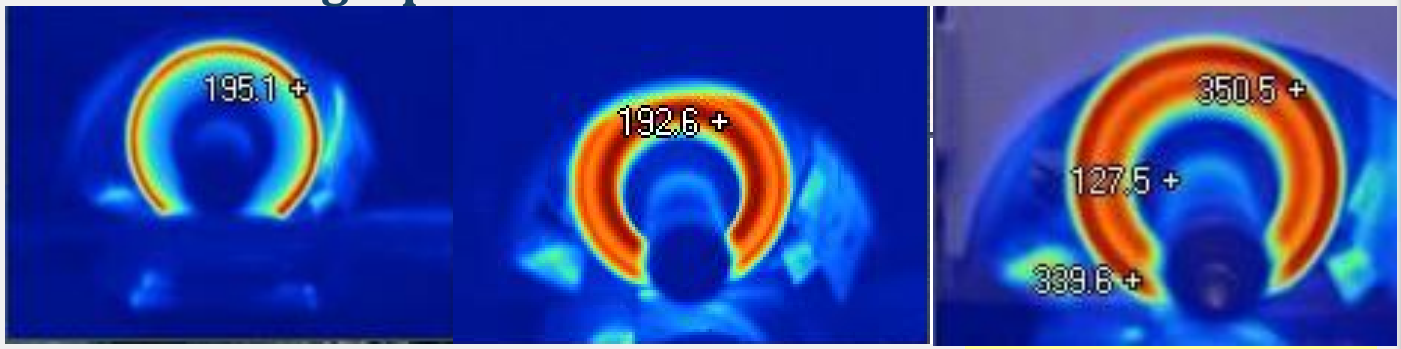


Less Pitch / Resin build-up on coated saws

Pitch on coated saws less adherent and easily removable

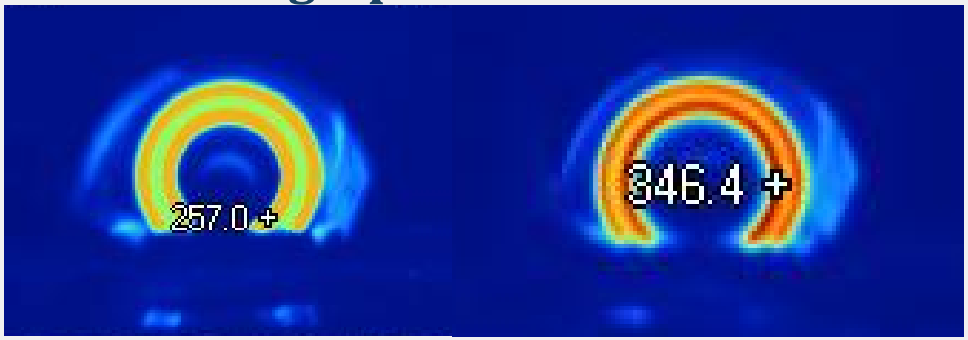
HEAT DISSIPATION FROM COATED SURFACES

Thermograph of coated blade



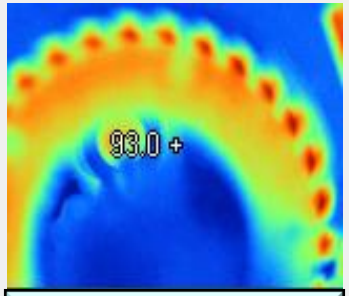
At 800 lineal ft (195° F) At 2800 lineal ft (193° F) At 3200 lineal ft (350° F) Blade failed at this point

Thermograph of uncoated blade

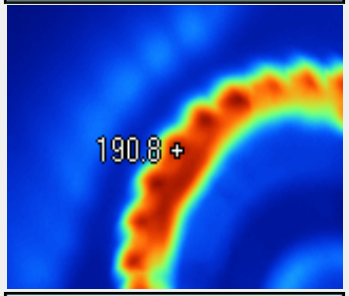


At 1200 lineal ft (257° F) At 1600 lineal ft (346° F) Blade failed at this point

Coated blades run twice as long before they reach the same temperature as an uncoated blade.



