

## Cutting 60° External Threads Using a Thread-Chasing Dial

### What are the steps to apply external right-hand threads?

1. Set the spindle speed at one-quarter the normal turning speed.
2. Set the quick-change gearbox for the desired pitch using the index plate or change wheels.
3. Set the leadscrew to turn in the forward direction. When engaged, the carriage will move from right to left.
4. Set the tool height on center and the compound slide angle to 30°.
5. Mount the work (between centers, in a chuck or in a chuck plus a center, in a collet or in a collet plus a center) and insure it is secure and there is no end-to-end play. Lubricate the lathe centers, if they are used.
6. Set the tool at right angles to the work using the thread center gage or fishtail, Figure 7-132 and Figure 7-136.
7. Measure the diameter of the work. Good practice is to have the work diameter 0.002 inch (0.05 mm) *under* the thread major diameter.
8. Start the lathe and chamfer the right end of the work to just under the thread final minor diameter using the left edge of the cutting tool.
9. Measure and mark the work where the threads will end by cutting a light ring with the threading tool bit. Crank the tool bit away from the work so the carriage can be moved. The spindle will still be turning. See Figure 7-138.
10. Manually position the carriage toward the right end of the workpiece and, using the compound rest, move the tool bit towards the work so it just lightly marks it. *Set both the cross slide and compound micrometer collars to zero.* See Figure 7-138.
11. Back the tool bit away from the work using the cross slide and position the carriage so the tool bit tip is  $\frac{1}{8}$  inch or more to the right end of the work, the starting point.
12. Using the compound slide, move the tool bit into the work between 0.001 and 0.003 inches with your left hand on the compound crank. Engage the half-nuts lever with your right hand when the thread dial reaches the right graduation. This will make the first, or scratch pass.
13. When the tool reaches the left end of the cut, quickly crank the tool away from the workpiece using the cross slide crank, and disengage the half-nuts.
14. Move the carriage manually back to the starting point and set the cross slide back to the zero position.

15. Stop the spindle, and using either a thread pitch gage or a ruler, check that the cut is the desired pitch. See Figure 7-139. Correct the gearbox setting and try again if the thread count is wrong.
16. Restart the spindle.

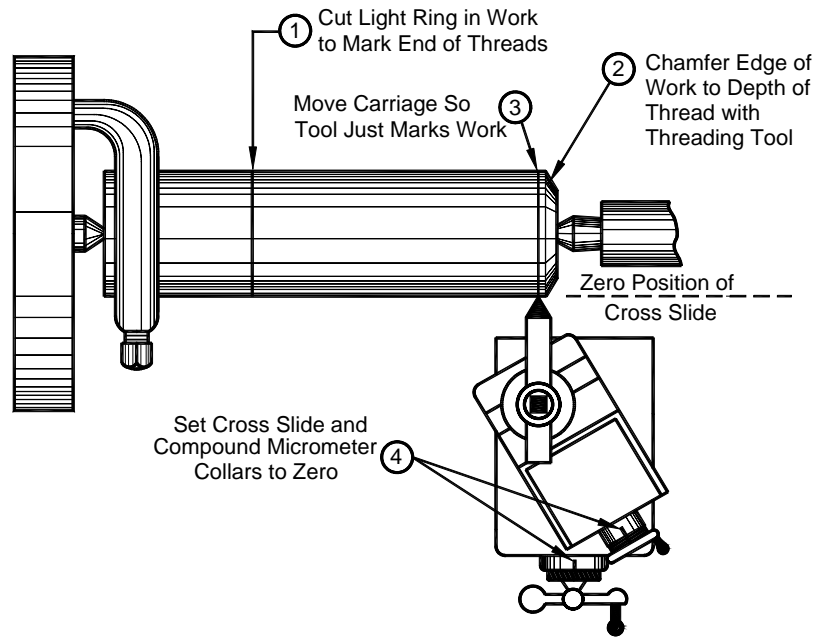


Figure 7-138. Preparation for threading.

