



The Basics of Thread Rolling

Tools, Tips & Design Considerations

What is thread rolling?

- Thread rolling is NOT a metal cutting process
- Rolling changes physical properties, hardening and strengthening the material



Cut Thread



Rolled Thread

What are the benefits?

- Lower costs
- Increased production
- Faster lead times
- Superior quality and accuracy:
 - Stronger threads
 - Improved finish
 - More accurate profile

Where to start:

✓ **Material Selection & Properties**

- ☐ Design Considerations
- ☐ Correct Tooling
- ☐ Speeds & Feeds
- ☐ Accurate Gaging
- ☐ Common Issues & Troubleshooting

The Formability Index

- The softer the material, the easier it is to roll threads
- Harder materials result shorter die life
- Some hard-to-roll material, such as stainless steel, produces excellent thread finish with a compromised tool life

The Formability Index

- Examples:

| | Hardness | Thread Finish | Die Life |
|----------------------------------|--------------|--------------------|-------------|
| Brass (345, 360) | < Rb 75, 70 | Good, Poor | Medium/High |
| Aluminum (2024-T4, 6061, T-6) | < Rb 120, 17 | Excellent, Good | High |
| Stainless (302, 440) | < Rc 32 | Excellent | Medium/Low |
| Steel (1018, 12L14) | < Rc 24 | Excellent, Fair | Medium |

Important material factors

Different materials have different forming characteristics

- In steel, sulfur creates flakes and slivers
- In aluminum, Bismuth creates flakes and slivers
- Sulfur, Bismuth, and Lead aid in the machining process, but hinder the thread finish when cold forming.
- A tradeoff exists between machining speed and thread finish. Sulfur and Lead allow for high speeds and feeds in machining, but the thread finish can suffer.

✓ Material Selection & Properties

✓ **Design Considerations**

☐ Correct Tooling

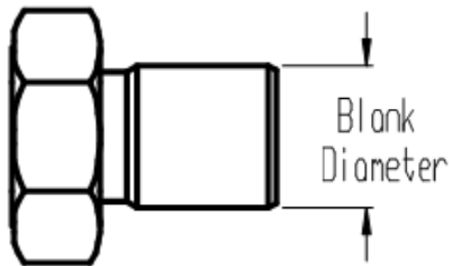
☐ Speeds & Feeds

☐ Accurate Gaging

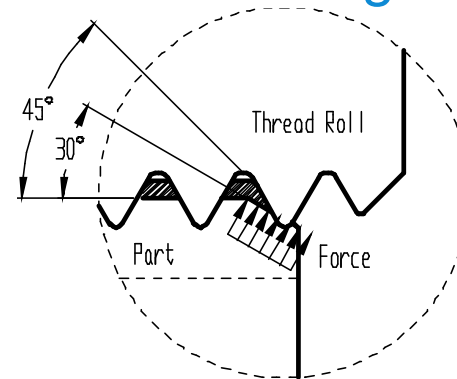
☐ Common Issues & Troubleshooting

Blank Design

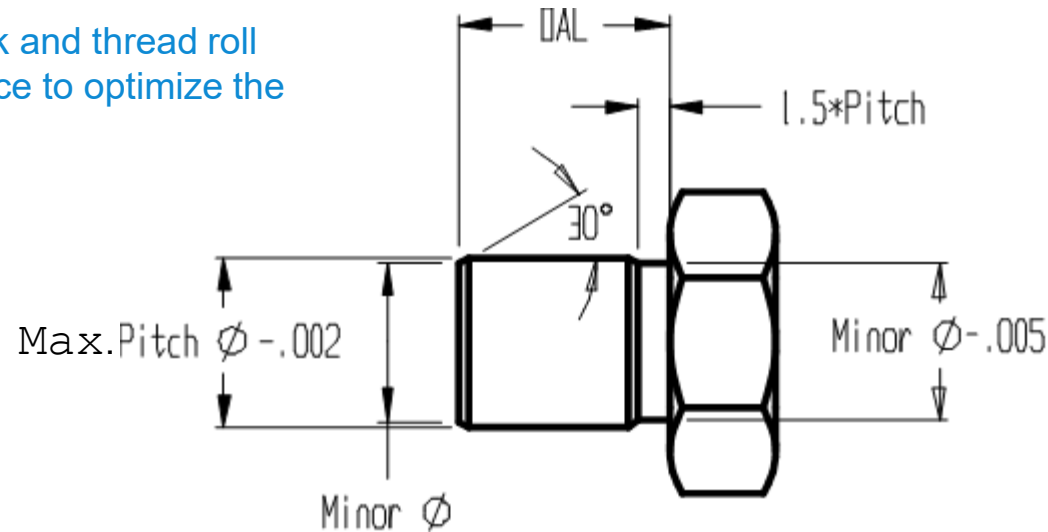
Blank Diameter



Chamfer Angle



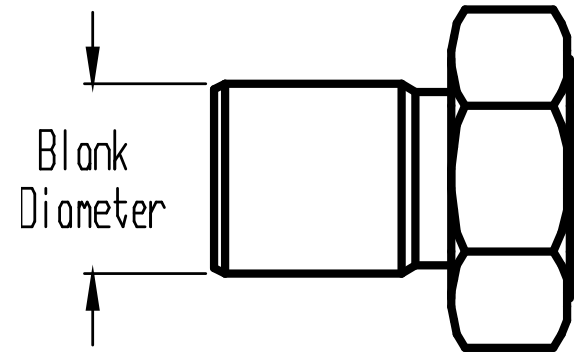
*CJWinter offers blank and thread roll design as a free service to optimize the thread roll process



Blank Diameter Properties

Blank diameter of rolled thread = Max pitch diameter - .002"

- When cutting a thread, the major diameter = the blank diameter of the threads.
- When thread rolling, material below the pitch diameter is displaced during cold form process and the excess material is squeezed up into the new major diameter.



Blank Diameter Properties

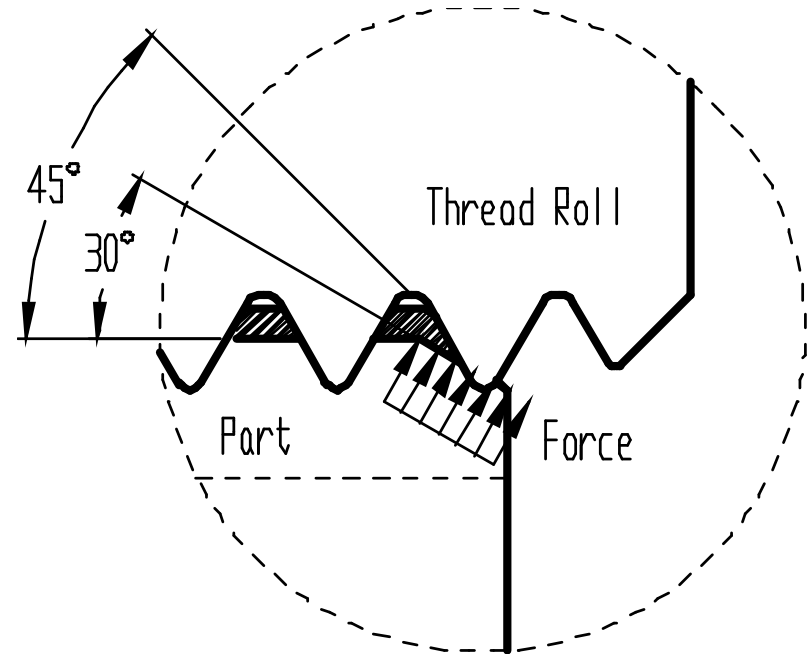
3:1 Ratio between Major and Blank Diameters

- For every .001" that the blank diameter is adjusted, the thread major diameter will change by .003".
- This ratio only applies when rolling close to the major diameter.

Chamfer Angle

Recommended Angle: 30° from the axis of the part

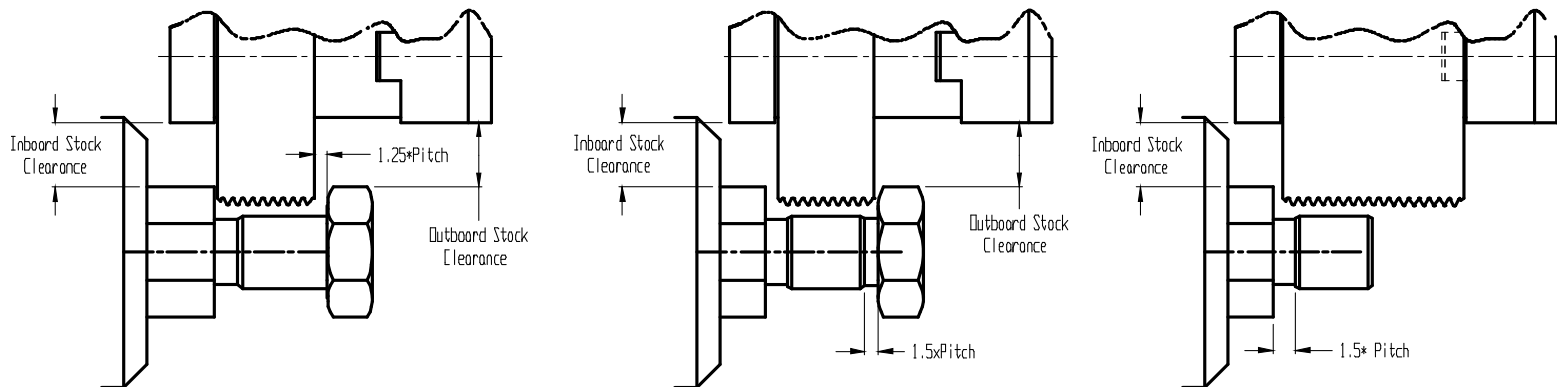
- A 30° chamfer will give an approximate 45° angle after rolling.
- When rolling harder materials a lower chamfer angle [25-28°] is preferred so thread roll life is not compromised.