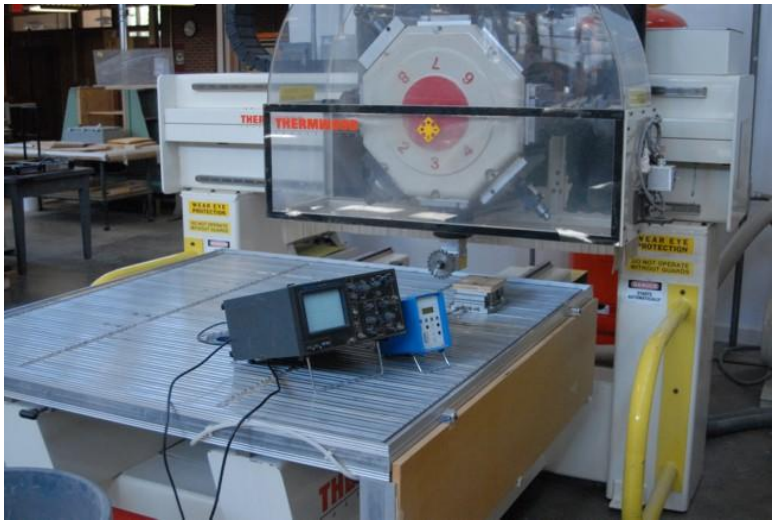
Coated Saw



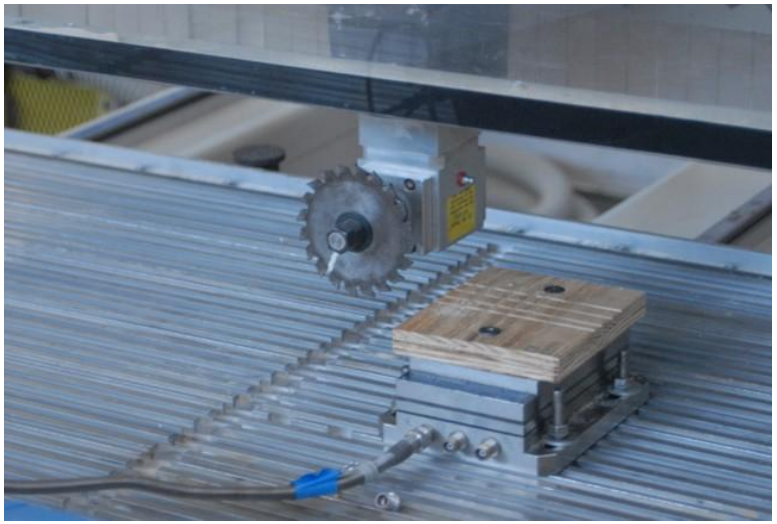
Un-coated Saw

Heat transfer away from cutting edge more effective with coated blade.

