Milling for Smoothness, Milling for Profit

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ROADTEC

People and Planning

The first step towards achieving a smooth milling job occurs way before the construction process begins

Everyone involved in the milling process contributes to the overall smoothness of the job, including:

- a. Mill operators
- b. Ground person
- c. Truck drivers
- d. Clean up.

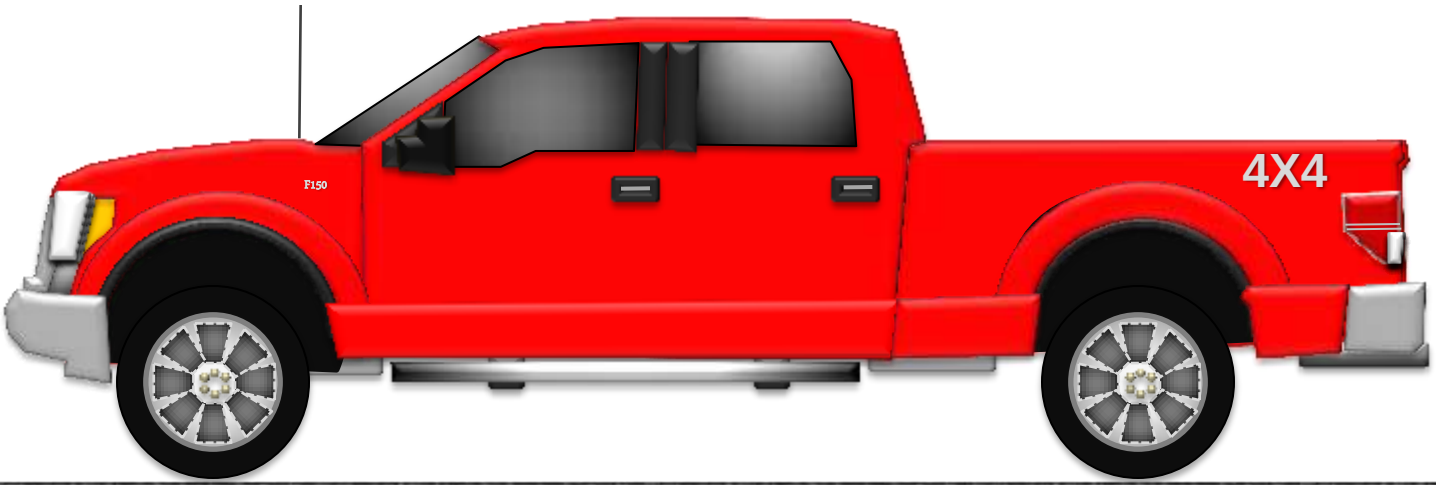
Do I have what I need?

Do I have all the correct safety equipment

Do I have enough teeth to get through the day?

Do we have a Game Plan for a Productive day?

It is important to understand the job. Cutting it once and Correctly is by far the most economical way for the Company.



Choose the proper equipment

Where Do We Start?

Tracking

Watch to see how the machine is tracking.

You may be keeping a good line with front tracks but if your tracking is off then you will have several problems.

Again the deeper you are the more this is critical.

You are looking for marking in the pavement as shown below.

Keeping a straight line

The deeper the cut the more that a straight line is important.

Side loading the cutter will reduce bearing life

End ring wear.

If you are not paying attention you will be into the holders very quick.

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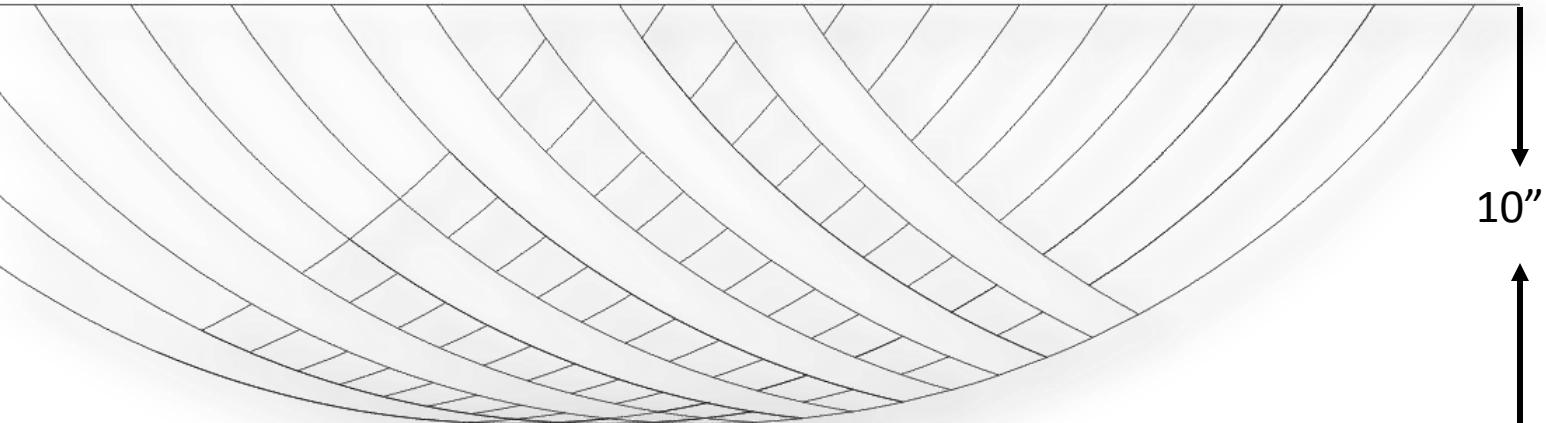
Cross hairs in the cut

Look for a cross hatch pattern in the cut.

a. You should be seeing a up and down cut pattern.

b. If the pattern is only going in one direction then this is what you are trying to avoid.

c. You may need to wipe the fines clean before you can see this pattern.



Cross hairs in the cut

2 Types of Smoothness

- Longitudinal Smoothness (Ride)
  - How to achieve
  - Factors on Ride
- Surface Smoothness
  - How to achieve
    - Factors on surface texture
      - Drum maintenance
      - Speed (of what?)
      - Drum pattern
  - Impacts on Production

Grade & Slope Controls
Endgate Averaging

Grade & Slope Controls
Averaging System

Grade & Slope Controls
3D Grade System

Trim Grade based on Position

Checking 0

Be sure you know where to check 0

This is what you want
0 is 0

Keep it Clean

How can you mill with this.

If you have this to work with you will never achieve grade.

Why?

No really, clean up your mess

Oh that Pile.

Our shovel is on the water truck.

The automatics will take that out…

Clean up your mess

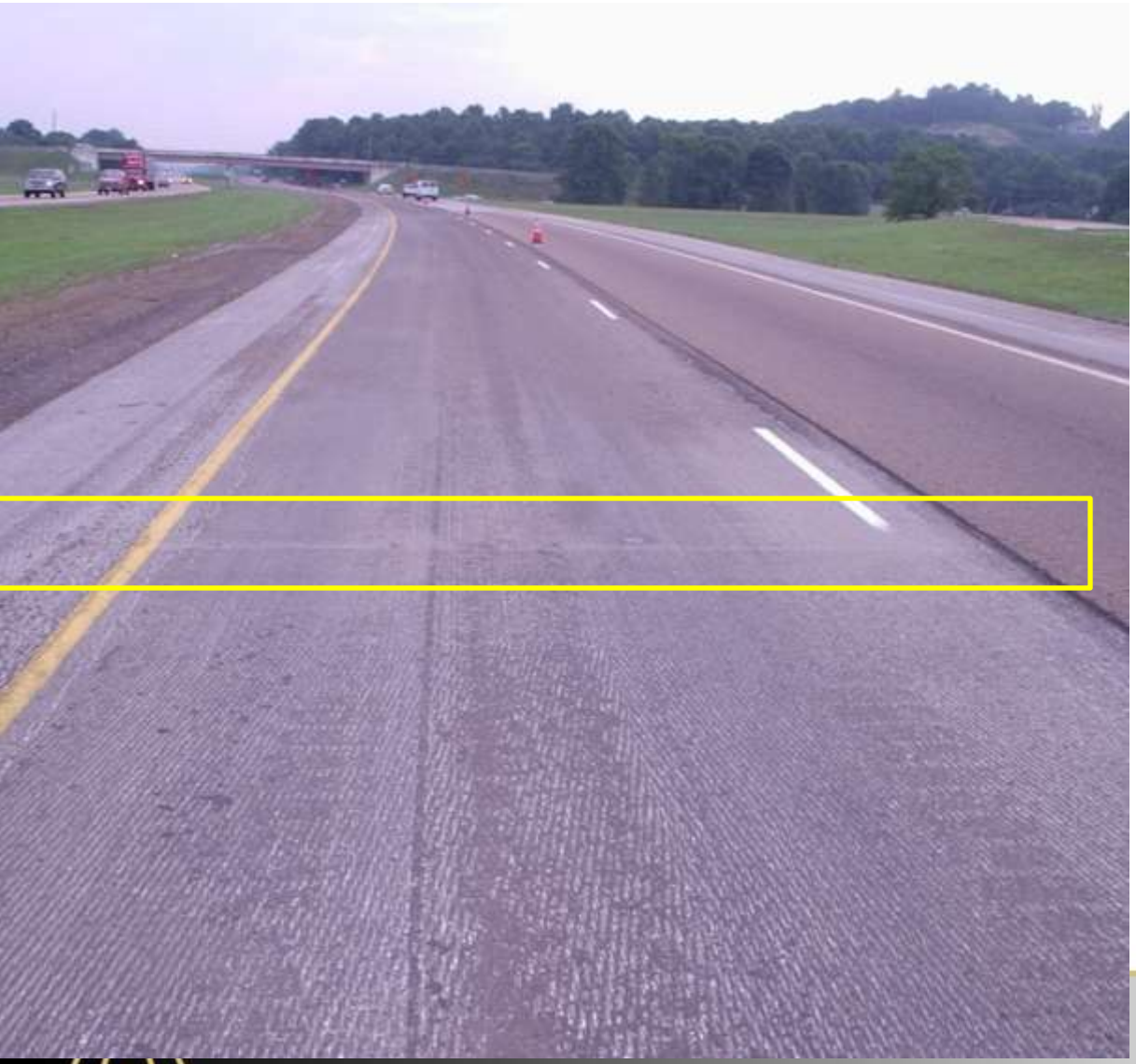
Clean up after you pick up.

What will happen when you set back down.

Instead of taking the time to clean this up I
Will just guess how thick this is.

Speed and Slope

Continuous Milling



There are a lot of forces generated during milling. When you stop so do the forces.
Plus all of the teeth now cut in one spot, no longer spread out.

2 Types of Smoothness

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  - Factors on Ride
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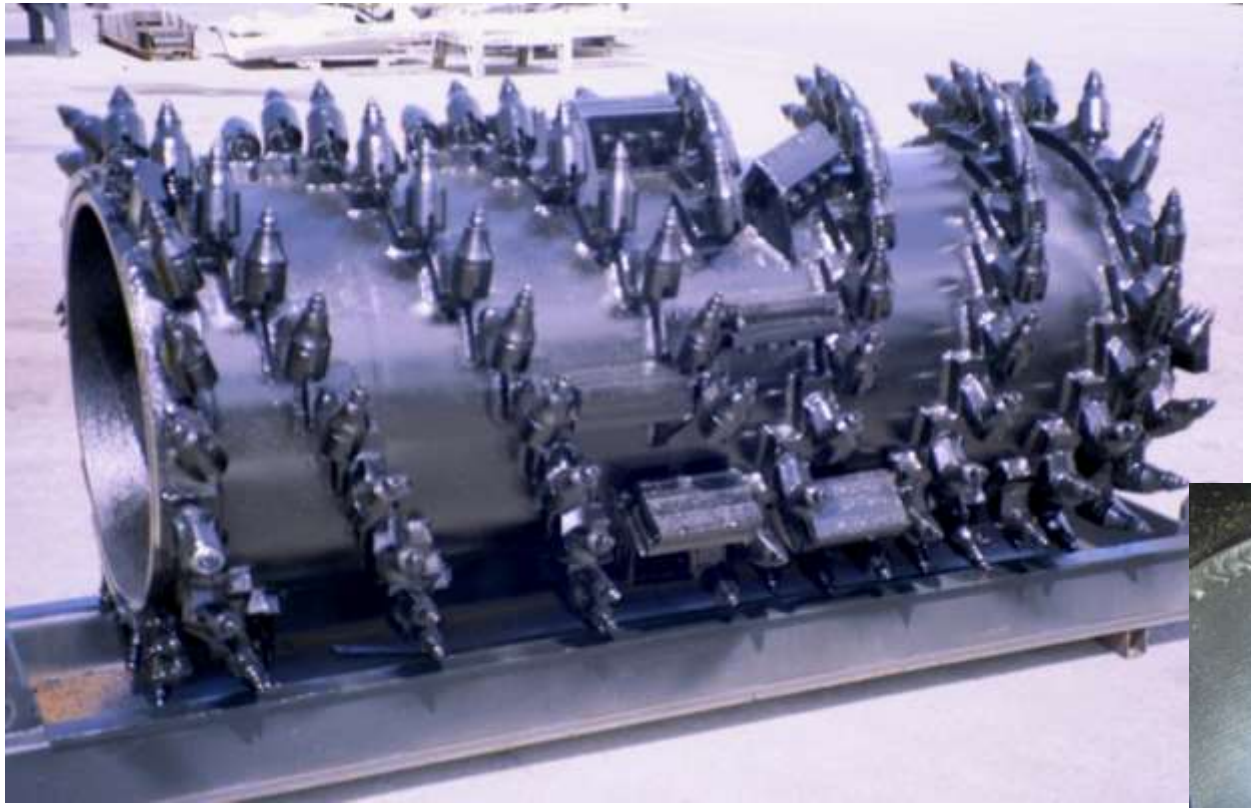
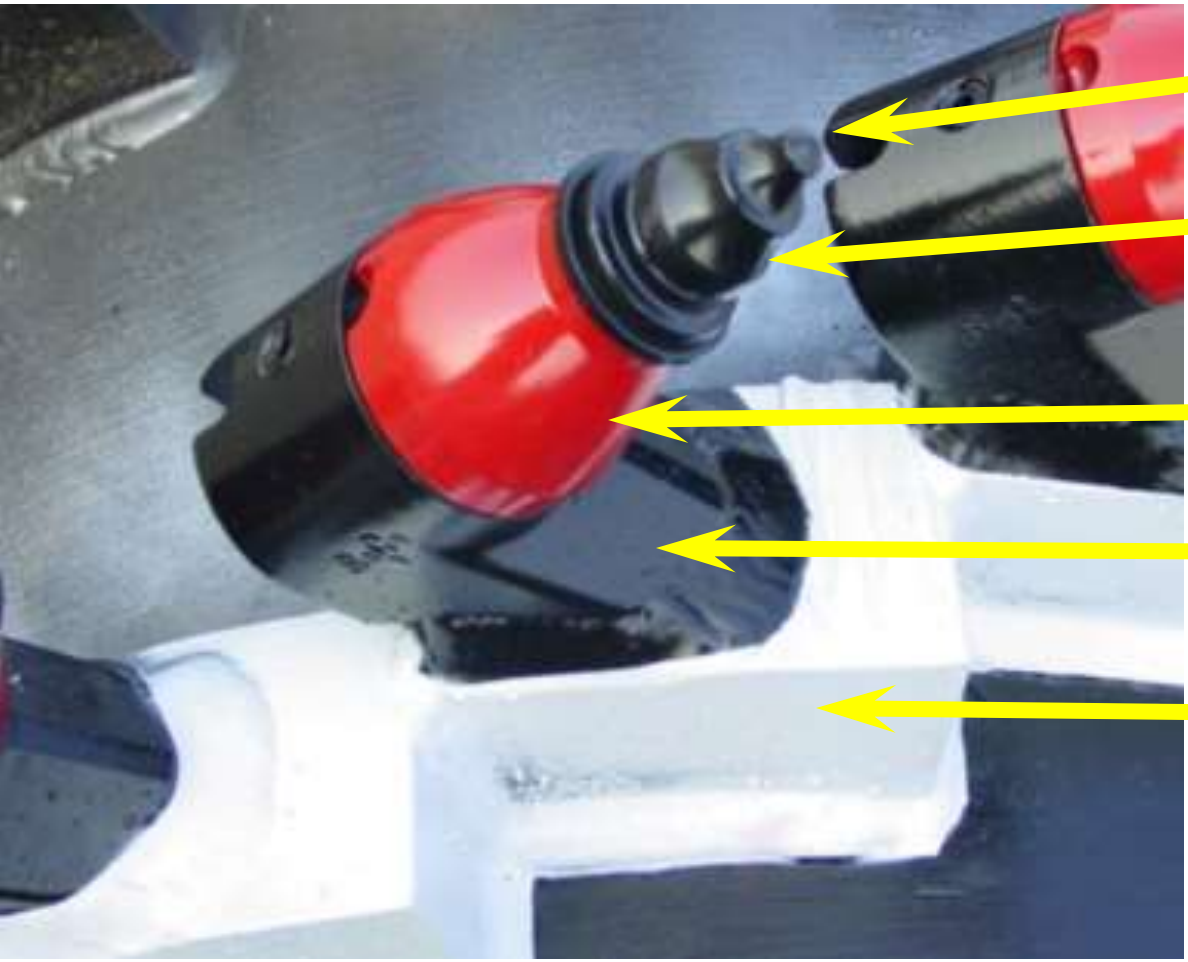
Surface Texture

