

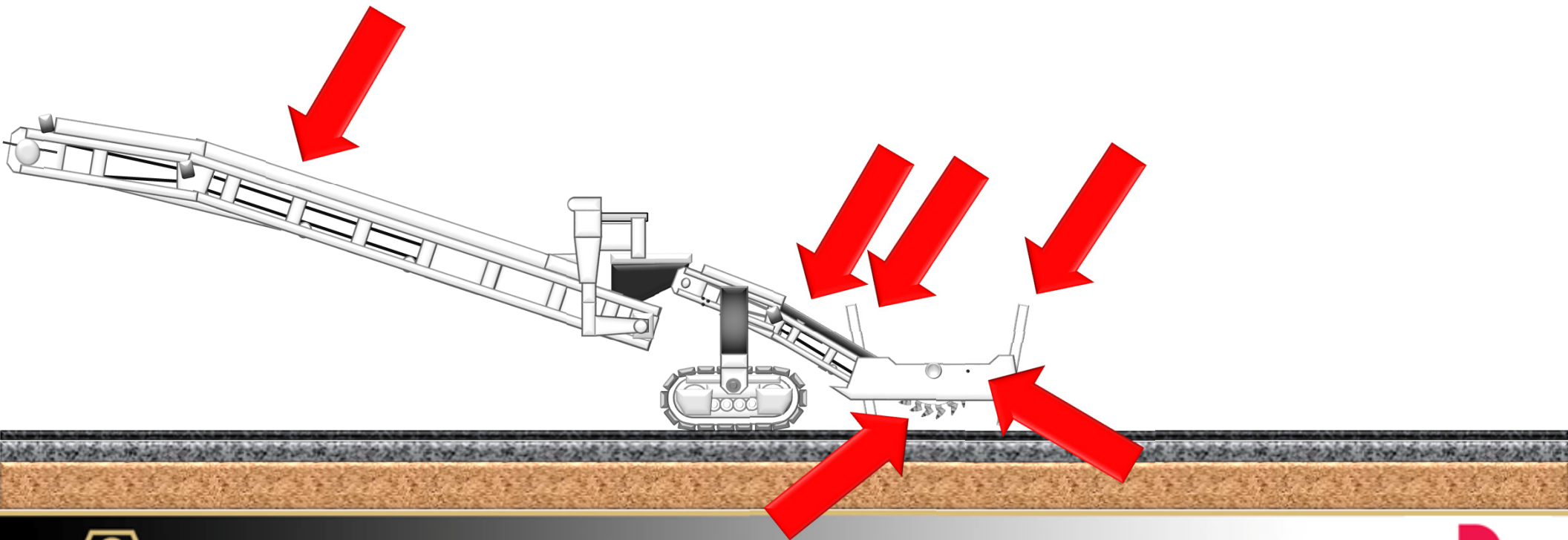
Milling for Smoothness & Quality

Overview

- Terminology
- Factors that affect the finished product
 - » Environment- Preparation
 - » Machine Maintenance
 - » Operating Practices
 - Common Mistakes and the Proper Correction
 - » **Machine Configuration**
 - **Drum Selection**
- Different ways to reach the finish line



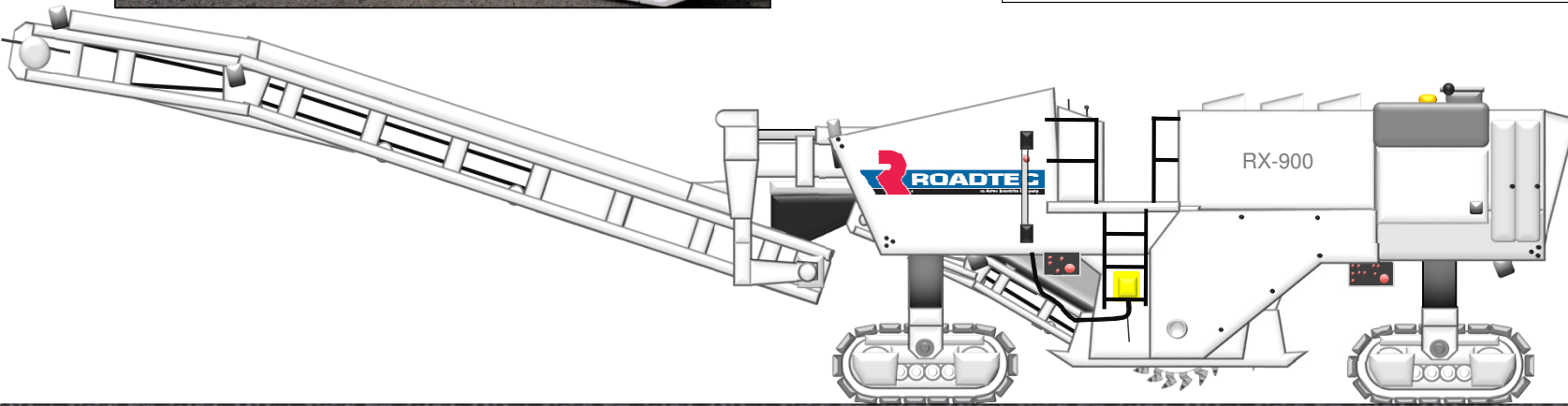
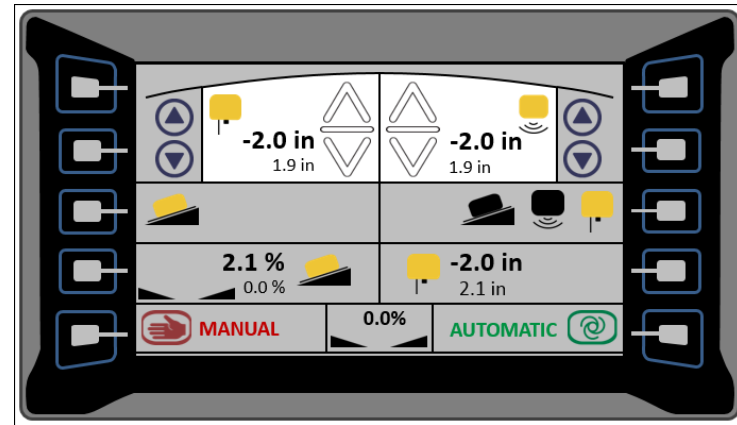
Terms of the machine



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2D Control Systems



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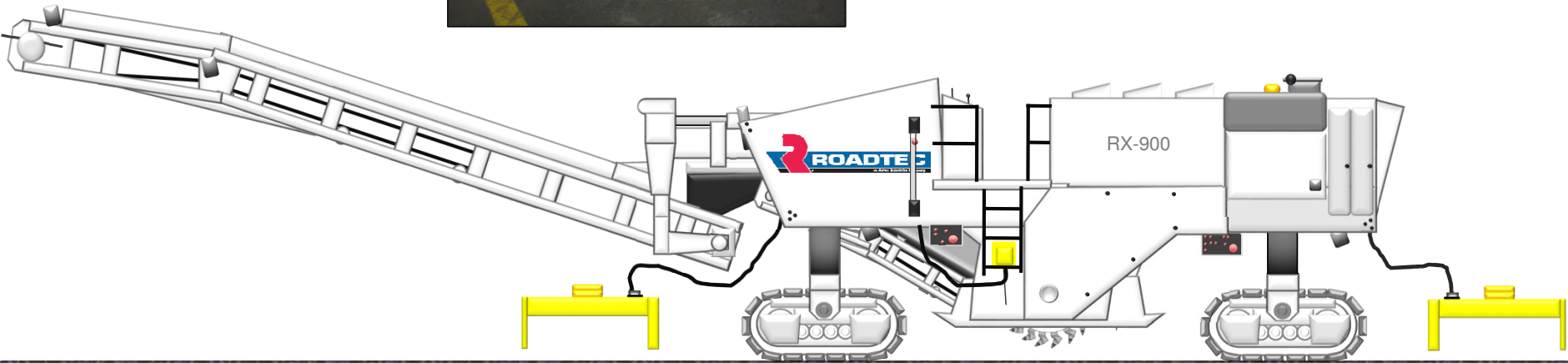


Averaging Systems



Do averaging systems work?