External Testing (NCSU) – Cutting loads



CNC Router Set-up



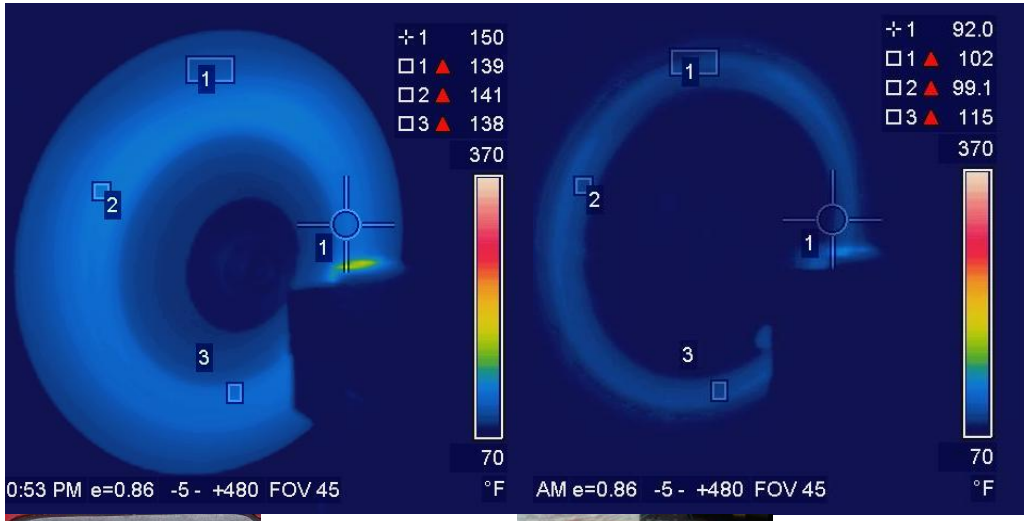
Blade cutting plywood block

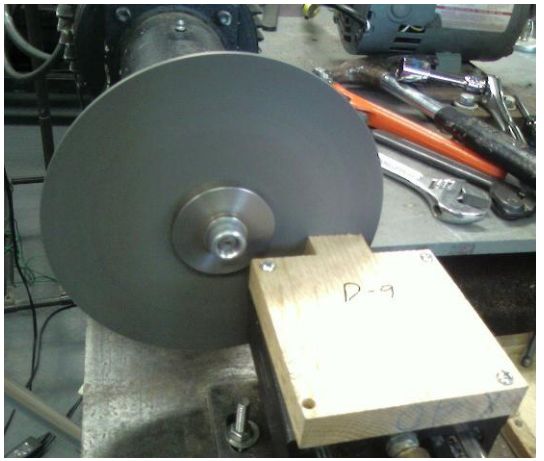
Industry standard side clearance for this type of cutting conditions is 0.012”. Coated blades; 0.006" tip to body side clearance. Cutting load ~ RMS milli-volts from 3-axes force dynamometer.

Species	Coated	Uncoated	Difference
MDF (blade set 1)	3.57	5.18	31.1%
MDF (blade set 2)	1.63	2.36	30.9%
Particleboard	3.57	5.18	31.1%
Pine	7.05	11.67	39.6%

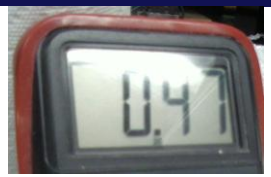
Thermal Characteristics – HP draw

Temp after 5 min at 7200 RPM





Uncoated Disk



Coated Disk

Disk	HP draw	% Change	Ave Temp	Difference
Uncoated	0.89 hp	★	142° F	★
Coated, unpolished	0.47 hp	-49%	102° F	-40° F

- Improved heat dissipation from coated surface.
- Lower friction forces on coated surface ➔ lower Horse Power draw.

Conclusions of recent external testing

- Tool temperature - reduced by 40 degrees
- Horse-Power draw - reduced by 49%
- CNC Cutting loads – reduced by 30-39%
- Accelerated Acid Wear Test – wear reduction of 50%

- **EXO saws generate lower cutting forces vs uncoated saws. This translates into:**
  - **Lower HP draw**
  - **Lower tool temperature**
- **Reduction of friction due to EXO provides reduction of heat, drag and wear – significant value driver for a diverse range of wood and metal working products.**

PROPERTIES OF
EXO treated tools and components

EXO treated tools dissipate heat more effectively – hence remain cooler over a longer period of time

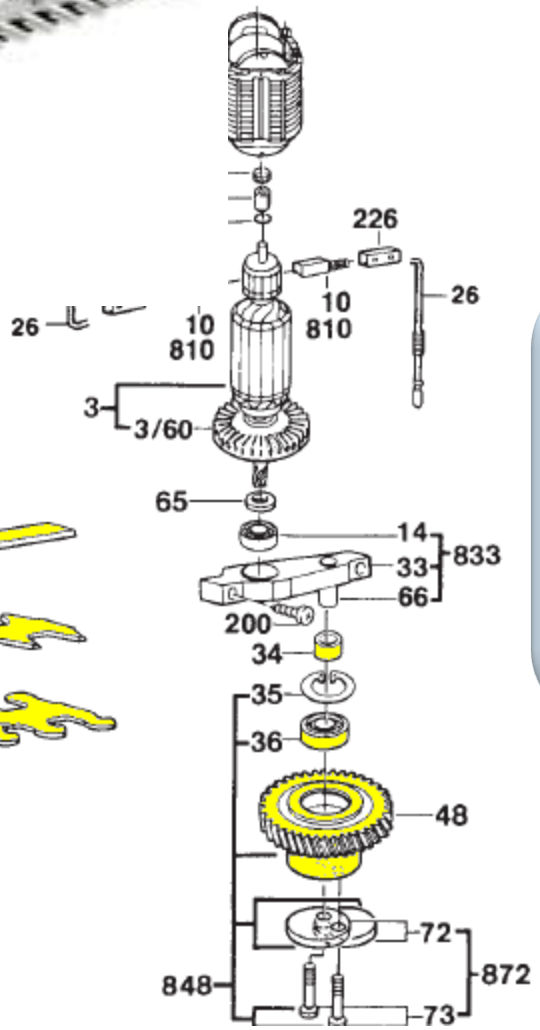
- Improved mechanical stability
- Less resin or work-piece material build-up
- Improved cut quality
- Lower 'operating' kerf ~ Less cutting deviation