Cutter Drum



Quick Change Drum Tooling

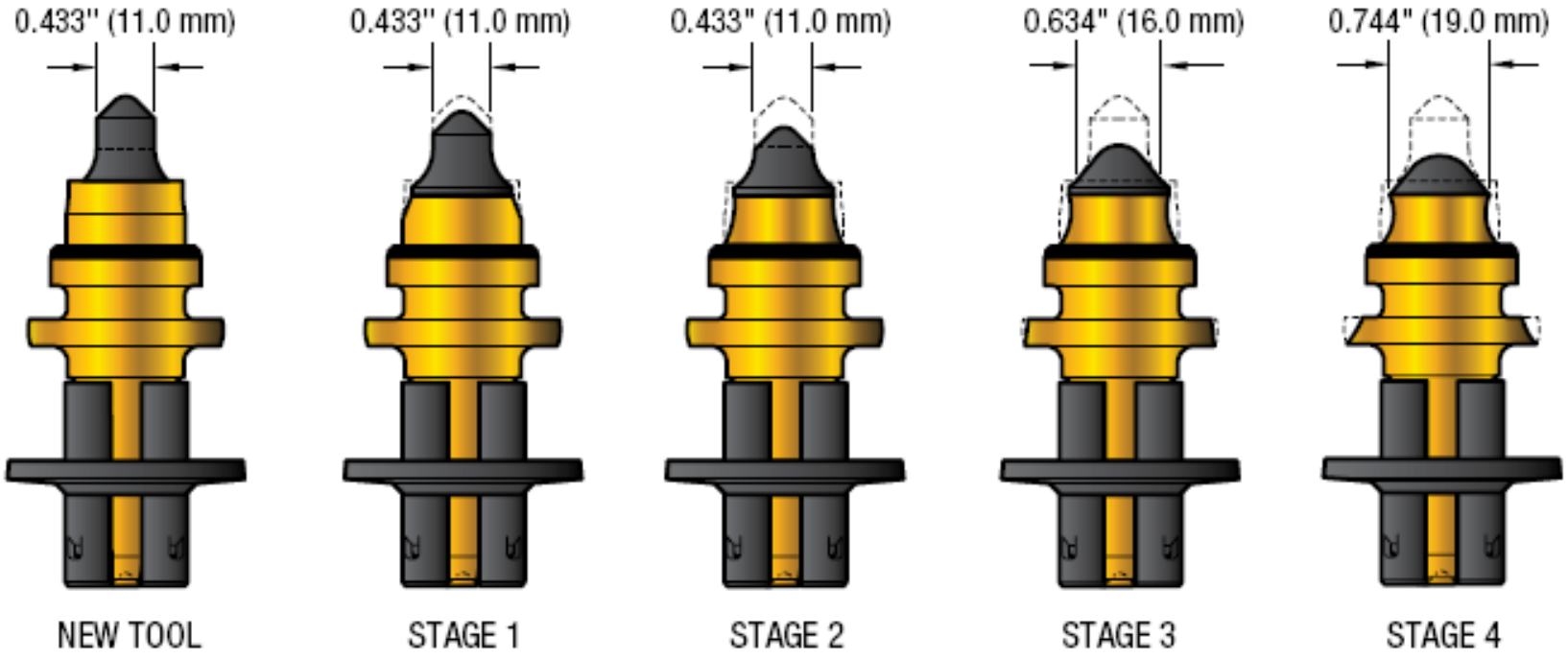


Cutter Drum

Proper Maintenance

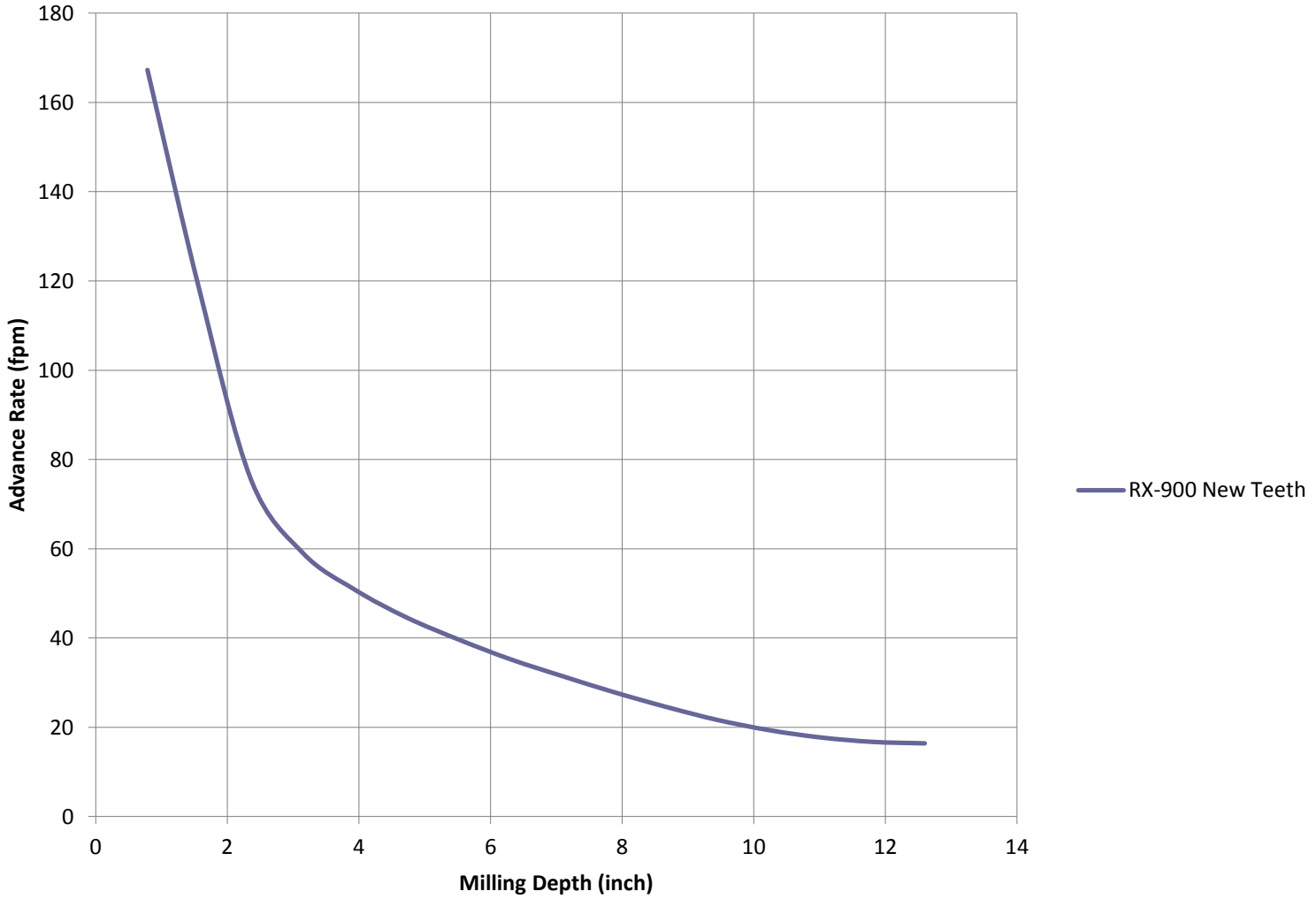
Tool Wear Characteristics

0.15 in^2 287% Increase in Surface Area 0.43 in^2

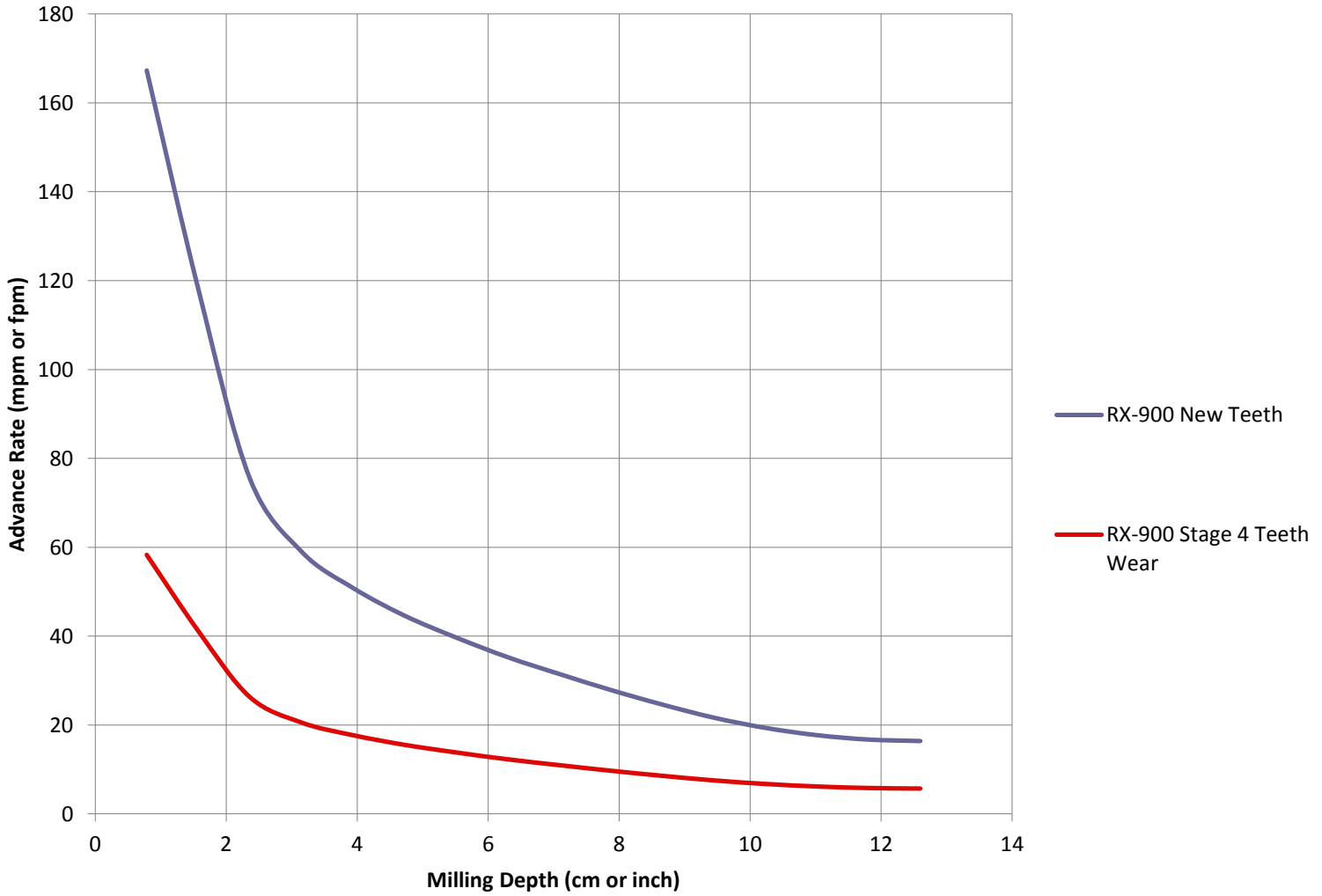


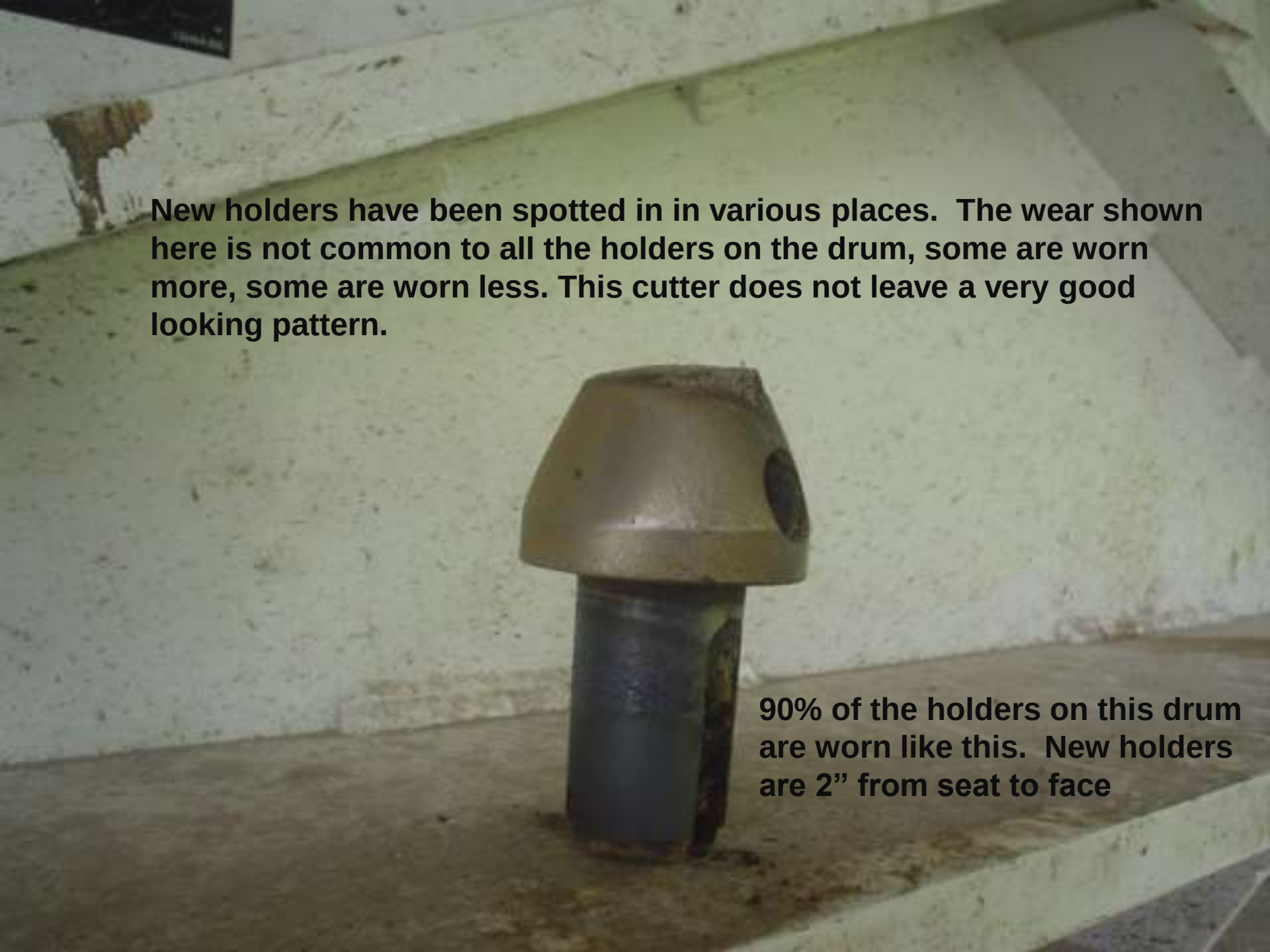
At Stage 3
Tool has lost 0.365 “ [9.3 mm]
of gage height

Production Tradeoff



Production Tradeoff




New holders have been spotted in in various places. The wear shown here is not common to all the holders on the drum, some are worn more, some are worn less. This cutter does not leave a very good looking pattern.