When should we use averaging?



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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?

Do I have the tools to carry out this plan?



Do I Have the Right Equipment?



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Control points- Where do we start?



The job should be properly laid out

The beginning and end of each pass should be properly marked, as well as desired grade



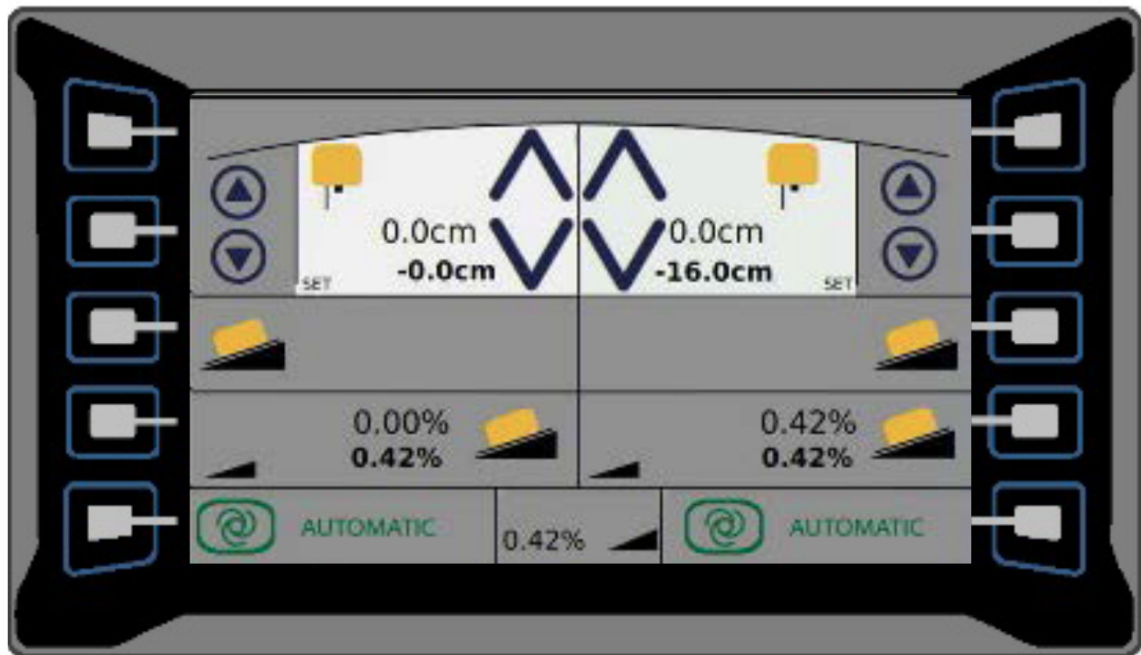
Ground man

Must to be in control of what is going on around the machine at all times.

A ground man needs to know what areas the machine will be referencing for grade, and make sure those surfaces are clean and free of obstructions



Calibrating Sensors- Checking Zero



Where to Check Zero



Scabbing & Rutting

Machines cannot control scabbing. You should go deeper or come up to get to stable material.

Rutting viewable in the milled surface will reflect through the overlay



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Tracking

Keeping a straight line applies to more than the the front tracks



Improper tracking will side load the cutter causing premature bearing and end ring wear



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Surface Condition



How do you approach this type of surface?

Slabs/Chunks can quickly damage the conveyors



Job Site Obstacles



Urban Areas



Different machines available for different environments



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Job Site Obstacles



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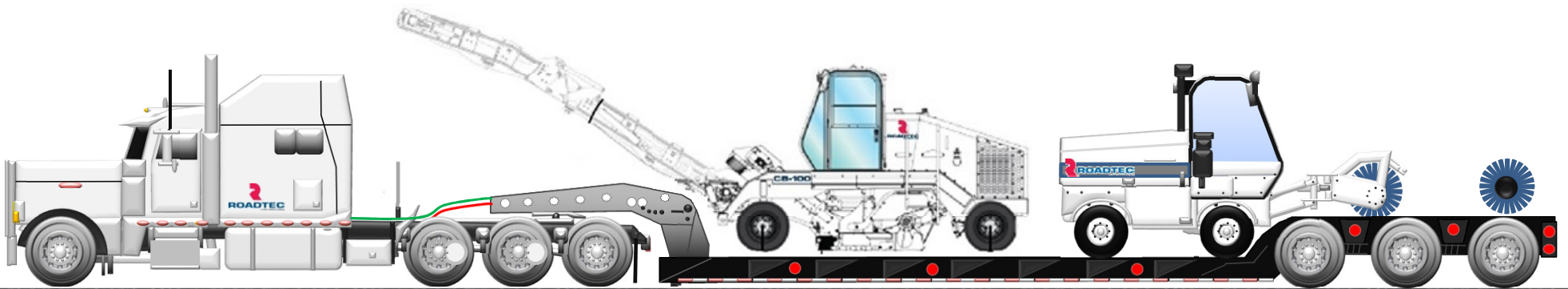
Keep it Clean



Your Cut surface is only as good
the surface you Walked on.

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

Why?



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Keep it Clean



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Clean up your mess

Clean up after you pick up.

What will happen when you set back down.



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Choosing Sensors

The end gate sensor won't always be the best reference

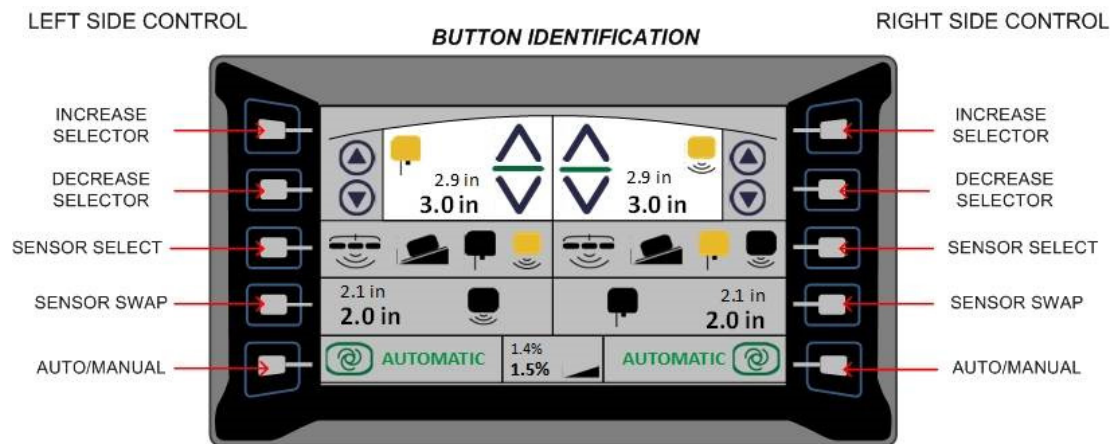
What should be done here?