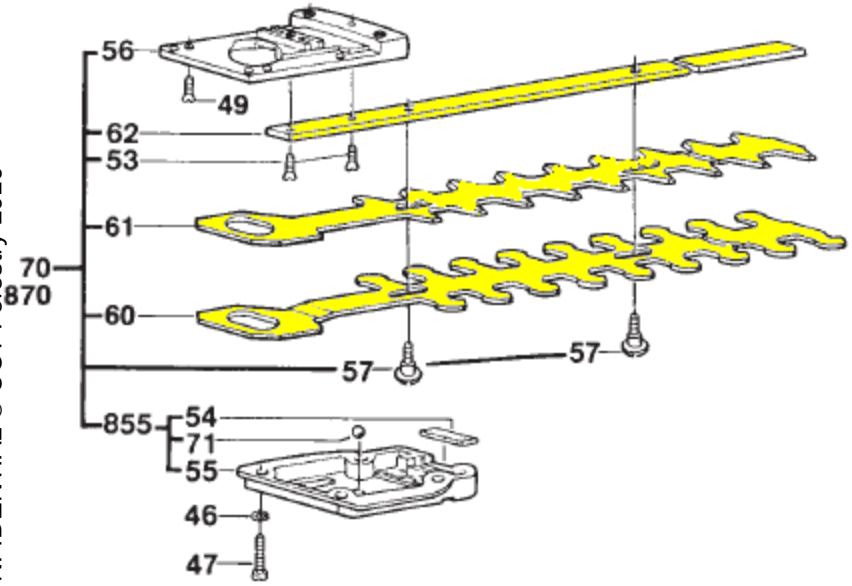
EXO treated tools and components have excellent lubricity

- Material has an inherently low coefficient of friction.
- Unique surface topography minimizes contact surface area and hence leads to lower friction forces.
- Lesser heat generation than uncoated saws
- Lower cutting forces and power requirements → reduced energy consumption
- Significantly reduced lubrication consumption

EXO TECHNOLOGY
AS APPLIED TO POWER TOOLS

Value Proposition for EXO HEDGE TRIMMERS





EXO Applications:

- Blades & Blade bars
- Internal drive components

EXO Propositions:

- ❑ Longer blade life
- ❑ Reduced gasoline consumption
- ❑ Lower lube consumption.