Shoulder/Stock Clearance

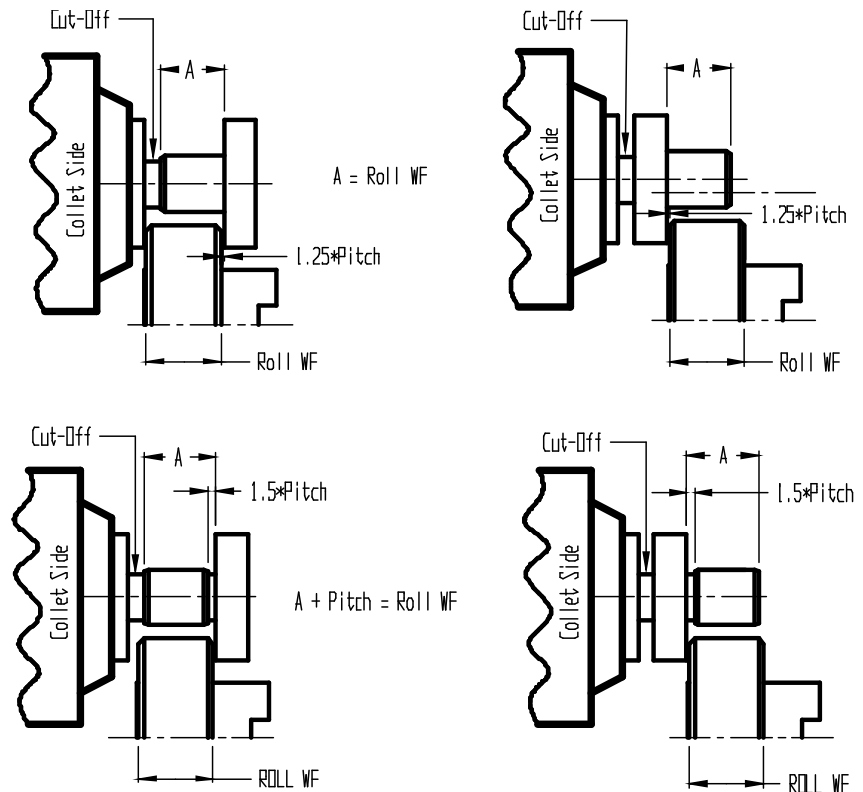
Maintain a minimum distance of 1.25 to 1.5 X pitch, depending on shoulder configuration

- Premature wear and damage will occur to the roll if the roll contacts the shoulder.
- Stock clearance is also an important consideration especially when hex stock is used.



Thread Length vs. Roll Length

- Roll work face needs to be calculated for each part to make sure proper clearances are used.
- We offer this as a free service to our customers to make sure that the thread roll process and tooling life are optimized.
- Rule of thumb =
 $\text{Roll WF} = (2.5 \times \text{Pitch}) + \text{Thread Length}$



- ✓ Material Selection & Properties
- ✓ Design Considerations
- ✓ **Correct Tooling**
 - ❑ Speeds & Feeds
 - ❑ Accurate Gaging
 - ❑ Common Issues & Troubleshooting

Correct Tooling – Rolls

Considerations:

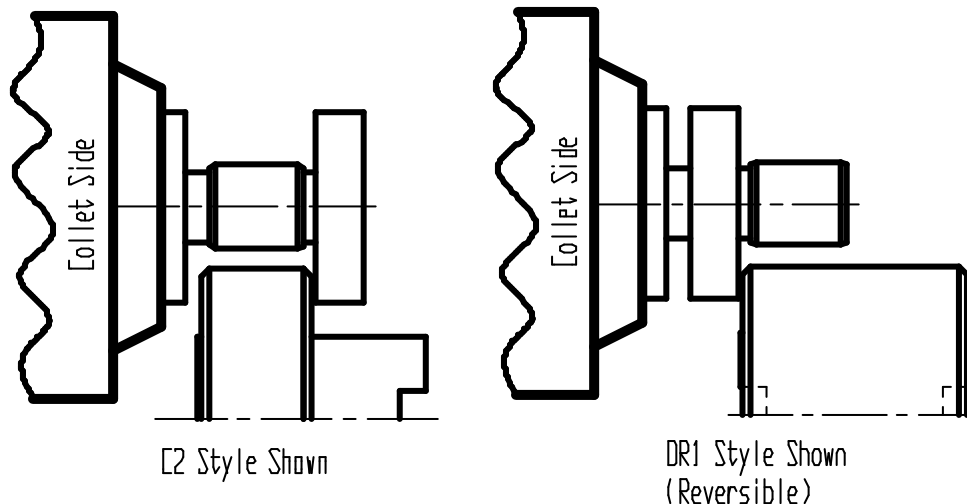
- Styles
- Material/Coating Options



Correct Tooling – Rolls

Styles

- Different styles depend on part orientation to the collet
- Some rolls are reversible; others are not
- In the configurations shown, the thread roll style required will be affected by roll/part orientation
- Send your part print to CJWinter to ensure correct style is calculated



Correct Tooling – Rolls

Options

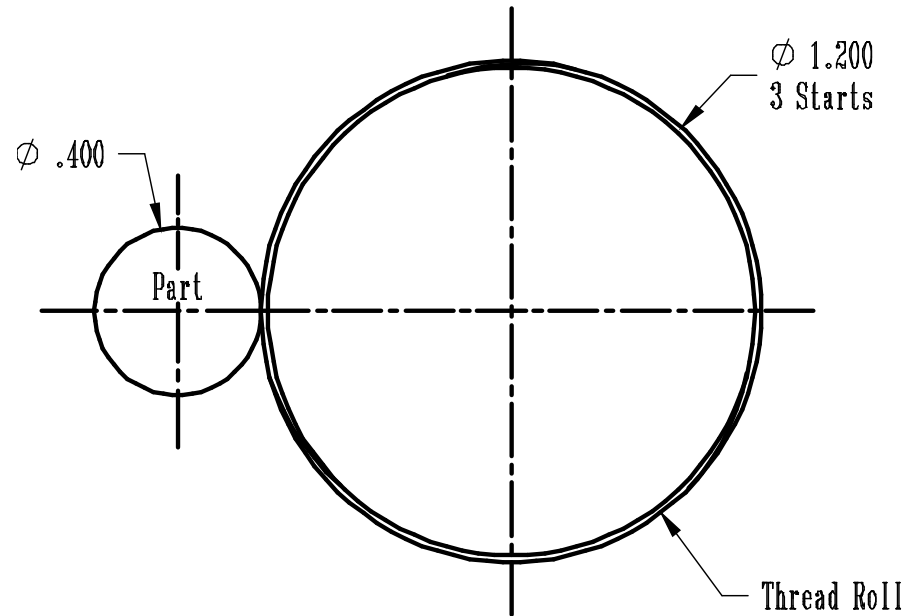
| Heat Treating | Special Materials | Coatings |
|---|--|---|
| <p>Toughness vs. Hardness Toughness implies longer roll life. Hardness has its own special applications.</p> | <p>Different substrate materials can improve roll life depending on application.</p> | <p>Improves die life and increases lubricity when rolling. Slightly more costly, but cost is outweighed by the increase in roll life.</p> |

Relationship of Roll to Blank

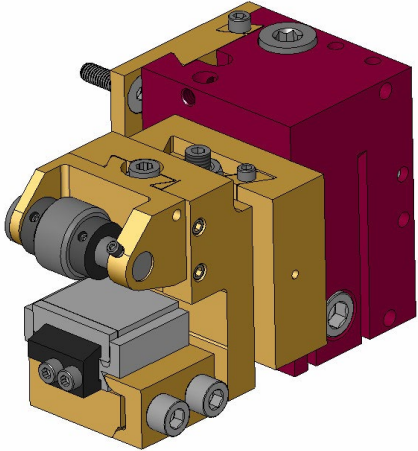
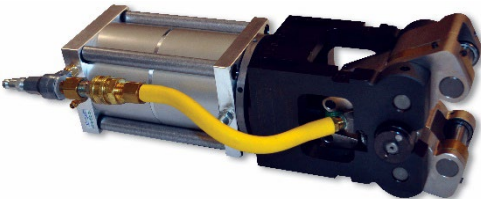

Rolls are designed to incorporate the maximum number of starts allowed to fit in attachment.

- More starts = Higher RPM allowed
- More starts = Longer roll life

Depending on the roll design, the roll WF should always overhang the part by at least 2-2.5 threads



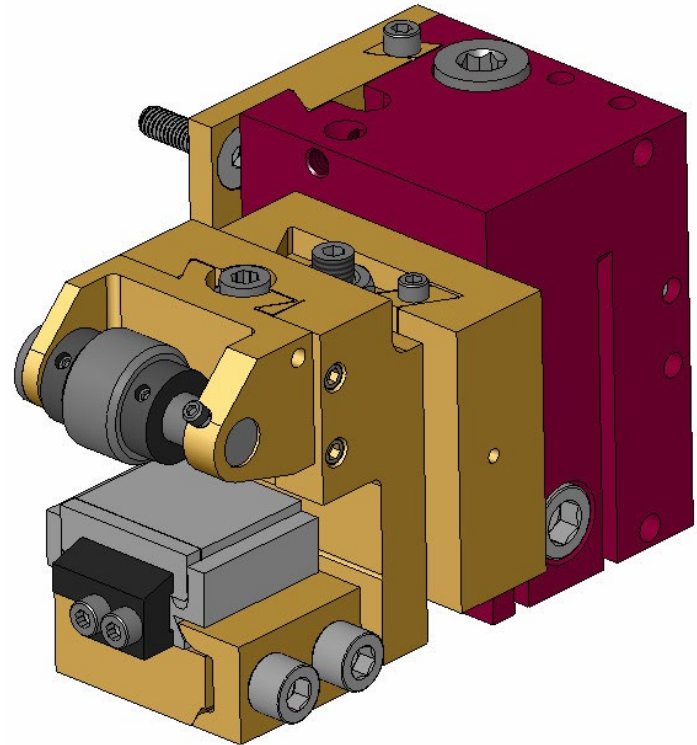
Correct Tooling

| Shave Tool | Attachments | Rolls |
|---|--|---|
|  A 3D CAD model of a shave tool assembly. It features a red rectangular base block with a yellow block mounted on top. The yellow block has a grey cylindrical component on its side and a black rectangular component at the bottom. Various screws and bolts are visible on the assembly. |  A photograph of a pneumatic attachment. It consists of a silver cylindrical body with a black handle and a yellow hose connected to the side. The attachment has several ports and a small nozzle at the front. |  A photograph of various metal rolls. There are several different sizes and types of rolls, some with internal threads and others with external threads. They are arranged in a pile on a dark surface. |

Correct Tooling – Shave Tools

Considerations:

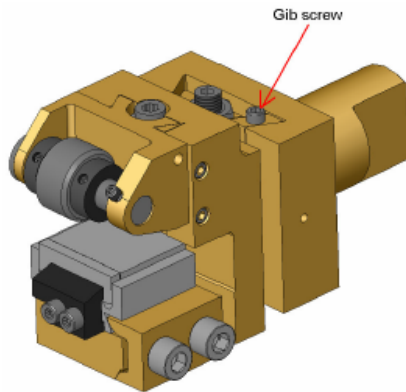
- Easy to adjust
- Repeatable adjustments
- Rigid design
- Smooth action
- Capacity range
- Workface flexibility
- Inboard
- Central - floating



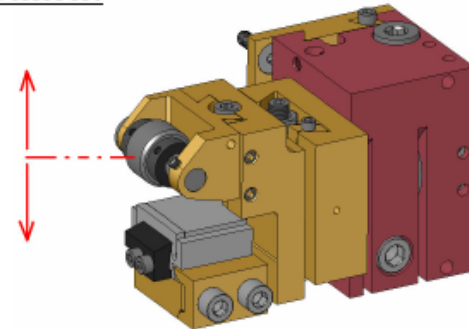
Correct Tooling – Shave Tools

Lift Adjustment

This adjustment is used to increase or decrease the amount of lift of the head.