Choosing Sensors

Sonic sensors positioned ahead of the front mold board to reference a solid surface

Easily switched from either ground box or operator station



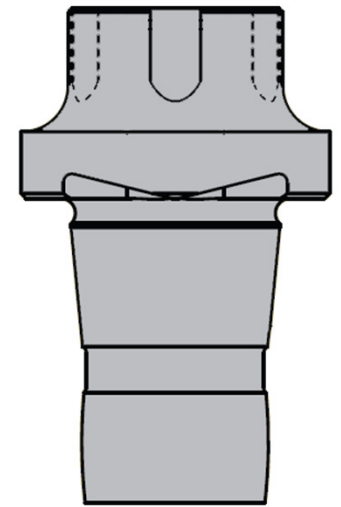
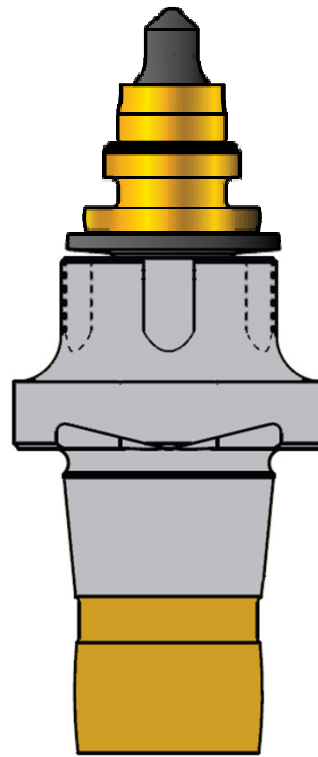
Proper Tooling Maintenance



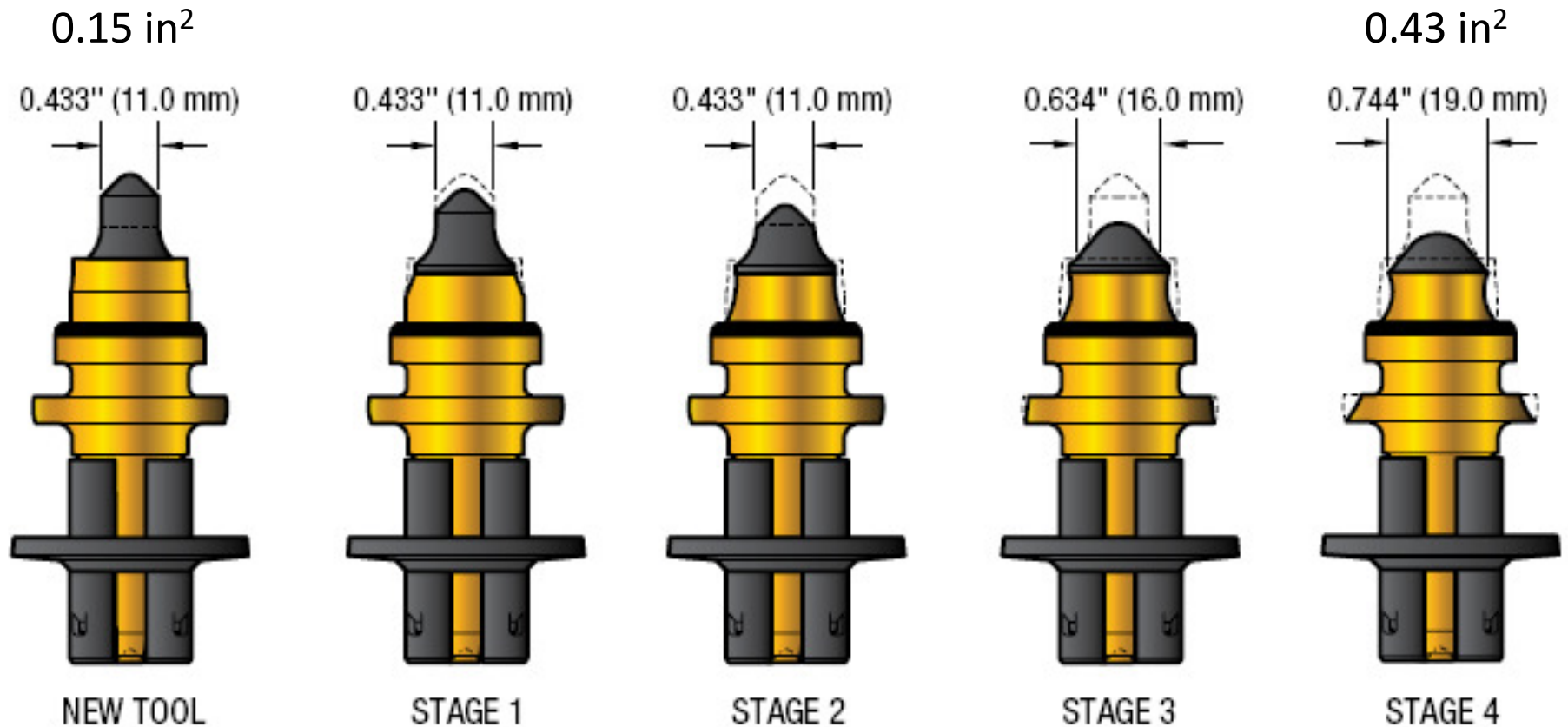
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Proper Holder Wear