90% of the holders on this drum are worn like this. New holders are 2” from seat to face

Caliper set at EXACTLY 2”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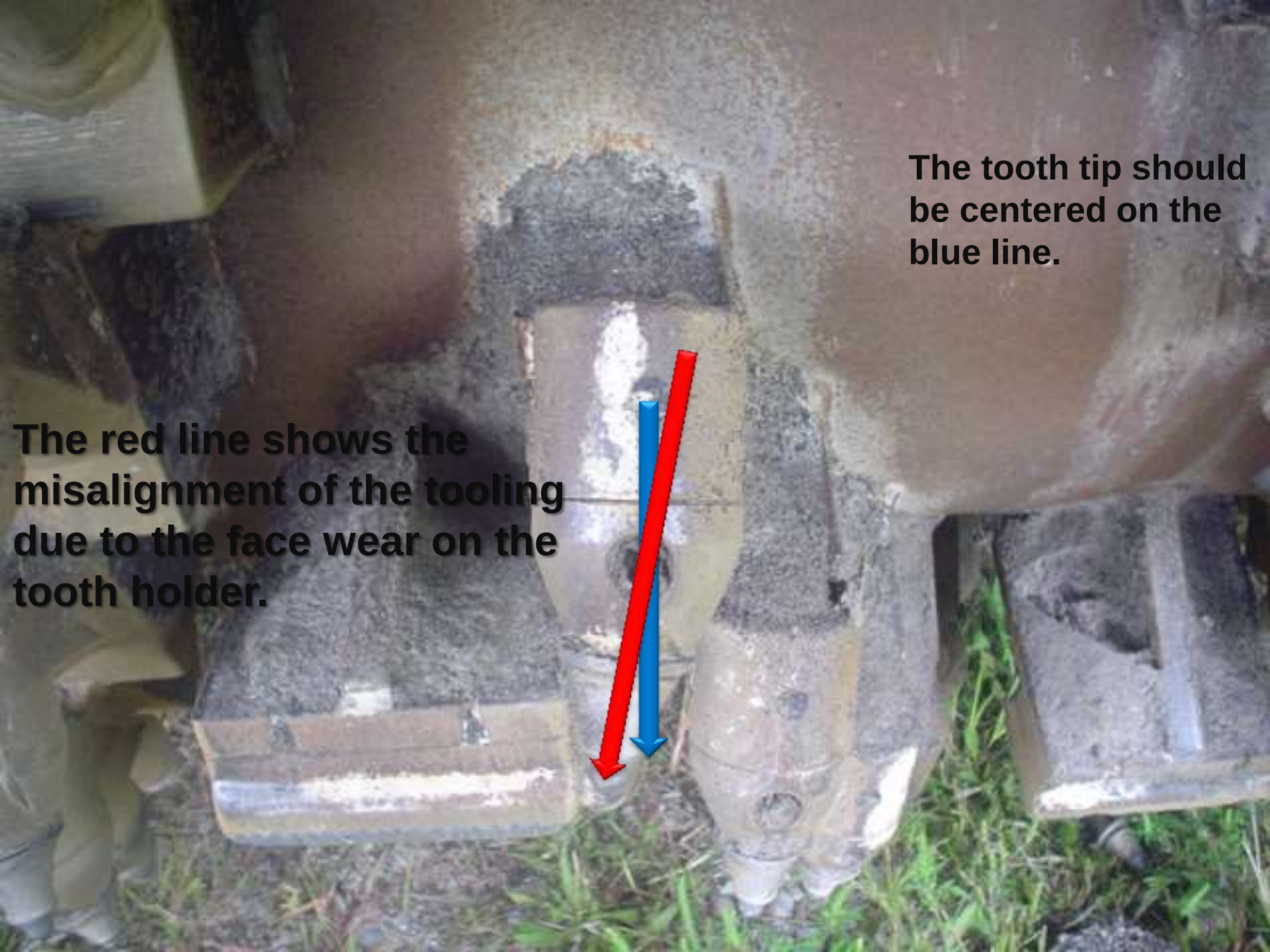
PAVING PROFESSIONALS
Same holder in previous picture turned 180 degrees

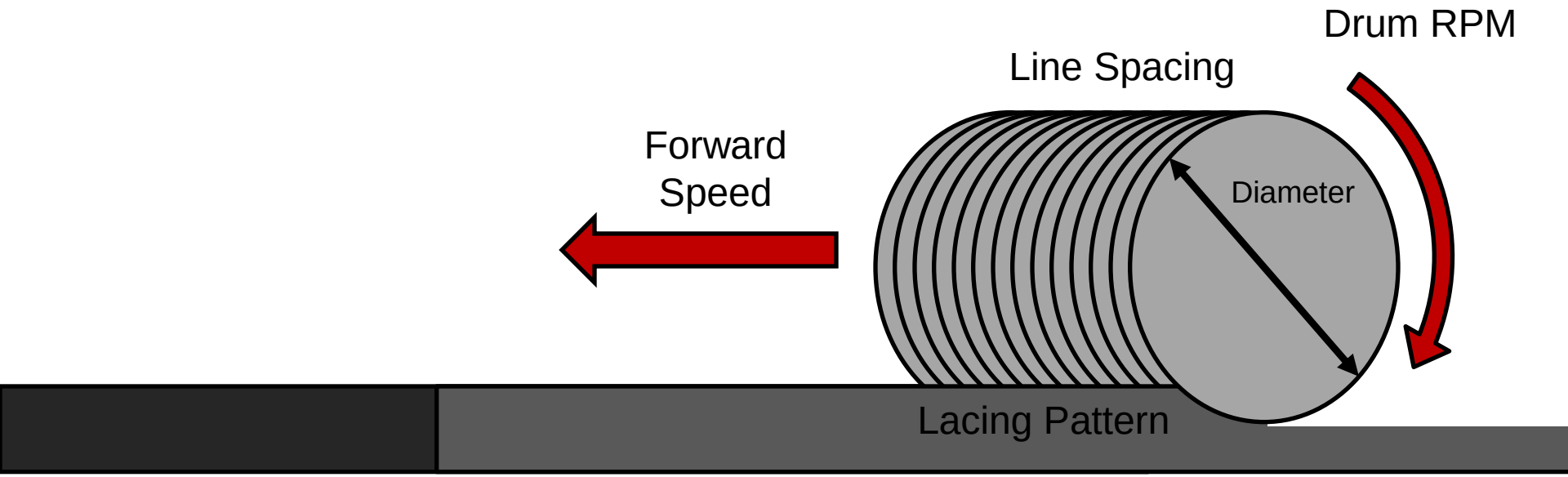

The tooth tip should be centered on the blue line.
The red line shows the misalignment of the tooling due to the face wear on the tooth holder.

Proper Maintenance

Proper Maintenance

Proper Maintenance

The Math of Milling



The 4 Main Factors that Affect Surface Texture

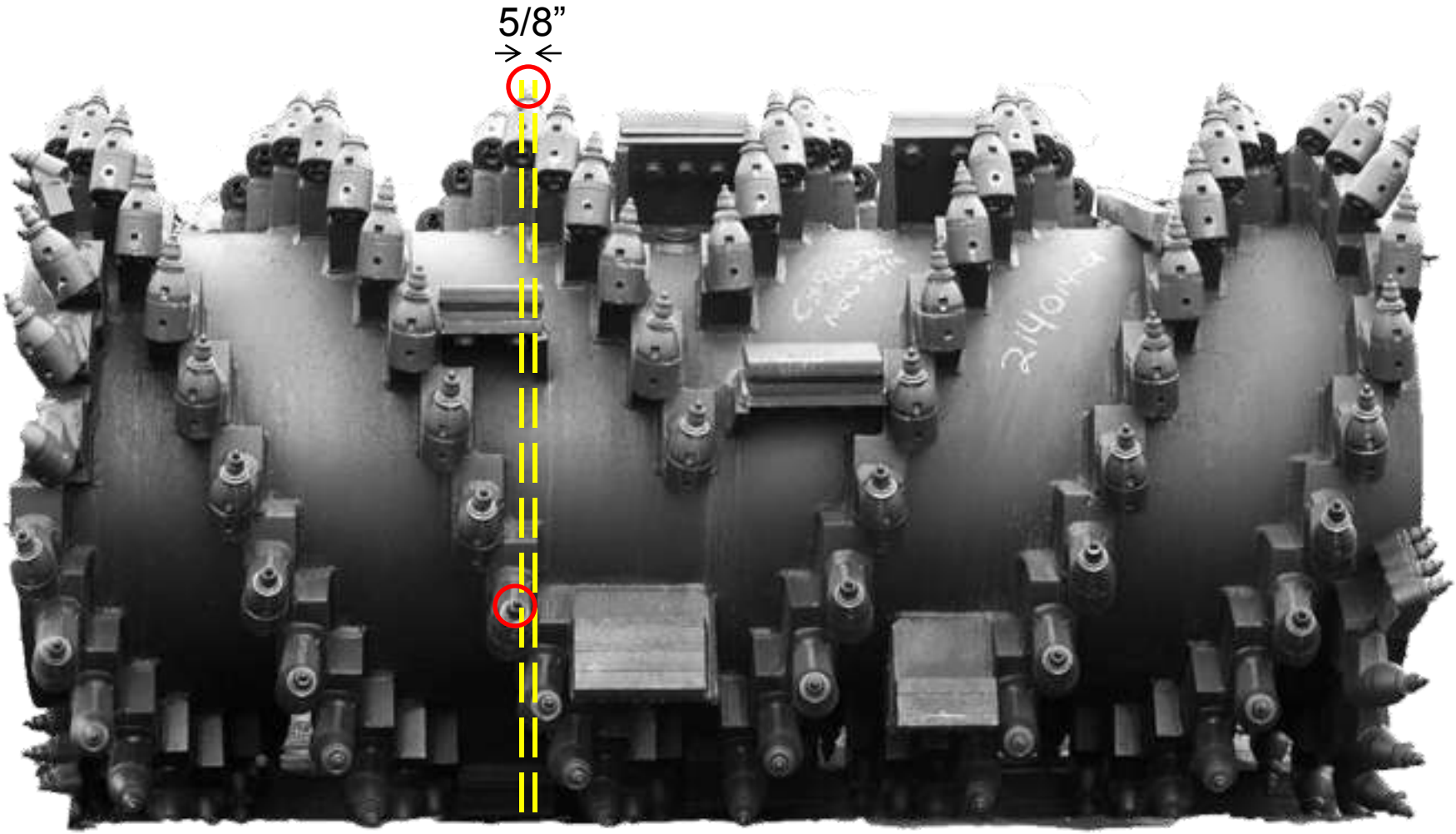
1. Line Spacing
2. Forward Speed
3. Drum RPM
4. Lacing Pattern