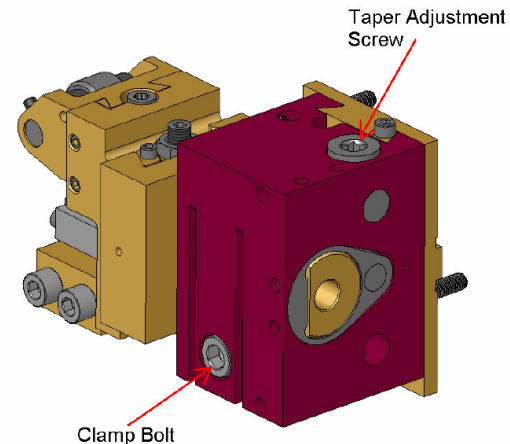
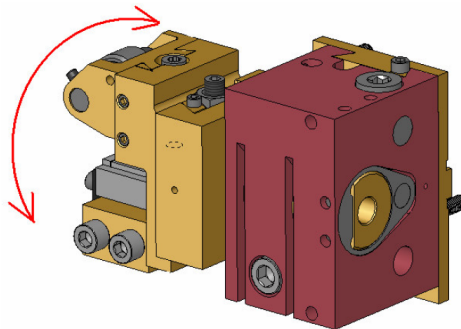


Roll Adjustment



Taper Adjustment

This adjustment will help to eliminate any taper you may have in your part.



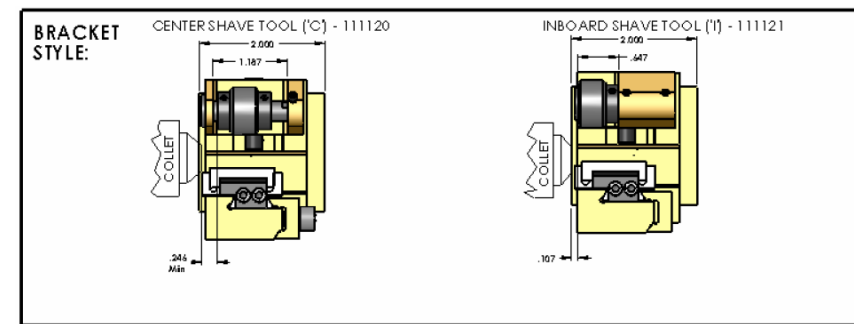
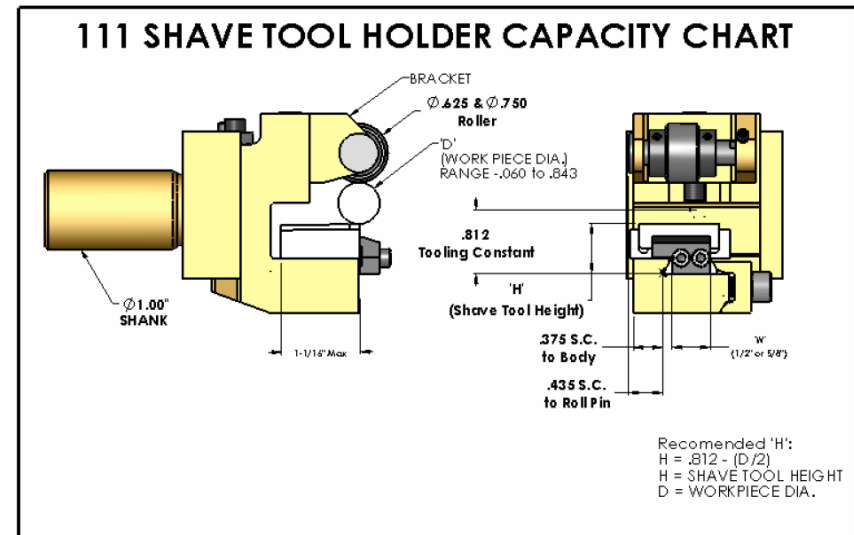
Correct Tooling – Shave Tools

Capacity:

- Ability to shave large range for a given machine

Workface Flexibility:

- Optional bracket configurations to allow proper support during shaving cycle



Correct Tooling – Attachments

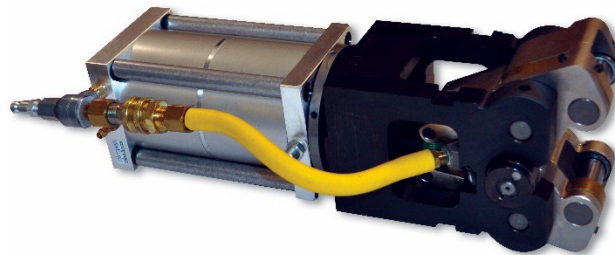
Considerations:

- Radial Pinch
- Axial End Rolling
- Tangential Attachments
- Axial Rotary Transfer
- Applications

Correct Tooling – Attachments

Radial Pinch

- Attachment advances rapidly over part in an open position and then rolls penetrate into work piece radially.
- Pitch diameter adjustments on the fly are possible without any tooling and without the removal of the attachment.
- Only one dwell cam is required to roll the entire thread rolling range.
- Penetration (Roll Feed) Rate is quickly adjusted via an air control valve.
- Equalized thread rolling pressure virtually eliminates spindle wear and part deflection.



CJWinter 160SA - Pneumatic Attachment

Correct Tooling – Attachments

Axial End Rolling

- Attachment traverses axially from tail stock / end, working spindles into workpiece centerline
- Allows forming of parts that are longer than the roll width if required.

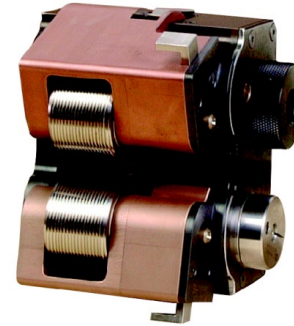


CJWinter 189,190, & 191 Series End Rolling Attachments
[ER Series]

Correct Tooling – Attachments

Tangential

- Attachment approaches part radially and straddles work piece to produce threads.
- The fixed distance between the rolls is set to the minor diameter of work piece. Some models require manual adjustment of pitch diameter while others are controlled by a pitch adjusting knob.



CJWinter NC-41 Tangential Attachment

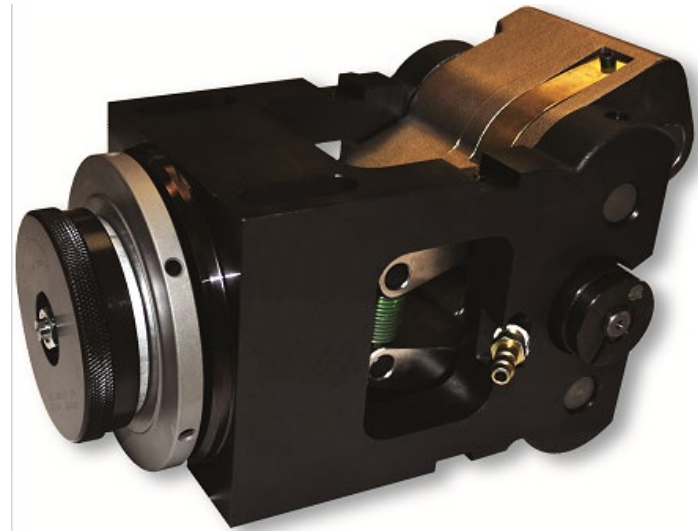


Detroit Attachment

Correct Tooling – Attachments

Tangential

- Tangential attachments are designed to roll threads at a controlled feed rate. Typically, different cams are required to modify feed rate — this can be costly and time consuming.
- The side pressure produced by the pushing tangential action can cause the part being tolled to deflect and accelerated spindle wear.

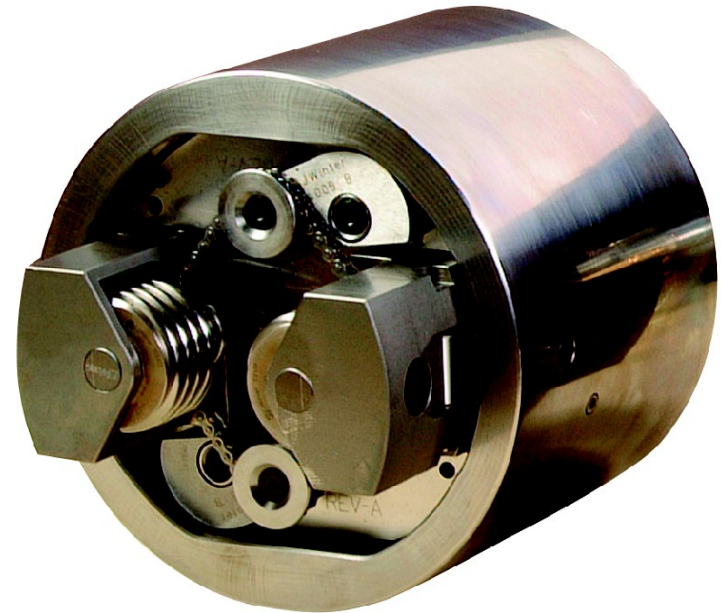


160 Tangential Attachment

Correct Tooling – Attachments

Axial Rotary Transfer

- The attachment advances over the part in an open position and then the rolls penetrate into the work piece radially.
- Attachment can also be used to produce threads behind the shoulder.
- The part thread length is less than the rolling length.