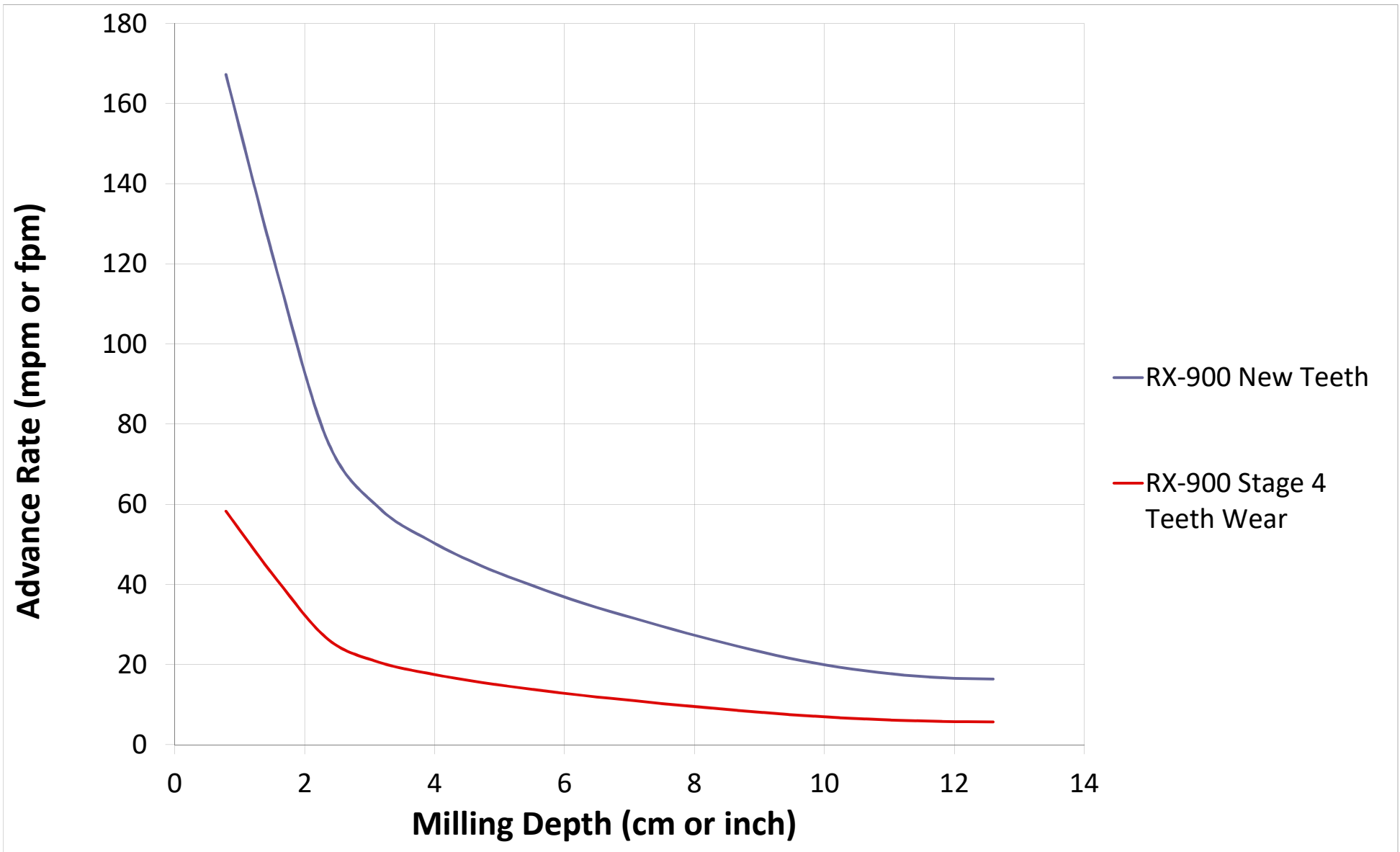
Tool Wear Characteristics



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



Production Tradeoff



Look at the Holders



New holders change the drum pattern.



**Caliper set at
EXACTLY 2"**



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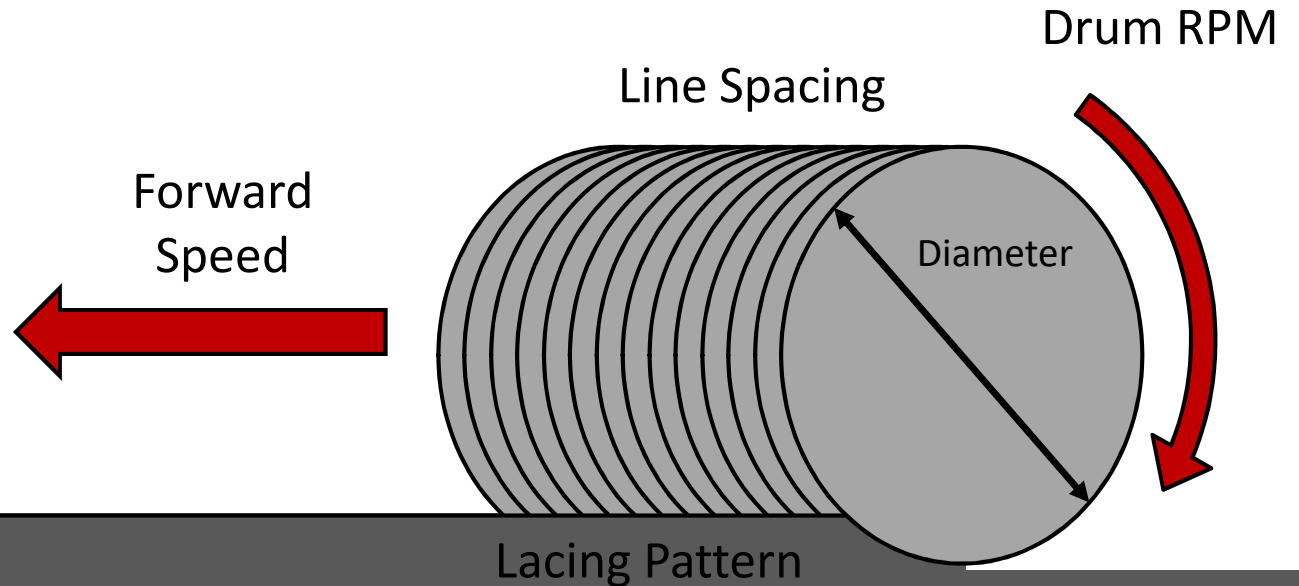
Proper Maintenance



