MILLING FOR SMOOTHNESS
Eric Baker, Marketing Manager, 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.

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

Averaging System

3D Grade System

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.

This is why you clean up
If you leave work like this,
you won’t last.

Speed
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.

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

Scabbing

Cutter Drum

Triple Wrap, Off Set Flighting

Proper Maintenance

Tool Wear Characteristics

At Stage 3
Tool has lost 0.395 in (9.3 mm) of gage height

287% Increase in Surface Area

0.15 in²

0.43 in²

0.899 in²

0.899 in²

0.203 in²
Production Tradeoff

Advance Rate (mpm)

Milling Depth (cm)

RX-900 New Teeth

RX-900 Stage 4 Tooth Wear

Tooth Pattern

Standard Drum

Profiling Drum

Straight Line Pattern

Micro-Milling Pattern
Production Tradeoff

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

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

5/8” (16 mm) Triple Wrap at 30 fpm 9 mpm

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

5/8”

= ¾” or 3.2 mm

5/8”

≈ ⅛” or 3.2 mm

3.2 mm

5/8”

(16 mm) Triple Wrap at 30 fpm 9 mpm

Advance Rate = 30 fpm or 9 mpm

Advance Rate = 9 mpm or 30 fpm

Drum Diameter = 115 cm or 46”

Drum Speed = 100 rpm

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 ≈ 9 mpm

60 fpm ≈ 18 mpm

90 fpm ≈ 27 mpm

Advance Rate = 60 fpm or 18 mpm
Advance Rate = 90 fpm or 27 mpm
Advance Rate = 120 fpm or 36 mpm
120 fpm ≈ 36 mpm

9 mpm vs. 36 mpm
3.7 km in a day vs. 14.6 km in a day

Drum Speed

<table>
<thead>
<tr>
<th>Engine Speed</th>
<th>Top Sheave Diameter (in)</th>
<th>Bottom Sheave Diameter (in)</th>
<th>Gear Ratio 20:1</th>
<th>Gear Ratio 24:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2100 rpm</td>
<td>16</td>
<td>15</td>
<td>9.2 rpm</td>
<td>7.7 rpm</td>
</tr>
<tr>
<td>2500 rpm</td>
<td>16</td>
<td>15</td>
<td>11.2 rpm</td>
<td>9.5 rpm</td>
</tr>
<tr>
<td>2800 rpm</td>
<td>14</td>
<td>13</td>
<td>12.0 rpm</td>
<td>10.0 rpm</td>
</tr>
<tr>
<td>3100 rpm</td>
<td>14</td>
<td>13</td>
<td>12.6 rpm</td>
<td>10.6 rpm</td>
</tr>
</tbody>
</table>

Advance Rate = 120 fpm or 36 mpm

Advance Rate = 36 mpm or 120 fpm
Drum Diameter = 115 cm or 46”
Drum Speed = 100 rpm

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

Amount of Tools

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Amount</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>12' 6&quot; (3.5 m) Full Lane Drum</td>
<td>268</td>
<td>$1340</td>
</tr>
<tr>
<td>5/8” (16 mm) Spacing</td>
<td>406</td>
<td>$2030</td>
</tr>
<tr>
<td>3/8” (9 mm) Spacing</td>
<td>770</td>
<td>$3850</td>
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</tbody>
</table>

Production Tradeoff

Advance Rate = 120 fpm or 36 mpm

Advance Rate = 36 rpm or 120 fpm

Drum Diameter = 115 cm or 46"

Drum Speed = 100 rpm

Triple Wrap, Off Set Flighting
**Double Hit Drums**

- Standard triple wrap drum
- Double hit Quad wrap drum

**Drum Lacings**

**Scroll Start Comparisons**

- Triple Wrap: 1 7/8" (48 mm) spacing per flight equals 5/8" (16 mm) spacing
- Double Hit Quad Wrap: 1 1/8" (32 mm) spacing per flight equals 5/8" (16 mm) spacing

**Pattern Comparison**

- 22 mm (7/8") DHQW at 30.5 mpm (100 fpm)
- 16 mm (5/8") Triple Wrap at 30.5 mpm (100 fpm)

**The Point of Breakout**

- ½" (13 mm) spaced DHQW at 43 mpm

**Apples to Apples**

- ¼" spaced DHQW at 140 FPM
- 3/8" spaced SH Profile at 120 FPM
Micro-mill surface at 20 mpm

Production Tradeoff

RX-900 2.5 m cutter width
RX-900 3.5 m cutter width
RX-900 3.5 m Micromill

Production Tradeoff

Amount of Tools

<table>
<thead>
<tr>
<th>12' 6&quot; (3.5 m) (Full Lane Drum)</th>
<th>Cost of Drum</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8&quot; Spacing (16 mm)</td>
<td>$1340</td>
</tr>
<tr>
<td>Standard Spacing DHQW</td>
<td>$1715</td>
</tr>
<tr>
<td>Fine Spacing DHQW</td>
<td>$2200</td>
</tr>
<tr>
<td>0.2&quot; Spacing (5 mm)</td>
<td>$3850</td>
</tr>
</tbody>
</table>

Sand Patch Test
ASTM E965

Thank you