CJWinter 234-SA Axial Attachment

Correct Tooling – Attachments

Application Chart

| Attachment | Type | Size/Model | Position | Travel | | REQUIRED COMPONENTS | | | REFERENCE INFO. | | |
|------------|---------------|------------|------------|--------|-------|-----------------------------|--------------|---------------|-----------------|---------------------|-------------|
| | | | | STD | Req'd | Adapter & Hardware Assembly | Setting Gage | Control Valve | Mount Info. Dwg | Trip Brkt Mount Dwg | Remarks |
| 160SA-1 | | | | | | | | | | | |
| A60X | Mona-Matic | 21-H | Rear | | | 160317 | 160079 | 141600 | 160247 | 160256 | |
| A60X | Schutte | SE-25F | 4th or 5th | 1.250 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | AD-40 | 5th or 6th | 1.791 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | SF-51 | 4th or 5th | 2.362 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | SD-32 | 4th or 5th | 1.508 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | SF-32 | 4th or 5th | 1.969 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | SF-40 | 4th or 5th | 2.362 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| A60X | Schutte | SF-40 | 4th or 5th | 2.362 | | 160327 | 160150 | 141600 | 160264 | 160256 | |
| | | | | | | No Req'd | 160079 | 141600 | 160215 | 160231 | |
| | | | | | | | 160079 | 141600 | 160215 | 160231 | |
| A60WS3300 | Warner Swasey | M3300 | | | | | | | | | |
| A60X | Warner Swasey | 1AB | Front/Rear | | | 160320 | | | | | |
| A60X | Warner Swasey | 2AB | | | | 160334 | 160079 | 141600 | | 160256 | |
| A60WM13/45 | Wickman | 1 3/4-5 | 3rd | 1 | 2.375 | No Req'd | 160079 | 141600 | 160219 | 160231 | (1) |
| A60WM13/46 | Wickman | 1 3/4-6 | 4th or 5th | 1.562 | 1.688 | No Req'd | 160079 | 141600 | 160202 | 160231 | SEC 293 (1) |
| A60X | Wickman | 1 3/4-8 | 3rd or 4th | 2.500 | 2.313 | 160305 | 160079 | 141600 | 160216 | 160231 | |
| A60WM13/48 | Wickman | 1 3/4-8 | 5th | 2 | 2.437 | 160305 | 160079 | 141600 | 160216 | 160231 | (1) |
| A60WM13/48 | Wickman | 1 3/4-8 | 6th | 1.750 | 2.437 | 160305 | 160079 | 141600 | 160216 | 160231 | (1) |
| A60WM13/86 | Wickman | 1 3/8-6 | 4th | 1.562 | 1.688 | No Req'd | 160079 | 141600 | 160202 | 160231 | SEC 293 (1) |
| A60WM13/86 | Wickman | 1 3/8-6 | 5th | 1.250 | 1.688 | No Req'd | 160079 | 141600 | 160202 | 160231 | SEC 293 (1) |
| A60WM21/45 | Wickman | 2 1/4-5 | 3rd | 1.000 | 2.375 | No Req'd | 160079 | 141600 | 160219 | 160231 | (1) |
| A60WM21/46 | Wickman | 2 1/4-6 | 4th | 1.625 | 2.313 | 160305 | 160079 | 141600 | 160216 | 160231 | SEC 393 (1) |
| A60WM21/46 | Wickman | 2 1/4-6 | 5th | 1.250 | 2.313 | 160305 | 160079 | 141600 | 160216 | 160231 | SEC 393 (1) |
| A60WM25/86 | Wickman | 2 5/8-6 | 4th | 2.000 | 2.313 | 160301 | 160079 | 141600 | 160204 | 160231 | SEC 593 (1) |

- ✓ Material Selection & Properties
- ✓ Design Considerations
- ✓ Correct Tooling
- ✓ **Speeds & Feeds**
- ❑ Accurate Gaging
- ❑ Common Issues & Troubleshooting

Speeds & Feeds

- Thread rolling tends to be the fastest operation
- Faster is usually better
- Rule of thumb:
 - **Part RPM: ~ 300 RPM per start of roll**
- Typically does not constrain the cycle time

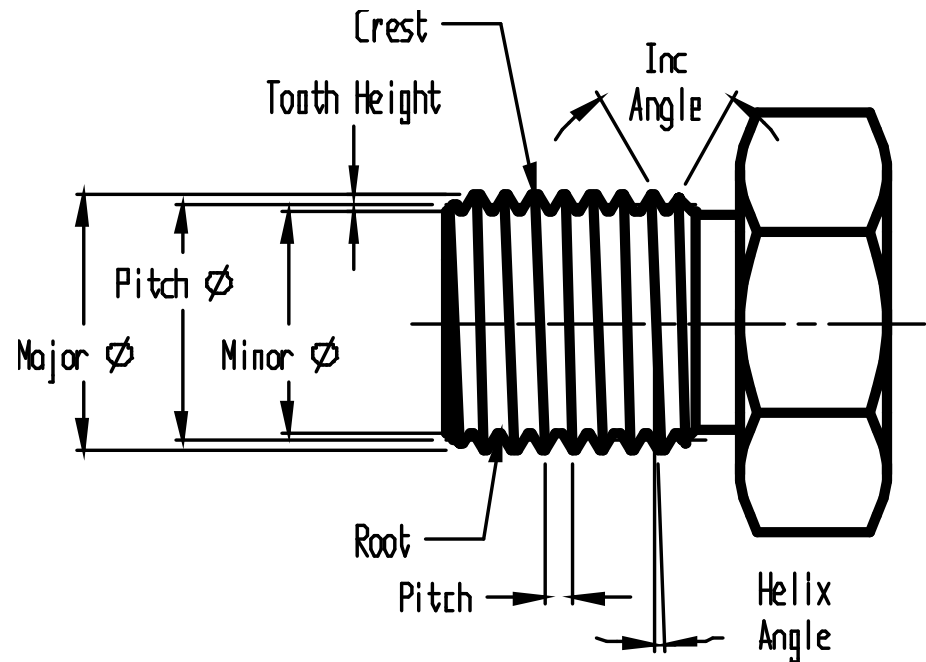
* See Appendix for handy Speed & Feed calculations

- ✓ Material Selection & Properties
- ✓ Design Considerations
- ✓ Correct Tooling
- ✓ Speeds & Feeds
- ✓ **Accurate Gaging**
- ❑ Common Issues & Troubleshooting

Accurate Gaging

Types

- Go / No-Go Ring gages
- Micrometers / Pitch micrometers
- Tri Roll [Johnson Gage]
- Functional Segments
- Pitch Diameter Rolls
- Pipe Threads
- 6 Step
- 1L, 2L Ring Gages

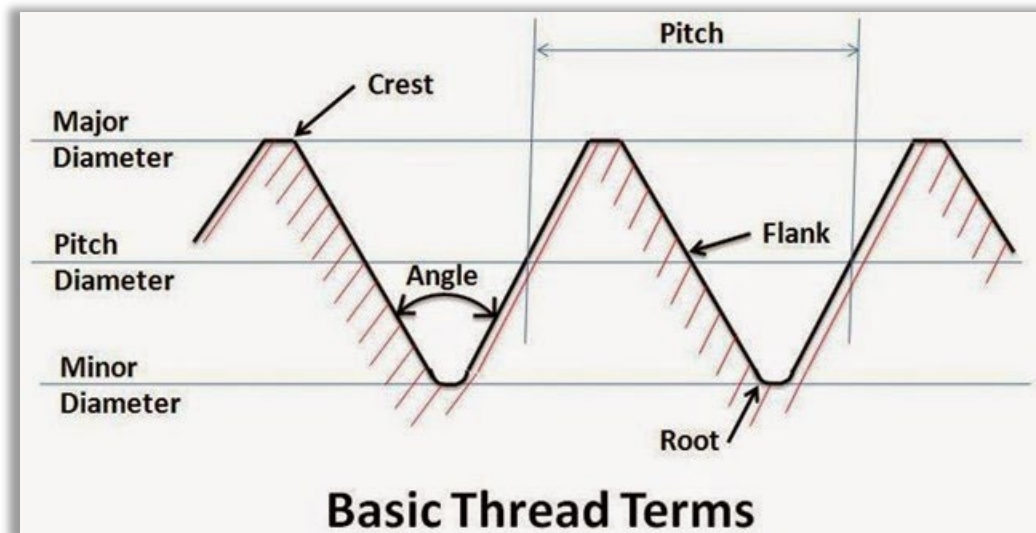


“To yield useful repeatable data, it is critical to align inspection methods to part geometry based on customer requirements, part geometry, and GD&T”

Gaging

Rolling a Straight Thread

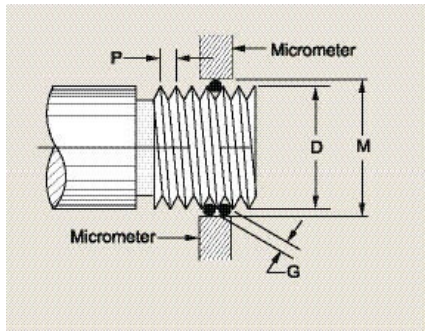
- Machine part blank diameter to \sim Max Pitch Diameter $-.002$
- Roll the thread until the pitch diameter is within specification – between Pitch Diameter max & min
- Adjust the blank diameter until the Major diameter is within specification – between Major diameter max & min



Gaging

Measuring features on a Straight Thread

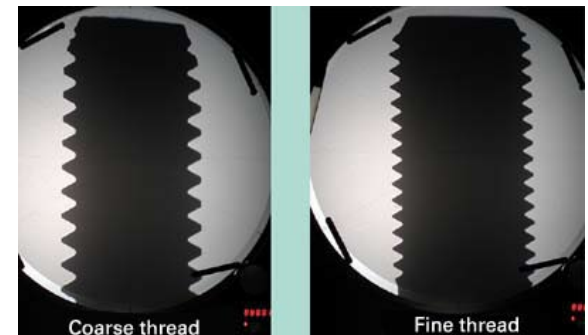
- Blank diameter – use micrometers and/or comparator
- Pitch diameter – use pitch micrometers and/or over pins
- Major diameter – use micrometers and/or comparator