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The Math of Milling



The 4 Main Factors that
Affect Surface Texture

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



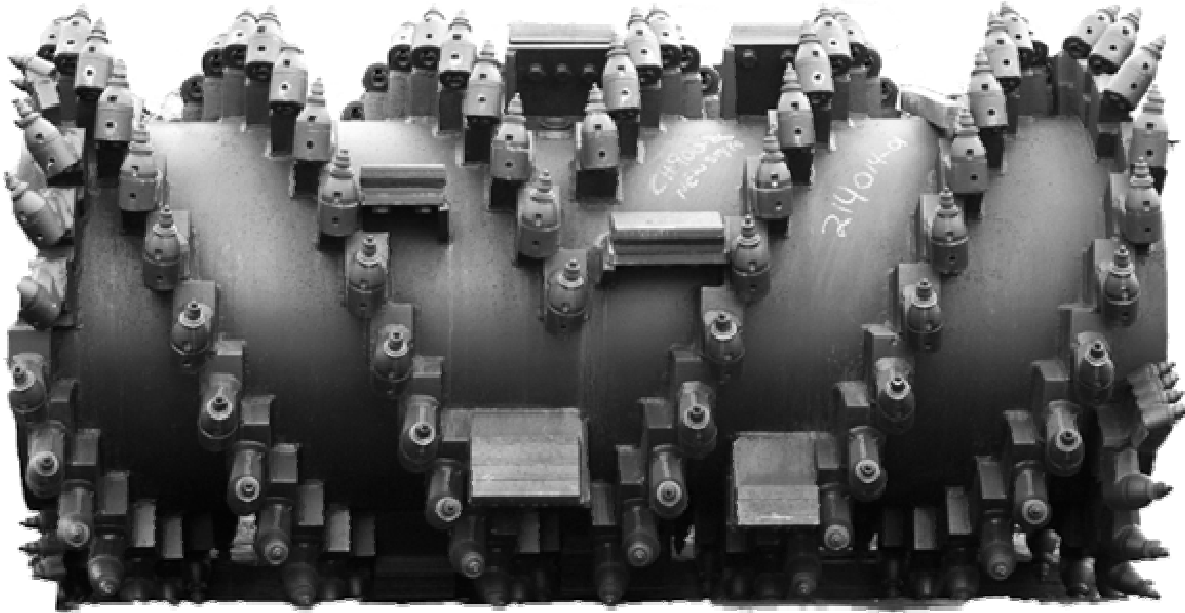
Drum Types

Selection Criteria

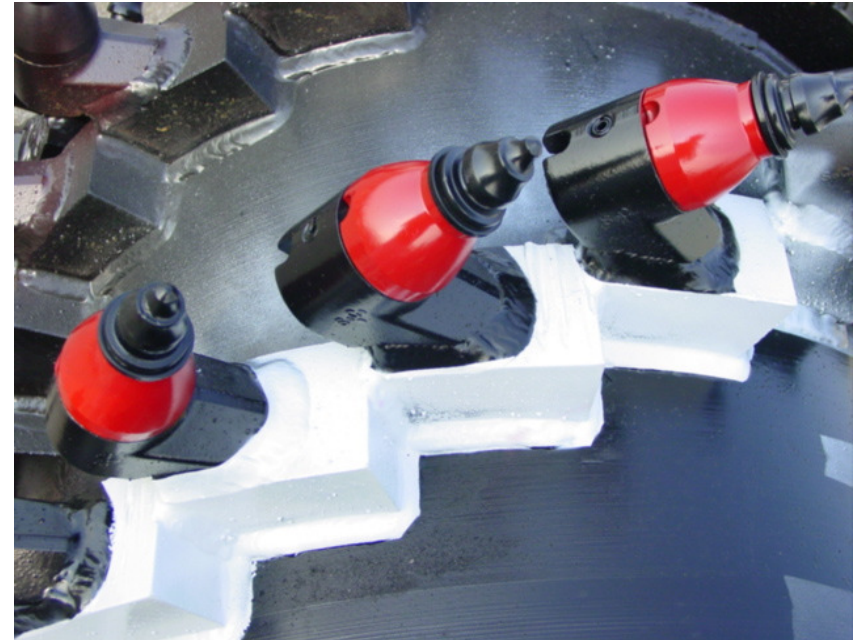
- How deep are we milling?
- What is the overlay thickness?
- Do we need to open the milled surface to traffic?



Triple Wrap, Off Set Flighting



Triple Wrap



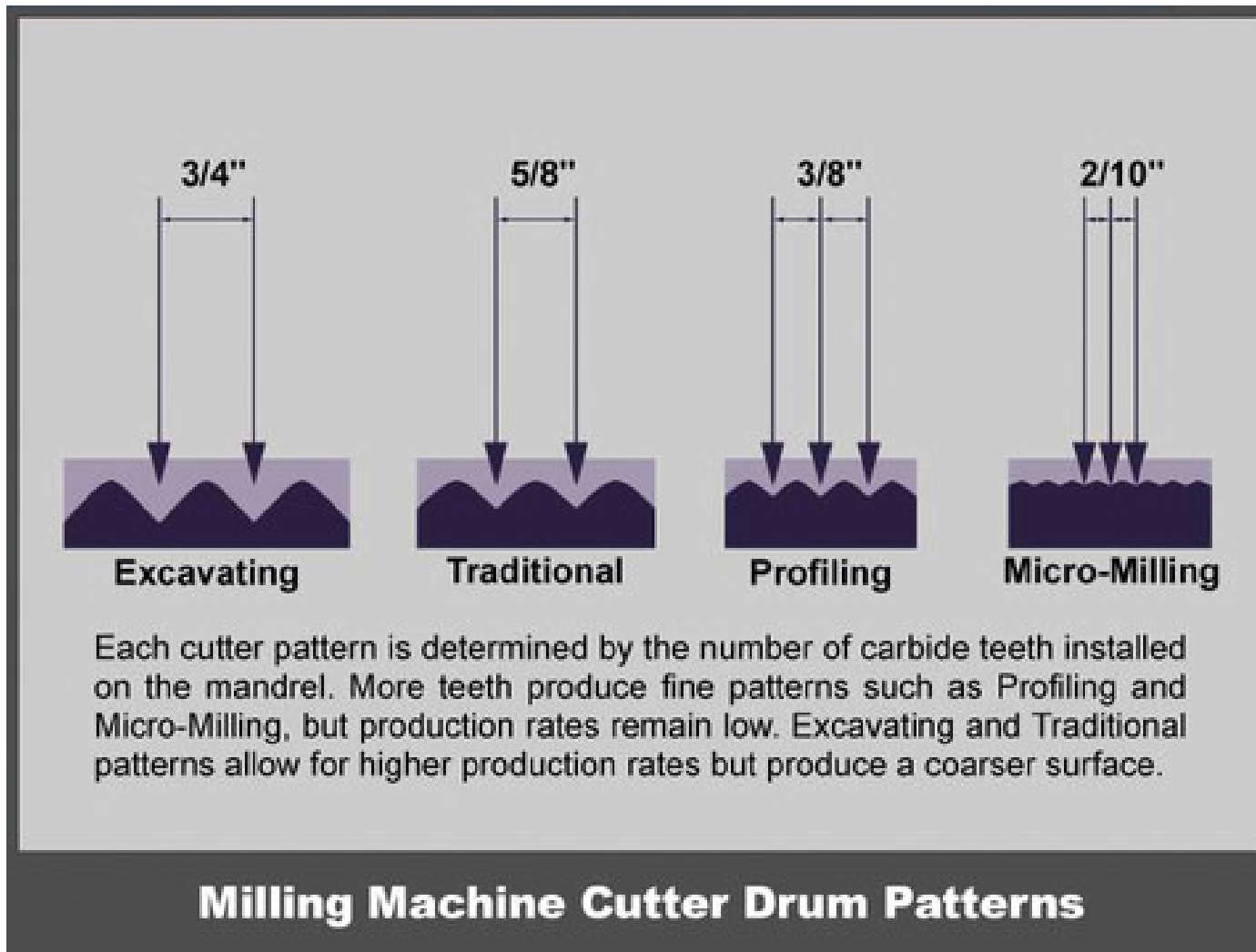
Off Set Flighting



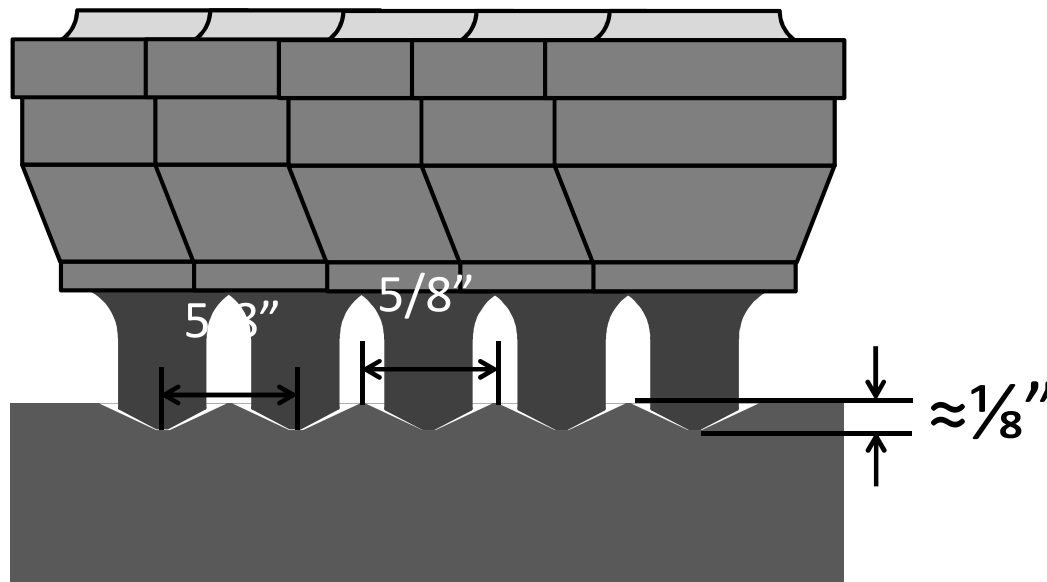
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Line Spacing and Texture