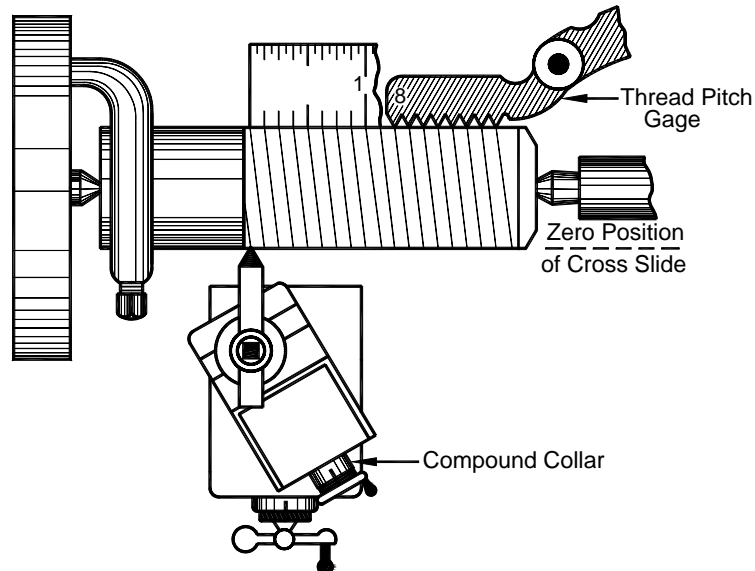


Figure 7-139. Checking thread pitch after initial threading pass.

17. Manually move the carriage to Position 1 as in Figure 7-140. Then, using the collar calibrations, move the cross slide to the zero position, Position 2. With the compound, advance the tool bit in preparation for the next thread cut, Position 3. Use Table 7-9 as a rough guide for the depth of each pass. The idea is to use cross slide motion to pull the tool away from the workpiece at the end of the thread and move the tool back to the zero position for the next pass. Once the compound collar has been set to zero, the compound is incremented for each pass and is never used to pull the tool away from the work.
18. Engage the half-nuts lever with your right hand when the threading dial reaches the correct graduation and the tool will move from Position 3, through Position 4, and to the end of the threads at Position 5. When the tool reaches Position 5, use the cross slide to quickly withdraw the tool to Position 6. Then manually move the carriage back to Position 1. You are now ready to begin the next cutting pass.

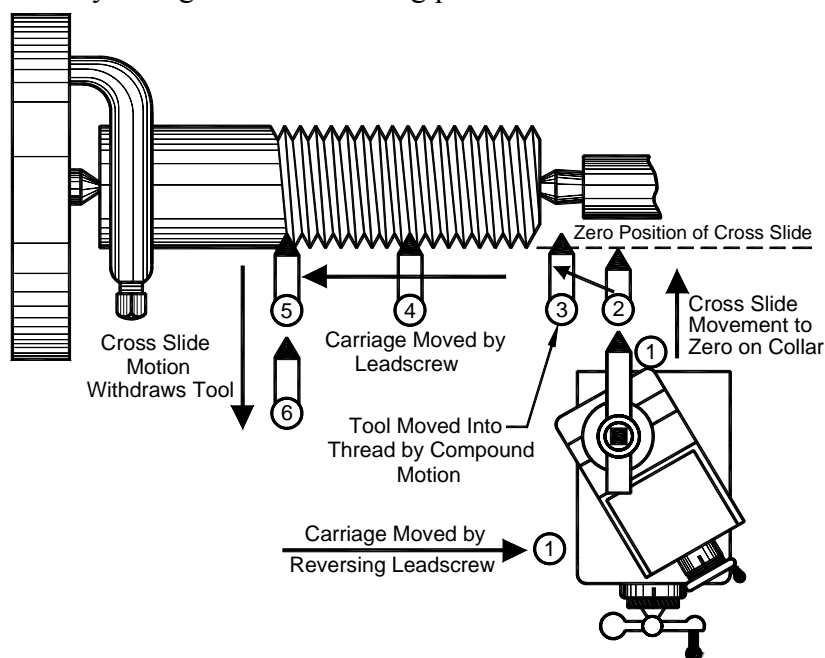


Figure 7-140. Completing the threading process.