Triple Wrap, Off Set Flighting

Triple Wrap

Off Set Flighting

Line Spacing

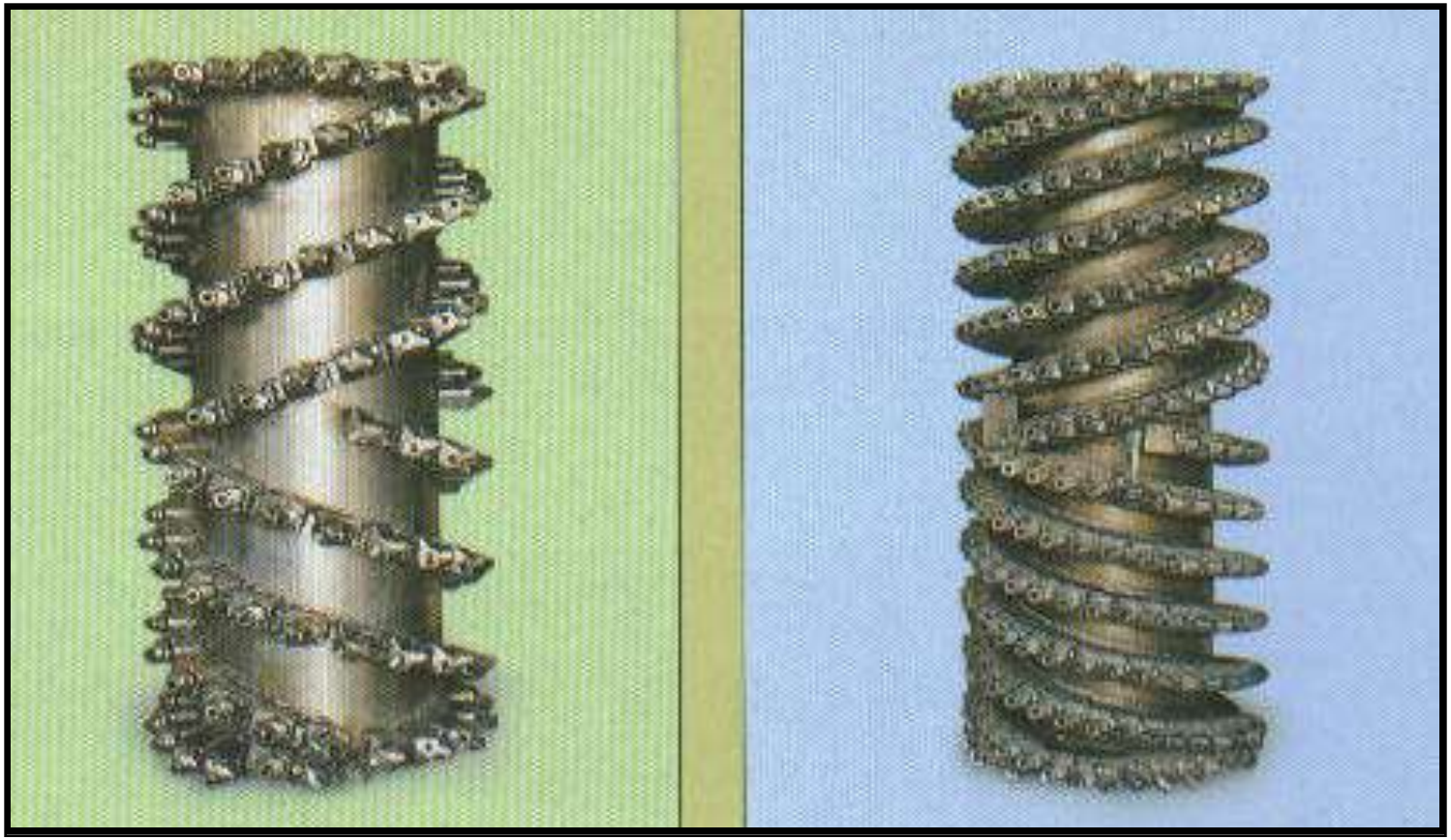


Standard Drum

5/8” Line Spacing

Profiling Drum

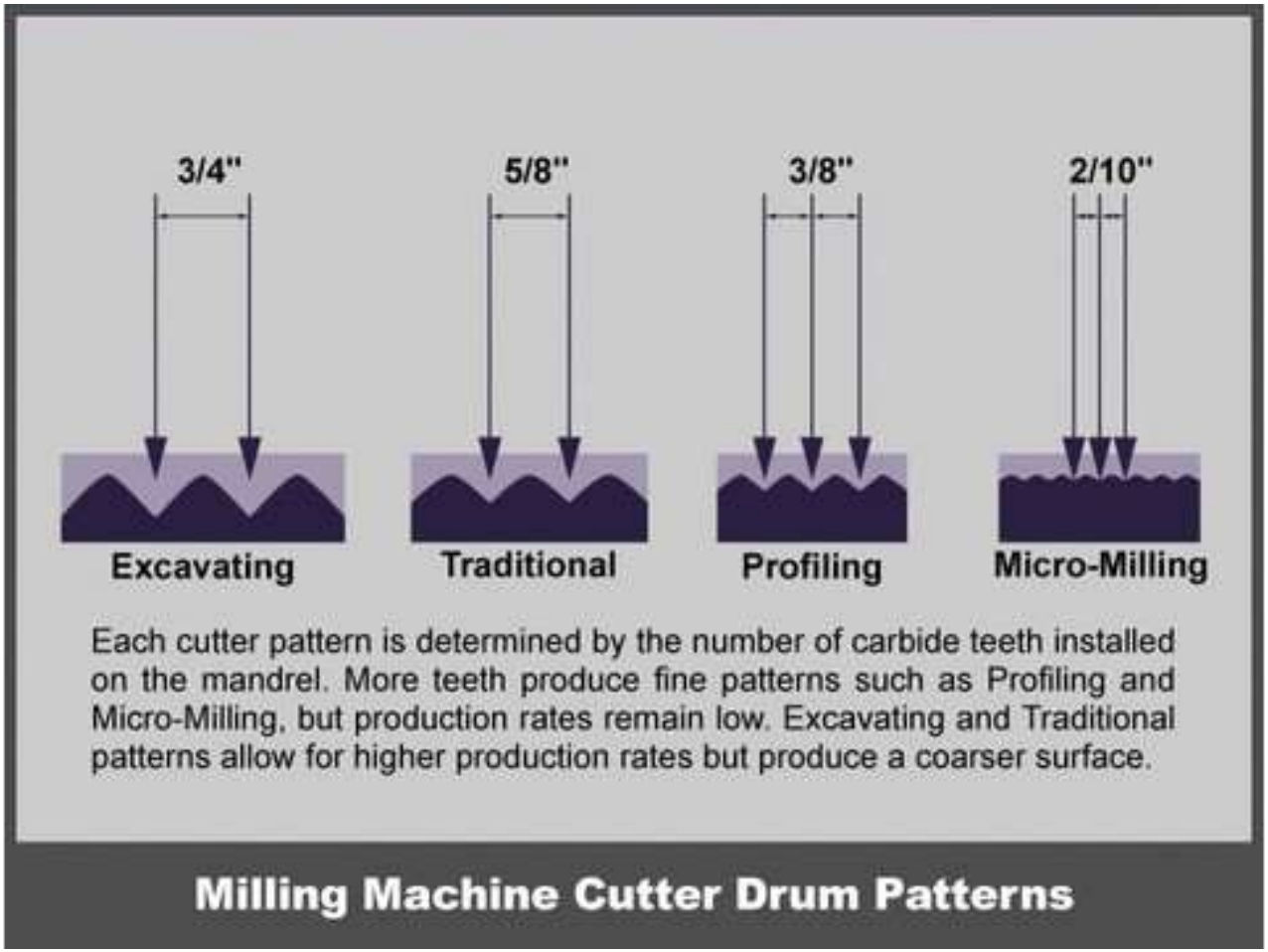
3/8” Line Spacing



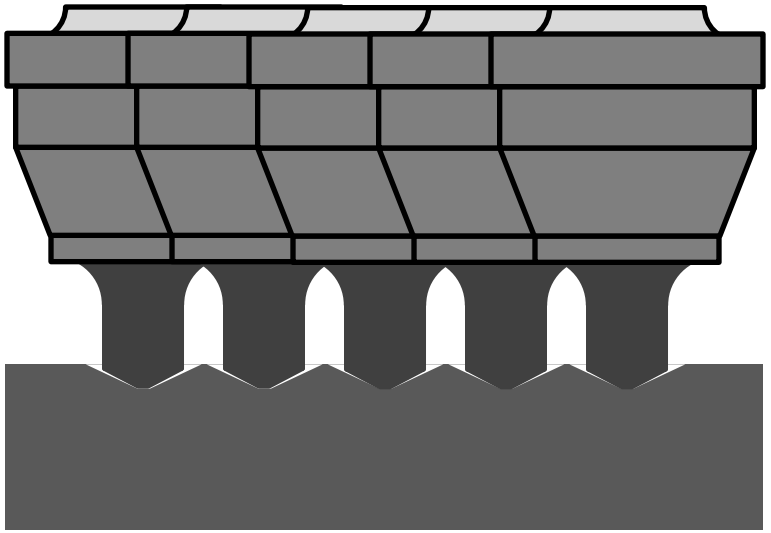
Micro-Milling Pattern

0.2” Line Spacing

Line Spacing and Texture



5/8” (16mm) Triple Wrap Lacing Pattern



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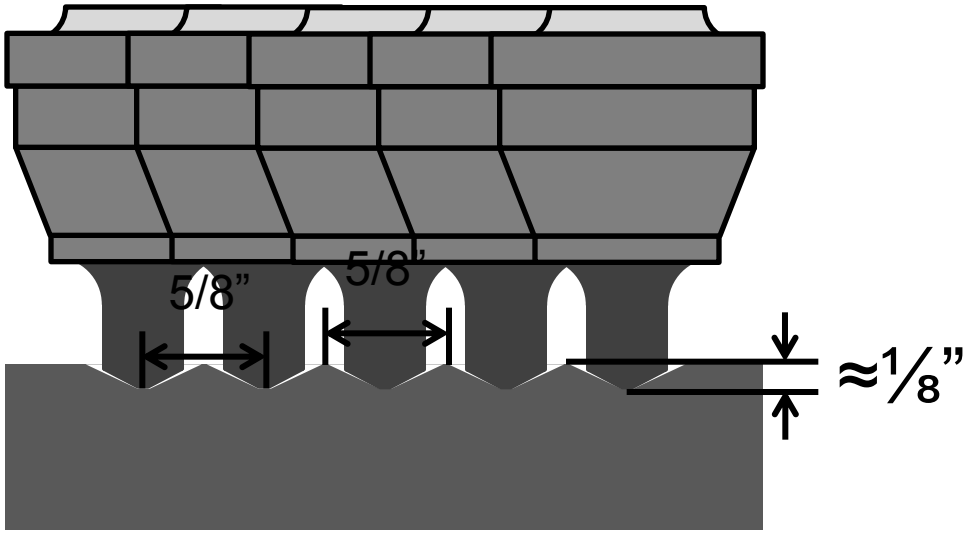
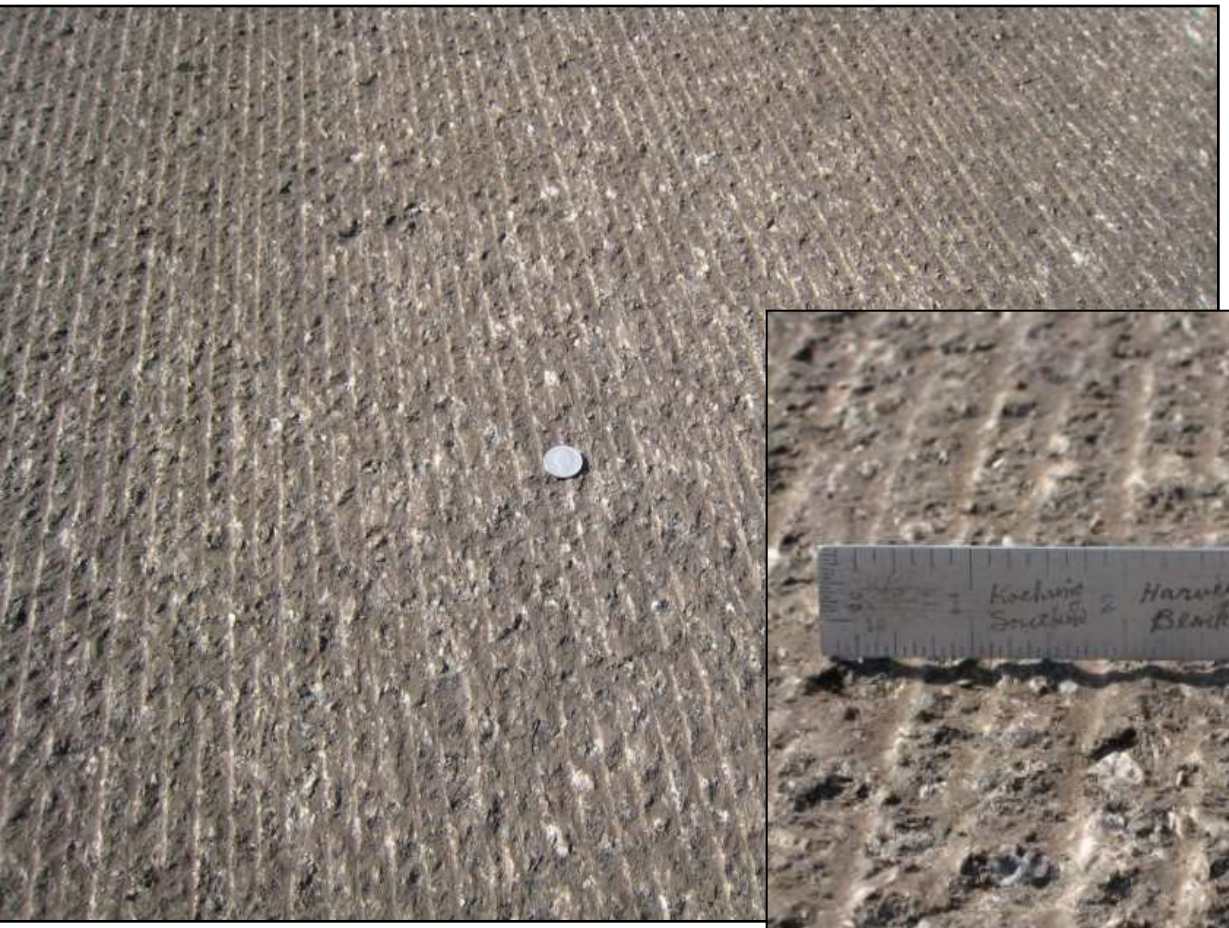
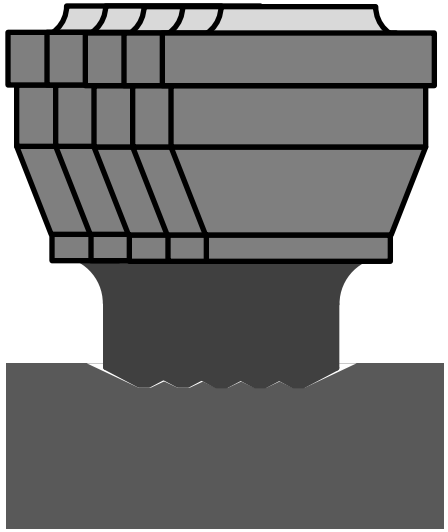