Micrometers



Pitch Micrometers

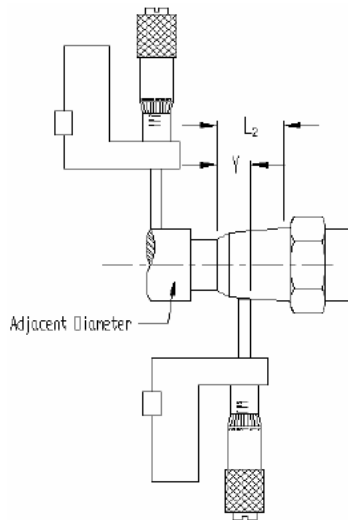


Comparator or Shadowgraph

Gaging

Rolling on a Tapered Pipe Thread

- Machine part blank diameter to specifications outlined in chart
 - Included angle of blank is 1°47'.
 - Verify blank diameter at location Y [column "Y" and "B.D.@Y"]
- Roll the thread until the pitch diameter gages within the L1 & L2 gage specifications.
- Adjust the blank diameter, until the Major diameter gages within 6 – Step gage specifications - if required



| BLANK SPECIFICATIONS | | | |
|-------------------------|------|------|-------------|
| PIPE SIZE NPT & NPTF | Y | L2 | B.D. @ Y |
| 1/16-27 | .130 | .261 | .279 |
| 1/8-27 | .132 | .264 | .372 |
| 1/4-18 | .200 | .402 | .489 |
| 3/8-18 | .203 | .408 | .625 |
| 1/2-14 | .266 | .534 | .774 |
| 3/4-14 | .273 | .546 | .985 |
| 1" -11 1/2 | .341 | .683 | 1.235 |
| 1 1/4-11 1/2 | .353 | .707 | 1.579 |
| 1 1/2-11 1/2 | .362 | .724 | 1.818 |

Gaging

Measuring features on a Tapered Pipe Thread

- Blank diameter – Use micrometers and/or comparator
- Pitch diameter
 - Use L1 gage to verify pitch E1 location
 - Use L2 gage to verify pitch E2 location
- Major diameter – Use 6-Step to verify major diameter

AMERICAN PIPE THREADS 1849

Table 4. Basic Dimensions, American National Standard Taper Pipe Threads, NPT
ANSI/ASME B1.20.1-1983 (R1992)

For all dimensions, see corresponding reference letter in table.
Angle between sides of thread is 60 degrees. Taper of thread, on diameter, is $\frac{1}{16}$ inch per foot. Angle of taper with center line is $1^{\circ}47'$.
The basic maximum thread height, h , of the truncated thread is $0.8 \times$ pitch of thread. The crest and root are truncated a minimum of $0.033 \times$ pitch for all pitches. For maximum depth of truncation, see Table 1.

| Nominal Pipe Size | Outside Dia. of Pipe, D | Threads per inch, n | Pitch of Thread, p | Pitch Diameter at Beginning of External Thread, E_3 | Handtight Engagement Length, ^a L_1 | Dia., ^a E_1 | Effective Thread, | |
|-------------------|---------------------------|-----------------------|----------------------|---|---|--------------------------|----------------------------|-------------|
| | | | | | | | Length, ^a L_2 | Dia., E_2 |
| | | | | | In. | | In. | |
| $\frac{1}{16}$ | 0.3125 | 27 | 0.03704 | 0.27118 | 0.160 | 0.28118 | 0.2611 | 0.28750 |
| $\frac{1}{8}$ | 0.405 | 27 | 0.03704 | 0.36351 | 0.1615 | 0.37360 | 0.2639 | 0.38000 |
| $\frac{3}{16}$ | 0.540 | 18 | 0.05556 | 0.47739 | 0.2278 | 0.49163 | 0.4018 | 0.50250 |
| $\frac{1}{4}$ | 0.675 | 18 | 0.05556 | 0.61201 | 0.240 | 0.62701 | 0.4078 | 0.63750 |
| $\frac{5}{16}$ | 0.840 | 14 | 0.07143 | 0.75843 | 0.320 | 0.77843 | 0.5337 | 0.79179 |
| $\frac{3}{8}$ | 1.050 | 14 | 0.07143 | 0.96768 | 0.339 | 0.98837 | 0.5457 | 1.00179 |
| $\frac{1}{2}$ | 1.315 | 11 $\frac{1}{2}$ | 0.08696 | 1.21363 | 0.400 | 1.23863 | 0.6828 | 1.25630 |
| $\frac{3}{4}$ | 1.660 | 11 $\frac{1}{2}$ | 0.08696 | 1.55713 | 0.420 | 1.58338 | 0.7068 | 1.60130 |
| 1 | 1.900 | 11 $\frac{1}{2}$ | 0.08696 | 1.79609 | 0.420 | 1.82234 | 0.7235 | 1.84130 |

Gaging

Measuring features on a Tapered Pipe Thread

- **NPT L1** rings inspect the functional size or hand tight engagement of pipe threads, Parts are acceptable when they generally acceptable when they come flush to end of ring +/- one turn.
- **NPTF L1:** Same as NPT; thread tolerances are more closely controlled, requiring an L2 thick ring gage as well as the L1 ring.



L1

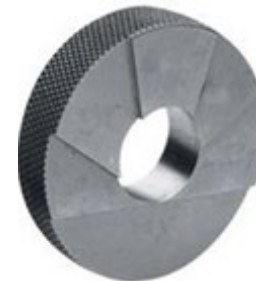
Gaging

Measuring features on a Tapered Pipe Thread

- **NPTF L2** ring inspects the wrench engagement threads and is to be used in conjunction or relationship with the NPTF L1. Thread tolerances are more closely controlled requiring an L2 thick ring gage as well as the L1 ring.
- **NPTF 6** step ring gages are used to check external threaded parts. NPTF 6 gages check the crest truncation or profile of the external threads and are used in conjunction or relationship with the L1 L2 ring gages.



L2



6 Step

- ✓ Material Selection & Properties
- ✓ Design Considerations
- ✓ Correct Tooling
- ✓ Speeds & Feeds
- ✓ Accurate Gaging
- ✓ **Common Issues & Troubleshooting**

Common Thread Rolling Problems

Thread Filled Out
in Center

Tapered Threads

Out of Round
Threads

Poor Thread Form

Thread with Expanded
Lead

Thread with
Contracted Lead

Split Thread-
Axially

Poor Finish on
Threads

Off-size Threads

Drunken Threads

Crests Not Filled
Out

Slivers or Flakes
on Threads

Hollow Work, Hole
Closed In

Relationship of
Roll to Blank

Hollow Work, Tapered
Threads

Top 10 Common Issues

1. Slivers/Flakes in Threads
2. Incorrect Pitch/Lead
3. Mismatched Helix Angle
4. Different Rolling Conditions
5. Hollow Work, Closed Hole, or Out of Round Conditions
6. Thread Filled out in Center, but Not End
7. Poor Finish
8. Poor Thread Form
9. Crests Not Filled Out
10. Scuffed Crests

Common Issue #1: **Slivers/Flakes in Threads**

- Are rolls in match?
 - **Resynchronize**
- Is the centerline of rolls parallel with work centerline?
 - **Check slide for alignment**
- Is cross slide adapter worn or loose?
 - **Check slide gib and springs; tighten adapter if used**
- Are rolls overfilled?
 - **Reduce blank diameter**
- Is roll diameter correct?
- Is material adaptable to cold working?
 - **Check with material supplier/customer**
 - **Change material if possible**
- Does blank have a rough finish?
 - **Regrind tooling**
- Is stock seamy?
 - **Not suitable for thread rolling**
- Do rolls slip on work?
 - **Feed rate is too slow; increase penetration rate**

Common Issue #2: Incorrect Pitch/Lead

1. Measure in a comparator

- Measure over as many full threads as possible

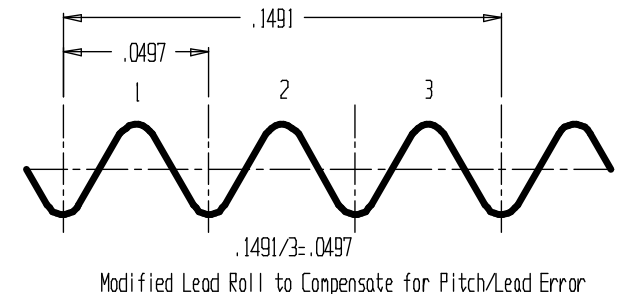
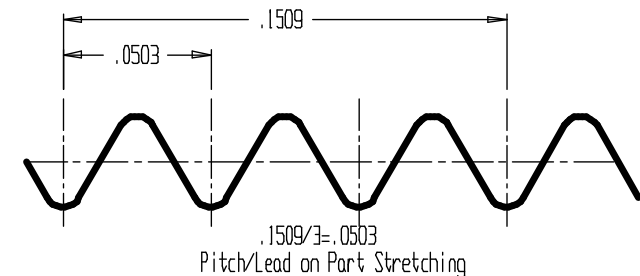
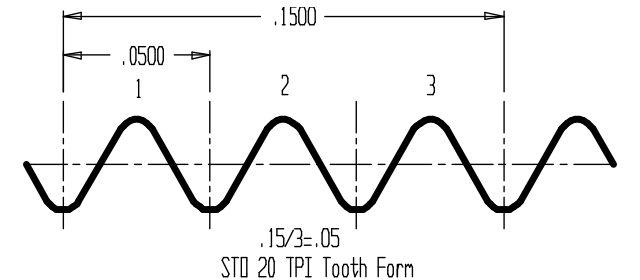
- $$\frac{\text{Number above}}{\text{Number of threads measured}} = \text{Pitch}$$

2. Use Rolls Modified Lead (ML)

- Used when thread is rolled on the part, and pitch has increased, causing a gaging problem
- Measure pitch/lead, then adjust pitch/lead to compensate part's stretch

3. Order new rolls

- For ML rolls, it is best to send sample parts that have been rolled to confirm pitch/lead error. Your manufacturer can then design rolls to correct ML error and product a part that gages properly



Common Issue #3: Mismatched Helix Angle

What happens when the roll contacts the blank?

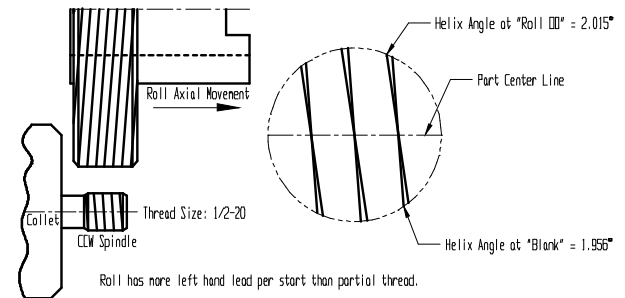
- “Screw jacking” – If kept on part for too long, attachments/rolls get pulled into collet.
- **Optimize rolling time.** Enter and exit as fast as possible. Allow thread to form properly and fully, then remove. The longer the roll remains in contact with the part, the greater the chance of problems developing.

Mismatched Helix Angle (cont.)

1. Roll OD first touches blank diameter.

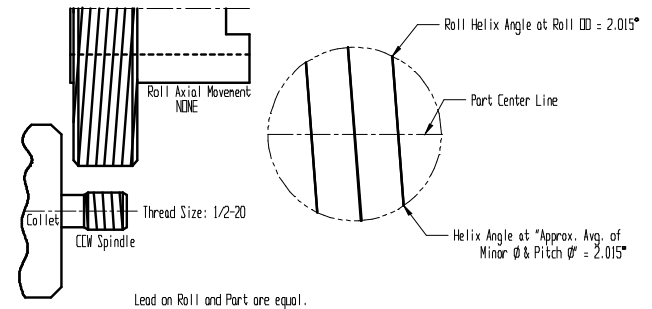
The roll helix angle is larger than the helix at the blank diameter.

