**Milling Equations**

**Rotational Speed (RPM’s)**

\[ N = \frac{v}{\pi D} \]

N = Rotational Speed (RPM’s)

v = Cutting Speed (SFPM)

D = Cutter Diameter

**Feed Rate: \( f_r \) (\( Dist/\text{Min} \))**

\[ f_r = N n_t f \]

\( f_r \) = Feed Rate (\( Dist/\text{Min} \))

N = Rotational Speed

\( n_t \) = Number of Teeth on the Cutter

f = Feed (\( \text{In.-}/\text{Tooth} \))
Approach Distances

A = Approach Distance
O = Cutter Run Out (Face Milling)
Milling Equations

**Approach Distance**: *Peripheral Milling*

\[ A = \sqrt{d \times (D-d)} \]

- \( A \) = Approach Distance
- \( D \) = Cutter Diameter
- \( d \) = Depth of Cut

**Approach Distance**: *Face Milling*

\[ A = O = \frac{D}{2} \]

- \( A \) = Approach Distance
- \( O \) = Cutter Run Out Distance
- \( D \) = Cutter Diameter
Milling Equations

**Machining Time: Peripheral Milling**

\[ T_m = \frac{L + A}{f_r} \]

- \( T_m \) = Machining Time (Min.)
- \( L \) = Length of Cut
- \( A \) = Approach Distance
- \( f_r \) = Feed Rate (\( \text{Dist.} / \text{Min.} \))

**Machining Time: Face Milling**

\[ T_m = \frac{L + A + O}{f_r} \]

- \( T_m \) = Machining Time (Min.)
- \( L \) = Length of Cut
- \( A \) = Approach Distance
- \( O \) = Cutter Run Out Distance
- \( f_r \) = Feed Rate (\( \text{Dist.} / \text{Min.} \))
Milling Equations

**Material Removal Rate** \((\text{in. cu.}/\text{Min.})\)

\[ MRR = w \cdot d \cdot f_r \]

- **MRR** = Material Removal Rate \((\text{cu. in.}/\text{Min.})\)
- **w** = Width of Cut
- **d** = Depth of Cut
- **f_r** = Feed Rate \((\text{Dist.}/\text{Min.})\)
Peripheral Milling Example

Data: D = 4.500”; d = 0.250”; w = 1.750”; f = 0.0005 \text{ in/tooth}; v = 128.5 \text{ SFPM}; n_t = 20 \text{ teeth}
Peripheral Milling Example

**Approach Distance**

\[ A = \sqrt{d(D - d)} \]

\[ A = \sqrt{0.250(4.500 - 0.250)} \]

\[ A = 1.0308'' \]
### Peripheral Milling Example

<table>
<thead>
<tr>
<th>Spindle Rotation</th>
<th>Feed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>( N = \frac{V}{\pi D} )</td>
<td>( f_r = N_0 n_t f )</td>
</tr>
<tr>
<td>( N = \frac{(128.5)(12)}{\pi 4.500} )</td>
<td>( f_r = (109.0742)(20)(0.0005) )</td>
</tr>
<tr>
<td>( N = 109.0742 \text{ RPM's} )</td>
<td>( f_r = 1.0907 \text{ in/Min} )</td>
</tr>
</tbody>
</table>
Peripheral Milling Example

**Machining Time**

\[ T_m = \frac{L + A}{f_r} \]

\[ T_m = \frac{7.000 + 1.0308}{1.0907} \]

\[ T_m = 7.3607 \text{ Min} \]
Peripheral Milling Example

Material Removal Rate

\[ MRR = w \ d \ f_r \]

\[ MRR = (1.750) \ (0.250) \ (1.0907) \]

\[ MRR = 0.4772 \text{ cu.in./min} \]
Face Milling Example

Data: $D = 0.625''$; $d = 0.375''$; $n_t = 6$; $f = 0.0015 \text{ in/tooth}$; $v = 100 \text{ SFPM}$
Face Milling Example

Approach & Over Travel Distance

\[ A = O = \frac{D}{2} \]

\[ A = O = \frac{0.625}{2} \]

\[ A = O = 0.3125" \]
# Face Milling Example

<table>
<thead>
<tr>
<th>Spindle Rotation</th>
<th>Feed Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ N = \frac{V}{\pi D} ]</td>
<td>[ f_r = N n_t f ]</td>
</tr>
<tr>
<td>[ N = \frac{(100)(12)}{\pi 0.625} ]</td>
<td>[ f_r = (611.1550)(6)(0.0015) ]</td>
</tr>
<tr>
<td>[ N = 611.1550 \text{ RPM's} ]</td>
<td>[ f_r = 5.5004 \text{ in/Min} ]</td>
</tr>
</tbody>
</table>
Face Milling Example

**Machining Time**

\[ T_m = \frac{L + A + O}{f_r} \]

\[ T_m = \frac{5.500 + 0.3125 + 0.3125}{5.5004} \]

\[ T_m = 1.3863 \text{ Min} \]
Face Milling Example

*Material Removal Rate*

\[ MRR = w \cdot d \cdot f_r \]

\[ MRR = (0.625) \cdot (0.375) \cdot (5.5004) \]

\[ MRR = 1.2892 \text{ cu.in./min} \]