19. Tables in *Machinery's Handbook* show the final thread depth for all common thread forms. This depth can be read off the compound collar and can be checked using a threading micrometer. Also, inch thread center gages have the thread depth for various tpi engraved on them. See Figure 7-132. Not having this information at hand, the operator can watch the thread develop until the width at the thread bottom (root) just about equals

the width of the thread top (crest). Then take additional small cuts until the mating part or master nut fits properly. Figure 7-141 (a through d) shows the thread development. Repeat steps 17 and 18 until the threading reaches full depth and is completed, as shown in Figure 7-141 (e).

20. Use a file to remove burrs on the top thread edge.

Cutting 60° external threads on a lathe equipped with a thread-chasing dial is the most common and least complicated threading operation.

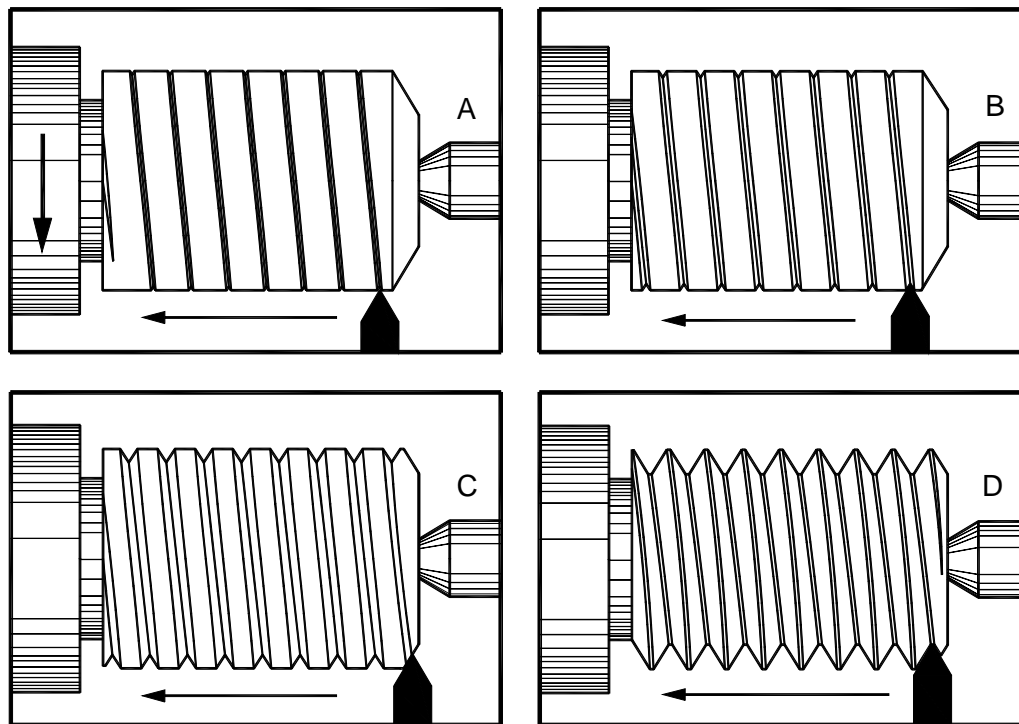


Figure 7-141. Appearance of 60° threads as they are developed.

## Threading without a Thread-Chasing Dial

**How is threading performed on lathes without a thread-chasing dial?**

Whenever a lathe lacks a thread-chasing dial, the half-nuts must not be opened and the carriage must be moved back to the start of the threads by reversing the spindle. *When using a chuck on lathes with a threaded nose spindle, use slow reverse speeds and observe that the chuck does not unscrew during reverse operation.*

## Left-Hand Threads

**What are the steps to apply external left-hand threads?**

1. Install the workpiece in the lathe.
2. Set the compound swung  $30^\circ$  to the left of the cross slide and the tool bit at right angles to the work. This is similar to Figure 7-140 with the exception of the direction of the compound with respect to the cross feed.
3. Set the tool bit on center.
4. Set both the collar on the cross slide and on the compound to zero as for right-hand threads.
5. It is preferable to have a starting groove, or gap, on the left side of the threads in which to begin the threading cuts, Figure 7-142.
6. Follow as for right-hand threads except work from left to right.