5/8” (16 mm) Triple Wrap at 30 fpm



2/10” (5mm) Triple Wrap Lacing Pattern



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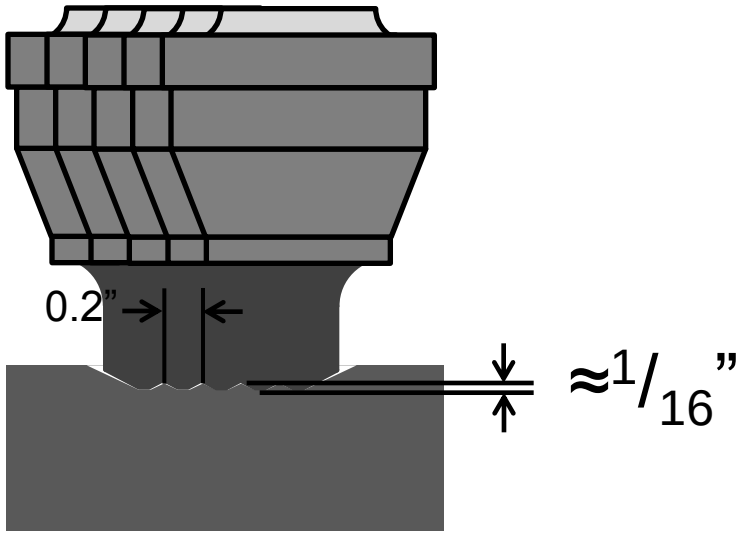


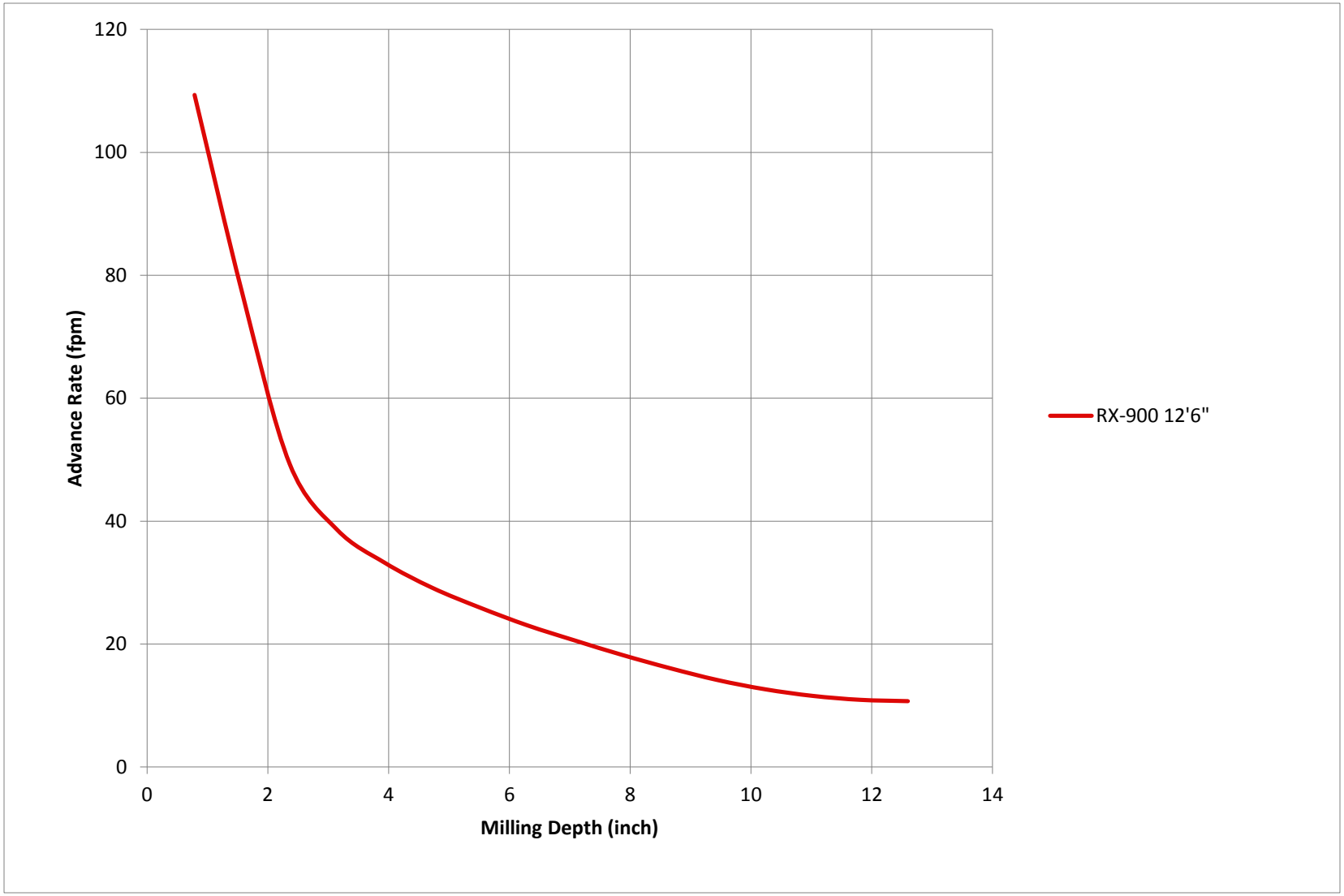
2/10” (5mm) Triple Wrap Lacing Pattern

Amount of Tools

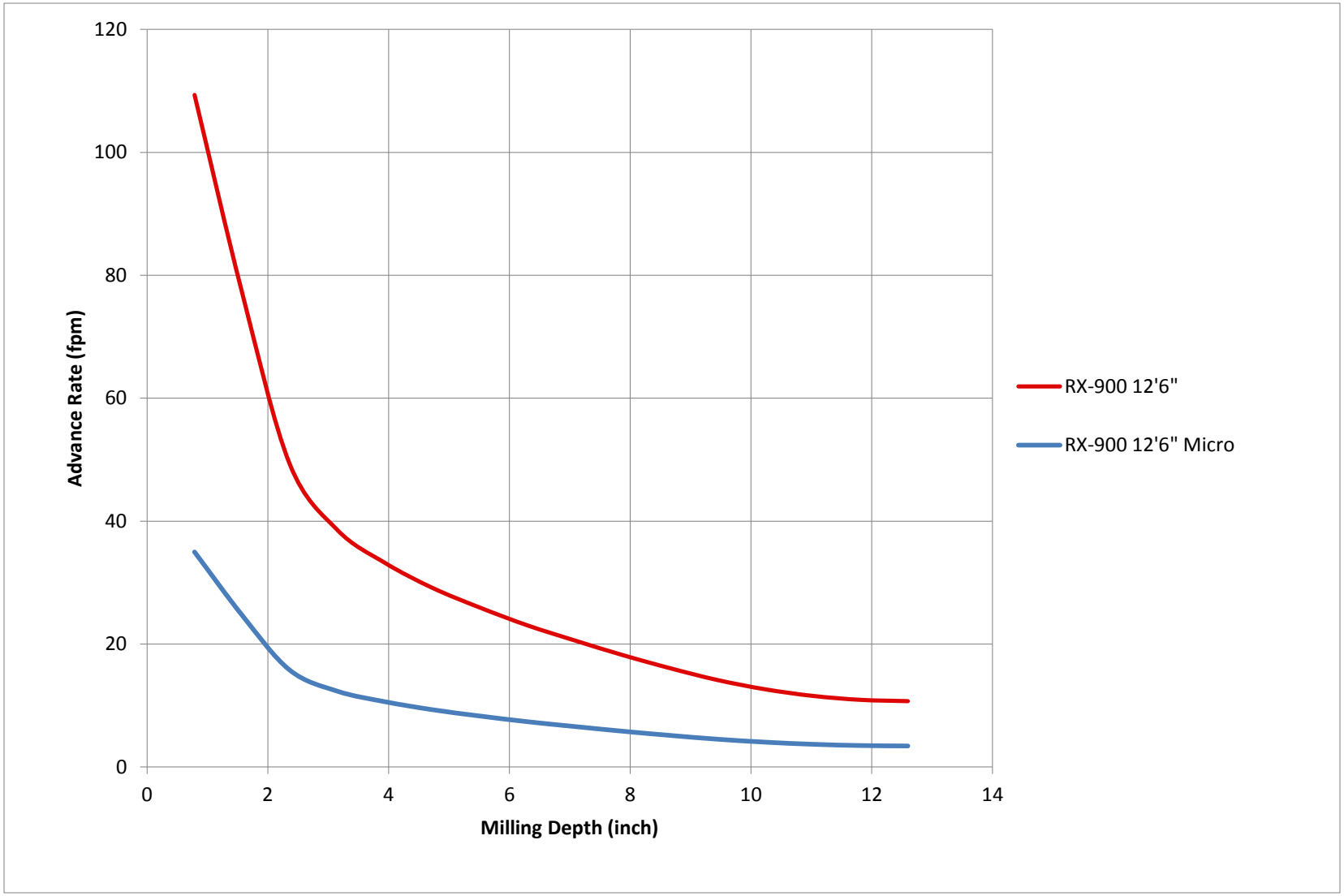
12’6” (3.5 m) Full Lane Drum		
Line Spacing	# of Teeth	Cost of Teeth
5/8” (16 mm)	**268**	**$1340**
3/8” (9 mm)	**406**	**$2030**
0.2” (5 mm)	**770**	**$3850**