- Roll pushes away from the collet.



2. Roll OD is halfway between blank diameter and minor diameter.

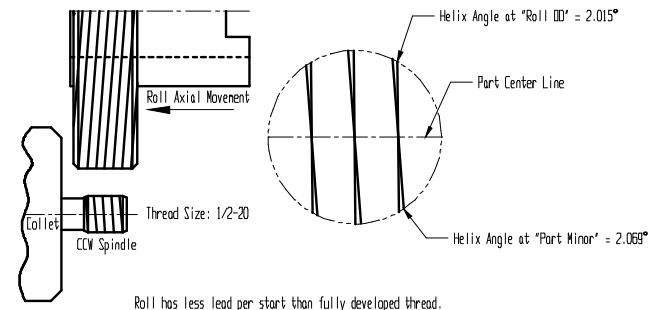
The helix on the part and roll will match and track perfectly.



3. Roll OD is at minor diameter of part.

The roll helix angle is smaller than the part.

- Roll pulls threads toward the collet (screw jacking).



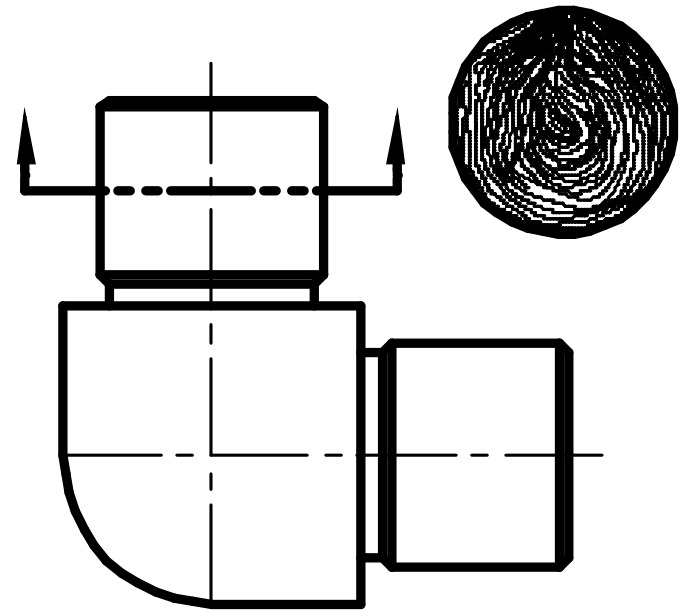
Common Issue #4: Different Rolling Conditions

Forgings

- Grain flow is a concern when rolling these parts. The grain structure material is not consistent within a section of material.

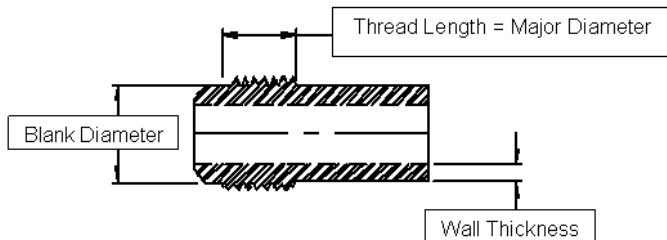
Work Hardening

- Occurs on different materials when tooling (form/shave) dulls
- Increase the penetration rate when rolling the thread



Common Issue #5: Hollow Work, Closed Hole, or Out of Round Conditions

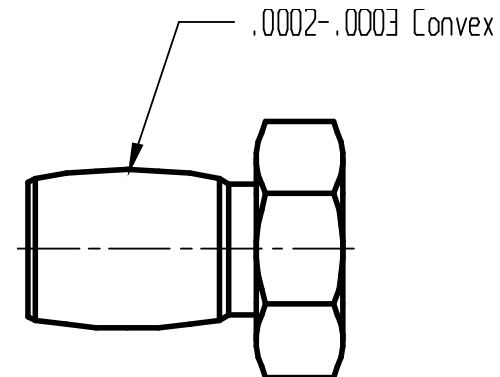
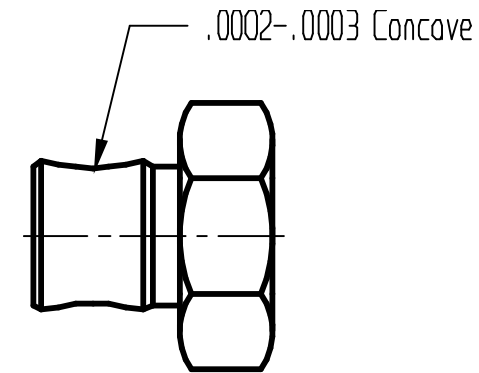
- Is wall thickness sufficient?
 - Drill later in cycle
- Is mandrel supported?
- Is feed rate too high?
 - Slow down penetration rate



| Threads per Inch | Blank Diameters in Inches | | | | | |
|------------------|---------------------------|---------------|---------------|---------------|---------------|---------------|
| | Up to ½ | ½ to 1 | 1 to 2 | 2 to 3 | 3 to 4 | 4 to 5 |
| 32 | 0.040 – 0.050 | 0.050 – 0.063 | 0.070 – 0.088 | 0.095 – 0.119 | 0.110 – 0.138 | 0.130 – 0.163 |
| 24 | 0.055 – 0.069 | 0.070 – 0.088 | 0.095 – 0.119 | 0.120 – 0.150 | 0.150 – 0.188 | 0.175 – 0.219 |
| 20 | 0.065 – 0.081 | 0.080 – 0.100 | 0.115 – 0.144 | 0.145 – 0.181 | 0.180 – 0.225 | 0.210 – 0.263 |
| 18 | 0.070 – 0.088 | 0.090 – 0.113 | 0.130 – 0.163 | 0.160 – 0.200 | 0.195 – 0.244 | 0.230 – 0.288 |
| 16 | 0.080 – 0.100 | 0.100 – 0.125 | 0.140 – 0.175 | 0.180 – 0.225 | 0.220 – 0.313 | 0.265 – 0.331 |
| 14 | 0.095 – 0.119 | 0.115 – 0.144 | 0.165 – 0.206 | 0.210 – 0.263 | 0.250 – 0.313 | 0.300 – 0.375 |
| 12 | 0.110 – 0.138 | 0.135 – 0.169 | 0.190 – 0.238 | 0.240 – 0.300 | 0.300 – 0.375 | 0.350 – 0.438 |
| 10 | .. | 0.160 – 0.200 | 0.230 – 0.288 | 0.290 – 0.363 | 0.360 – 0.450 | 0.420 – 0.525 |
| 8 | .. | .. | 0.285 – 0.356 | 0.360 – 0.450 | 0.450 – 0.563 | 0.530 – 0.633 |

Common Issue #6: Thread Filled out in Center, but Not End

- Does blank maintain diameter throughout?
 - Check blank for taper or shave tool not reaching center
- Is roll center line parallel with work center line?
 - Check slide for alignment
- Is thread long enough?
 - Generate concave blank, .0002 - .0003
- Is thread too long?
 - Generate convex blank, .0002 - .0003



Common Issue #7: Poor Finish

- Are rolls overfilled?
 - Check if blank diameter is oversized
- Are rolls synchronized?
 - Resynchronize thread rolls
- Has material accumulated in threads?
 - If material cannot be removed, replace rolls
- Is material ductile enough for cold working?
 - Change material if possible
- Are there chips from other operations?
 - Ensure a good jet of clean oil is reaching rolling position
- Are rolls worn or broken?
 - Replace rolls

Common Issue #8: Poor Thread Form

- Is work bending during rolling?
 - Support part during rolling
- Does rolls' timing match?
 - Resynchronize rolls
- Are there too many work revolutions?
 - Increase roll penetration
 - Most coming thread rolling issues are due to rolling too slow
- Is centerline of rolls parallel with center line?
 - Check slide for alignment
 - Check attachment/mounting hardware

Common Issue #9: Crests Not Filled Out

- Is blank too small?
 - Increase blank diameter
- Is thread on roll too deep?
 - Replace with rolls of correct depth
 - *Note: Special truncated rolls are available if burnish crest or round crest are required on your part

*Many users do not consider crests a serious problem, and allow thread forms to be produced with crests not completely filled out — avoiding roll overload and prolonging roll life.

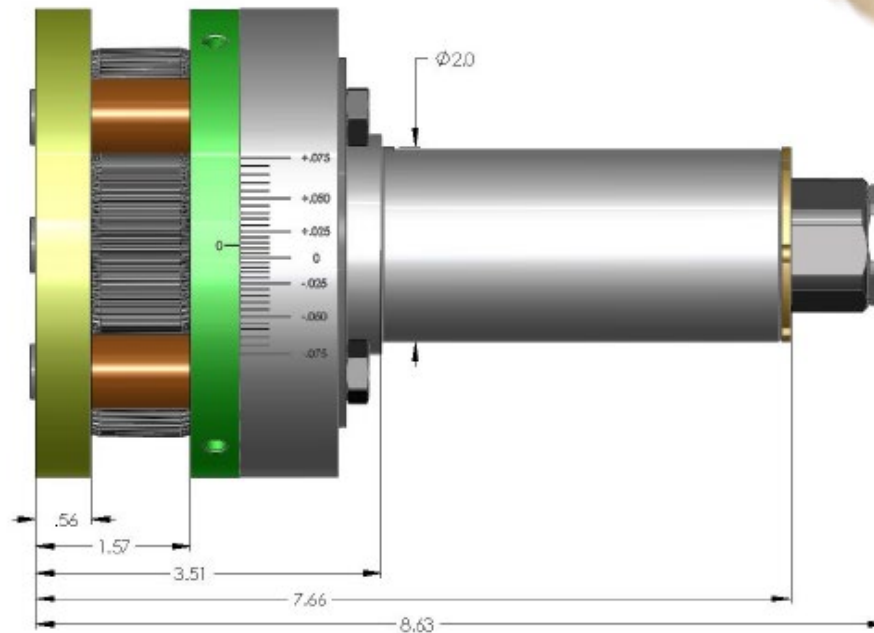
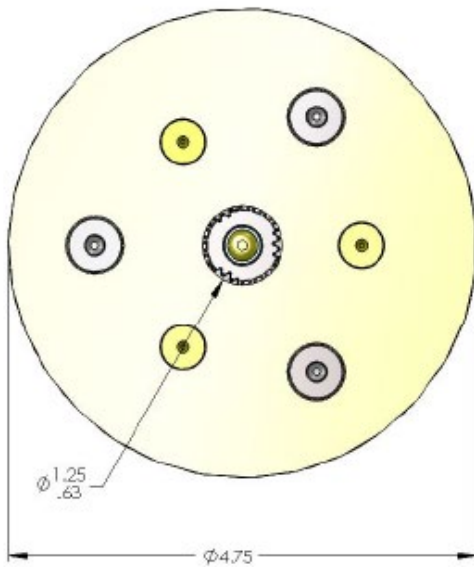
Common Issue #10: Scuffed Crests

- Is the attachment retracting too slowly?
 - Increase speed of roll retraction
- Are rolls and gear train binding?
 - Check gear train, remove any foreign matter
- Is the rolling set off the center line of work?
 - Reset slide with gage
- Are materials accumulating in threads?
 - Check coolant flowing on rolling position and make sure a good jet of clean oil is flushing and lubricating this position properly.