If there is not a starting groove, or gap, on the left side of the threads, manually rotate the spindle while the leadscrew is engaged. As the tool approaches the start of the thread, use the cross slide to move the tool into the zero position. Then power up the lathe.

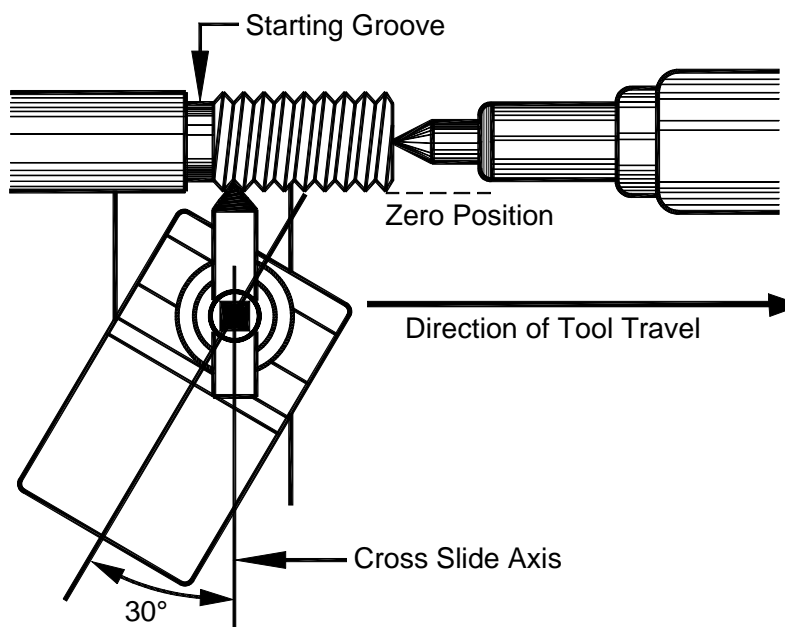


Figure 7-142. Setup for cutting left-hand threads.

## Metric Threads with an Inch Leadscrew

**What problems are encountered when cutting metric threads on a lathe with an inch leadscrew?**

*Because the thread-chasing dial will not work for metric threads, the half-nuts must remain closed during the entire threading process.*

Here is how to apply 4-mm metric threads on an inch lathe with a quick-change gearbox:

1. Install the 127-tooth gear on the leadscrew.
2. Install the 50-tooth gear on the spindle. Together these two gears convert the gearbox settings from tpi to threads/cm.
3. Convert the 4 mm pitch to threads/cm:

$$10 \text{ mm} = 1 \text{ cm}$$

$$\text{Pitch} = 10/4 = 2.5 \text{ threads/cm}$$

4. Set the quick-change gearbox to 2.5 tpi and, with the changed gearing, it will cut 2.5 threads/cm.
5. Set up the lathe and the work as for cutting a 60° thread detailed above.
6. Make a trial scratch cut as if 60° thread cutting and, using the cross slide, withdraw the tool at the end of the cut. *Do not open the half-nuts at the end of the cut.* Stop the spindle, then check that the required thread pitch has been cut. Adjust the gearbox if necessary. See Figure 7-143.
7. Reverse the spindle, which will reverse the direction of the leadscrew.