Nearly 3 times more teeth
Nearly 5 times the cost
No more quick change holders

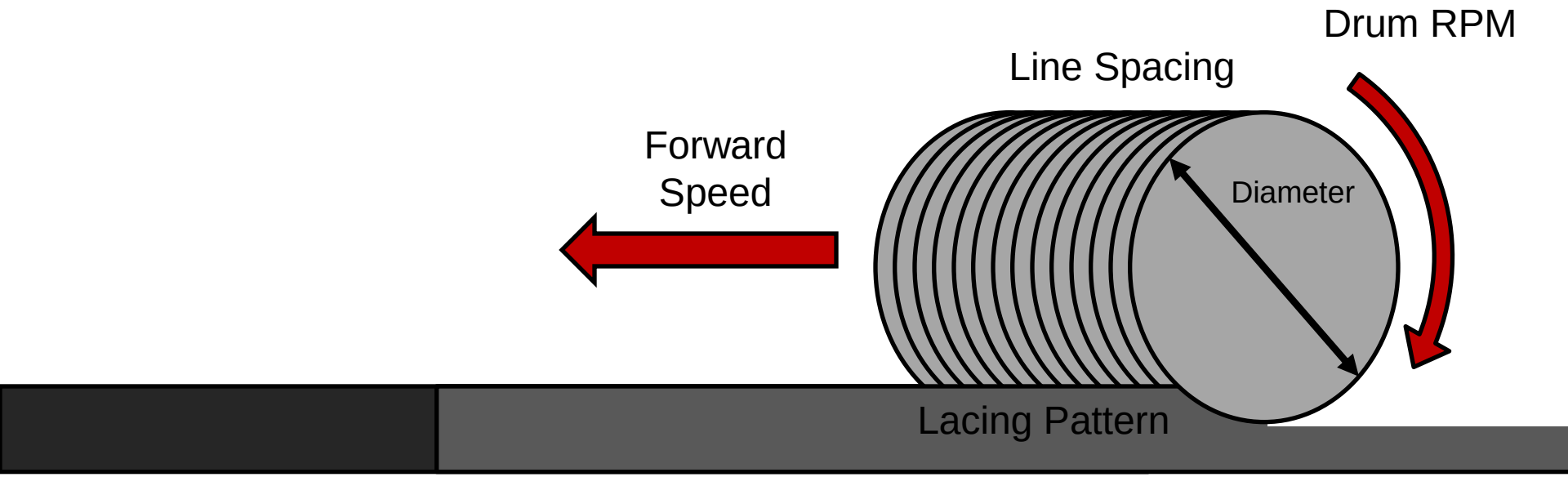
Production Tradeoff



Production Tradeoff



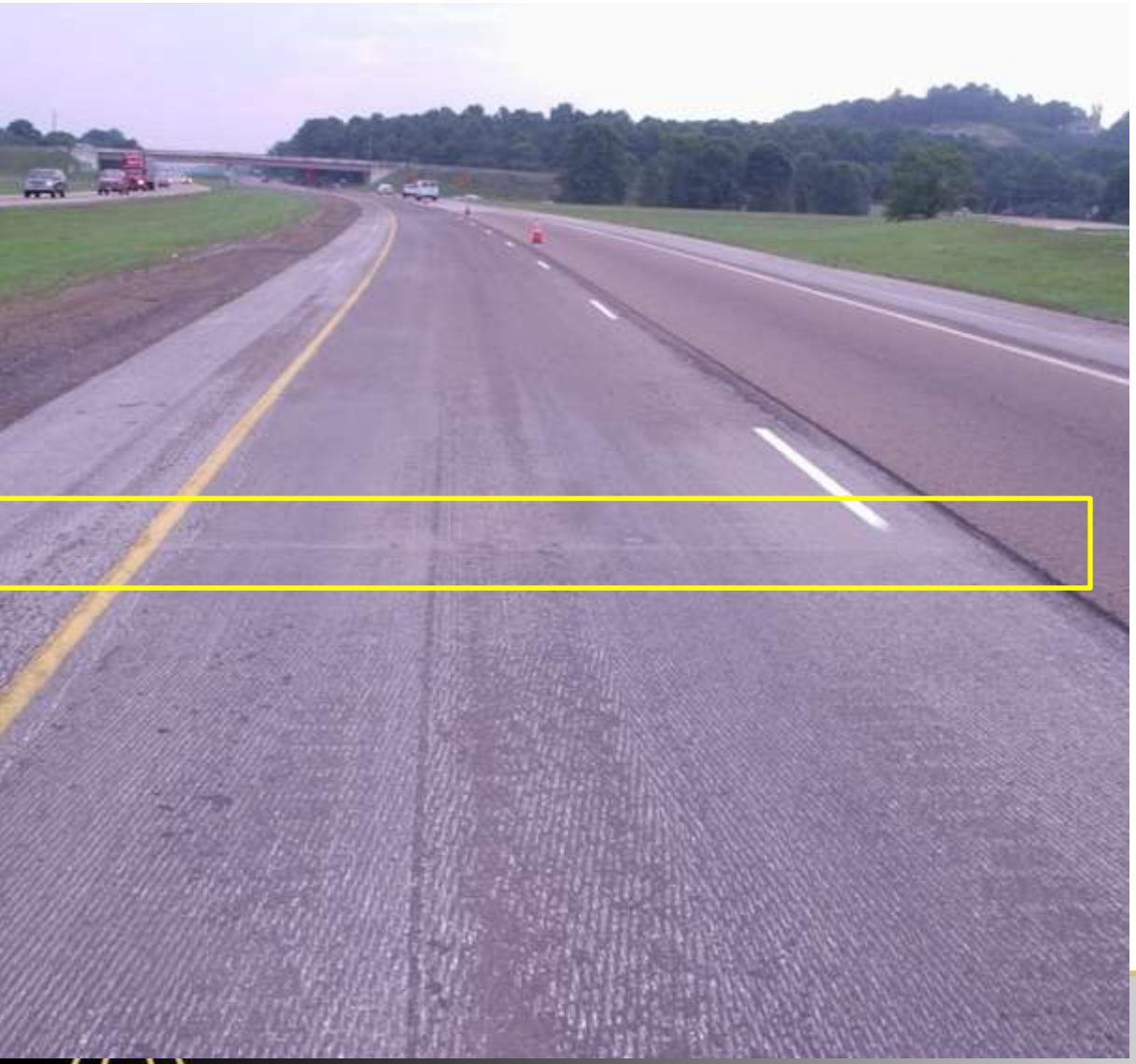
The Math of Milling



The 4 Main Factors that Affect Surface Texture

1. Line Spacing
2. Forward Speed
3. Drum RPM
4. Lacing Pattern

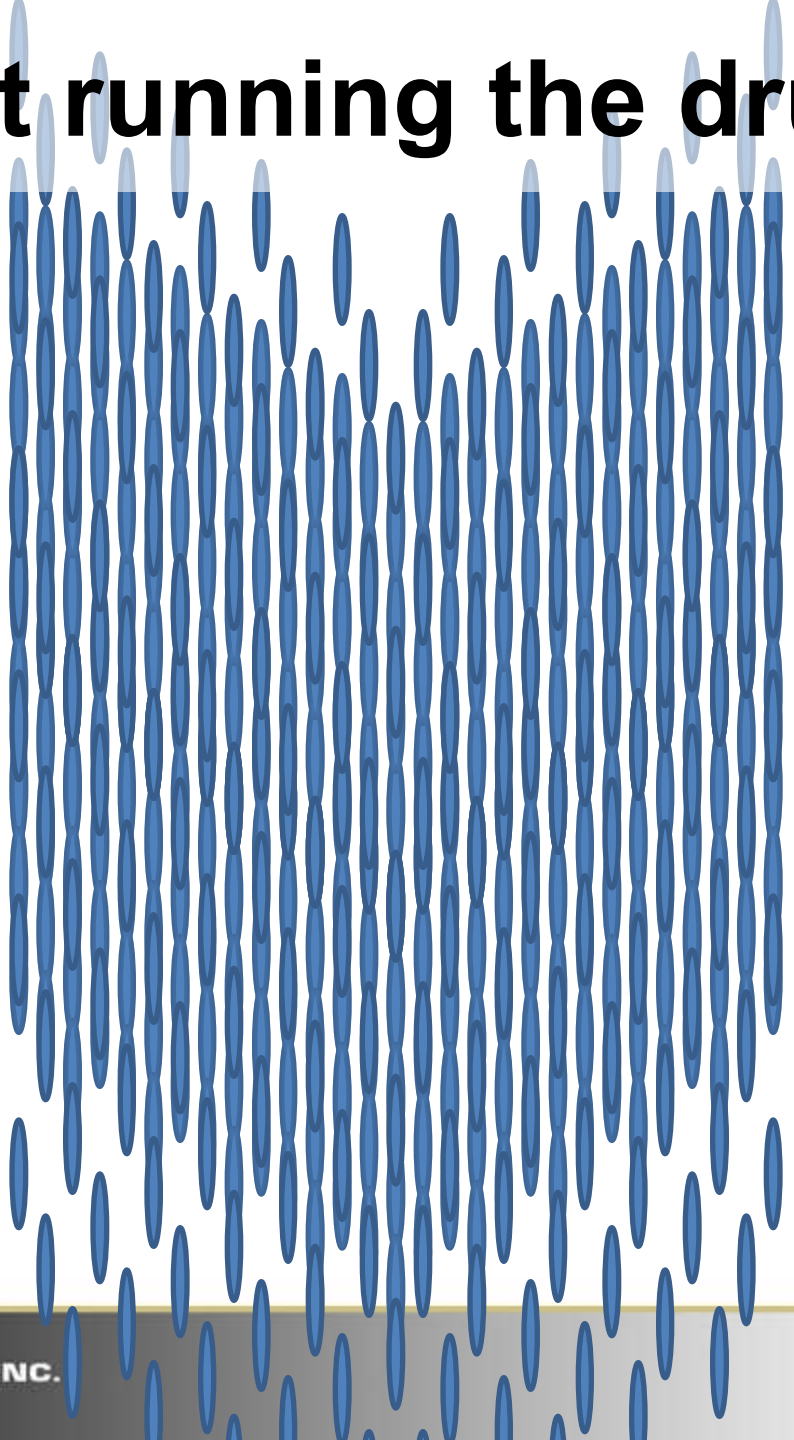
Continuous Milling



There are a lot of forces generated during milling. When you stop so do the forces.
Plus all of the teeth now cut in one spot, no longer spread out.

Forward Speed

“Out running the drum”



Tooth Strikes Line Up in Straight Lines

Tooth Strikes in One Drum Rotation

Machine Speeds Up

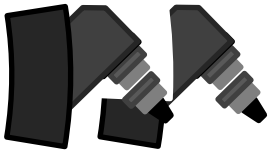
Pattern Spreads Out

Straight Line Pattern

Advance Rate = 30 fpm

Advance Rate = 30 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm

Machine
Advance
3.6”
←

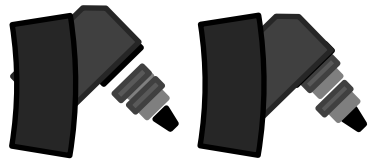


30 fpm

Advance Rate = 60 fpm

Advance Rate = 60 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm

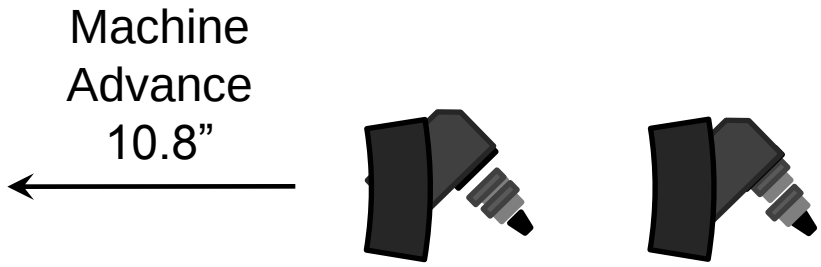
Machine
Advance
7.2”



60 fpm

Advance Rate = 90 fpm

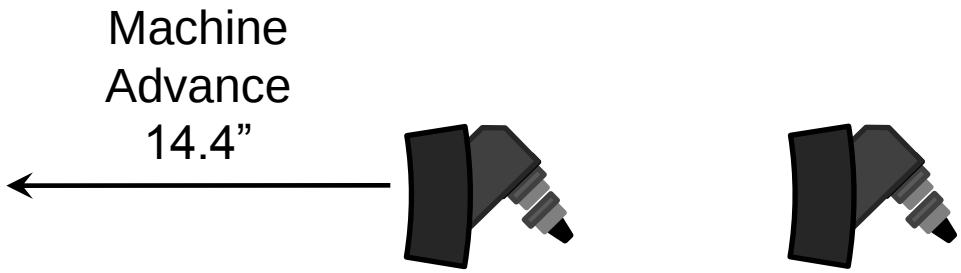
Advance Rate = 90 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm



90 fpm

Advance Rate = 120 fpm

Advance Rate = 120 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm



120 fpm

30 fpm vs. 120 fpm

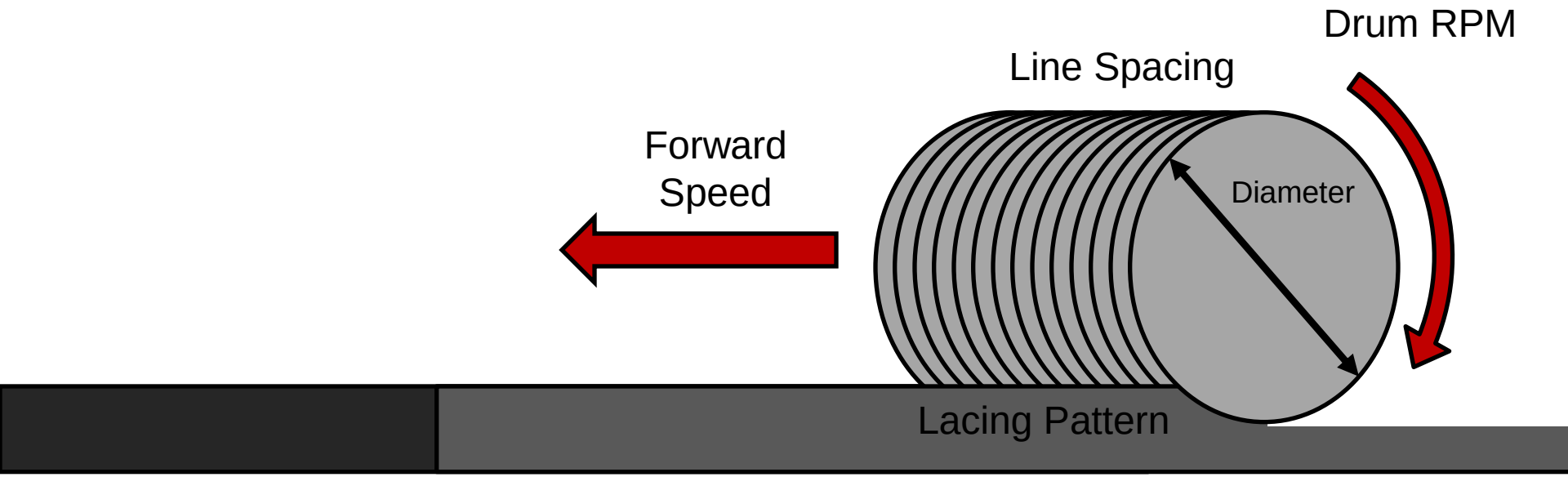
2.3 miles in a day vs. 9.1 miles in a day