5/8" (16mm) Triple Wrap Lacing



5/8" (16 mm) Triple Wrap at 30 fpm



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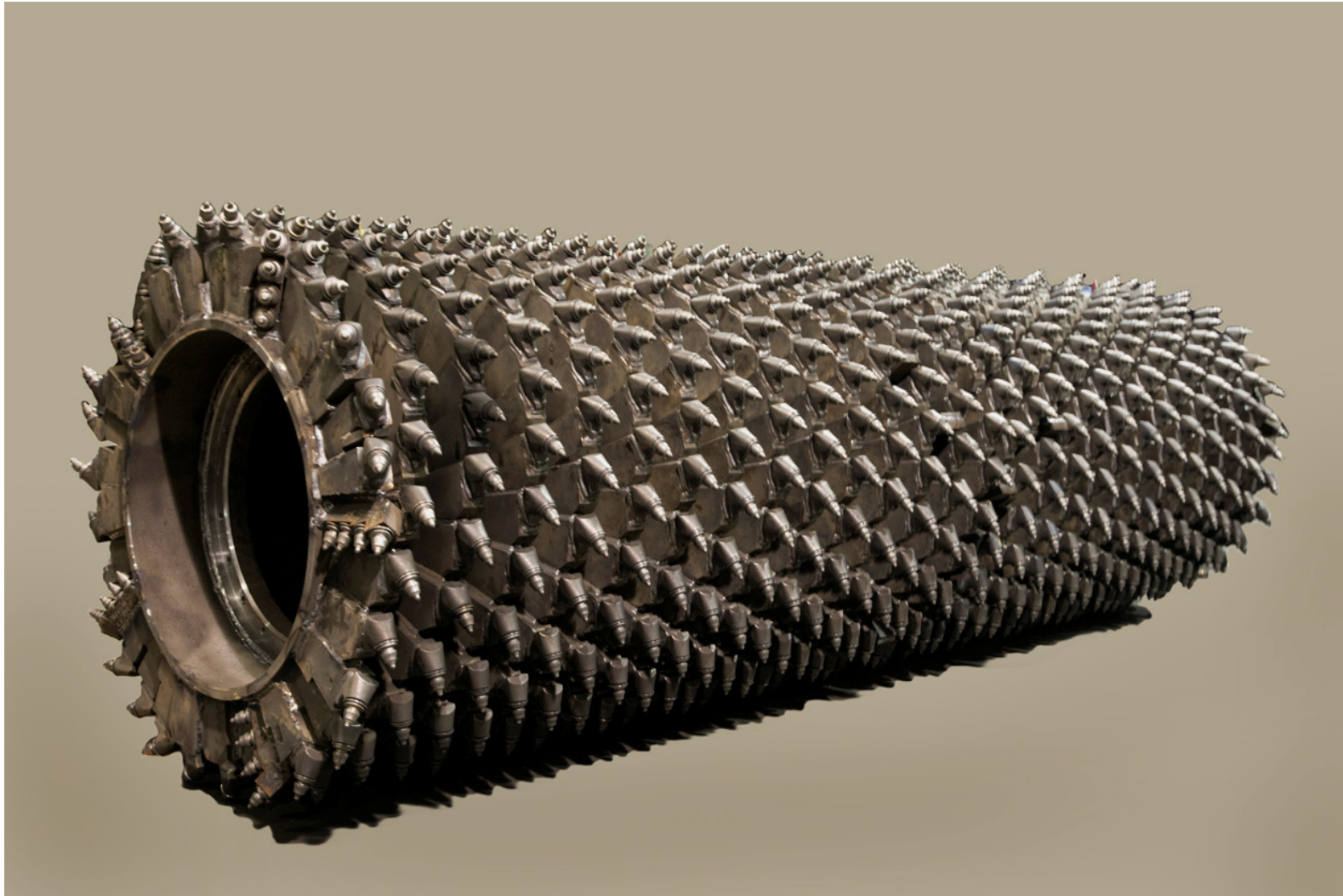
5/8" (16 mm) Triple Wrap at 100 fpm



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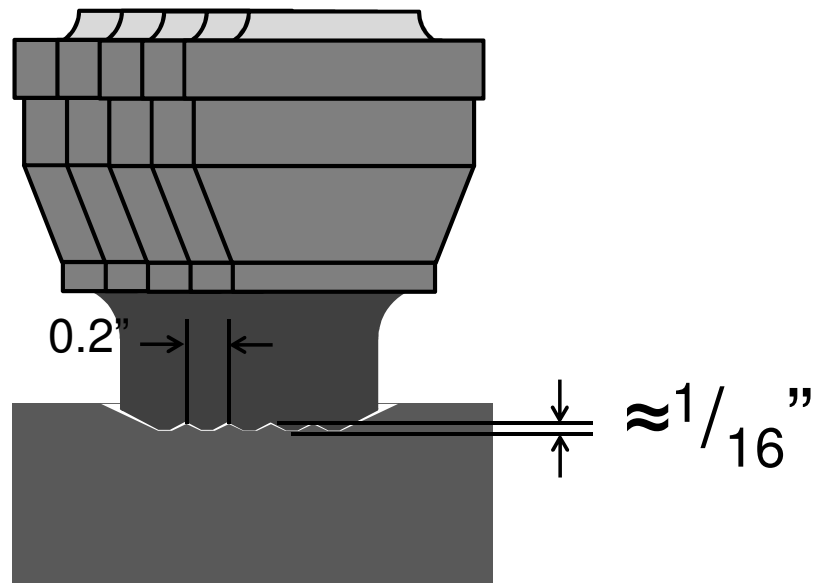
Micro-Milling Pattern



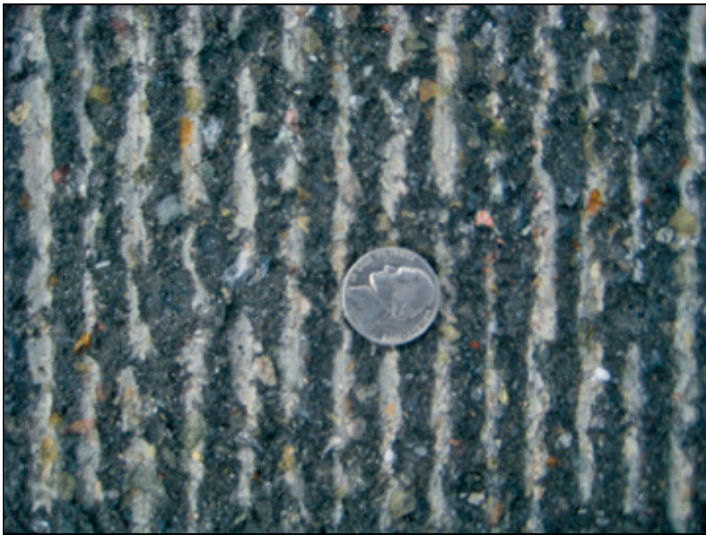
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2/10" (5mm) Quad Wrap Lacing