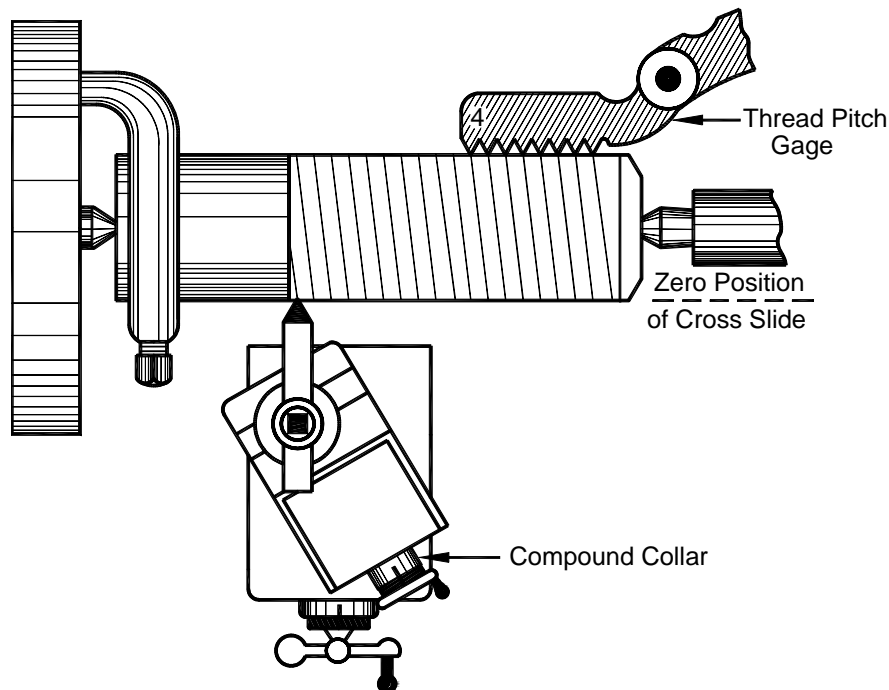


Figure 7-143. Making the scratch cut for a metric thread.

8. With the cross slide still withdrawn, Position 6, start the spindle and move the carriage back to the starting point. Stop the spindle, and when it has stopped turning, set it to turn forward and turn it on.
9. Bring the thread to the required depth with additional passes. Do not open the half-nuts until the thread is completed and has been checked because you will lose the ability to pick up the thread again. The metric thread cutting sequence is shown in Figure 7-144.