Value Proposition for EXO CHAIN SAWS

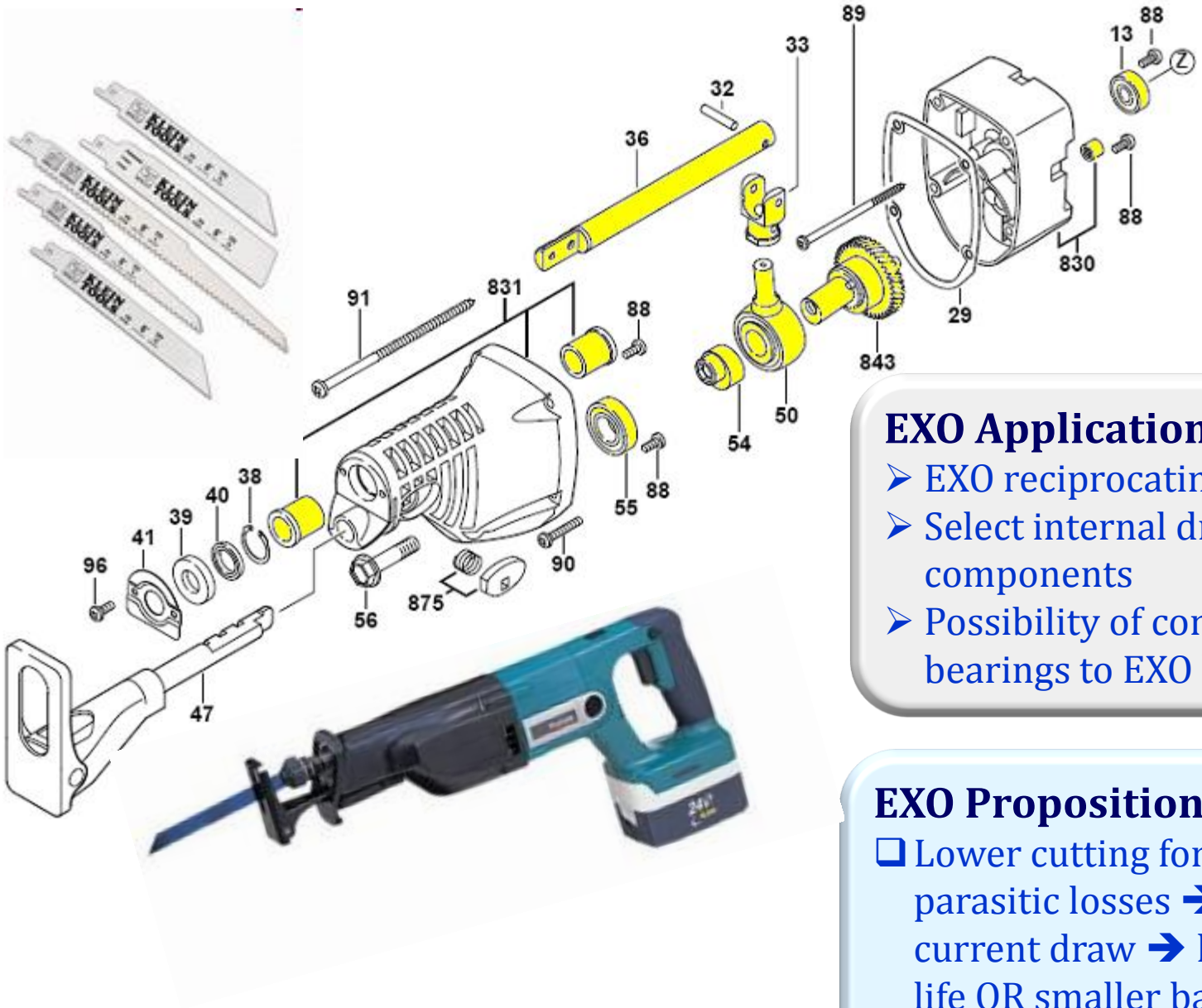
EXO Applications:

- Guide-bars, cutters & chain sprockets
- Internal drive components.

EXO Propositions:

- ❑ Life extension of guide bar and cutters.
- ❑ Lube reduction
- ❑ Thinner-kerf cutters.
- ❑ Lower cutting forces ➔ longer battery life OR smaller battery ➔ weight reduction.

Premium EXO RECIPROCATING SAW



EXO Applications:

- EXO reciprocating saw blades
- Select internal drive components
- Possibility of converting bearings to EXO bushings

EXO Proposition:

- Lower cutting forces & parasitic losses ➔ lower current draw ➔ longer battery life OR smaller battery ➔ weight reduction.

SUMMARY

VALUE PROPOSITION FOR POWER TOOLS:

- **REDUCED CUTTING FORCES:**
  - **LOWER POWER CONSUMPTION**
  - **LOWER LUBE CONSUMPTION ➔ "GREEN" TECHNOLOGY**
  - **LESS EFFORT ➔ ERGONOMIC DESIGN**

- **PROLONGED LIFE OF TOOLS AND INTERNAL COMPONENTS**

- **IMPROVED CUT QUALITY**

THINK GREEN

EXO COATED ACCESSORIES & INTERNAL DRIVE COMPONENTS become an ENABLING TECHNOLOGY for a PREMIUM line of POWER TOOLS

Thank You!

For further details please contact:

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