2/10" (5mm) Quad Wrap Lacing



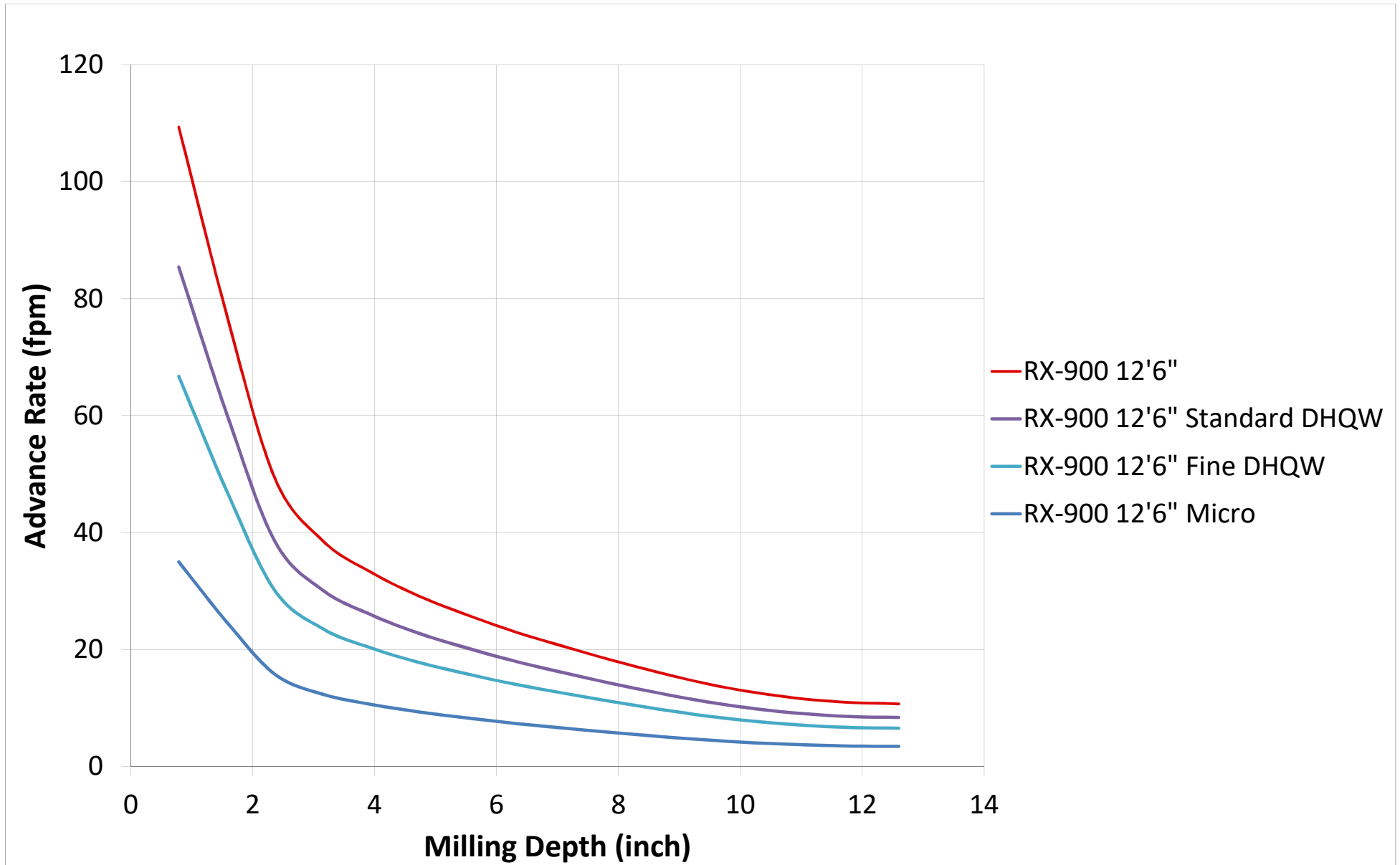
Amount of Tools

12'6" (3.5 m) Full Lane Drum		
Line Spacing	# of Teeth	Cost of Teeth
5/8" (16 mm)	268	\$1608
3/8" (9 mm)	406	\$2436
0.2" (5 mm)	770	\$4620

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



Production Tradeoff



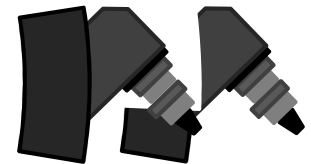
Advance Rate = 30 fpm or 9 mpm

Advance Rate = 9 mpm or 30 fpm

Drum Diameter = 115 cm or 46"

Drum Speed = 100 rpm

Machine
Advance
9 cm or 3.6"



0.18 cm or 0.071"



30 fpm



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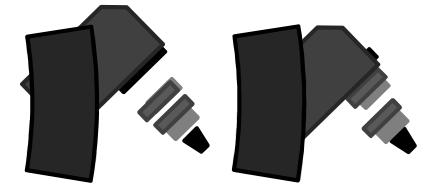
Advance Rate = 60 fpm

Advance Rate = 60 fpm

Drum Diameter = 46"

Drum Speed = 100 rpm

Machine
Advance
7.2"



0.28"



60 fpm



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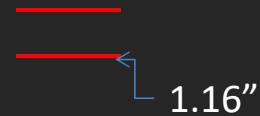
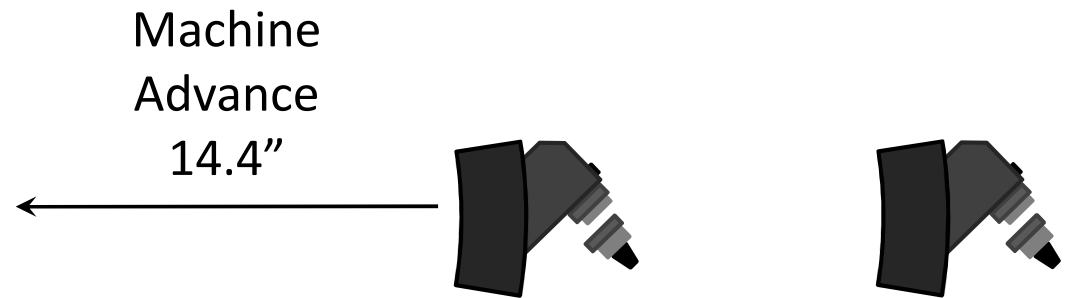


Advance Rate = 120 fpm

Advance Rate = 120 fpm

Drum Diameter = 46"

Drum Speed = 100 rpm



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120 fpm



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Longitudinal Smoothness



Out-Running the Drum



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30 fpm vs. 120 fpm

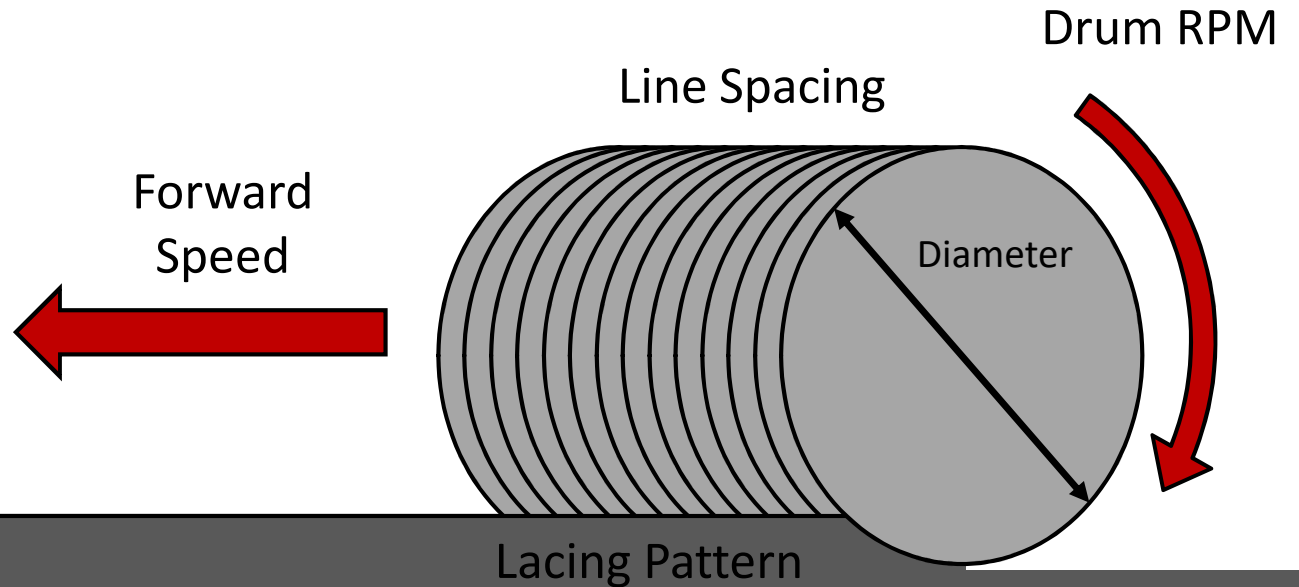
2.3 miles in a day vs. 9.1 miles in a day