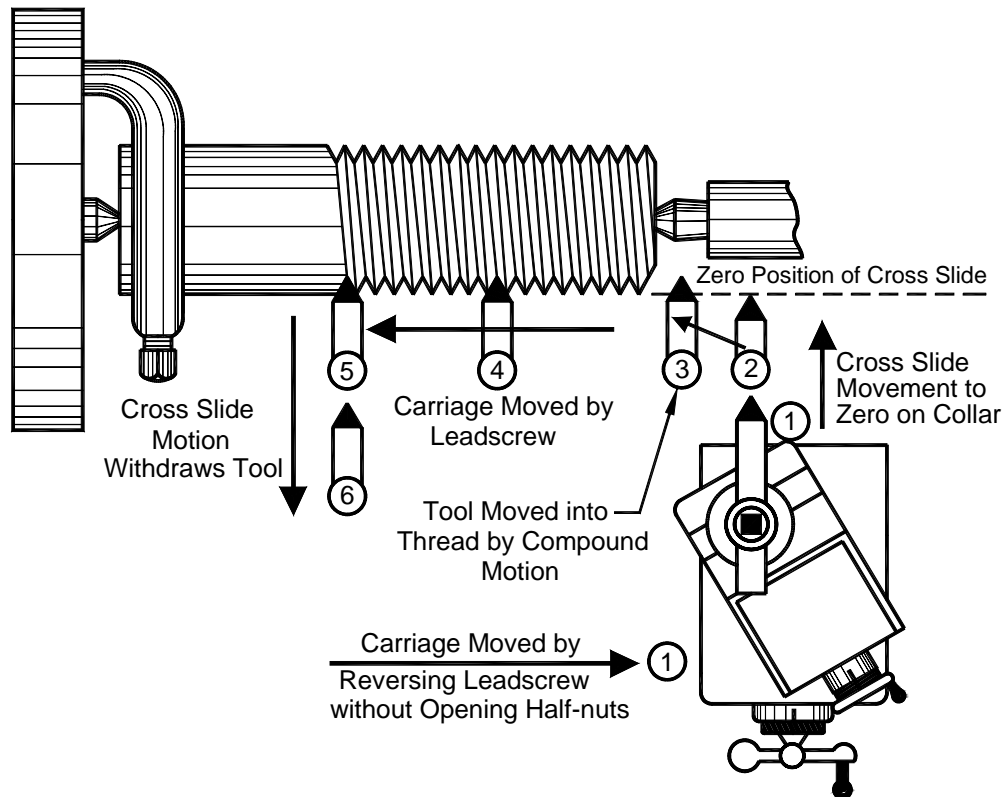


Figure 7-144. Metric thread cutting sequence.

## Tapered Threads

### What steps must be taken to cut tapered threads?

The threading tool must be set at right angles to the axis of the work, not the face of the section to be threaded. See Figure 7-145.

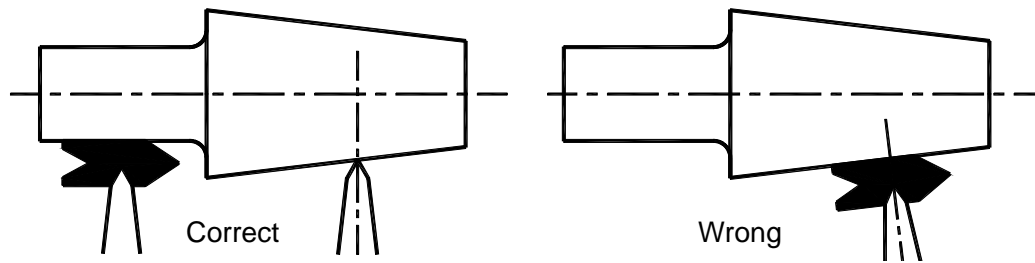


Figure 7-145. Threading tool setup for tapered threads.

There are two other issues when cutting tapered threads:

- Tapered threads are best cut using a taper attachment, not by offsetting the tailstock, because the thread will not advance at a uniform rate and form a true helix. The greater the taper, the more this inaccuracy is a problem.
- Offsetting the tailstock puts additional wear on lathe centers since they do not bear symmetrically against their center holes. One solution to this problem is to use ball centers or adjustable centers, Figure 7-118.
- Note: Relatively mild tapers, like those on NPT (National Pipe Threads) for liquid joint seals, may be cut without problems by offsetting the tailstock.

## 60° Internal Threads

### What tools are used to cut internal threads?

There are two common types of tools:

- Commercial boring bars with either HSS, alloy steel or tungsten carbide tool bits are the most common.
- For holes too small for a boring bar, an HSS tool bit blank may be ground into a small, single-piece threading tool. These are also commercially available. See Figure 7-146.

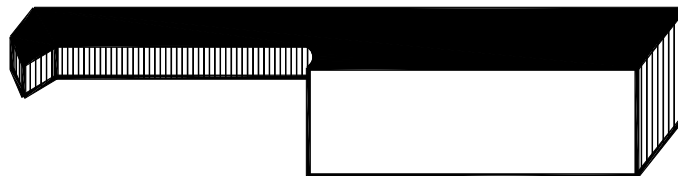


Figure 7-146. Single-piece threading tool ground from a square tool bit blank.

### What are two methods for setting the tool bit axis perpendicular to the work for internal threads?

See Figure 7-147.