Sand Patch Test
ASTM E965

Indiana Glass Bead Test (ITM 812)

http://www.in.gov/indot/div/mt/itm/pubs/812_testing.pdf

The Math of Milling



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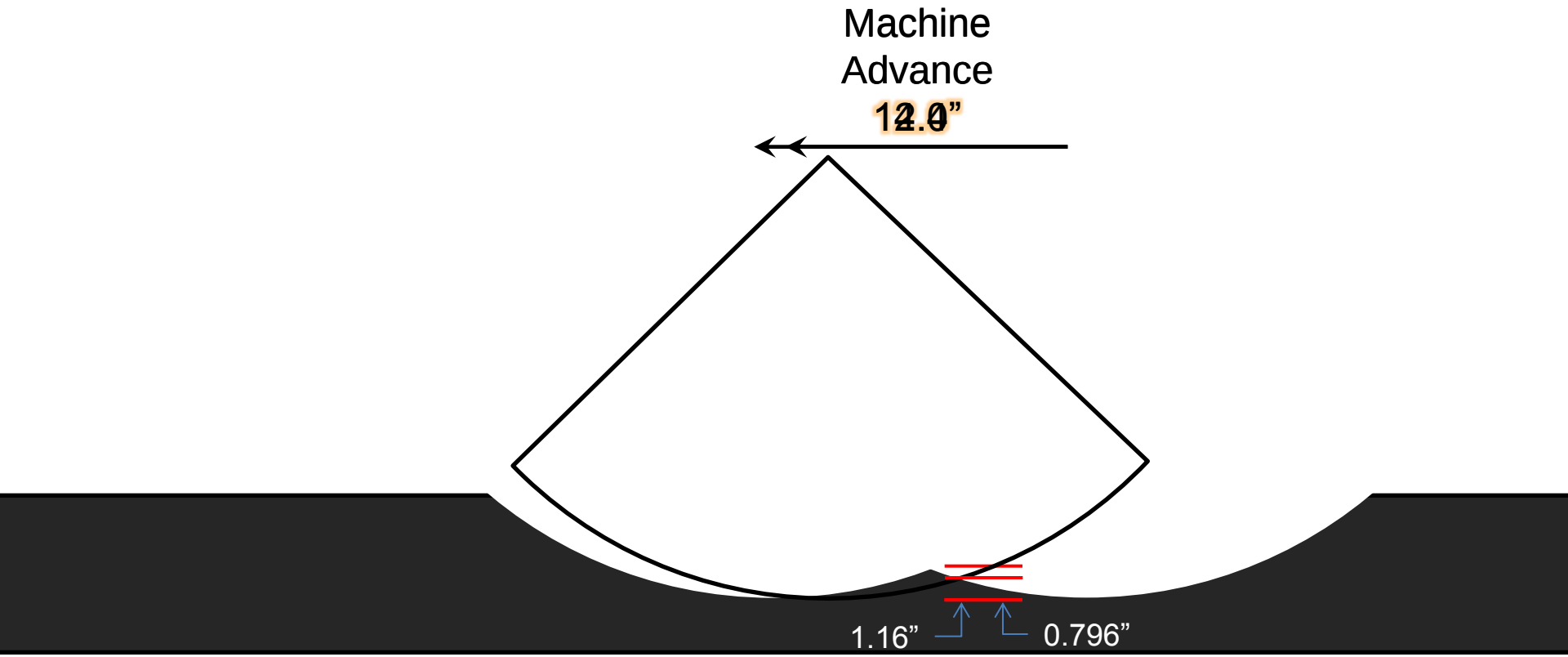
Drum Speed

RX-900 Drum Speeds				
Engine Speed	**Top Sheave Diameter (in)**	**Bottom Sheave Diameter (in)**	**Gear Ratios 20:1**	**24:1**
2100 rpm	16	14	120 rpm	100 rpm
2100 rpm	16	15	112 rpm	93 rpm
2100 rpm	14	15	98 rpm	82 rpm
2100 rpm	14	16	92 rpm	77 rpm

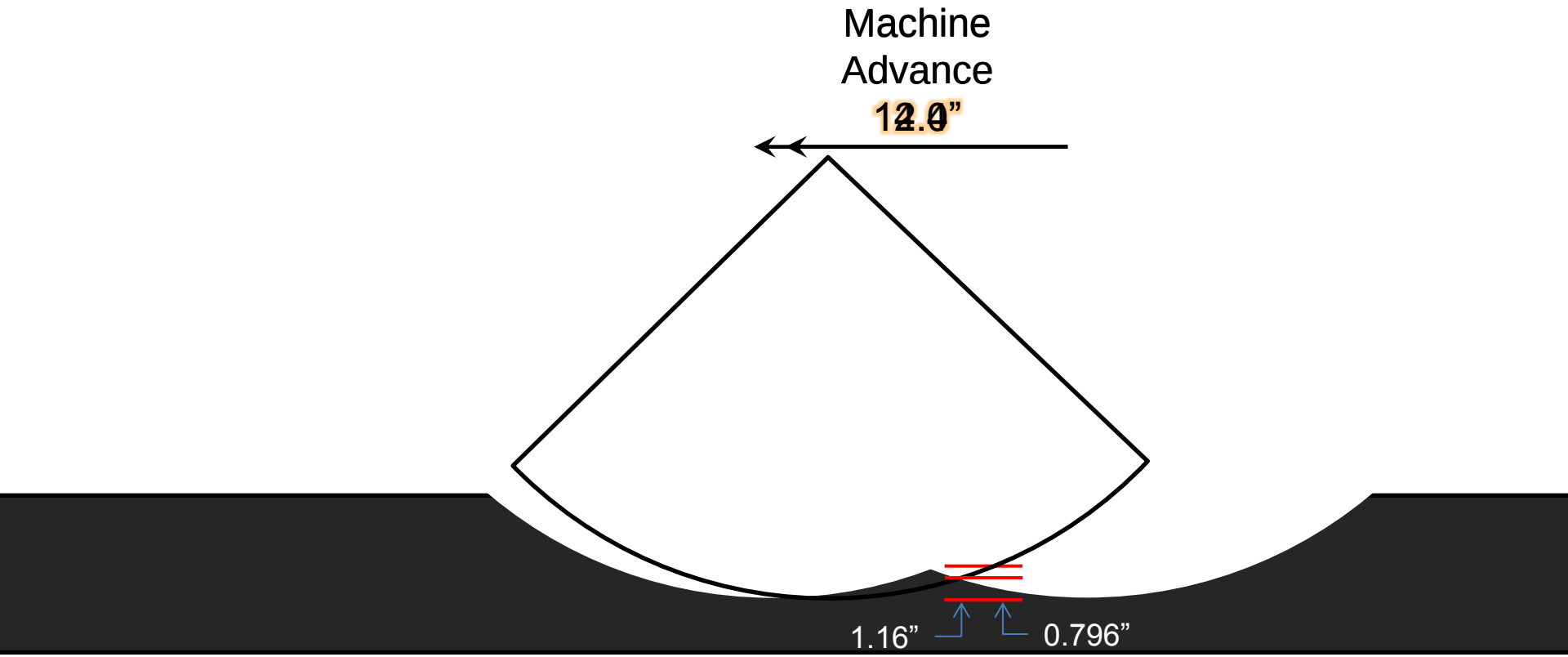
Advance Rate = 120 fpm

Advance Rate = 120 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm

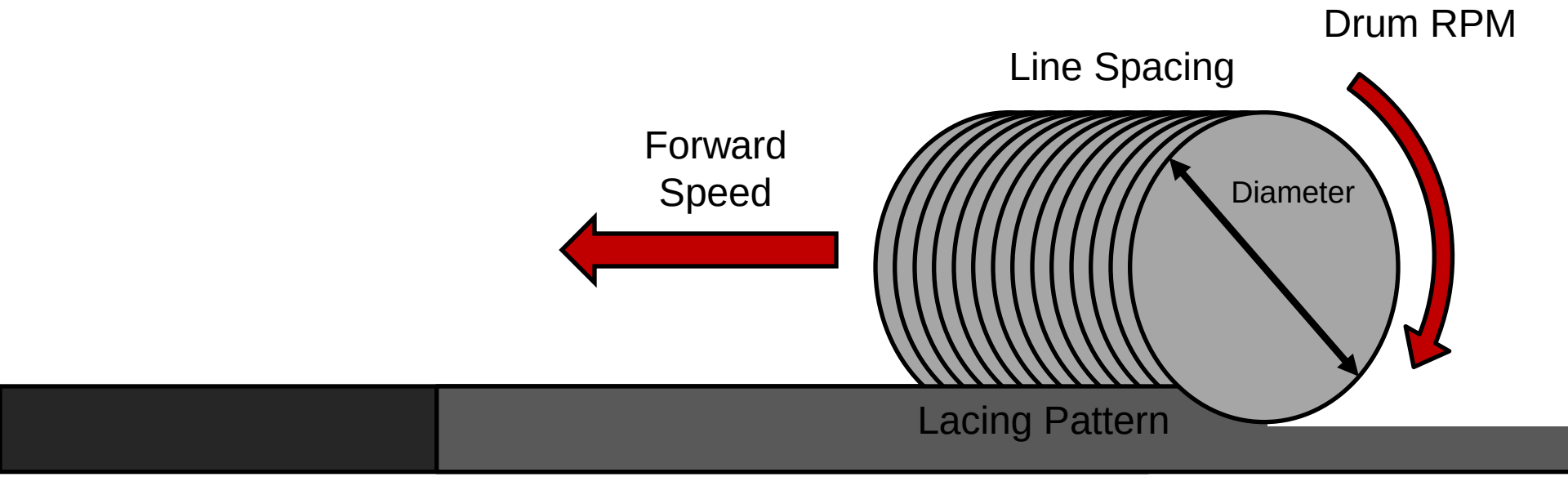


Advance Rate = 120 fpm

Advance Rate = 120 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm



The Math of Milling



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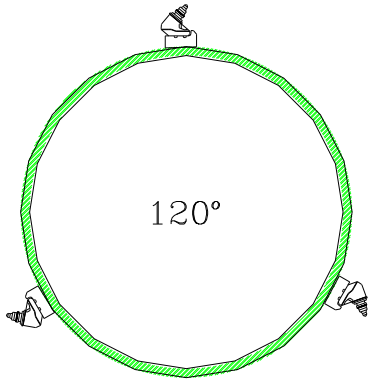
Triple Wrap, Off Set Flighting