NEW Products in Thread Rolling

Precision Involute Knurls and Splines

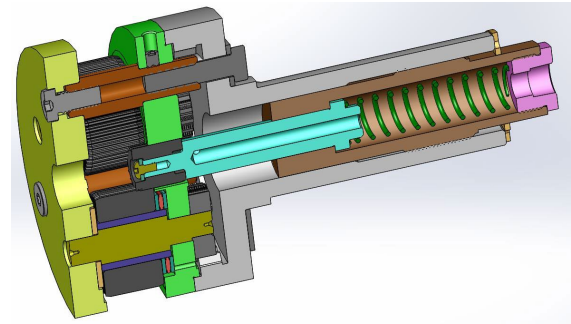
192 Series Tool Size and Capacity



Spline Rolling

192-ES: Precision Involute Knurls and Splines

- Overall dimensions for the standard tool are illustrated to the right.
- Capacity of the tool includes most parts in the following ranges:



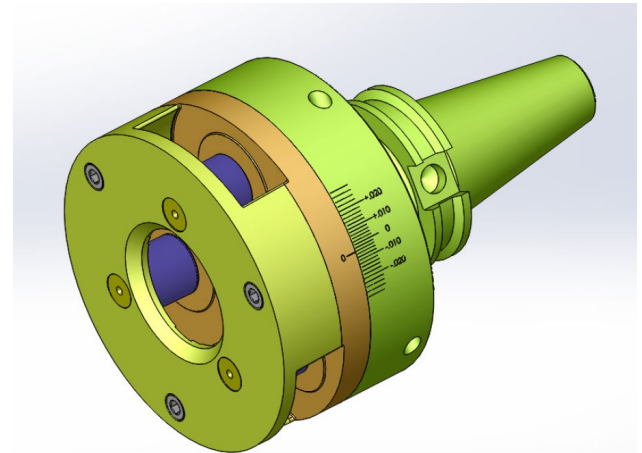
| | | | |
|---------------------------|-----------------------|----|-------------|
| Knurl Major Diameter: | Ø0.630" min | to | Ø1.250" max |
| Knurl Lengths up to: | .813" all diameters | | |
| | 2.0" for Ø.80 or less | | |
| Typical Involute Pitches: | 16 D.P | to | 128 D.P. |

** Note: Not all pitches can be rolled on all size parts without interference.
Contact CJWinter engineering for an evaluation of your application.*

Spline Rolling

193-ER: End Rolling Attachment

- Overall dimension & capacity:
 - Head OD 4.625"
 - Length from CAT40 gage line: 4.230"
 - Part capacities:
 - Ø1.75 x 1/094 long or
 - Ø1.094 x 3.750 long or
 - Ø .532 x 5.375 long

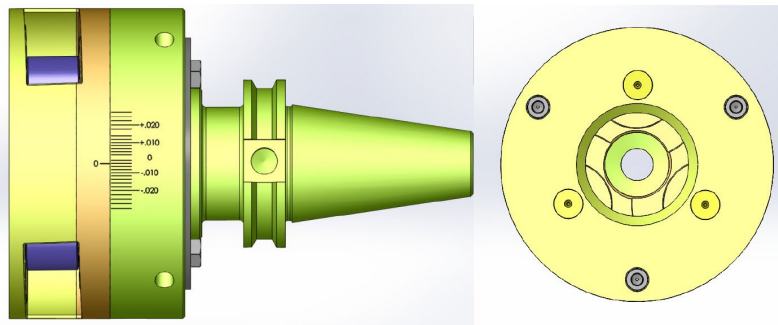


Other Thread Rolling Attachments

193-ER: End Rolling Attachment

Features/Advantages:

1. Front plate with integral standoffs is more rigid than multi-piece assembly on F34 head
2. Clutch-less, 1-piece Cat40 shank offers increased rigidity and eliminates reset failure mode
3. Fewer wear parts than F34 head
4. Sealed Pitch Adjustment gear train with fine-adjust screws
5. Thru-coolant capacity to lube rolls and minimize chip issues with part and rolls
6. Low-friction, ultra-hard coating to increase longevity of wear components

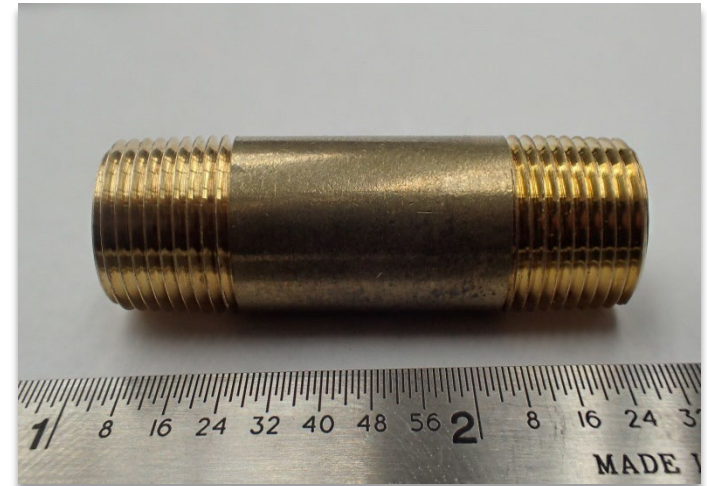


NEW Developments in Thread Rolling

Lead-Free Brass

- On Non-leaded Brass (ECO BRASS). We have been able to roll threads with 16 TPI [1.5] or finer with good success.
- A process for coarser threads is still under-development.

Photo A



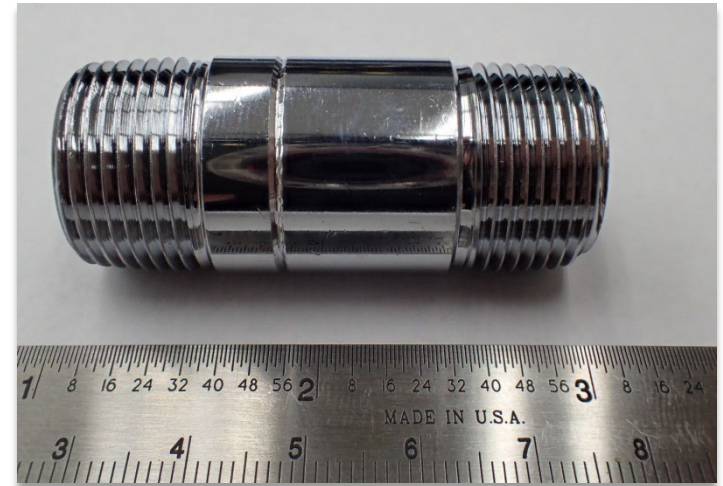
- 1/8 – 27 run on a 1" ACME
- 4th and 6th position

NEW Developments in Thread Rolling

Lead-Free Brass

- We used a radial pneumatic attachment – This pneumatic attachment will allow for very fast and precise adjustment of both the penetration rate and pitch diameter. We have learned that this is critical for rolling no lead brass.
- The radial approach allows displacement of material in more even / balanced material flow than using a tangential attachment. Radial method seems to work better for no lead applications.
- The Pneumatic attachment allows for the independent setting of the rate of flow- independent of cam.

Photo B



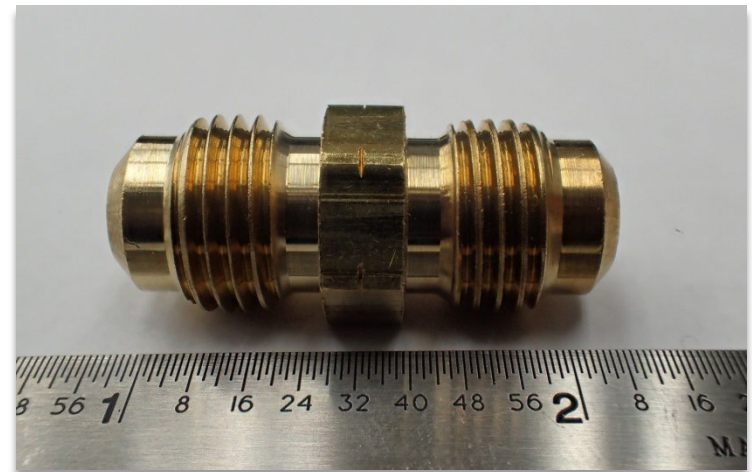
- 3/8 – 18 run on a 1" ACME
- 4th and 6th position

NEW Developments in Thread Rolling

Lead-Free Brass

- Standard Thread Rolls should work fine. If you have to have a full thread and experience flaking on the top of the thread, try using thread rolls designed for burnishing crests.
- Good cutting oil can also make a big difference. You need a good mineral base oil with extreme pressure additives worked well for us.

Photo C



- 7/16 – 20 run on a 1" ACME
- 4th and 6th position

NEW Developments in Thread Rolling

Lead-Free Brass

- You need to have a good blank before thread rolling.
- Due to the 3:1 ratio between the blank diameter and the major diameter, you need less than 0.0005" repeatability on your blank diameter.

Photo D



- 1/4 – 28 run on a Davenport
- 3rd position

Acknowledgements

Thanks to the Chase team for their hard work and feedback on these developments:

- Tommie Clair
- Thaddeus Scranton
- Thomas Christie



Questions?