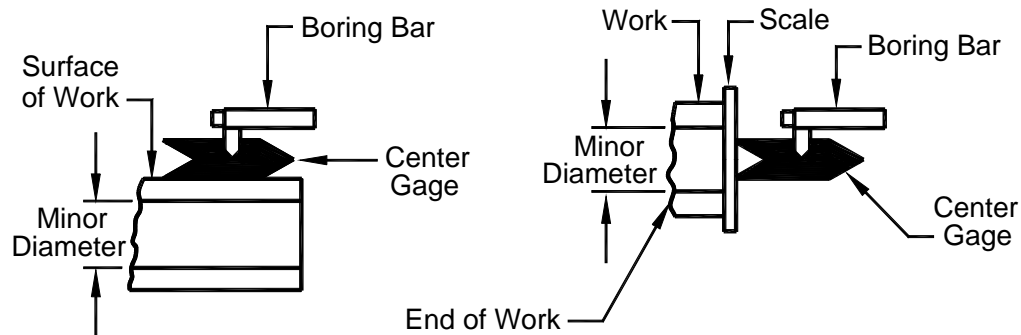


Figure 7-147. Two ways to check alignment of a tool bit for internal threads.

**What are the steps to apply internal 60° right-hand threads?**

1. Mount the work in a chuck, collet or face plate and drill a starting hole for the boring tool, Figure 148 (a).

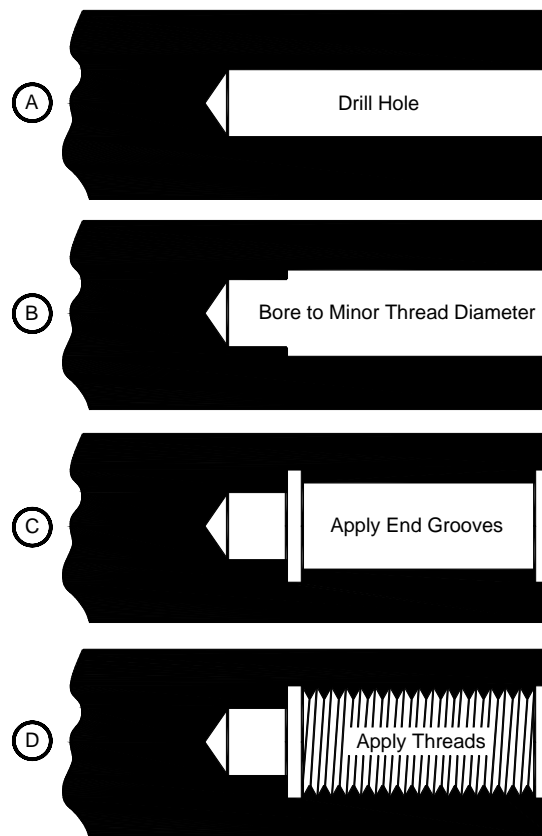


Figure 7-148. Preparing the workpiece for internal threading.

2. In the workpiece, drill or bore a hole of the threads' minor diameter, Figure 7-148 (b). This diameter may be obtained from *Machinery's Handbook*.
3. Where the thread does not run completely through the work, use a square-nose tool inside the workpiece to cut a groove where the threads end. This makes it easier to start or stop the threading process because there is no abrupt end of the thread. See Figure 7-148 (c).
4. Cut a recess in the open end of the workpiece equal to the threads' major diameter so the thread depth can be observed during threading. See Figure 7-148 (c).
5. Threading may be done either starting from the outside of the work, Figure 7-149, or from the inside, Figure 7-150. Starting threading from the inside of the work eliminates the problem of not being able to see the internal end of the threads so you know when to open the half-nuts. This method is only suitable on lathes with a long-taper or cam-lock spindle nose which will not unscrew from the spindle when run in reverse under load. Select one of these methods, then install the boring bar (or single-piece tool bit) with the properly shaped cutting bit in the tool holder, and set the compound at an angle of  $30^\circ$  to the work axis.