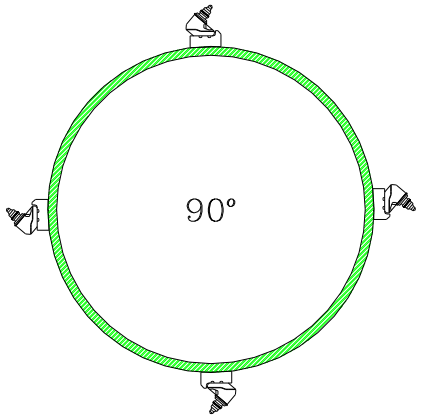
Triple Wrap

Off Set Flighting

Drum Lacings
Scroll Start Comparisons



Triple Wrap



Double Hit
Quad Wrap

Double Hit Drums

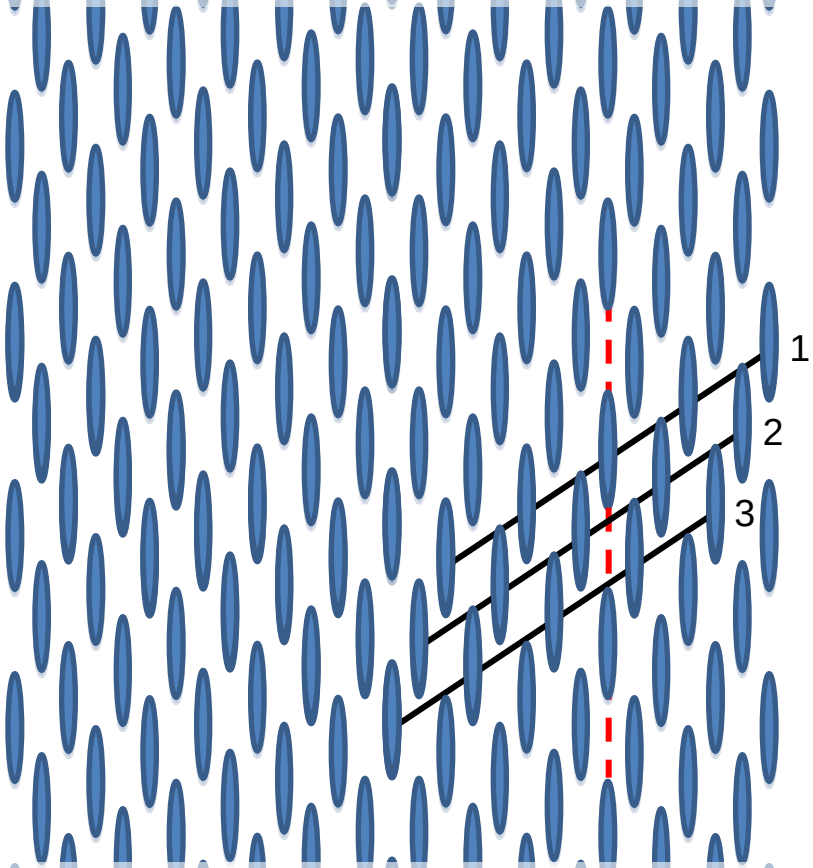
Above

Double hit Quad wrap drum

Standard triple wrap drum

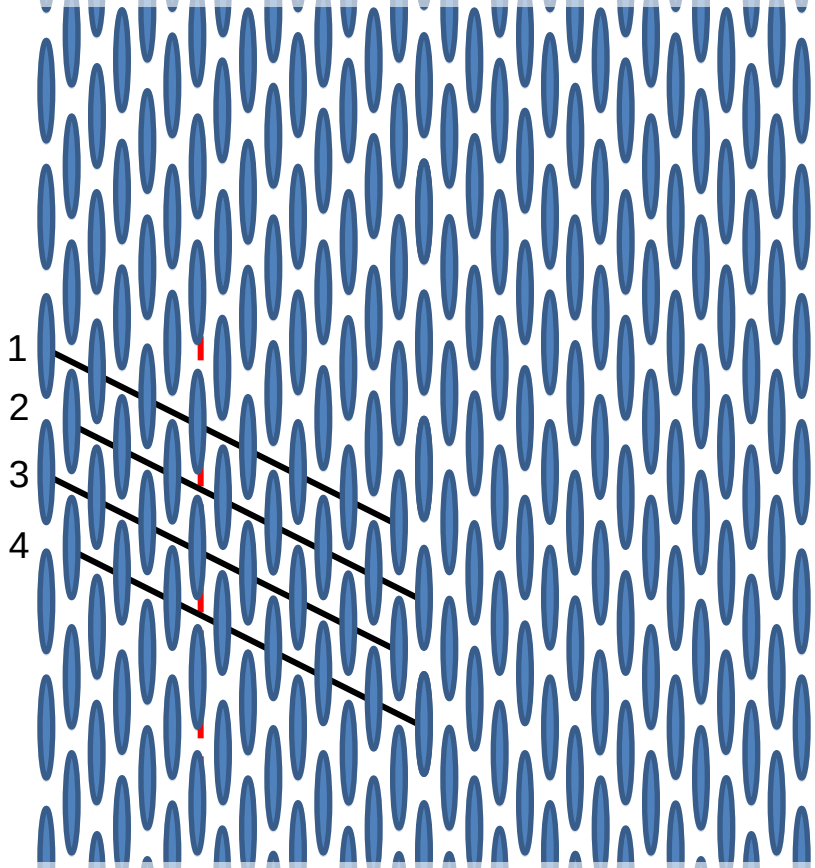
Below

Pattern Comparisons



Single Hit
Triple Wrap

1 7/8” (48 mm) spacing per flight
Equals
5/8” (16 mm) spacing

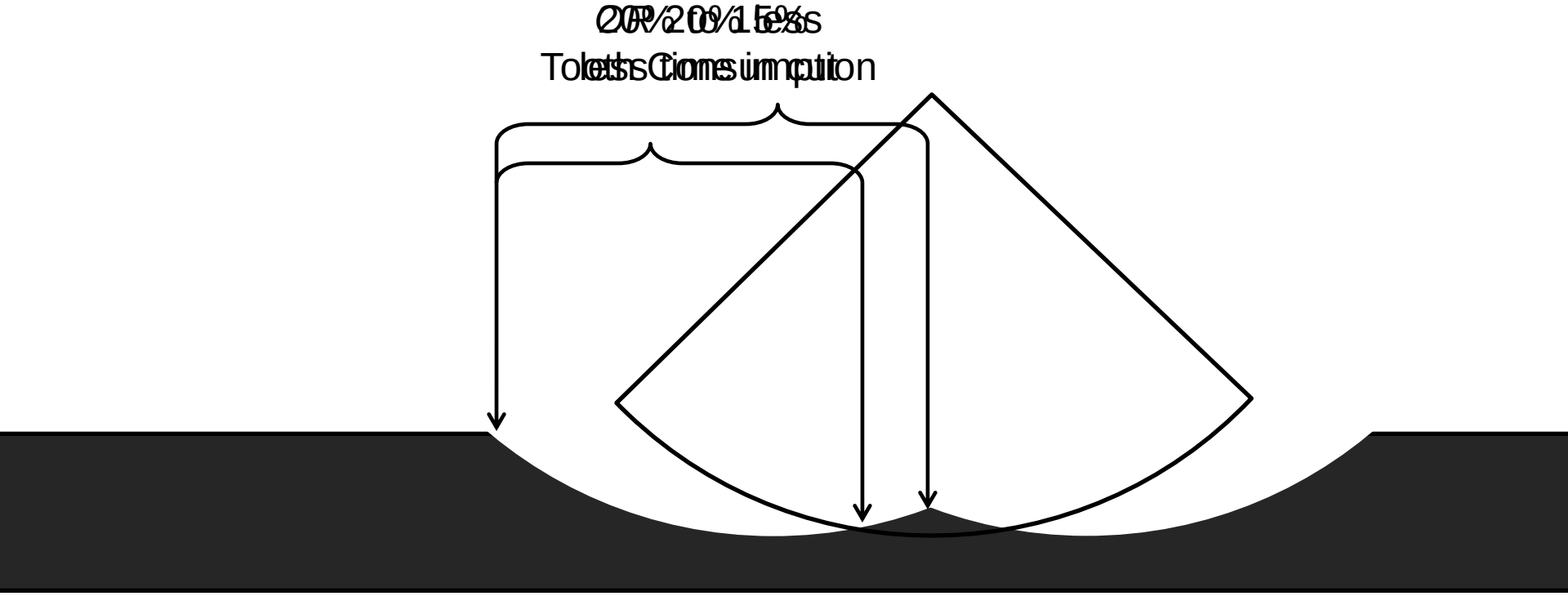


Double Hit
Quad Wrap

1 ¼” (32 mm) spacing per flight
Equals
5/8” (16 mm) spacing

Advance Rate = 120 fpm

Advance Rate = 120 fpm
Drum Diameter = 46”
Drum Speed = 100 rpm



Pattern Comparison

5/8” Triple Wrap at 100 FPM

7/8” DHQW at 100 FPM

Same Speed Comparison

Single Hit Profiling Drum

- 100 fpm
- 8 hr shift/7 hr milling = 56,000 sq yd/day
- Crew cost (operator and ground man) = $720 for the day
- Let's say 250 Teeth per day
- @ $5 per Tooth = $1250
- Fuel Usage = 25 gph
  - 200 gal/day
  - $700 @ $3.50 /gal

$0.05 per sq yd

Double Hit Profiling Drum

- 100 fpm
- 8 hr shift/7 hr milling = 56,000 sq yd/day
- Crew cost (operator and ground man) = $720 for the day
- 20% less Teeth = 200
- @ $5 per Tooth = $1000
- Fuel Usage = 25 gph
  - 200 gal/day
  - $700 @ $3.50 /gal

$0.04 per sq yd

From sand patch tests
course milled surface can use 4 times more material to fill than a fine milled surface

This relates to about 25 tons per lane mile

The Point of Breakout

Same Texture – Very Different Production

Full Lane 8mm (0.3”)standard at 45 FPM

½ spaced DHQW at 140 FPM

Same Texture Comparison

Single Hit Profiling Drum

- 45 fpm
- 8 hr shift/7 hr milling = 25,200 sq yd/day
- Crew cost (operator and ground man) = $720 for the day
- Let's say 160 Teeth for the day
- @ $5 per Tooth = $800
- Fuel Usage = 20 gph
  - 160 gal/day
  - $560 @ $3.50 /gal

$0.08 per sq yd

Double Hit Profiling Drum

- 140 fpm ≈ 3 X production
- 8 hr shift/7 hr milling = 78,400 sq yd/day
- Crew cost (operator and ground man) = $720 for the day
- 20% less = 497 w/ production gain
- @ $5 per Tooth = $2485
- Fuel Usage = 25 gph
  - 200 gal/day
  - $700 @ $3.50 /gal

$0.03 per sq yd

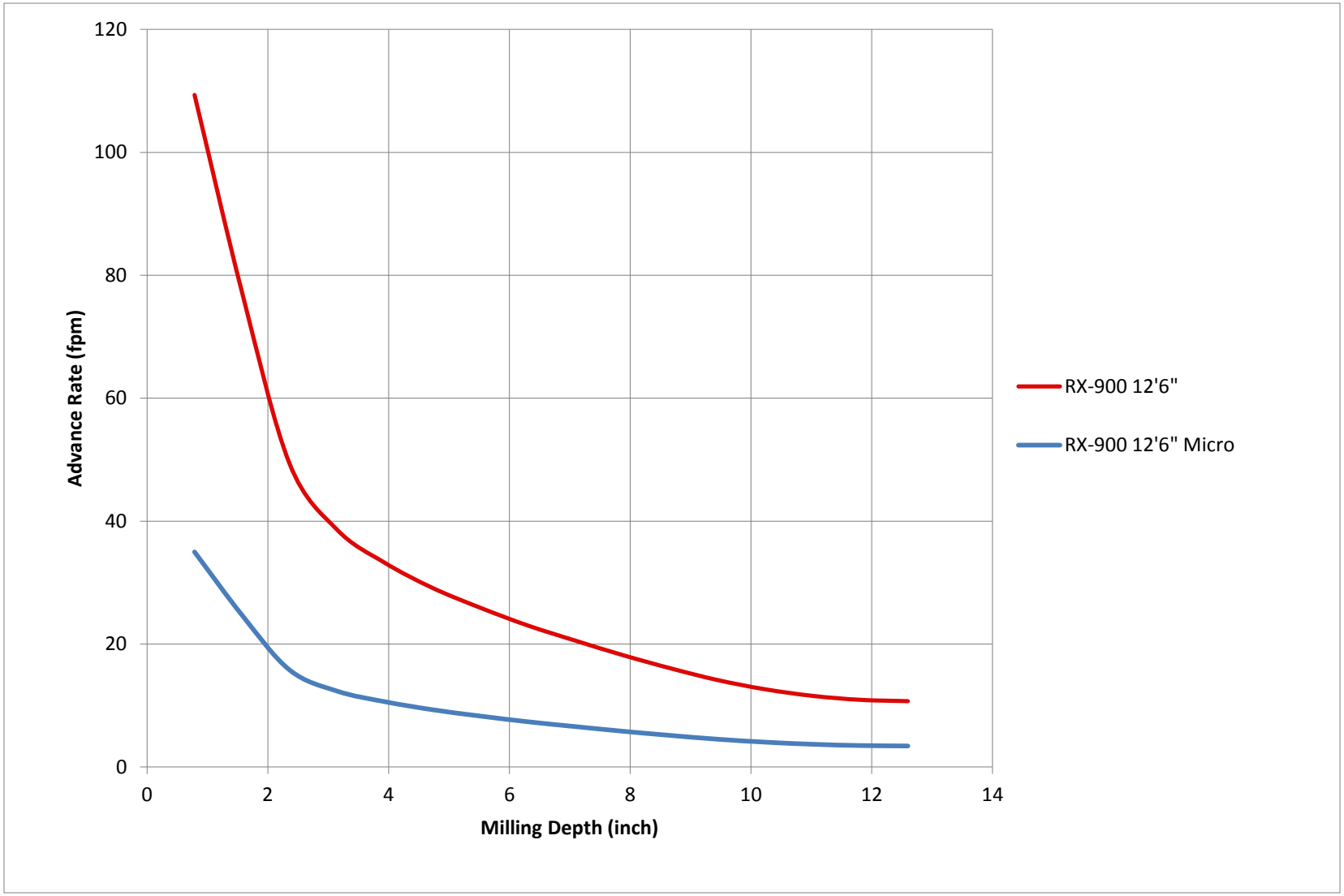
Apples to Apples

3/8” spaced Single Hit “Profiling” Drum at 120 FPM

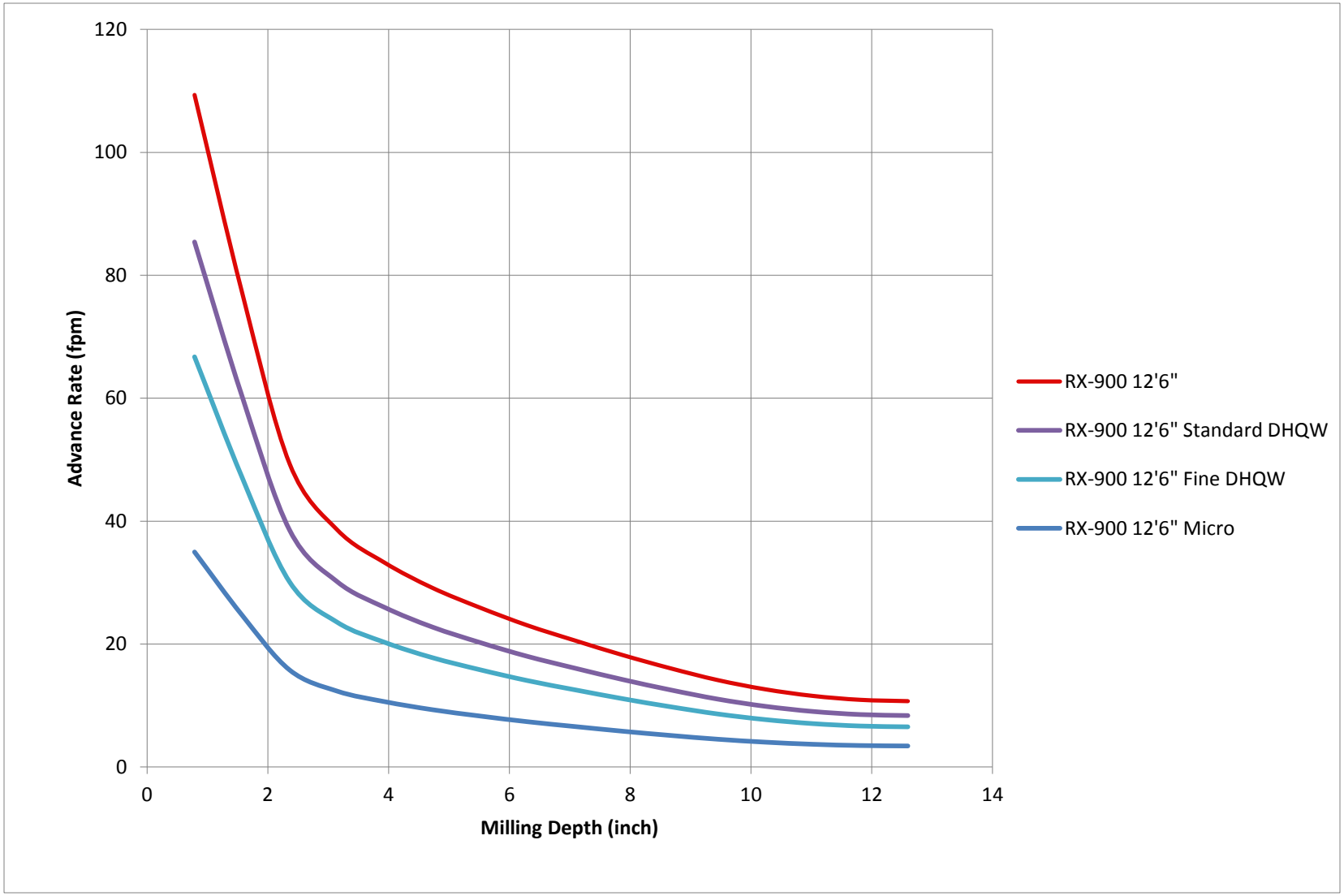
½” spaced Double Hit Drum at 140 FPM

Micro-mill surface at 65 FPM

Production Tradeoff



Production Tradeoff



Amount of Tools

12’6” (3.5 m) (Full Lane Drum)		
Spacing	# of Tools	Cost of Drum
5/8” (16 mm) SH	**268**	**$1340**
Standard DHQW	**343**	**$1715**
Profile DHQW	**440**	**$2200**
0.2” (5 mm) SH	**770**	**$3850**

Fewer teeth
Less cost
Still quick change holders

Questions?