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- Thread Rolling Attachments
 - PNEUMATIC
 - END ROLLING
 - CNC
 - TANGENTIAL
 - MATCH TAPER
 - OUTBOARD
- Thread Rolls
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Appendix

Additional Thread Rolling Issues

Common Issue #11: Hollow Work in Tapered Threads

- Is wall thickness uneven or insufficient?
 - Drill later in cycle
- Is mandrel offering enough support where needed?
 - Check mandrel for size with hole
- Is high feed rate causing rapid penetration?
 - Slow penetration rate
- Does taper of rolls compensate for tendency of work to taper?
 - Use correct rolls for job

Common Issue #12: Drunken Threads

- Do rolls match?
 - Resynchronize rolls
- Is roll centerline set off from centerline of work?
 - Check slide for alignment
- Are rolls inaccurate?
 - Replace rolls
- Is work bending during rolling?
 - Support part during rolling operation or slow penetration rate
 - Check centerline of rolls to part

Common Issue #13: Split Thread Axially

- Is stock seamy?
 - Change stock
- Are there marks from shave tool or hollow mill?
 - Regrind tooling
- Is tubing material welded?
 - Use seamless tubing material

Common Issue #14: Off-size Threads

Are any of the following oversized?

- Blanks
 - Reduce blank diameter
- Pitch diameter
 - If major diameter is correct size, oversize the blanks
 - If major diameter is undersize, increase roll penetration
- Major diameter
 - If pitch diameter is correct size, reduce blank diameter

If pitch diameter and major diameter are both undersize, increase the blank diameter.

Common Issue #15: Undersize Threads

Are any of the following undersized?

- Blanks
 - Increase blank diameter
- Pitch diameter
 - If major diameter is oversize, reduce roll penetration
 - If major diameter is correct size, increase blank diameter
- Major diameter
 - Increase blank diameter

Common Issue #16: Off-of-Round Threads

- Is blank out of round?
 - Shave tool is not reaching center, or not cleaning up rough form diameter
- Is roll centerline set off from centerline of work?
 - Check slide for alignment
- Is feed rate too high?
 - Reduce penetration rate
- Are there insufficient work revolutions?
 - Reduce penetration rate
- Is material ductile enough for cold working?
 - Change material, check with supplier
- Is the attachment off the centerline of work?
 - Reset the cross slide with gage

Common Issue #17: Tapered Threads

- If pitch diameter is straight, major diameter is tapered and not filled out on small end:
 - Straighten blank
- If pitch diameter and major diameter are both tapered in the same way:
 - Straighten blank
 - Taper adjust roll pins
- If pitch diameter and major diameter are tapered in opposite directions and thread is not filled out on end:
 - Support part during rolling. Part deflecting out of contact with center of rolls

Common Issue #18: Thread with Expanded Lead

- For expanded lead in rolls:
 - Use correct rolls (Modified Lead)
- For extruding material on short length of blank:
 - Use longer blank; remove excess in another position

Other Thread Rolling Problems

Get answers on CJWinter.com's
[troubleshooting guide](#)

Calculating Speeds & Feeds

| | |
|--|---|
| $SFM \div .262 \div Diameter = RPM$ <i>Example: $190 \div .262 \div .500 = 1450 RPM$</i> | $LongestMachineCycle + IdleTime = TotalMachineTime$ <i>Example: $10.3Sec. + 1.13IdleTime = 11.43TotalMachineTime$</i> |
| $RPM \times .262 \times .500 = SFM$ <i>Example: $1450 \times .262 \times .50 = 190SFM$</i> | $MachineRPM \div AttachmentRPM = Ratio$ <i>Example: $1450MachineRPM \div 375AttachmentRPM = Ratio$</i> |
| $Stroke \div Feed = Revolutions$ <i>Example: $.500Stroke \div .002Feed = 250 Revs.$</i> | $WorkingRevs. \div 150Degrees = Revs.PerDegree$ <i>Example: $97.5WorkingRevs \div 150 = .65Revs.PerDegree$</i> |
| $Revolutions \times 60Sec. \div RPM = MachiningCycle$ <i>Example: $250Revs \times 60Sec. \div 1450RPM = 10.3Sec.$</i> | $Revs.PerDegree \times DegreeOfCam = TotalRevs.$ <i>Example: $.65Revs \times 30DegreeCam = 19.5TotalRevs.$</i> |
| $MachineRPM \div 60 \times ActualCycleTime = WorkingRevs$ <i>Example: $1450RPM \div 60Sec. \times 10.3 = 248.9WorkingRevs$</i> | $Stroke \div TotalRevs = Feed$ <i>Example: $.125Stroke \div 19.5Revs = .0064Feed$</i> |
| $Stroke \div Revs = FeedRate$ <i>Example: $.500Stroke \div 250Revs = .002Feed$</i> | |

NEW Developments in Thread Rolling



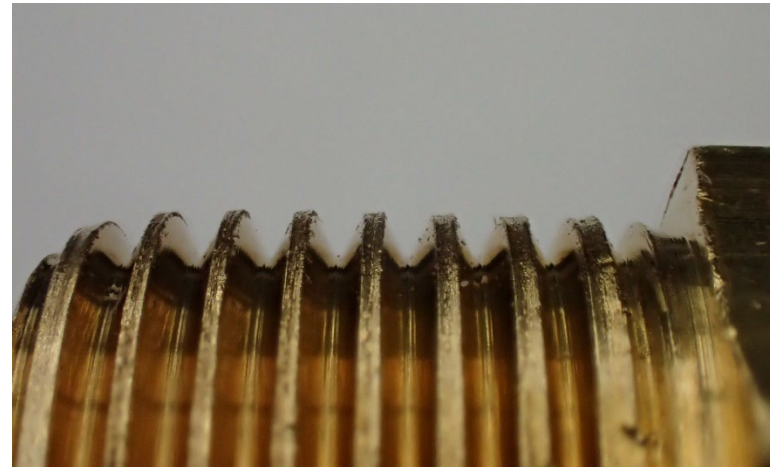
Examples of some of the parts produced:

| Photo Part reference | Machine Type | Machine Positions | Thread #1 (PHOTO #) | Thread #2 (PHOTO #) |
|----------------------|--------------|-----------------------------------|---------------------|---------------------|
| A | 1" ACME | 4 TH & 6 TH | 1/8-27 (2) | N/A |
| B | 1" ACME | 4 TH & 6 TH | 3/8-18 (4) | N/A |
| C | 1" ACME | 4 TH & 6 TH | 7/16-20 (6) | N/A |
| D | DAVENPORT | 3 RD | 1/4-28 (8) | N/A |
| E | 1" ACME | 4 TH & 6 TH | 9/16-24 (10) | 3/8-18 (11) |
| F | DAVENPORT | 3 RD & 4 TH | 1/8-27 (13) | 7/16-24 (14) |
| G | DAVENPORT | 3 rd | 1/4-18 (16) | N/A |

NEW Developments in Thread Rolling

Lead-Free Brass

Photo E

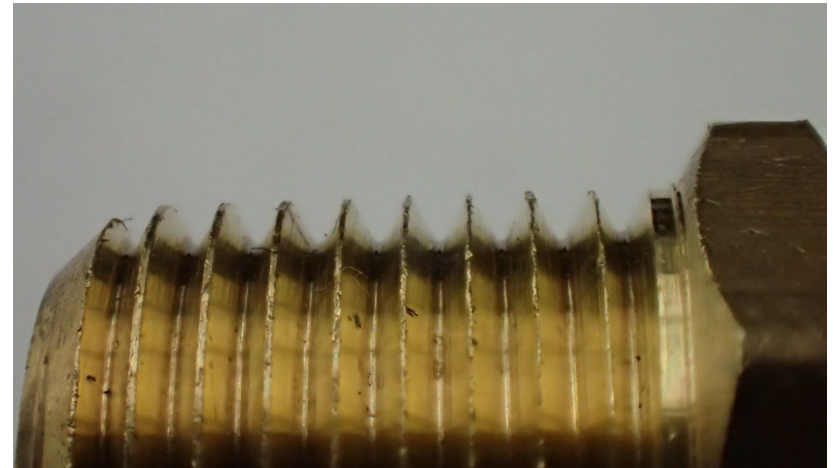


- 9/16 – 24 run on a 1" ACME
- 4th and 6th position

NEW Developments in Thread Rolling

Lead-Free Brass

Photo F

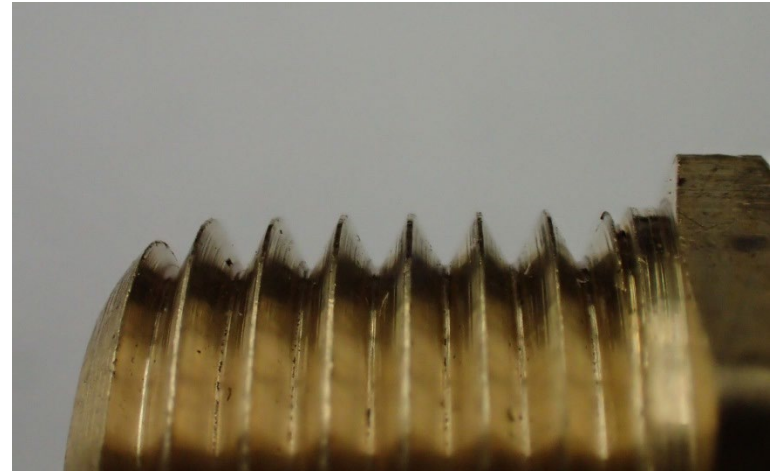
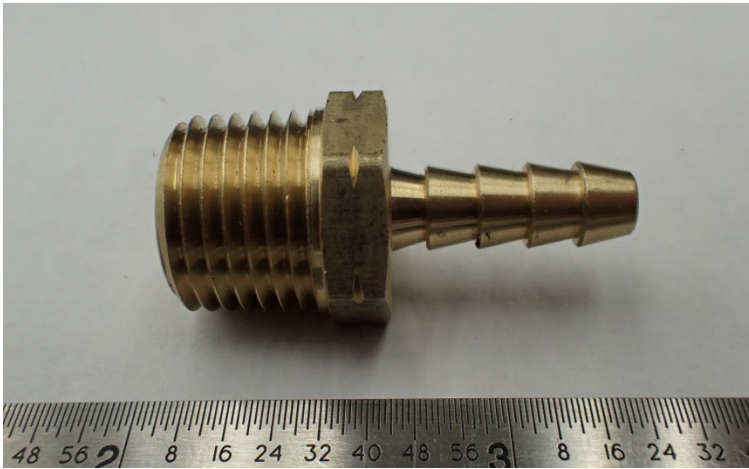


- 1/8 – 27 run on a Davenport
- 3rd and 4th position

NEW Developments in Thread Rolling

Lead-Free Brass

Photo G



- 1/4 – 18 run on a Davenport
- 3rd position