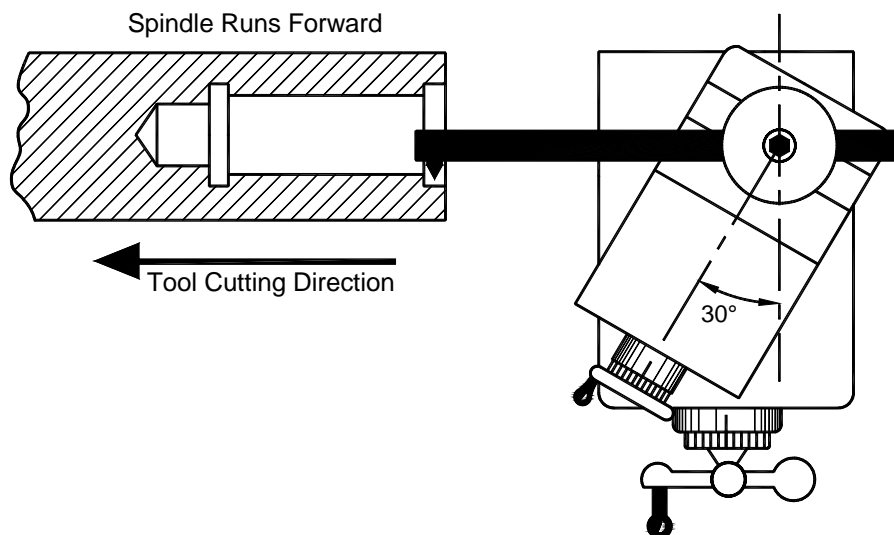


Figure 7-149. Setup for cutting internal threads starting from the outside of the work.

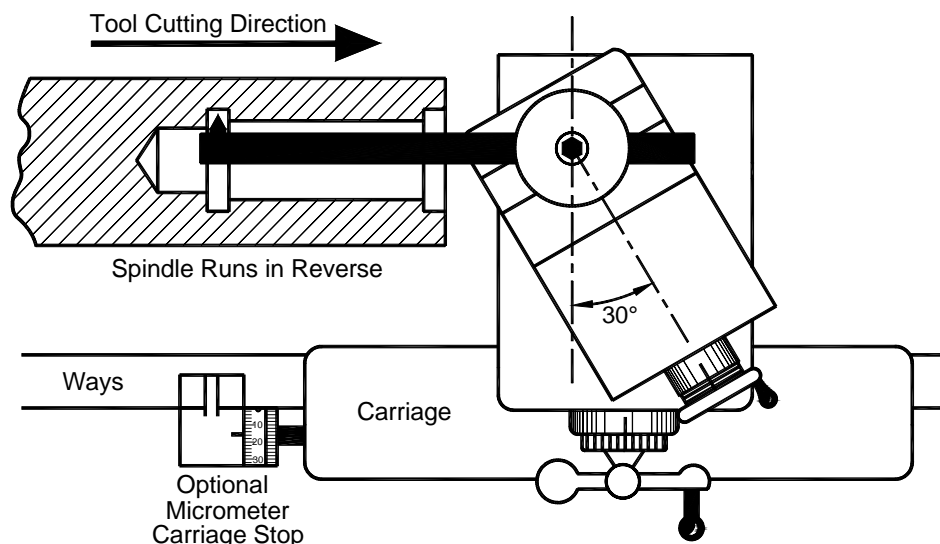


Figure 7–150. Setup for cutting internal threads starting from inside the work.

6. Adjust cutter bit height exactly on center, using the tailstock center as a reference. Make sure that there is adequate end clearance on the lower face of the cutter bit and that there is enough room behind the boring bar and cutter bit so that they will not bump into the interior of the workpiece when the tool bit is withdrawn from the threads.
7. Set the spindle and the leadscrew to turn forward, that is, to move from right to left. This will make the tool run into the work.
8. Apply the threads as in external threading operations, except that the cross slide is moved *forward* to clear the tool, and return the carriage to the starting point. It is helpful to place a mark or piece of tape on the boring tool bit arm or on the ways to indicate the stopping point at the end of the internal threads.
9. Observe the depth of the threads in the recessed starting area to determine when the threads are complete, Figure 7–148 (d). Check with a plug gage or the mating part.

Minimize the length of the unsupported boring bar because it will deflect and make taking smaller cuts impossible. Plan to make the final pass more than 0.001 inch depth as the spring in the bar will make such a small cut impossible.

When the operator cannot see the starting point of the threads, a *micrometer stop*, which clamps to the ways, provides an accurate starting point for positioning the carriage when using this method. See Figure 7–151.