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The Math of Milling



The 4 Main Factors that
Affect Surface Texture

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



Double Hit Drums



Above

Double hit Quad wrap drum

Standard triple wrap drum

Below

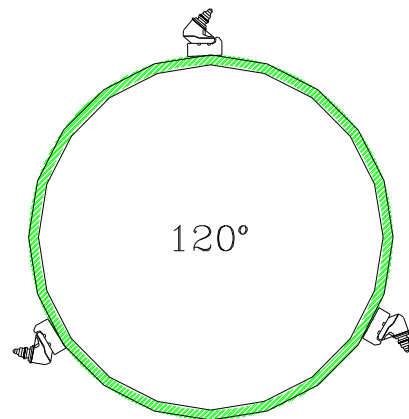


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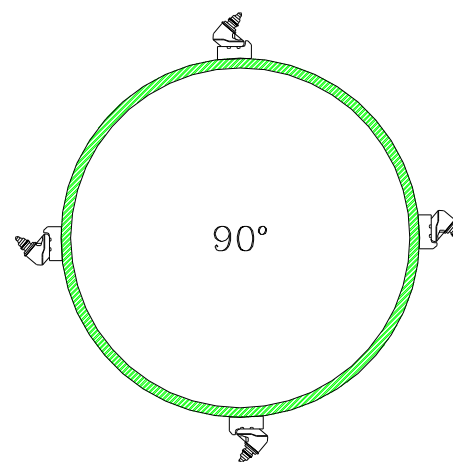


Drum Lacings

Scroll Start Comparisons



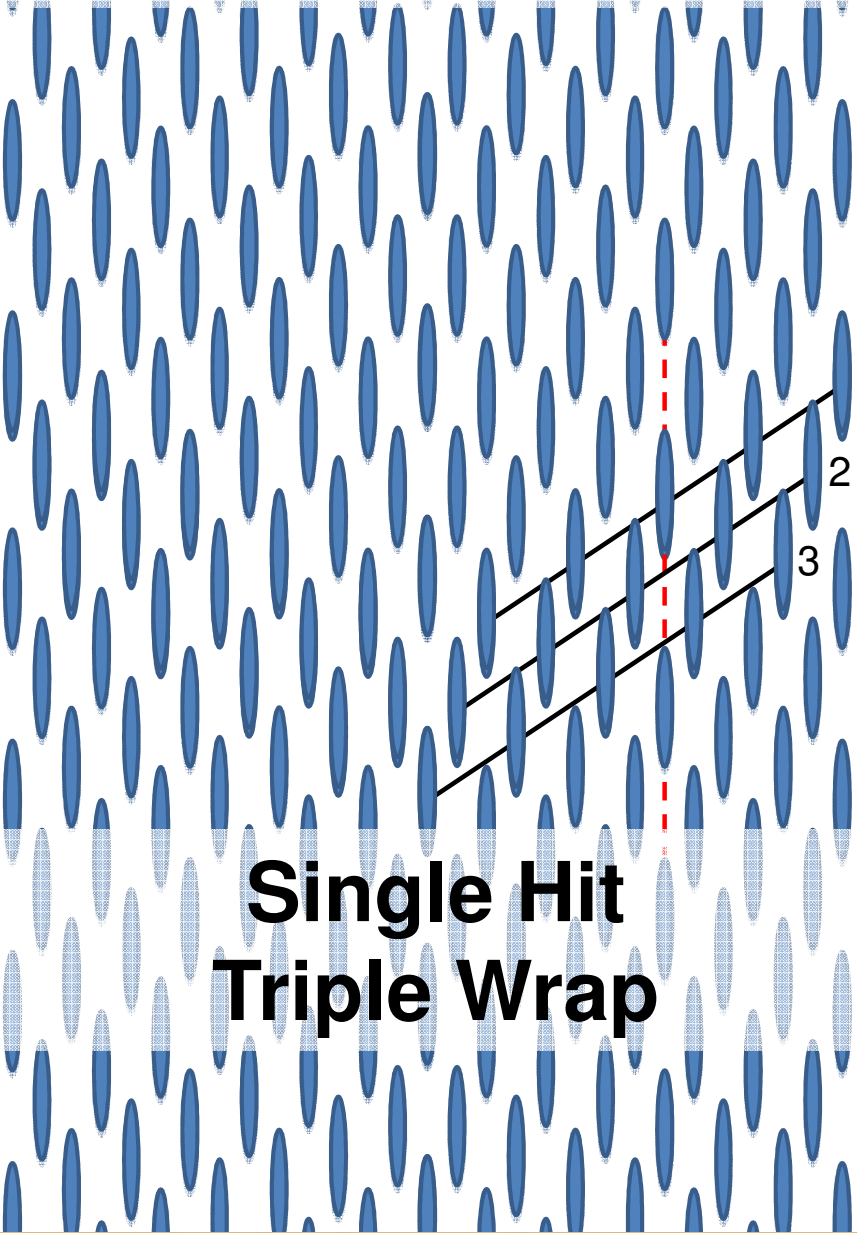
Triple Wrap



**Double Hit
Quad Wrap**



Pattern Comparisons



The diagram shows a grid of blue oval-shaped particles. A vertical dashed red line indicates a single impact point. Three parallel black lines, labeled 1, 2, and 3 from top to bottom, represent the wrap-around paths of the particles. Line 1 is the topmost, line 2 is in the middle, and line 3 is the bottommost. The impact point is located between lines 2 and 3.

**Single Hit
Triple Wrap**



The diagram shows a grid of blue oval-shaped particles. A vertical dashed red line indicates a single impact point. Four parallel black lines, labeled 1, 2, 3, and 4 from top to bottom, represent the wrap-around paths of the particles. Line 1 is the topmost, line 2 is in the upper middle, line 3 is in the lower middle, and line 4 is the bottommost. The impact point is located between lines 2 and 3.

**Double Hit
Quad Wrap**



Pattern Comparison



5/8" Triple Wrap at 100 FPM



7/8" DHQW at 100 FPM



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The Point of Breakout

Same Texture – Very Different Production

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



1/2” spaced DHQW at 140
FPM



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Double Hit Milled Surface- GA



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Wide Spaced Double Hit- VA



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Double Hit Surface- NYC



Scarifying concrete surface for overlay
-Original spec called for micro mill



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Sand Patch Test ASTM E965



Indiana Glass Bead Test (ITM 812)



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



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